WILEY FINANCE

BANK ASSET AND LIABILITY MANAGEMENT

Strategy, Trading, Analysis

Moorad Choudhry

Foreword by Irving Henry
Director
British Bankers' Association

Contents

PART III: Financial Instruments, Applications and Hedging

PART IV: Funding and Balance Sheet Management using Securitisation and Structured Credit Vehicles

Advance Praise for *Bank Asset and Liability Management* *"Like the author's book The Bond and Money Markets: Strategy, Trading, Analysis, this is again a superb example how a financial book should be written! Not only has Moorad managed to write another hit, but as with the previous book he has managed to show workable illustrations so that a novice or a full-blown professional can make good use of the examples – either for understanding the subject better or for simply brushing up on one's memory. The book comes highly recommended!"*

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Bloomberg L.P., London

"Again, Moorad Choudhry takes his readers beyond the older books in the market that simply list a string of facts, and into a world of highly practical and up-to-the-minute concepts and strategies. Bank asset–liability management is about knowing when and how to use all the tools available. The modern practitioner can't be limited to just managing rate and liquidity risk, but must be highly versed in securitisation and other balance sheet techniques. This book tackles the whole spectrum."

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"A brilliant and comprehensive account of all the various disciplines that make up the art of bank asset–liability management. Professor Choudhry brings together the instruments, the procedures and the strategies that are vital knowledge for any successful risk manager or ALCO member. This book will be appreciated and respected by all bankers in all fields. A fantastic work! Every bank should have a copy of this book."

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"*Bank Asset And Liability Management* offers a clear, insightful perspective of the global banking and liquidity markets. It covers all the major products in just the right level of detail and is written in a practical, accessible style. This book is a great reference tool for all finance professionals. Really, really impressive."

***Bhavin Parmar** Securities Finance Trader*

ABN Amro Bank N.V., London "An informative account of banking ALM from the point of view of the market practitioner. The author brings together all the various strands that make up this important discipline in a technical yet accessible way"

***Shahid Ikram** Head of UK Sovereign bonds and G7 hedge fund Morley Fund Management IT, London "Moorad Choudhry has managed to update and include the most relevant and practical knowledge required for ALM in a modern financial institution, especially with Basle II requirements and adoption looming ahead in 2008. Balance sheet management, financial markets and credit risk management, coupled with regulatory capital implications, are important considerations that are well addressed in this book that anybody looking to learn about or have a handy guide on ALM will find useful!"*

***Lee Ka Shao** Managing Director, Head of Investments DBS Bank Limited, Singapore*

Bank
Asset and Liability Management

Strategy, Trading, Analysis

Moorad Choudhry

With contributions from Andrew Oliver, Jaffar Hussain,
Kevin Zhuoshi Liu, Rod Pienaar, Abukar Ali and Suleman Baig

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For Angela...my dream girl.
I wish we'd met years ago.

Foreword

Asset and liability management (ALM) is a key aspect of risk management in the financial services industry. The business of financial services firms is risk and return, using their skills in the measurement of risks to make profits. In modern finance, this often involves using complex products. The types of risks taken by firms are often complex and hidden, reflecting the financial products on offer and the wider marketplace. As such, when analysing risks, it is important to think about the firm's balance sheet holistically. A firm's ALM Committee (ALCO) uses this *modus operandi,* managing its assets and liabilities, and supervising liquidity, credit, market and operational risks, in short prudential matters, at the most senior level.

Financial services firms, especially banks, are essential to the global economy. Therefore, ALM is a major aspect of their operations. Liquidity, the ability of a firm to generate money at often short notice and ideally low cost to meet a liability when it falls due, is important to the stability and smooth running of the global financial system. Poor planning has an impact beyond the individual financial institution. In similar vein, market risk, including yield curve and gap risks, requires thoughtful management, including monitoring and reporting.

There is no single metric that gives a full picture of these risks. The assessment of liquidity risk needs thinking about on-and off-balance sheet items. The management of market risk is complicated. These risks often overlap. ALM accepts this by monitoring them simultaneously. The process is as much qualitative as quantitative. Some observers even compare ALM to an art, not dissimilar to stress testing. ALCOs have to think about future market scenarios, the probability of these events occurring and their impact, and take action to mitigate these risks. In addition to making sure that the firm can withstand any event, including a stress, the Committee has to allocate assets and liabilities in order to meet certain objectives, profits and returns on equity (ROE) and the discipline of liquidity management.

ALM specialists have a wide variety of products and techniques to mitigate risk. Some tools, for example securitisation, have been around for years. Some techniques use fairly new products, for example credit derivatives. Moorad's magisterial work brings all the issues into a single publication. The book is written in an easy to understand manner, ideal for both practitioners and regulators. The book is also practical for those who want to learn ALM. There is something for every stakeholder in this book.

Irving Henry Director British Bankers' Association

Preface

As Sir Arthur Conan Doyle would have put it, so elementary a form of literature as the textbook on financial economics hardly deserves the dignity of a preface. It is possible, though, to bring some instant clarity to the purpose of such a book if we open with a few words here.

The traditional view of a bank is that of a financial institution that is in the business of taking deposits and advancing loans, and which makes its money from the difference in interest rate paid and received on these two products. While this quaint image would have been true a few hundred years ago, it is decidedly incomplete today. The modern banking institution is a complex beast, which in many cases operates in a wide range of products and services and across international markets. Banks are the cornerstone of the global economy, and at the highest level the banking sector influences, and is influenced by, macroeconomic trends such as GDP growth, central bank base interest rates, equity and debt capital markets activity, and the supply and demand for investments and credit.

However, notwithstanding our first statement that banks now engage in many complex activities outside traditional borrowing and lending, we must remember that at the core of *all* capital markets activity lies the need to bring together the suppliers of capital with the borrowers of capital. This was the original business logic behind the very first banks, so in that respect very little has changed! There is much other activity surrounding this basic function in the markets, but this need is paramount. Hence a key ingredient in bank strategy is the management of its assets and liabilities. It is this that is the subject of this book: Asset and Liability Management (ALM). These days there are a large number of instruments, in cash and derivative form, that make up a bank's assets and liabilities. No matter. For the ALM desk in a bank, the cash assets and liabilities are king and must be managed prudently. That there is more to this than may meet the eye is apparent immediately from the thickness of this book!

Let us set the scene further with some discussion on banks.

Introduction

Banking operations encompass a wide range of activities, all of which contribute to the asset and liability profile of a bank. Table P.1 shows selected banking activities, and the type of risk exposure they represent. The terms used in the table, such as "market risk", are explained elsewhere in this book. In Chapter 2 we discuss elementary aspects of financial analysis, using key financial ratios, that are used to examine the profitability and asset quality of a bank. We also discuss bank regulation and the concept of bank capital.

Table P.1 Selected banking activities and services

Service or function	**Revenue generated**	**Risk**
Lending		
– Retail	Interest income, fees	Credit, Market
– Commercial	Interest income, fees	Credit, Market
– Mortgage	Interest income, fees	Credit, Market
– Syndicated	Trading, interest income, fees	Credit, Market
Credit cards	Interest income, fees	Credit, Operational
Project finance	Interest income, fees	Credit
Trade finance	Interest income, fees	Credit, Operational
Cash management		
– Processing	Fees	Operational
– Payments	Fees	Credit, Operational
Custodian	Fees	Credit, Operational
Private banking	Commission income, interest income, fees	Operational
Asset management	Fees, performance payments	Credit, Market, Operational
Capital markets		
– Investment banking	Fees	Credit, Market
– Corporate finance	Fees	Credit, Market
– Equities	Trading income, fees	Credit, Market
– Bonds	Trading income, interest income, fees	Credit, Market
– Foreign exchange	Trading income, fees	Credit, Market
– Derivatives	Trading income, interest income, fees	Credit, Market

Before considering the concept of ALM, all readers should be familiar with the way a bank's earnings and performance are reported in its financial statements. A bank's income statement will break down the earnings by type, as we have defined in Table P.1. So we need to be familiar with interest income, trading income and so on. The other side of an income statement is the costs, such as operating expenses and bad loan provisions.

That the universe of banks encompasses many different varieties of beast is evident from the way they earn their money. Traditional banking institutions, perhaps typified by a regional bank in the United States or a building society in the United Kingdom, will generate a much greater share of their revenues through net interest income than trading income, and vice versa for an investment bank such as Lehman International or Merrill Lynch. The latter firms will earn a greater share of their revenues through fees and trading income.

During 2004 a regional European bank reported the following earnings breakdown, as shown in Table P.2.

Table P.2 European regional bank, earnings structure 2004

Source: Author's notes.

Core operating income	% share
Net interest income	62
Fees and commissions	27
Trading income	11

However, this breakdown varies widely across regions and banks, and in fact would be reversed at an investment bank whose core operating activity was market-making and proprietary trading.

Let us consider now the different types of income stream and costs.

Interest income

Interest income, or net interest income (NII), is the main source of revenue for the majority of banks worldwide. As we saw from Table P.2, it can form upwards of 60% of operating income, and for smaller banks and building societies it reaches 80% or more.

NII is generated from lending activity and interest-bearing assets, the "net" return is this interest income minus the cost of funding the loans. Funding, which is a cost to the bank, is obtained from a wide variety of sources. For many banks, deposits are a key source of funding, as well as one of the cheapest. They are generally short-term, though, or available on demand, so they must be supplemented with longer term funding. Other sources of funds include senior debt, in the form of bonds, securitised bonds and money market paper.

NII is sensitive to both credit risk and market risk. Market risk, which we will look at later, is essentially interest-rate risk for loans and deposits. Interest-rate risk will be driven by the maturity structure of the loan book, as well as the match (or mismatch) between the maturity of the loans against the maturity of the funding. This is known as the interest-rate gap.

Fees and commissions

Banks generate fee income as a result of the provision of services to customers. Fee income is very popular with bank senior management because it is less volatile and not susceptible to market risk like trading income or even NII. There is also no credit risk because the fees are often paid up front. There are other benefits as well, such as the opportunity to build up a diversified customer base for this additional range of services, but these are of less concern to a bank ALM desk.

Fee income uses less capital and also carries no market risk, but does carry other risks such as operational risk.

Trading income

Banks generate trading income through trading activity in financial products such as equities (shares), bonds and derivative instruments. This includes acting as a dealer or market-maker in these products, as well as taking proprietary positions for speculative purposes. Running positions in securities (as opposed to derivatives) in some cases generates interest income, some banks strip this out of the capital gain made when the security is traded to profit, while others include it as part of overall trading income.

Trading income is the most volatile income source for a bank. It also carries relatively high market risk, as well as not inconsiderable credit risk. Many banks, although by no means all, use the Value-at-Risk (VaR) methodology to measure the risk arising from trading activity, which gives a statistical measure of expected losses to the trading portfolio under certain selected market scenarios.

Costs

Bank operating costs comprise staff costs, as well as other costs such as premises, information technology and equipment costs. Further significant elements of cost are provisions for loan losses, which are a charge against the loan revenues of the bank. The provision is based on a subjective measure by management of how much of the loan portfolio can be expected to be repaid by the borrower.

The capital markets

Capital markets is the term used to describe the market for raising and investing finance. The economies of developed countries and a large number of developing countries are based on financial systems that contain investors and borrowers, *markets* and trading arrangements. A market can be one in the traditional sense such as an exchange where financial instruments are bought and sold on a trading floor, or it may refer to one where participants deal with each other over the telephone or via electronic screens. The basic principles are the same in any type of market. There are two primary users of the capital markets: lenders and borrowers. The source of lenders' funds is, to a large extent, the personal sector made up of household savings and those acting as their investment managers such as life assurance companies and pension funds. The borrowers are made up of the government, local governments and companies (called corporates). There is a basic conflict in the financial objectives of borrowers and lenders, in that those who are investing funds wish to remain *liquid*, which means they have easy access to their investments. They also wish to maximise the return on their investment. A borrower, on the other hand, will wish to generate maximum net profit on its activities, which will require continuous investment in plant, equipment, human resources and so on. Such investment will therefore need to be as long-term as possible. Government borrowing, as well, is often related to long-term projects such as the construction of schools, hospitals and roads. So while investors wish to have ready access to their cash and invest short, borrowers desire funding to be as long as possible. The economist John Hicks[1] referred to this conflict as the "constitutional weakness" of financial markets, especially when there is no conduit through which to reconcile the needs of lenders and borrowers. To facilitate the efficient operation of financial markets and the price mechanism, intermediaries exist to bring together the needs of lenders and borrowers. A bank is the best example of this. Banks accept deposits from investors, which make up the *liability* side of their balance sheet, and lend funds to borrowers, which form the *assets* on their balance sheet. If a bank builds up a sufficiently large asset and liability base, it will be able to meet the needs of both investors and borrowers, as it can maintain liquidity to meet investors' requirements, as well as create long-term assets to meet the needs of borrowers. The bank is exposed to two primary risks in carrying out its operations, one that a large number of investors decide to withdraw their funds at the same time (a "run" on the bank), or that large numbers of borrowers go bankrupt and default on their loans. In acting as a financial intermediary, the bank reduces the risks it is exposed to by spreading and pooling risk across a wide asset and liability base.

Corporate borrowers wishing to finance investment can raise capital in various ways. The main methods are:

- continued reinvestment of the profits generated by a company's current operations;
- selling shares in the company, known as equity capital, equity securities or *equity*, which confirm on buyers a share in ownership of the company. The shareholders as owners have the right to vote at general meetings of the company, as well as the right to share in the company's profits by receiving dividends;
- borrowing money from a bank, via a bank loan. This can be a short-term loan such as an overdraft, or a longer term loan over two, three, five years or even longer. Bank loans can be at either a fixed or more usually, variable rate of interest;
- borrowing money by issuing debt securities, in the form of *bills*, *commercial paper* and *bonds* that subsequently trade in the debt capital market.

The first method may not generate sufficient funds, especially if a company is seeking to expand by growth or acquisition of other companies. In any case a proportion of annual after-tax profits will need to be paid out as dividends to shareholders. Selling further shares is not always popular among existing shareholders as it dilutes the extent of their ownership; there are also a host of other factors to consider, including if there is any appetite in the market for that company's shares. A bank loan is often inflexible, and the interest rate charged by the bank may be comparatively high for all but the highest quality companies. However, it is often the first source of corporate finance. We say comparatively, because there is often a cheaper way for corporates to borrow money: by tapping the bond and money markets. And that is where banks come in.

Layout of the book

Bank Asset and Liability Management is written in seven parts, covering the various different but related aspects of bank ALM. These are:

Part I – Banking business, bank capital and debt market instruments

Part II – Bank treasury asset–liability management

Part III – Financial instruments, applications and hedging

Part IV – Funding and balance-sheet management using securitisation and structured credit vehicles

Part V – Regulatory capital and the Basel rules

Part VI – Treasury middle office operations

Part VII – Applications software enclosed with the book.

For newcomers to the market there is a primer on financial market arithmetic located in the Appendix, as well as a Glossary of market terms.

Highlights of the book include:

- a detailed look at ALM activity and operation as undertaken by banks and securities houses, including risk management and management reporting;
- comprehensive coverage of the money markets;
- a look at the syndicated loan market;
- the use of securitisation in balance sheet management;
- applications of synthetic structured finance securities;
- yield curve analysis, the determinants of the swap spread and understanding the term premium;
- the role of the ALM committee (ALCO);
- coverage of market instruments including interest-rate derivatives (FRAs, futures, caps, floors and swaps) and credit derivatives, and their use and application for hedging purposes;
- calculating the credit risk exposure hedge notional amount;
- the latest developments in structured funding vehicles;
- description and analysis of structured credit products including collateralised debt obligations (CDOs) and structured investment vehicles (SIVs), and their application in ALM;
- the process of structuring a securitisation deal;
- synthetic CDO note pricing and tranche correlation; and
- a look at the Basel II regulatory capital rules and its implications.

The book also features a contribution from Andrew Oliver of KBC Financial Products in London, who wrote the chapter on Treasury middle office operations. This is an important element in overall ALM for banks and we are pleased to have Mr Oliver's expert opinion on this subject. Parts of the chapters on credit derivatives and CDOs were co-authored with Abukar Ali of Bloomberg L.P., Richard Pereira of JPMorgan Chase and Jaffar Hussein of the Saudi National Commercial Bank, and my grateful thanks to them.

The accompanying CD-R features software co-written with Kevin Zhuoshi Liu, Rod Pienaar, Suleman Baig, Abukar Ali, Stuart Turner and Didier Joannas,

and again my grateful thanks to them.

As ever, the intention is to remain accessible and practical throughout. We hope this aim has been achieved. Comments on the text are most welcome and should be sent to the author care of John Wiley & Sons (Asia) Ltd.

Acknowledgments and special thanks

With thanks to Luis Perez and Zhuoshi Liu for assistance with the Errata, much appreciated.

Big, big, emotional hug to the **Raynes Park Footy Boys** (Abubakar, Abukar, Anuk, Clax, Farooq, Harry, Kevin, Khurram, Mohamoud, Richard and Rod, plus honourary members Melvin Chan, Mike Brand, Brian Eales and Carol Alexander) – you are total legends and I love you like my own brother. *A Solid Bond In Your Heart.*

Salaam Aleikum to Adnan Jaffery at Citigroup, Bhavin Parmar at ABN Amro and Ali Mahdavi at Bloomberg. David Walters, I have high hopes for you, all the best. El Gunista get some desk sweets in mate... Thanks to Suraj Gohil and Bruno Pajusco at KBC FP for expert help on all matters CDS... Special thanks to Anne Carter as always for help with the proofing process, you are an absolute darling. Mr James Harrison, as you can see when I can't remember the numbers in the calculations I just use *x* and *y*..!

Thanks to the Teesside 5-a-side boys including Jonno, Cooper, Dick, Walker and Pie – your attitude is spot on, and it's my privilege and pleasure to know you.

Thanks to the publishing Dream Team that is Janis Soo, Paul Lim and Edward Caruso, you guys can make *any* book look good. Awesome – thank you.

Thanks to that other Dream Team which is any group of capital markets lawyers led by the legendary Jim Croke – the man is a demon!

EDG United thank you for the swansong... Also thanks to a company of youth on the football field for their first-class teamwork, the essence of success in any endeavour: Mark Burgess, Frank Spiteri, John Key, Russell Betteridge, Sam McArthur, Richard Silver, Hirak Chakravorty, Henrik Ljungstrom, Petch Pompili, Vladan Ognjenovic, Bilal Mannaa, Adam Hockley, Paul Muttett and Philip Cooper.

Finally, thank you to Terry Williams, Andrew Calvy, John Marshall, Ray Saunders, Anthony Goodin, Damon Carter, Rich Lynn, Neil Lewis, Stuart

Medlen, Michael Nicoll, Jonathan Rossington, Alan Fulling, Sean Murphy and Michael Beddow for demonstrating consistently the unquantifiable, yet vital, characteristic that is the ability to inspire. Quintessential Best of British.

Or, as Justin Rockberger would say – “Be up for it!”

I beg that readers indulge me as I list my eight desert-island discs:

1. *Lean On Me!*, Redskins
2. *My Sweet Lord*, George Harrison
3. *Rattlesnakes*, Lloyd Cole and The Commotions
4. *Still Ill*, The Smiths
5. *Don’t Let Me Down*, The Beatles
6. *I Can’t Help Myself*, Orange Juice
7. *A Lover Sings*, Billy Bragg
8. *Speak Like A Child*, The Style Council

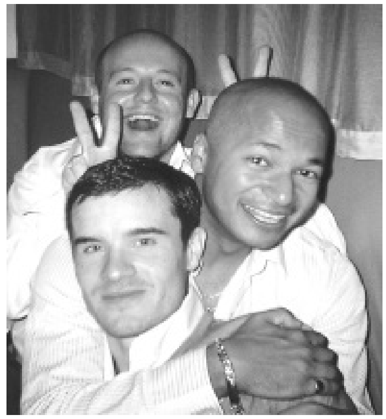
And, after nine years...that’s yer lot! Goodbye...

Moorad Choudhry

Surrey, England

30 January 2007

[1] Hicks, J. 1939, *Value and Capital*, Oxford University Press, Oxford.



About the Author

Moorad Choudhry is Head of Treasury at KBC Financial Products in London. He is a Visiting Professor at the Department of Economics, London Metropolitan University; a Visiting Research Fellow at the ICMA Centre, University of Reading; a Senior Fellow at the Centre for Mathematical Trading and Finance, Cass Business School; a Fellow of the Global Association of Risk Professionals, a Fellow of the Institute of Sales and Marketing Management; a Fellow of the Securities and Investment Institute and a member of the Chartered Institute of Bankers. He is on the Editorial Board of the *Journal of Structured Finance.*

I must frankly admit that, if I had known beforehand the labour which this book entailed, I should never have been courageous enough to commence it.

– Isabella Beeton, *Mrs Beeton's Household Guide*, Ward, Lock & Co., c.1861

PART I

Banking Business, Bank Capital and Debt Market Instruments Part I is something of a primer on banking, and is designed to set the scene for beginners, be they students or practitioners. We need to be familiar with the nature of banking business, as well as the types of instruments used in money market trading. We also need to be familiar with banking capital and financial statements, the former preparatory to a discussion of regulatory capital and the Basel rules, the latter simply for general knowledge purposes. So the first part of this book covers all these areas.

We begin with a look at the fundamentals of banking business, and the different elements of bank capital. This is essentially an introduction into the nature of banking. We then look at financial statements, which comprise balance sheet and profit and loss account. The contents of this chapter may appear more at home in a textbook on accounting, but an understanding of

ratio analysis is vital for the ALM practitioner, who is concerned with issues such as return on capital.

The remainder of Part I looks at financial market debt instruments, which are the main products issued and traded by banks. Chapter 3 discusses money market instruments and Chapter 4 is concerned with capital market instruments or bonds. For undergraduate students and junior practitioners we cover elements of financial arithmetic, which are essential to an understanding of ALM, in the Appendix at the back of the book.

> "[Cassandra is] a bit like me – an achiever. I've always been an achiever ... ...I've never actually achieved anything, mind...but I've always been up there with a shout."

— Derek 'Del-Boy' Trotter, "The Jolly Boys Outing"

Only Fools and Horses

BBC TV 1989

PART II

Bank Treasury Asset–Liability Management

Having introduced the market instruments, we are in a position to introduce the basics of asset–liability management (ALM). In Part II we review the main strands of the discipline, including a look at the role of the ALM Committee (ALCO) and ALCO reporting. We also consider the yield curve, relative value analysis, determinants of the swap spread and the expected magnitude of the term premium, all of which feed into ALM decision-making.

We describe the ALM function in four chapters. In Chapter 5 we introduce basic concepts, such as liquidity, gap and the cost of funds. This is illustrated with case studies that show how an hypothetical medium-sized bond and derivatives trading house, which we call XYZ Securities Limited, would structure its ALM policy. There are also case studies that illustrate how XYZ would use floating-rate notes (FRNs) and sovereign bond portfolios as part of its treasury management. Chapter 6 develops these concepts with realworld illustrations. We take an interlude with Chapter 7 which introduces the basic techniques of money market trading and hedging; these are essential elements in the daily ALM process. Finally we describe in detail the function of the bank ALM committee or ALCO, in Chapter 8.

CHAPTER 5

Asset–Liability Management I

Asset–liability management (ALM) is a generic term that is used to refer to a number of things by different market participants. We believe however that it should be used to denote specifically the high-level management of a bank's assets and liabilities; as such it is a strategy-level discipline and not a tactical one. It may be set within a bank's Treasury division by its asset–liability committee (ALCO). The principle function of the ALM desk is to manage interest-rate risk and liquidity risk. It will also set overall policy for credit risk and credit risk management, although tactical-level credit policy is set at a lower level within credit committees. Although the basic tenets of ALM would seem to apply more to commercial banking rather than investment banking, in reality it is applied to both functions. A trading desk still deals in assets and liabilities, and these must be managed for interest-rate risk and liquidity risk. In a properly integrated banking function the ALM desk must have a remit overseeing all aspects of a bank's operations.

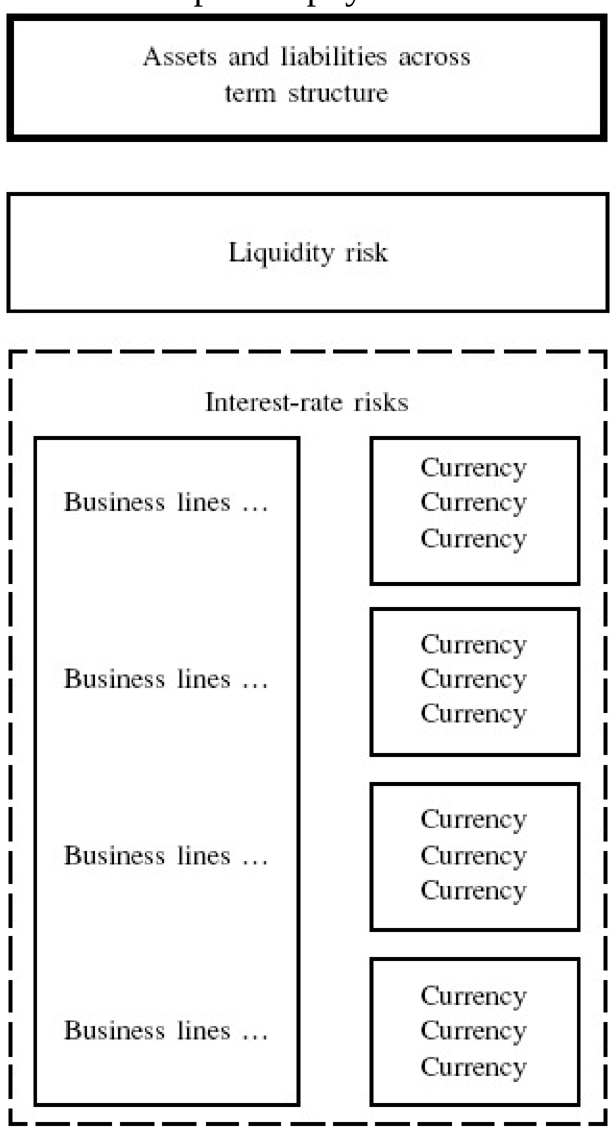
In this chapter we introduce the key ALM concepts of liquidity, management policy and the internal cost of funds.

Basic concepts

In financial markets two main strands of risk management are interest-rate risk and liquidity risk. ALM practice is concerned with managing this risk. Interest-rate risk exists in two strands. The first strand is the more obvious one, the risk of changes in asset–liability value due to changes in interest rates. Such a change impacts the cash flows of assets and liabilities, or rather their present value, because financial instruments are valued with reference to market interest rates. The second strand is that associated with optionality, which arises with products such as early redeemable loans. The other main type of risk that ALM seeks to manage is liquidity risk, which refers both to the liquidity of markets and the ease with which assets can be translated to cash.

ALM is conducted primarily at an overview, balance sheet level. The risk that is managed is an aggregate, group-level risk. This makes sense because one could not manage a viable banking business by leaving interest-rate and liquidity risk management at individual operating levels. We illustrate this in Figure 5.1, which highlights the cornerstones of ALM. Essentially, interest-rate risk exposure is managed at the group level by the Treasury desk. The drivers are the different currency interest rates, with each exposure being made up of the net present value (NPV) of cash flow as it changes with movements in interest rates. The discount rate used to calculate the NPV is the prevailing market rate for each time bucket in the term structure.

Figure 5.1 Cornerstone of ALM philosophy



The interest-rate exposure arises because rates fluctuate from day to day, and continuously over time. The primary risk is that of interest-rate reset, for floating-rate assets and liabilities. The secondary risk is liquidity risk: unless assets and liabilities are matched by amount and term, assets must be funded on a continuous rolling basis. Equally, the receipt of funds must be placed on a continuous basis. Whether an asset carries a fixed or floating-rate reset will determine its exposure to interest-rate fluctuations. Where an asset is marked at a fixed rate, a rise in rates will reduce its NPV and so reduce its value to the bank. This is intuitively easy to grasp, even without recourse to financial arithmetic, because we can see that the asset is now paying a below-market rate of interest. Or we can think of it as a loss due to opportunity cost foregone, since the assets are earning below what they could earn if they were employed elsewhere in the market. The opposite applies if there is a fall in rates: this causes the NPV of the asset to rise. For assets marked at a floating-rate of interest, the risk exposure to fluctuating rates is lower, because the rate receivable on the asset will reset at periodic intervals, which will allow for changes in market rates.

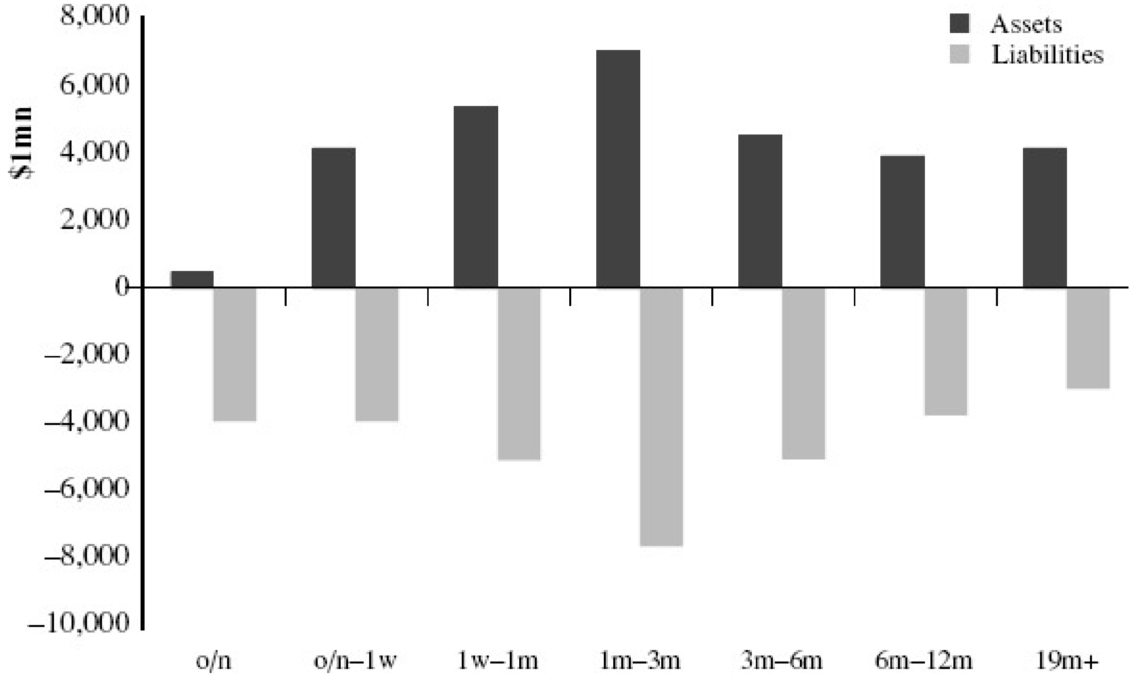
We speak of risk exposure as being for the group as a whole. This exposure must therefore aggregate the net risk of all the bank's operating business. Even for the simplest banking operation, we can see that this will produce a net mismatch between assets and liabilities, because different business lines will have differing objectives for their individual books. This mismatch will manifest itself in two ways:

- the mismatch between the different terms of assets and liabilities across the term structure;
- the mismatch between the different interest rates that each asset or liability contract has been struck at.

This mismatch is known as the ALM *gap*. The first type is referred to as the *liquidity gap*, while the second is known as the *interest-rate gap*. We value assets and liabilities at their NPV; hence, we can measure the overall sensitivity of the balance sheet NPV to changes in interest rates. As such ALM is an art that encompasses aggregate balance sheet risk management at the group level.

Figure 5.2 shows the aggregate group-level ALM profile for a securities and derivatives trading house based in London. There is a slight term mismatch as no assets are deemed to have "overnight" maturity whereas a significant portion of funding (liabilities) is in the overnight term. One thing we do not know from looking at Figure 5.2 is how this particular institution is defining the maturity of its assets.[1] To place these in the relevant maturity buckets, one can adopt one of two approaches, namely:

Figure 5.2 Securities and derivatives trading house ALM profile



- the actual duration of the assets;
- the "liquidity duration", which is the estimated time it would take the firm to dispose of its assets in an enforced or "firesale" situation, such as a withdrawal from the business.

Each approach has its adherents, and we believe that actually there is no "right" way. It is up to the individual institution to adopt one method and then consistently adhere to it. The second approach has the disadvantage, however, of being inherently subjective – the estimate of the time taken to dispose of an asset book is not an exact science and is little more than educated guesswork. Nevertheless, for long-dated and/or illiquid assets, it is at least a workable method that enables practitioners to work around a specified ALM framework with regard to structuring the liability profile.

Liquidity gap

There is an obvious risk exposure arising because of liquidity mismatch of assets and liabilities. The maturity terms will not match, which creates the liquidity gap. The amount of assets and liabilities maturing at any one time will also not match (although overall, as we saw in Chapter 2, by definition assets must equal liabilities). Liquidity risk is the risk that a bank will not be able to refinance assets as liabilities become due, for any reason.[2] To manage this, the bank will hold a large portion of assets in very liquid form.[3] A surplus of assets over liabilities creates a funding requirement. If there is a surplus of liabilities, the bank will need to find efficient uses for those funds. In either case, the bank has a liquidity gap. This liquidity can be projected over time, so that one knows what the situation is each morning, based on net expiring assets and liabilities. The projection will change daily of course, due to new business undertaken each day.

We could eliminate liquidity gap risk by matching assets and liabilities across each time bucket. Actually, at individual loan level this is a popular strategy: if we can invest in an asset paying 5.50% for three months and fund this with a three-month loan costing 5.00%, we have locked in a 50-basis point gain that is interest-rate risk free. However, while such an approach can be undertaken at individual asset level, it would not be possible at an aggregate level, or at least not possible without imposing severe restrictions on the business. Hence, liquidity risk is a key consideration in ALM. A bank with a surplus of long-term assets over short-term liabilities will have an ongoing requirement to fund the assets continuously, and there is the ever-present risk that funds may not be available as and when they are required. The concept of a future funding requirement is itself a driver of interest-rate risk, because the bank will not know what the future interest rates at which it will deal will be.[4] So a key part of ALM involves managing and hedging this forward liquidity risk.

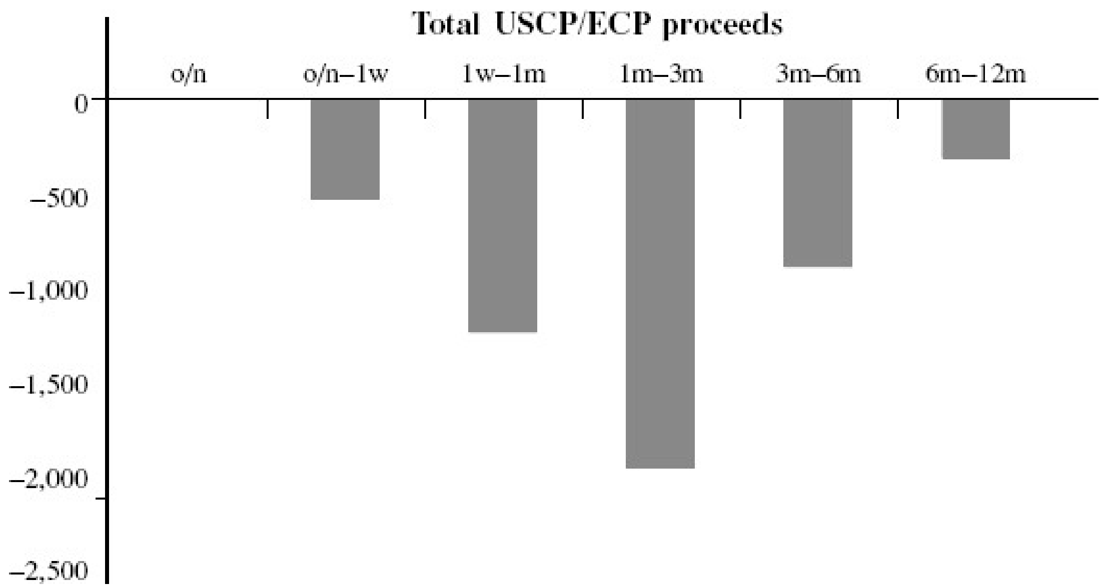
Definition and illustration

To reiterate then, the liquidity gap is the difference in maturity between assets and liabilities at each point along the term structure. Because for many banks ALM concerns itself with a medium-term management of risk, this will not be beyond a five-year horizon, and in many cases will be considerably less than this. Note from Figure 5.2 how the longest-dated time bucket in the ALM profile extends out to only "12-month plus", so that all liabilities longer than one year were grouped in one time bucket. This recognises that most liabilities are funded in the money markets, although a proportion of funding will be much longer term, up to 30 years or so.

For each point along the term structure at which a gap exists, there is (liquidity) gap risk exposure. This is the risk that funds cannot be raised as required, or that the rate payable on these funds is prohibitive.[5] To manage this risk, a bank must perforce:

- disperse the funding profile (the liability profile) over more than just a short period of time. For example, it would be excessively risky to concentrate funding in just the overnight to one-week time bucket, so a bank will spread the profile across a number of time buckets. Figure 5.3 shows the liability profile for a European multi-currency asset-backed CP programme, with liabilities extending from one month to one year;
- manage expectations so that large-size funding requirements are diarised well in advance, as well as not planned for times of low liquidity such as the Christmas and New Year period;
- hold a significant proportion of assets in the form of very liquid instruments such as very short term cash loans, T-bills and high-quality short-term bank CDs.

Figure 5.3 CP programme liability profile



Observing the last guideline allows a bank to maintain a reserve of liquidity in the event of a funding crisis, because such assets can be turned into cash at very short notice.

The size of the liquidity gap at any one time is never more than a snapshot in time, because it is constantly changing as new commitments are entered into on both the asset and liability side. For this reason some writers speak of a "static" gap and a "dynamic" gap, but in practice one recognises that there is only ever a dynamic gap, because the position changes daily. Hence we will refer only to one liquidity gap.

A further definition is the "marginal" gap, which is the difference between the change in assets and change in liabilities during a specified time period. This is also known as the "incremental" gap. If the change in assets is greater than the change in liabilities, this is a positive marginal gap, while if the opposite applies this is a negative marginal gap.[6]

We illustrate these values in Table 5.1. This is a simplified asset–liability profile from a regional European bank, showing gap and marginal gap at each time period. Note that the liabilities have been structured to produce an "ALM Smile", which is recognised to follow prudent business practice. Generally, no more than 20% of the total funding should be in the overnight to one-week time bucket, and similarly for the 9–12 month bucket. The marginal gap is measured as the difference between the change in assets and the change in liabilities from one period to the next.

Table 5.1 Simplified ALM profile for regional European bank

	One week	One month	3–month	6–month	9–12 month	> 12months	Total
Assets	10	90	460	710	520	100	1890
Liabilities	100	380	690	410	220	90	1890
Gap	–90	–290	–230	300	300	10	
Marginal gap		200	–60	–530	0	290	

Figure 5.4 shows the graphical profile of the numbers in Table 5.1; and Figure 5.2 shown earlier illustrates the "ALM Smile".

Figure 5.4 ALM time profile

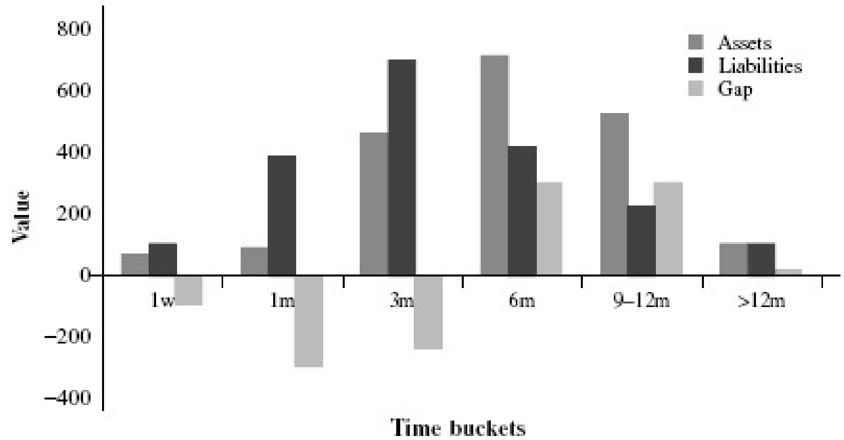


Figure 5.4 ALM time profile

[6] Note that this terminology is not a universal convention.

Liquidity risk

Liquidity risk exposure arises from normal banking operations. That is, it exists irrespective of the type of funding gap, be it excess assets over liabilities for any particular time bucket or an excess of liabilities over assets. In other words, there is a funding risk in any case, either funds must be obtained or surplus assets laid off. The liquidity risk in itself generates interest-rate risk, due to the uncertainty of future interest rates. This can be managed through hedging, and we discuss interest-rate hedging in chapters 13, 14 and 15.

If assets are floating-rate, there is less concern over interest-rate risk because of the nature of the interest-rate reset. This also applies to floating-rate liabilities, but only insofar that these match floating-rate assets. Floating-rate liabilities issued to fund fixed-rate assets create forward risk exposure to rising interest rates. Note that even if both assets and liabilities are floating-rate, they can still generate interest-rate risk. For example, if assets pay six-month Libor and liabilities pay three-month Libor, there is an interest-rate spread risk between the two terms. Such an arrangement has eliminated liquidity risk, but not interest-rate spread risk.

Liquidity risk can be managed by matching assets and liabilities, or by setting a series of rolling term loans to fund a long-dated asset. Generally, however, banks will have a particular view of future market conditions, and manage the ALM book in line with this view. This would leave in place a certain level of liquidity risk.

Matched book

The simplest way to manage liquidity and interest-rate risk is the matched book approach, also known as cash matching. This is actually very rare to observe in practice, even among conservative institutions such as the smaller UK building societies. In matched book, assets and liabilities, and their time profiles, are matched as closely as possible. This includes allowing for the amortisation of assets.[7] As well as matching maturities and time profiles, the interest-rate basis for both assets and liabilities will be matched. That is, fixed loans to fund fixed-rate assets, and the same for floating-rate assets and liabilities. Floating-rate instruments will further need to match the period of each interest-rate reset, to eliminate spread risk.

Under a matched book, also known as *cash flow matching,* in theory there is no liquidity gap. Locking in terms and interest rate bases will also lock in profit. For instance, a six-month fixed-rate loan is funded with a six-month fixed-rate deposit. This would eliminate both liquidity and interest-rate risk. In a customer-focused business it will not be possible to precisely match assets and liabilities, but from a macro-level it should be possible to match the profiles fairly closely, by netting total exposure on both sides and matching this. Of course, it may not be desirable to run a matched book, as this would mean the ALM book was not taking any view at all on the path of future interest rates. Hence a part of the banking book is usually left unmatched, and it is this part that will benefit (or lose out) if rates go the way they are expected to (or not!).

Managing the gap with undated assets and liabilities

We have described a scenario of liquidity management where the maturity date of both assets and liabilities is known with certainty. A large part of retail and commercial banking operations revolves around assets that do not have an explicit maturity date however. These include current account overdrafts and credit card balances. They also include drawn and undrawn lines of credit. The volume of these is a function of general economic conditions, and can be difficult to predict. Banks will need to be familiar with their clients' behaviour and their requirements over time to be able to assess when and for how long these assets will be utilised.

Undated assets are balanced on the other side by non-dated liabilities, such as non-interest-bearing liabilities (NIBLs), which include cheque accounts and instant-access deposit accounts. The latter frequently attract very low rates of interest, and are usually included in the NIBL total. Undated liabilities are treated in different ways by banks; the most common treatment places these funds in the shortest time bucket, the overnight to one-week bucket. However, this means the firm's gap and liquidity profile can be highly volatile and unpredictable, which places greater strain on ALM management. For this reason some bank's take the opposite approach and place these funds in the longest-dated bucket, the greater-than-12-month bucket. A third approach is to split the total undated liabilities into a "core" balance and an "unstable" balance, and place the first in the long-dated bucket and the second in the shortest dated bucket. The amount recognised as the core balance will need to be analysed over time, to make sure that it is accurate.

Managing liquidity

Managing liquidity gaps and the liquidity process is a continuous, dynamic one because the ALM profile of a bank changes on a daily basis. Liquidity management is the term used to describe this continuous process of raising and laying off funds, depending on whether one is long or short cash that day.

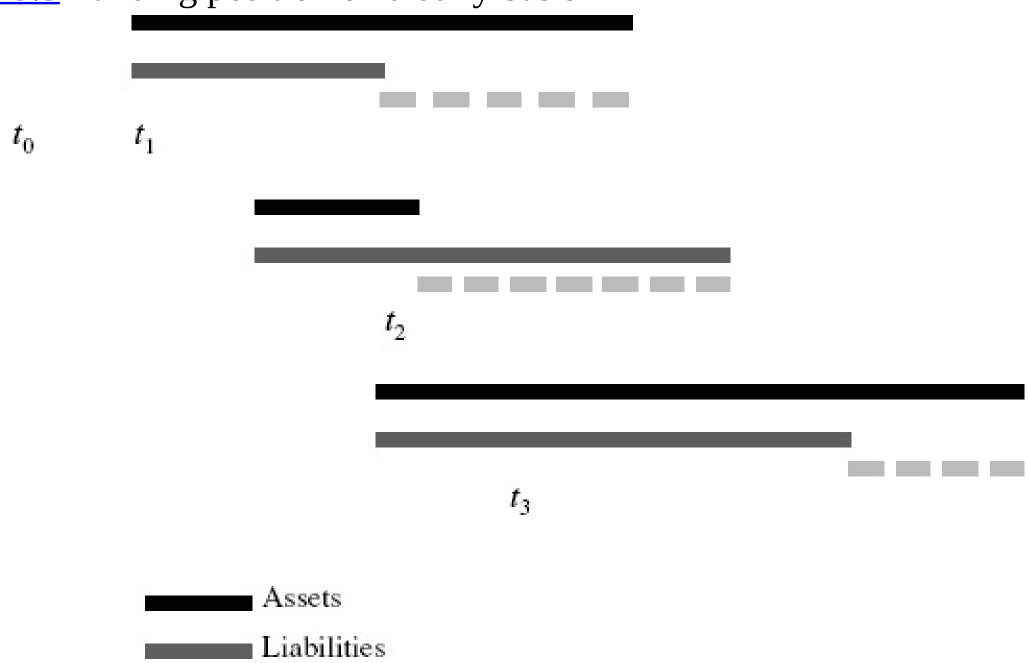
The basic premise is a simple one: the bank must be "squared off" by the end of each day, which means that the net cash position is zero. Thus, liquidity management is both very short-term, as well as projected over the long term, because every position put on today creates a funding requirement in the future on its maturity date. The ALM desk must be aware of their future funding or excess cash positions and act accordingly, whether this means raising funds now or hedging forward interest-rate risk.

The basic case: the funding gap

A funding requirement is dealt on the day it occurs. The decision on how it will be treated will factor the term that is put on, as well as allowing for any new assets put on that day. As funding is arranged, the gap at that day will be zero. The next day there will be a new funding requirement or surplus, depending on the net position of the book.

This is illustrated in Figure 5.5 on page 222. Starting from a flat position on the first day (t_0) we observe a gap (the dotted line) on t_1, which is closed by putting on funding to match the asset maturity. The amount of funding to raise, and the term to run it to, will take into account the future gap as well as that day's banking activities. So at t_2 we observe a funding excess, which is then laid off. We see at t_3 that the assets invested in run beyond the maturity of the liabilities at t_2, so we have a funding requirement again at t_3. The decision on the term and amount will be based on the market view of the ALM desk. A matched book approach may well be taken where the desk does not have a strong view, or if its view is at odds with market consensus.

Figure 5.5 Funding position on a daily basis



There are also external factors to take into account. For instance, the availability of funds in the market may be limited, due to both macro-level issues and to the bank's own ability to raise funds. The former might be during times of market correction or recession (a "credit crunch"), while the latter includes the bank's credit lines with market counterparties. Also some funds will have been raised in the capital markets and this cash will cover part of the funding requirement. In addition, the ALM desk must consider the cost of the funds it is borrowing; if, for example, it thought that interest rates in the short term, and for short-term periods, were going to fall, it might cover the gap with only short-term funds so it can then refinance at the expected lower rates. The opposite might be done if the desk thought rates would rise in the near future.

Running a liquidity gap over time, beyond customer requirements, would reflect a particular view of the ALM desk. So maintaining a consistently underfunded position suggests that interest rates are expected to decline, at which longer-term funds can be taken at cost. Maintaining an over-funded gap would imply that the bank thinks rates will be rising, and so longer-term funds are locked in now at lower interest rates. Even if the net position is dictated by customer requirements (for example, customers placing more on deposit than they take out in loans), the bank can still manage the resultant gap in the wholesale market.

Excess liabilities generally is a rare scenario in a bank and it is not, under most circumstances, a desirable position to be in. This is because the bank will have target return on capital ratios to achieve, and this requires that funds be put to work, so to speak, by acquiring assets. In the case of equity capital it is imperative that these funds are properly employed.[8] The exact structure of the asset book will depend on the bank's view on interest rates and the yield curve generally. The shape of the yield curve and expectations on this will also influence the structure and tenor of the asset book. The common practice is to spread assets across the term structure, with varying maturities. There will also be investments made with a forward start date, to lock in rates in the forward curve now. Equally, some investments will be made for very short periods so that if interest rates rise, when the funds are reinvested they will benefit from the higher rates.

The basic case: illustration

The basic case is illustrated in Table 5.2, in two scenarios. In the first scenario, the longest-dated gap is −130, so the bank puts on funding for +130 to match this tenor of three periods. The gap at period t_2 is −410, so this is matched with a 2-period tenor funding position of +280. This leaves a gap of −180 at period t_1, which is then funded with a 1-period loan. The net position is zero at each period ("squared off"), and the book has been funded with three bullet fixed-term loans. The position is not a matched book as such, although there is now no liquidity risk exposure.

Table 5.2 Funding the liquidity gap: two examples

(i)

Time	t_1	t_2	t_3
Assets	970	840	1,250
Liabilities	380	430	1,120
Gap	–590	–410	–130
Borrow 1: tenor 3 periods	130	130	130
Borrow 2: tenor 2 periods	280	280	
Borrow 3: tenor 1 periods	180		
Total funding	+590	+410	+130
Squared off	0	0	0

(ii)

Time	t_1	t_2	t_3
Assets	970	840	1,250
Liabilities	720	200	1,200
Gap	–250	–640	–50
Borrow 1: tenor 3 periods	50	50	50
Borrow 2: tenor 2 periods	200	200	
Borrow 3: tenor 1 periods	0	390	
Total funding	+250	+640	+50
Squared off	0	0	0

In the second case, the gap is increasing from period 1 to period 2. The first period is funded with a three-period and a two-period borrowing of +50 and +200 respectively. The gap at t_2 needs to be funded with a position that is not needed *now*. The bank can cover this with a forward-start loan of +390 at t_1 or can wait and act at t_2. If it does the latter it may still wish to hedge the interest-rate exposure.[9]

The liquidity ratio

The *liquidity ratio* is the ratio of assets to liabilities. It is a short-term ratio, usually calculated for the money market term only; that is, up to one year. Under most circumstances, and certainly under a positive yield curve environment, it would be expected to be above 1.00; however, this is less common at the very short end because the average tenor of assets is often greater than the average tenor of liabilities. So in the one-month to three-month period, and perhaps out to six months, the ratio may well be less than one. This reflects the fact that short-term borrowing is used to fund longer-term assets.

A ratio of below one is inefficient from an RoE point of view. It represents an opportunity cost of return foregone. To manage it, banks may invest more funds in the very short term, but this also presents its own problems because the return on these assets may not be sufficient. This is especially true in a positive yield curve environment. This is one scenario where a matched book approach will be prudent, because the bank should be able to lock in a bid–offer spread in the very short end of the yield curve.[10] A more risky approach would be to lend in the short term and fund these in the long term, but this would create problems because the term premium in the yield curve will make borrowing in the long term expensive relative to the return on short-dated assets (unless we have an inverted yield curve). There is also the liquidity risk associated with the more frequent rolling over of assets compared to liabilities. We see then, that maintaining the liquidity ratio carries something of a cost for banks.

Case study 5.1: Hypothetical derivatives trading house ALM policy and profile

We conclude this introduction to the basic concept of ALM with a look at the ALM policy and profile of a hypothetical securities and derivatives trading house, which we will call XYZ Securities Limited. The business is a financial institution based in London, with a number of business lines in FX, equity, and credit derivatives trading and market-making. We outline the various firm-wide policies on ALM, cash management, liquidity and investment that have been formalised at XYZ Securities.

XYZ Securities Limited

Funding and ALM

This note outlines the approach to managing the asset–liability profile that is generated by the funding requirements of XYZ Securities Limited ("XYZ"). The principal source of funding is the parent bank. Funds are also taken from a variety of external sources (prime brokerage, bank lines, TRS and repo lines, a repo conduit and an ABCP programme). The overall management of the ALM profile is centralised within XYZ Treasury desk.

The key objective of the Treasury desk is to undertake prudent management of XYZ's funding requirement, with regard to liquidity management, interest-rate management (gap profile) and funding diversification. This process includes management information and reporting. The primary deliverable of the Treasury desk is the ALM report. This is presented in Table 5.3 on page 233.

Table 5.3 XYZ Securities Limited ALM report and profile

	o/n	o/n–1	1w–1m	1m–3m	3m–6m	6m–12m	12m+	**Total**
Assets	481	4,104	5,325	6,954	4,478	3,845	4,128	29,315
Liabilities	–3,947	–844	–5,107	–7,579	–5,053	–3,799	–2,986	(29,315)
Gap	3,466	3,260	218	625	575	46	1,142	9,332
Percent of total funding	13%	3%	17%	26%	17%	13%	10%	100%
Gap as % of total gap	37%	35%	2%	7%	6%	0%	12%	100%
Gap as % of total funding	12%	11%	1%	2%	2%	0%	4%	
Gap limit	20%	20%	20%	20%	20%	20%	20%	
Limit breach	–	–	–	–	–	–	–	
Cumulative assets	481	4,585	9,910	16,864	21,342	25,187	29,315	
Cumulative liabilities	–3,947	–4,791	–9,898	–1,747	–22,530	–26,329	–29,315	
Net gap	–3,466	–206	12	–613	–1,188	–1,142	0	

ALM report

The ALM profile of all combined XYZ business lines is shown in Table 5.3. The report comprises the following segments:

- the ALM report;
- asset liquidity profile;
- liabilities.

We consider each part next.

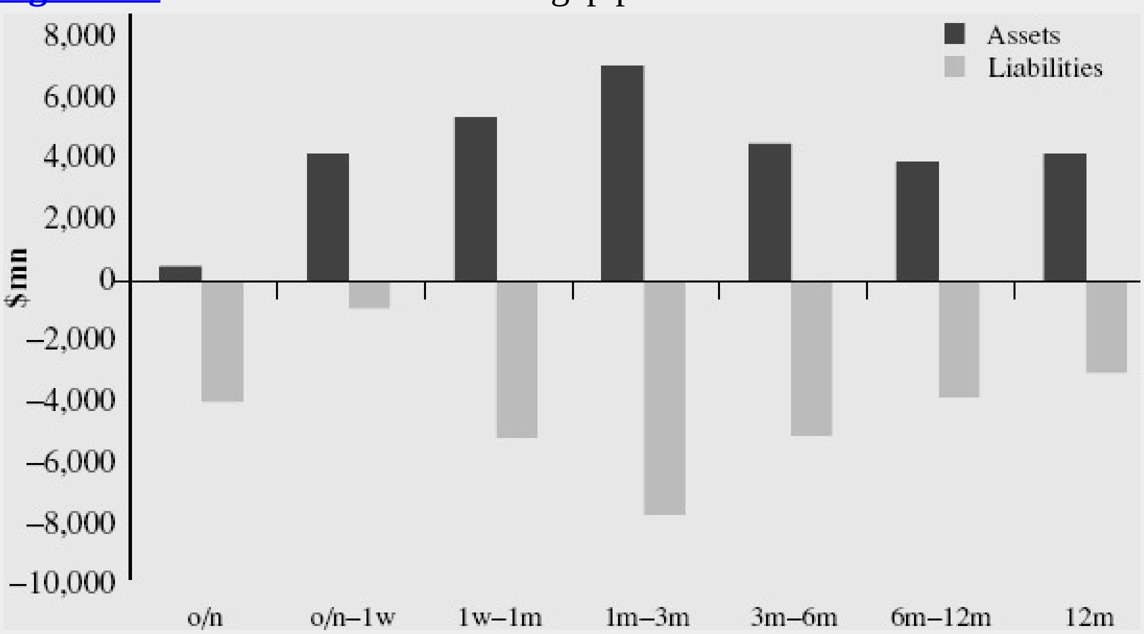
ALM report

This report summarises the total funding requirement of each of XYZ’s business lines. The business lines are: FX, interest-rate and credit derivatives market-making; equity derivatives proprietary trading, asset management and equity brokerage. The funding is profiled against the asset profile to produce the firm-wide ALM profile. Liability represents the funding taken by each business line. They are set out in accordance with the maturity term structure of each constituent loan of the total funding requirement. The maturity buckets used are:

- overnight
- overnight – one week
- one week – one month
- one month – three months
- three months – six months
- six months – 12 months
- over 12 months.

The asset pool is distributed along the same maturity buckets in accordance with certain assumptions. These assumptions are concerned with the expected turnover of assets in each business, and the time estimated to liquidate the business under enforced conditions.[11] Underneath the ALM profile is the gap profile (see Figure 5.6 on page 233). Gap is defined as the difference between assets and liabilities per maturity bucket; it shows how the liability profile differs from the asset profile. It is also a snapshot that reflects where the forward funding requirement lies at the time of the snapshot.

Figure 5.6 XYZ Securities Limited gap profile



Asset liquidity profile

This report is a detailed breakdown of the funding requirement of each business line. Assets and liabilities are split according to desk within each business line, set out by maturity profile.

Liabilities

This is the detailed liability profile breakdown of all the business lines. Funding is split into term structure of liabilities. A separate table is given for each business line. There is also a detailed breakdown of use of funds from each source of funds.

Aims and objectives

Historically, the funding of XYZ business was concentrated overwhelmingly on a very short-term basis. This reflected primarily the short-term trading nature of XYZ’s assets, which meant that the asset profile was effectively changing on a high frequency. Over time, XYZ’s business evolved into dealing in more longer-term asset classes and as a consequence XYZ moved to funding in the longer-term to more adequately match its asset profile. The Treasury objective is based on the following reasoning:

- to minimise forward funding gap;
- to term out the funding away from the very short-dated tenors used hitherto;
- to construct an ALM profile that recognises the differing requirements of individual business lines. For example, the market-making businesses are expected to have a more flexible liquidity profile than the asset management business. Hence, the liability profile of the former will be concentrated along the short end of the funding term structure when compared to the latter;
- to even out the liability profile such that no one maturity bucket contains more than 20% of the total funding requirement. This will be treated as a funding limit.

A 20% gap limit will apply to the overall XYZ funding requirement.

Application of cost of funds

The effect of terming out funding is to produce a cost of funds that is not explicitly observable without calculation. That is, the cost of funds must be determined as a pooled or weighted-average cost of funds (WAC). XYZ uses a simplified version of this calculation that is essentially the interest charged on each loan as a proportion of the total borrowing, or, put another way, the daily interest payable on all loans divided by the total notional amount. This is standard market practice and is used, for example, at a number of European investment banks. Treasury applies the WAC interest rate to each business line.

XYZ Securities Limited

Funding and ALM: enhanced procedures

As XYZ increases in size and complexity, it becomes necessary to implement a more sophiscated ALM approach. This is described below.

ALM report

The ALM report summarises the total funding requirement of each of XYZ's business lines. The funding is profiled against the asset profile to produce the firm-wide ALM profile. Liability represents the funding taken by each business line. They are set out in accordance with the maturity term structure of each constituent loan of the total funding requirement. The asset pool is distributed along the same maturity buckets in accordance with certain assumptions. These assumptions are concerned with the expected turnover of assets in each business, and the time estimated to liquidate the business under enforced conditions. Underneath the ALM profile is shown the gap profile. Gap is defined as the difference between assets and liabilities per maturity bucket; it shows how the liability profile differs from the asset profile. It is also a snapshot that reflects where the forward funding requirement lies at the time of the snapshot.

Aims and objectives

The aims and objectives remain the same as described on pages 227–8.

Modifications and updates

The new ALM policy includes the following improvements:

- the ALM profile of XYZ has been structured in line with market good practice, with more accurate matching of liabilities to assets; it now resembles a banking ALM profile more accurately;
- the overnight funding profile of XYZ, which represented significant liquidity risk, has now been transformed such that overnight funding now represents 13% of overall funding, compared with over 40% at the start of the new policy;
- the 20% gap limit has been formalised and put in place, and now is a formal limit that is observed by Treasury;
- there is regular weekly reporting of ALM and funding for XYZ (see Table 5.3 and Figure 5.6);
- greater diversity in funding sources has been achieved, with bank lines in place for XYZ access to unsecured, un-guaranteed funding, secured funding using repo and total return swaps, a repo conduit and an asset-backed CP programme.

The Treasury desk is charged with implementing market best practice with regard to ALM and funding policy.

Funding cost allocation

The major change in policy is now a move from a WAC-funding cost allocation to each of the business lines to a Treasury "pool" funding method.[12] In this approach, all funding, both overnight and term loans, is placed in a central Treasury pool. These funds are lent out, on an overnight basis, to the various business lines in accordance with their funding requirement. This removes interest-rate risk hedging considerations from the business lines and places them with Treasury. All business lines receive the same funding rate, the overnight Libor rate, so no business line has a funding cost advantage over another.

Treasury moves from being a cost-centre to a profit-centre, with any savings it makes in structuring the funding, below that of Liborflat at which it lends funds, being retained within it.

Interest-rate hedge

Under the new funding regime, all interest-rate risk exposure generated when putting on term loans is hedged within the Treasury book. The policy is as follows:

- Treasury has an interest-rate exposure limit of USD30,000 total interest-rate risk, measured as present value of a basis point (PVBP, or "DV01"), for all time buckets greater than 30 days.
- This exposure is generated by the use of term loans. Exposure is offset by lending funds in matching terms, running the liquidity book of CP, CDs, sovereign bonds and FRNs.
- Remaining DV01 is hedged using Eurodollar, Bund and short-sterling futures contracts.

The interest-rate exposure is monitored daily and subject to dynamic hedging as term loans are replaced.

Cash management

Cash management at XYZ is undertaken by the Treasury desk. Its aim is to undertake prudent management of XYZ's funding requirement, with regard to liquidity management, interest-rate management (gap profile and gap risk) and funding diversification. It is also responsible for producing management information and ALM reporting. The Treasury desk carries out its responsibilities working in conjunction with the middle office and back office. The back office reports each day's funding requirement, and the funding itself is carried out by Treasury in accordance with its view. The middle office reports the funding allocated to each line of business as part of regular p&l reporting.

The objective of ALM policy is to apply market-standard guidelines to the XYZ business and to follow prudent market practice. It is also to make the whole funding process more transparent with regard to management reporting and to centralise funding into one desk within the group.

ALM and funding report

The firm-wide ALM report is shown in Table 5.3 and Figure 5.6. From Table 5.6 we observe the following:

- the "gap" is defined as the absolute value of the assets and liabilities added together, which, because liabilities are reported as negative numbers, is essentially assets minus liabilities;
- the funding within each time bucket is reported as a percent of total funding. This is a key control measure, as prudent ALM policy suggests that the liability profile should be humped in shape ("the ALM Smile"), so that each bucket should not hold more than approximately 15–20% of the total funding;
- the next control value is the "gap as percent of total gap". This is noted to prevent an excessive forward gap developing in one time bucket;
- the key control measure is the gap as percent of total funding, which at XYZ is set at a 20% limit. We see that on this date there was no breach of this limit in any of the time buckets;
- the report also lists cumulative assets and liabilities, as well as the "net gap", which is the sum of the two cumulative values for each time bucket.

We observe that the ALM profile at XYZ follows roughly the ALM Smile shape that is recommended as the ideal profile over the term structure, and accepted good business practice.

The firm-wide funding report is shown in Figure 5.7. This is reported in graphical form to observe adherence to funding limits and indicate breaches. Unlike the ALM report, which is produced by Treasury (a front-office function), the funding report is produced by the bank's Middle Office, which is a control function. Figure 5.8 shows the breakdown by business line.

Figure 5.7 XYZ Securities Limited funding usage and limit report

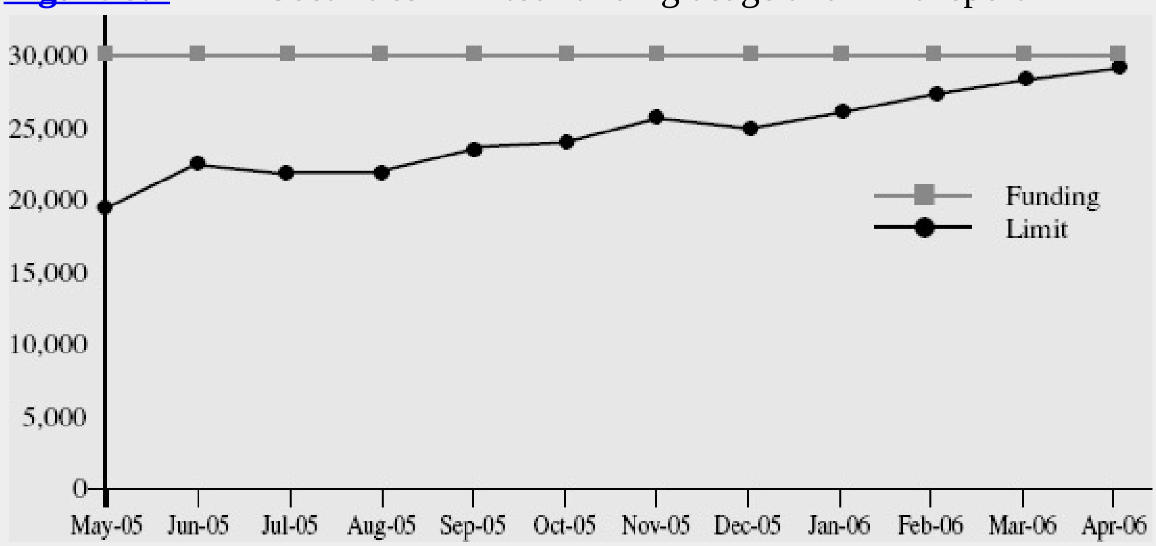
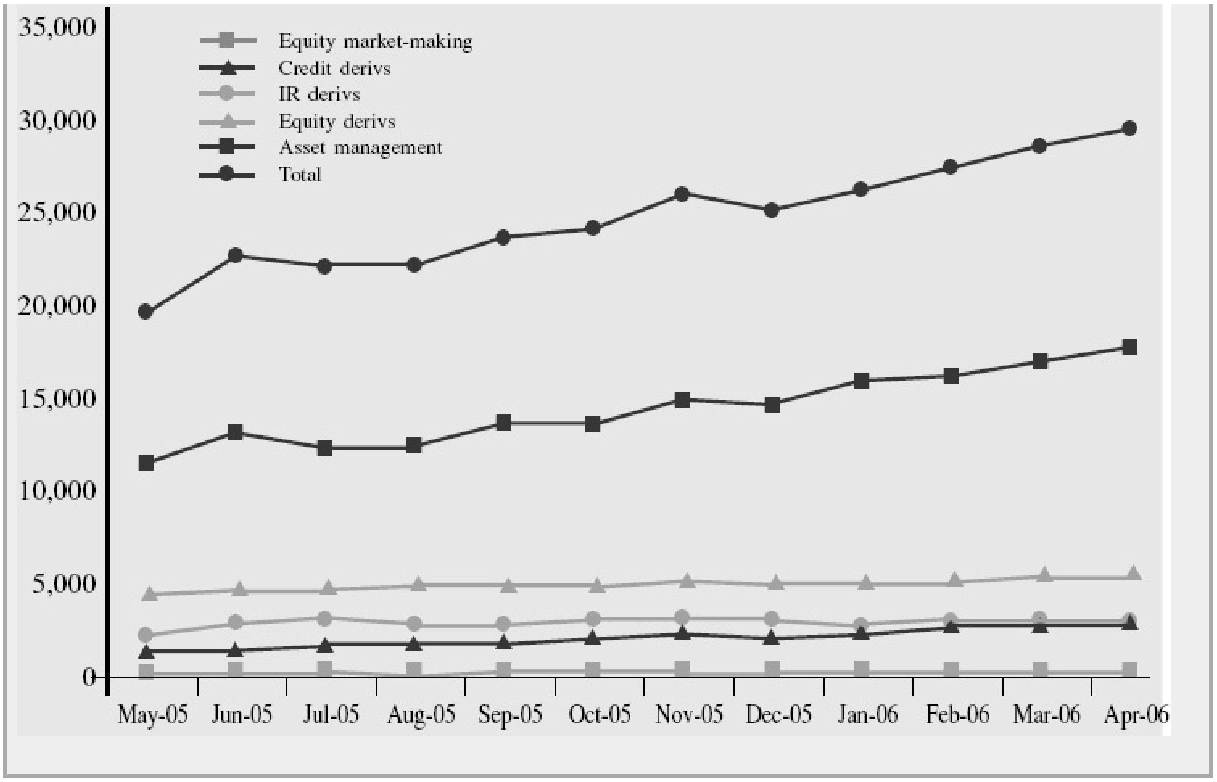


Figure 5.8 XYZ Securities Limited funding usage by business line



35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Equity market-making
Credit derivs
IR derivs
Equity derivs
Asset management
Total
May-05
Jun-05
Jul-05
Aug-05
Sep-05
Oct-05
Nov-05
Dec-05
Jan-06
Feb-06
Mar-06
Apr-06

ALM reporting

XYZ Treasury follows the ALM policy previously described to and approved by senior management. One strand of the ALM discipline is the regular reporting of the firm's ALM profile, by means of the ALM report. This is produced by Treasury using data recorded by itself as well as data from Middle Office (MO).

ALM procedures

The ALM report for XYZ Securities Limited is sent to senior management. The liabilities side of the report is determined by the actual liability profile of all XYZ loans, from overnight to one-year maturity and beyond. The asset side of the report is determined by senior management breakdown of the liquidation profile of all XYZ assets, and input as the "asset-liquidation input". The basis for this breakdown is senior management opinion on the length of time it would take to liquidate the trading book of each business in an enforced "fire sale" situation.[13]

The process of assigning liquidation maturity buckets is based on the subjective view of senior management. For each business line, senior management ask the question, "What reasonable time period would it take to liquidate positions if it were decided to close down the business?" The answer to this question is a function of the secondary market trading liquidity of the assets in question.[14] Hence, for frequently traded assets such as Eurobonds, we assume that one week would be sufficient time to trade out of all assets. For business lines with illiquid assets, such as some part of the asset management book, a longer time period (specifically in this case, in excess of one year) is noted. Management allocate this estimated time period in the same time buckets as we have established for the liabilities.

We assume that assets equal liabilities.

The procedure for compiling the report is as follows:

- Treasury compiles its own funding report, independent of MO, from its own record of overnight and term funding for XYZ. The procedure for creating this document is documented internally;
- the Treasury report is used to populate the "Liabilities" segment on the ALM report. This segment lists the current funding profile (liabilities) of XYZ by business line;
- senior management will instruct any change to the asset liquidation breakdown, otherwise these values are retained;
- the "asset liquidity profile" segment is linked directly to the asset liquidation segment (for the asset side) and liabilities input segment (for the liability side).

The ALM graph is automatically updated when the input tabs are populated.

The Treasury liquidity book

Following conventional banking business practice, XYZ Treasury maintains a liquidity book of T-bills, CDs, sovereign bonds and bank FRNs. The firm's capital as well as a proportion of long-term cash is held in the liquidity book.

In the next case study we set out the firm's policy for maintaining the FRN book.

Case Study 5.2: XYZ Securities liquidity book: FRN portfolio

Banks maintain a pool of low-risk FRNs issued by other banks and building societies as part of their reserve and liquidity requirements. This well-established practice is favoured because of low capital requirements against these assets and because it enables institutions that are funded at sub-Libor to hold Libor-plus floating-rate assets with funding locked in.

The XYZ Treasury desk is able to secure sub-Libor funding via its commercial paper vehicle. Within the parent group funding limit of USD30 billion, Treasury maintains a low-risk portfolio of bank and building society assets to employ spare capacity by holding a low-risk, lockedin funding portfolio of bank and building society FRNs.

Objectives of the business activity

To maintain a portfolio of short-to medium-dated bank and building society FRNs, all rated A or better, and held to maturity. These will be FRNs paying a spread over three-month Libor, and denominated in USD, EUR or GBP.

Bonds are funded in their own currency by means of three-month CP issued from the CP conduit, funded at sub-Libor. There is no gap funding risk.

Motivation behind the business

A portfolio of bank and building society FRNs enables XYZ Securities Ltd to:

- earn a low-risk but material return over lockedin funding;
- utilise spare capacity in funding availability.

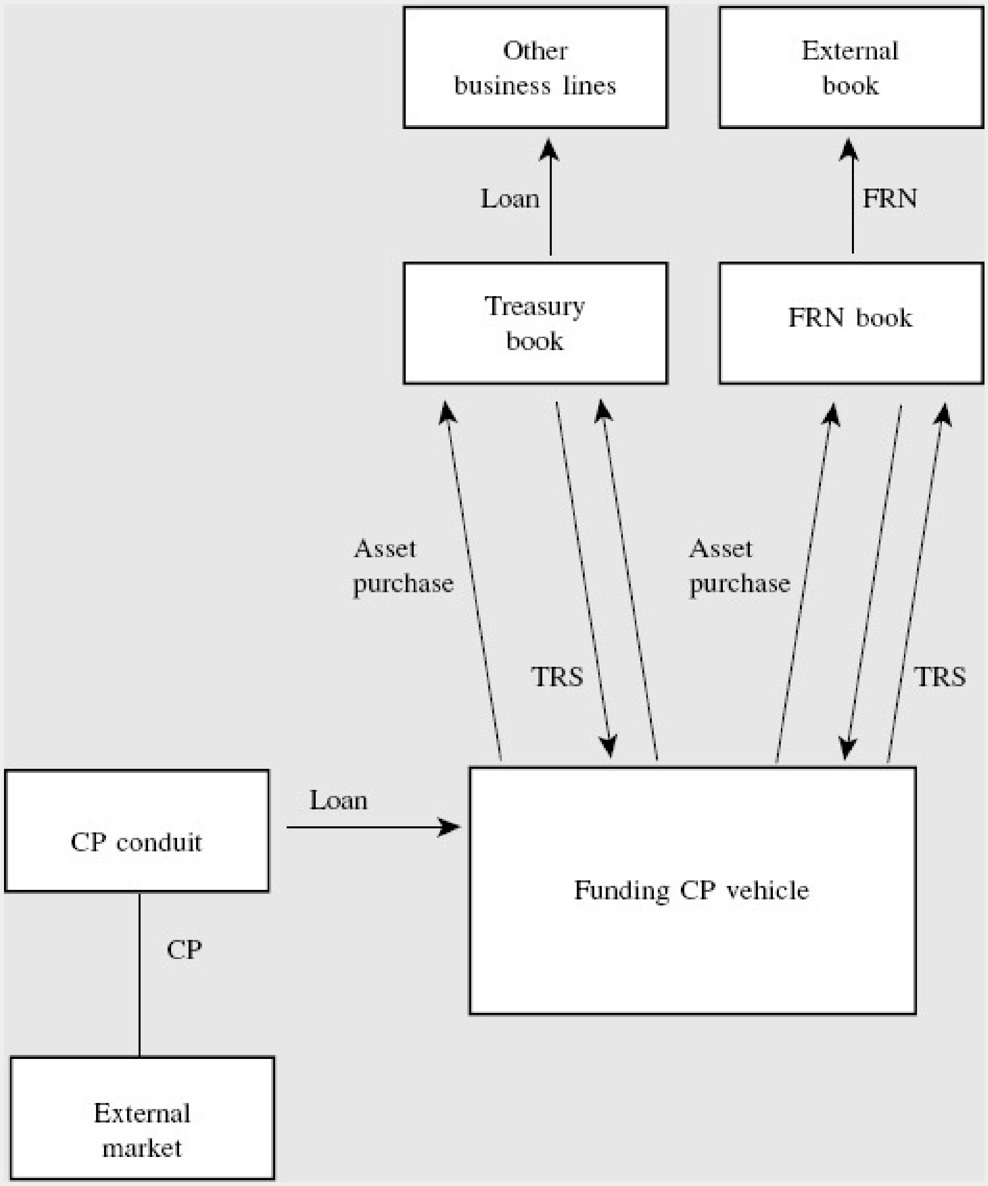
Bonds will be purchased at par or below par so there is no capital loss if held to maturity.

Building society paper carries particular value relative to their credit rating. There has never been a default in the history of the building society movement (traditionally building societies merge or are taken over if in any financial difficulty) and this implies that their financial risk warrants stronger than the Arating they receive. In effect, XYZ would carry bank risk (AA-rated) for A-rated return.

Booking procedure

The FRN book is held in a separate trading book within the Treasury book, in order to ring-fence the match-funded positions. The booking procedure is shown in Figure 5.9.

Figure 5.9 FRN book: schematic of booking cash flows



Expected return

Assume that the portfolio stands at USD350 million. A sample of the securities held in the book is shown in Table 5.4, all funded using 3-month CP issuance. This eliminates gap funding risk as the bonds all pay quarterly coupon.

Table 5.4 Assumed XYZ Securities Ltd FRN book (yields represent market rates as at September 2004)

Currency	Bond	Maturity	Offer price	Spread 3-m Libor	Rating
USD	Kaupthing Bank	Feb-07	100.15	12.9	A2
USD	Bradford & Bingley	Dec-07	99.935	16.7	A1
USD	NIB Capital Bank	Mar-08	99.94	9.0	AA3 / AA–
EUR	HBOS	Jun-09	99.835	9.9	AA2 / AA
EUR	ANZ	Sep-09	100.03	11.4	AA3 / AA–
EUR	Alliance & Leicester	Sep-09	99.81	14.0	A1 / A+
EUR	ABN Amro	Sep-11	99.75	13.4	Aa3 / AA–
GBP	Anglo Irish Bank	Dec-06	99.96	10.3	A2
GBP	Bradford & Bingley	Dec-06	99.925	13.4	A1
GBP	MacQuarie Bank	Feb-07	99.95	12.6	A2
GBP	Anglo Irish Bank	Mar-07	100.02	14.0	A2
GBP	Fin Danish	Oct-08	99.92	14.7	A1
GBP	Bradford & Bingley	Feb-09	99.725	19.5	A1

For a $350 million portfolio earning an average spread of 12 basis points, the net p&l (assuming L-2 basis points funding cost) would be approximately an average net gain of $490,000 per annum.

Capital and taxation issues

There are no taxation issues in the name of XYZ Securities, which is a UK-incorporated legal entity. The capital implications are that the securities are all 20% risk-weighted under Basel I.

Sovereign bond portfolio for interest-rate hedging

Using XYZ Securities again as our hypothetical bank, we now consider a bond portfolio maintained for ALM hedging purposes by XYZ Treasury. The Treasury desk maintains a liquidity book of US Treasury, German Bund and UK gilts. This is also used to facilitate a repo business, as well as reduce the quantity of interest-rate futures needed as part of the interest-rate exposure hedge.

Description of the product/business activity

XYZ Treasury is required to fund a large size of the firm-wide funding requirement in term loans, as part of prudent ALM. The resulting DV01 exposure is managed using Eurodollar futures. It has also established a US government bond portfolio as a lower cost means of managing the DV01 risk. The objective is to manage the DV01 exposure of the Treasury book by buying very short-dated Treasury notes and strips, which sets up an income stream that is diversified from other sources and that represents zero credit risk. This is achieved by:

- establishing a portfolio of very short-dated US Treasuries and Treasury strips on the balance sheet (maximum maturity recommended 1–1.5 years, majority in three-to six-months);
- placing the composition of the book as:
  - 200m, 3-m
  - 300m, 6-m
  - 50m, 1-year;
- having the average maturity of portfolio at around the six-month tenor;
- funding these in Treasury repo, under the standard GMRA legal agreement;[15]
- holding Treasury securities and Treasury strips to maturity to generate a steady income stream. With ultra-short-dated strips, this also benefits from the pull-to-par effect on mark-to-market.

All funding is locked into maturity, thus there is no gap risk.

Objectives of the business

The sovereign bond book is business that:

- allows XYZ to undertake cheaper hedging of its interest-rate risk (DV01), complementing the standard arrangement using Eurodollar, Euribor and short sterling futures;
- establishes a risk-free portfolio that generates a funding gain for XYZ;
- enables XYZ to use a AAA risk-free portfolio for use in setting up total-return swaps (TRSs) and repo lines with market counterparties.

The benefits to XYZ of holding such a portfolio include:

- earning the spread between yield and funding cost; a bonus that is not available when using Eurodollar futures for DV01 hedging, which do not earn any income. XYZ also saves on the commission and margin costs associated with maintaining Eurodollar futures positions;
- using the business to set up dealing relationships with bank counterparties that could then be used as sources of additional funding if required, adding to the diversity of funding (required as part of the Treasury remit);
- assisting Treasury in undertaking ALM objectives through lower cost hedging of DV01 risk, compared to futures, which impose a cost on the book.

Expected return

The fundamental gain is the removal of the requirement to hold Eurodollar futures. In a rising interest-rate environment, this will significantly reduce hedging costs.

Net profit in the first full year is upwards of $250,000–$280,000 funding gain on a £350 million average position (10–12 basis points on average per trade). This does not take into account any mark-to-market profit that is realised on Treasury bonds and strips.

Capital and taxation issues

Treasury securities are 0% risk-weighted under Basel I (and II), except where they create DV01 risk when the charge is 0.7%. However, if held for interest-rate risk hedging purposes (as is the case here), they may actually reduce overall capital requirements.

Profitable risk-free trade examples observed on 1 July 2004

Below are examples of hypothetical funding trades that were observed on July 2004 that generated a risk-free funding gain, rates as at 1 July 2004 (data source: Bloomberg LP). This shows where value was obtained from holding a book of Treasuries in the first instance. The following positions all yielded funding profit:

- buy the 2% November 2004 Treasury at a yield of 1.597% and hold to maturity, and repo to maturity at a rate of 1.56%. This is a lockedin gain of 3.70 basis points for the term to maturity, on a position of USD150 million a profit of USD24,800;
- buy the 31 July 2004 strip at a yield of 1.568% and repo to maturity at 1.28%, a spread of 28.8 basis points at risk-free lockedin funding. On a position of USD200 million this represents positive p&l of USD48,000 – this is risk-free income.
- the ability to take advantage of special rates for stocks we are long in. On 1 July a position in 1% May 2005 Treasury could be funded cheaper than normal repo (“GC”) due to special status, by 7–8 basis points. So the gain on holding that stock would be around this amount for the term of the trade, as our funding cost in repo would be lower by this amount. It would be an objective of the Treasury desk to be aware of stocks expected to go special and act accordingly.

These opportunities are not frequent but they do occur, as shown above. As the book is primarily designed to hedge, trading is infrequent and only undertaken as opportunities arise.

Risks

There is no gap (funding) risk and no credit risk.

As the positions are held on a Trading book, and not the Banking book, they are marked-to-market. The desk expects volatility in short-dated government bonds to be lower than for the term loans they are hedging, but volatility is a risk exposure and there may be periods when the desk will experience mark-to-market losses.

Case Study 5.3: XYZ Securities UK gilt portfolio

Commercial banks and building societies are natural holders of government bonds such as gilts, for the following reasons:

- for liquidity purposes, as gilts are the most liquid instruments in the UK market;
- as an instrument in which to invest the firm's capital reserves;
- for income generation purposes, given the favourable funding costs of gilt repo and the zero credit and liquidity risk;
- to intermediate between gilt, stock loan and interbank markets in CDs;
- to benefit from being long in gilts that go "special" and can be funded at anything from 25 basis points to 2–3% cheaper than "general collateral" (GC) repo;
- to establish an asset pool that receives favourable capital treatment (0% risk-weighted under Basel I and Basel II).

The benefits to XYZ Securities Ltd of holding such a portfolio would include some of the above, as well as the following:

- earning the spread between yield and funding cost;
- using the business to set up dealing relationships with bank counterparties that could then be used as sources of additional funding if required, adding to the diversity of funding (required as part of the Treasury remit);
- assisting Treasury to undertake ALM objectives.

Business line

This is a UK government bond portfolio at XYZ Treasury. The objective is to maintain an income stream that is diversified from current sources and that is also relatively low risk, but stable. This is achieved by:

- establishing a portfolio of very short-dated gilts and gilt strips on the balance sheet (the maximum maturity recommended is one year, the majority in three-to six-months). The expected make-up of the book might be:
  - 125m, 3-m
  - 200m, 6-m
  - 25m, 1-year
  - average maturity of the portfolio in the first year would be around the six-month mark;
- funding these in gilt repo, under the GMRA agreement and also funding using TRS under ISDA if required;
- the repo funding margin for gilts in the wholesale market, which is often 0%. With zero or a very low margin or "haircut", all positions will be virtually fully funded;
- holding gilts and gilt strips to maturity to generate a steady income stream. With ultra-short-dated strips, we also benefit from the pull-to-par effect.

Market rates

Table 5.5 on pages 245–6 shows income yields and funding rates as at 2 June 2004. This shows where value could be obtained from holding a book of gilts in the first instance. For example, all the following positions yielded funding profit:

Table 5.5 Market rates as at 2 June 2004

Market rates

GC rates 2 Jun

1w	4.15	4.10	4m	4.40	4.30
2w	4.25	4.15	5m	4.43	4.33
3w	4.25	4.15	6m	4.50	4.40
1m	4.15	4.15	9m	4.67	4.57
2m	4.28	4.18	1y	4.78	4.68
3m	4.32	4.22			

Source: HBOS screen

Gilt yields 2 Jun			**Special rates**
	GRY%	DV01	
5% Jun 04	5.05		
6T Nov 04	4.33	0.00416	100 basis points
9H Apr 05	4.668	0.00817	30 basis points cheaper than GC
8H Dec 05	4.818	0.014	25 basis points cheaper, down from 1.5%
7T Sep 06	4.945	0.02141	
7H Dec 06	4.966	0.02364	10 basis points

Sources: Butler Securities / KSBB screens.

Gilt strip yields 2 Jun

	GRY %	DV01
P Jun 04	3.78	
C Sep 04	4.342	0.00195
C Dec 04	4.509	0.00432
C Mar 05	4.633	0.00664
C Jun 05	4.744	0.00888
C Sep 05	4.829	0.01107
P Dec 05	4.85	0.01321

Source: Bloomberg.

- holding gilts and funds in general collateral (GC); depending on the specific stock and the term of funding arranged, a gain ranging from 15 to 50–60 basis points;
- holding strips to maturity; for example, a gain of approximately 35 basis points for Dec 04 Principal strip at 1w or 2w funding. Lockedin funding gain (buy 6-m strip and fund in 6-m) of 9 basis points for the Dec 04 strip – this is risk-free income;
- holding strips at 3-, 6-and 9-month maturities as longer-dated bills and holding to maturity. Funding will be locked in if available or rolled:
    - for example, as at 2 June 2004, XYZ Securities Ltd purchased the Sep 04 coupon strip at 4.34% and funded in the one-week term at 4.15% (and ran the resultant funding gap risk – but this gilt had a strong pull-to-par effect. If funding is no longer profitable in the short dates, XYZ would have sold the gilt for a probable realised mark-to-market profit)
    - coupon strips are bid for in repo by the main market-makers, thereby reducing liquidity risk in these products
- taking advantage of special rates for stocks XYZ when long in. On 2 June 2004, a position in the 9.5% 2005 gilt was funded cheaper due to special status, from 35 basis points (down from 50 basis points the week before). The 6.75% 2004 gilt was being funded at 100 basis points cheaper than GC. So the gain on holding that stock would be significant, as the funding cost in repo would be very low. It would be an objective of the Treasury desk to be aware of stocks expected to go special and act accordingly.

Risks

The principal risk is funding roll-over (gap risk). Where possible XYZ Treasury will lock in funding with an expected holding period of positions, but will also look to take advantage of markets rates as appropriate and roll over funding. Gap risk will be managed in the normal way as part of overall Treasury operations. Gaps will be put on to reflect the interest-rate and yield curve view of the desk.

There is no credit risk.

The interest-rate risk and gap risk is managed as a standard banking ALM or cash book. The objective is to set up an income stream position at low risk, but if necessary DV01 risk would be managed where deemed necessary using 90-day sterling futures, overnight-index swap (OIS) or short-dated swaps. XYZ can also sell out of positions where it expects significant market movement (for example, a central bank base rate hike). The main objective, however, is to establish an income stream, in line with a view on short-term interest rates. Hedging would only be carried out when necessary for short-term periods (say, ahead of a data release or anticipated high volatility).

The interest-rate risk for longer-dated stocks is shown in Table 5.5 below, measured as DV01 (dollar-value of loss for a 1 basis point rise in yields). Longer-dated stocks expose XYZ Securities Ltd to greater interest-rate risk position when marking-to-market.

Bibliography

Gup, B.E. and Brooks, R. 1993, *Interest Rate Risk Management*, New York, NY: Irwin.

[1] This report is discussed in full in the Case Study later in the chapter.

[2] The reasons can be macro-level ones, affecting most or all market participants, or more firm-or sector-specific. The former might be a general market correction that causes the supply of funds to dry up, and would be a near-catastrophe situation. The latter is best illustrated with the example of Barings plc in 1995: when it went bust overnight due to large, hitherto covered-up losses on the Simex exchange, the supply of credit to similar institutions was reduced or charged at much higher rates, albeit only temporarily, as a result.

[3] Such assets would be very short-term, risk-free assets such as T-bills.

[4] It can of course lock in future funding rates with forward-starting loans, which is one way to manage liquidity risk.

[5] Of course the opposite applies: the gap risk refers to an excess of liabilities over assets.

[6] Note that this terminology is not a universal convention.

[7] Many bank assets, such as residential mortgages and credit-card loans, are repaid before their legal maturity date. Thus the size of the asset book is constantly amortising.

[8] The firm's capital will be invested in risk-free assets such as government T-bills or, in some cases, bank CDs. It will not be lent out in normal banking operations because the ALM desk will not want to put capital in a credit-risk investment.

[9] We look at the mechanics of this, using different derivative instruments, in chapters 13, 14 and 15.

[10] In addition, the bank will be able to raise funds at Libid, or at worst at Li-

mid, while it should be able to lend at Libor in interbank credit quality assets. Li-mid is an unofficial term and refers to the mid-rate between Libid and Libor.

[11] The percentage breakdown that reflects senior management assumptions of the maturity profile of assets is an input into the ALM report.

[12] This approach is described fully in Chapter 28.

[13] The liquidity duration of the asset pool is unrelated to the actual duration of the assets themselves.

[14] In practice, other factors (such as whether the market was aware that this was an enforced sale or not) would also influence this timing but cannot be factored into any estimation.

[15] See Chapter 12 on repo.

CHAPTER 6

Asset–Liability Management II

In our second introductory chapter, we delve deeper, or more accurately wider, into ALM. The art of asset and ALM is essentially one of risk management and capital management, and although the day-to-day activities are run at the desk level, overall direction is given at the highest level of a banking institution. The risk exposures in a banking environment are multidimensional, as we have seen they encompass interest-rate risk, liquidity risk, credit risk and operational risk. Interest-rate risk is one type of market risk. Risks associated with moves in interest rates and levels of liquidity[1] are those that result in adverse fluctuations in earnings levels due to changes in market rates and bank funding costs. By definition, banks' earnings levels are highly sensitive to moves in interest rates and the cost of funds in the wholesale market. ALM covers the set of techniques used to manage interest rate and liquidity risks; it also deals with the structure of the bank's balance sheet, which is heavily influenced by funding and regulatory constraints and profitability targets.

In this chapter we review the concept of balance sheet management, the role of the ALM desk, liquidity risk and maturity gap risk. We also review a basic gap report. The increasing use of *securitisation* and the responsibility of the ALM desk in enhancing the return on assets on the balance sheet is also introduced. For readers who are interested in developing their knowledge further, as usual we list a selection of articles and publications in the bibliography.

Introduction

For newcomers to the subject, an excellent introduction to the primary activity of banking is contained in a supplement in *The Economist* entitled "The Business of Banking".[2] Those who are complete beginners may wish to refer to this article. In this section we provide an overview of the main business of banking before considering the subject of ALM.

One of the major areas of decision-making in a bank involves the maturity of assets and liabilities. Typically, longer-term interest rates are higher than shorter-term rates; that is, it is common for the yield curve in the short-term (say 0–3 year range) to be positively sloping. To take advantage of this banks usually raise a large proportion of their funds from the short-dated end of the yield curve and lend out these funds for longer maturities at higher rates. The spread between the borrowing and lending rates is in principle the bank's profit. The obvious risk from such a strategy is that the level of short-term rates rises during the term of the loan, so that when the loan is refinanced the bank makes a lower profit or a net loss. Managing this risk exposure is the key function of an ALM desk. As well as managing the interest-rate risk itself, banks also match assets with liabilities – thus locking in a profit – and diversify their loan book, to reduce exposure to one sector of the economy.

Another risk factor is liquidity. From a banking and Treasury point of view the term *liquidity* means funding liquidity, or the "nearness" of money. The most liquid asset is cash money. Banks bear several interrelated liquidity risks, including the risk of being unable to pay depositors on demand, an inability to raise funds in the market at reasonable rates and an insufficient level of funds available with which to make loans. Banks keep only a small portion of their assets in the form of cash, because this earns no return for them. In fact, once they have met the minimum cash level requirement, which is something set down by international regulation, they will hold assets in the form of other instruments. Therefore the ability to meet deposit withdrawals depends on a bank's ability to raise funds in the market. The market and the public's perception of a bank's financial position heavily influences liquidity. If this view is very negative, the bank may be unable to raise funds and consequently be unable to meet withdrawals or loan demand. Thus liquidity management is running a bank in a way that maintains confidence in its financial position. The assets of the banks that are held in near-cash instruments, such as T-bills and clearing bank CDs, must be managed with liquidity considerations in mind. The asset book on which these instruments are held is sometimes called the *liquidity book.*

Basic concepts

In the era of stable interest rates that preceded the breakdown of the Bretton–Woods agreement, ALM was a more straightforward process, constrained by regulatory restrictions and the saving and borrowing pattern of bank customers.[3]

The introduction of the negotiable CD by Citibank in the 1960s enabled banks to diversify both their investment and funding sources. With this there developed the concept of the *interest margin,* which is the spread between the interest earned on assets and that paid on liabilities. This led to the concept of the *interest gap* and the management of the gap, which is the cornerstone of modern-day ALM. The increasing volatility of interest rates, and the rise in absolute levels of rates themselves, made gap management a vital part of running the banking book. This development meant that banks could no longer rely permanently on the traditional approach of borrowing short (funding short) to lend long, as a rise in the level of short-term rates would result in funding losses. The introduction of derivative instruments such as FRAs and swaps in the early 1980s removed the previous uncertainty and allowed banks to continue the traditional approach while hedging against medium-term uncertainty.

Foundations of ALM

The general term *asset and liability management* entered common usage from the mid-1970s onwards. In the changing interest-rate environment, it became imperative for banks to manage both assets and liabilities simultaneously, in order to minimise interest rate and liquidity risk and maximise interest income. ALM is a key component of any financial institution's overall operating strategy. ALM is defined in terms of four key concepts, which are described below.

The first is *liquidity*, which in an ALM context does not refer to the ease with which an asset can be bought or sold in the secondary market, but the ease with which assets can be converted into cash.[4] A banking book is required by the regulatory authorities to hold a specified minimum share of its assets in the form of very liquid instruments. Liquidity is very important to any institution that accepts deposits because of the need to meet customer demand for instant-access funds. In terms of a banking book the most liquid assets are overnight funds, while the least liquid are medium-term bonds. Short-term assets such as T-bills and CDs are also considered to be very liquid.

The second key concept is the money market *term structure* of interest rates. The shape of the yield curve at any one time, and expectations as to its shape in the short-and medium-term, impact to a significant extent on the ALM strategy employed by a bank. Market risk in the form of *interest-rate sensitivity* is significant, in the form of present-value sensitivity of specific instruments to changes in the level of interest rates, as well as the sensitivity of floating-rate assets and liabilities to changes in rates. Another key factor is the *maturity profile* of the book. The maturities of assets and liabilities can be matched or unmatched; although the latter is more common the former is not uncommon, depending on the specific strategies that are being employed. Matched assets and liabilities lock in return in the form of the spread between the funding rate and the return on assets. The maturity profile, the absence of a locked-in spread and the yield curve combine to determine the total interest-rate risk of the banking book.

The fourth key concept is *default risk:* the risk exposure that borrowers will default on interest or principal payments that are due to the banking institution.

These issues are placed in context in the simple hypothetical situation described in Example 6.1 "ALM considerations".

Example 6.1: ALM considerations

Example 6.1: ALM considerations

Assume that a bank may access the markets for three-month and six-month funds, whether for funding or investment purposes. The rates for these terms are shown in Table 6.1. Assume no bid–offer spreads. The ALM manager also expects the three-month Libor rate in three-months to be 5.10%. The bank can usually fund its book at Libor, while it is able to lend at Libor plus 1%.

Table 6.1 Hypothetical money market rates

Term	**Libor**	**Bank rate**
90-day	5.50%	6.50%
180-day	5.75%	6.75%
Expected 90-day rate in 90 days' time	5.10%	6.10%
3v6 FRA[1]	6.60%	

[1] FRA – forward rate agreement

The bank could adopt any of the following strategies, or a combination of them:

- Borrow three-month funds at 5.50% and lend this out in the three-month period at 6.50%. This locks in a return of 1% for a three-month period.
- Borrow six-month funds at 5.75% and lend in the six-month at 6.75%; again this earns a locked-in spread of 1%.
- Borrow three-month funds at 5.50% and lend this in the six-month term at 6.75%. This approach would require the bank to re-fund the loan in three months' time, which it expects to be able to do at 5.10%. This approach locks in a return of 1.25% in the first three-month period, and an expected return of 1.65% in the second three-month period. The risk of this tactic is that the three-month rate in three months does not fall as expected by the ALM manager, reducing profits and possibly leading to loss.
- Borrow in the six-month at 5.75% and lend these for a three-month period at 6.50%. After this period, lend the funds in the three-month or six-month period. This strategy does not tally with the ALM manager's view, however, who expects a fall in rates and so should not wish to be long of funds in three months' time.
- Borrow three-month funds at 5.50% and again lend this in the six-month period at 6.75%. To hedge the gap risk, the ALM manager simultaneously buys a 3v6 FRA to lock in the three-month rate in three months' time. The first period spread of 1.25% is guaranteed, but the FRA guarantees only a spread of 15 basis points in the second period. This is the cost of the hedge (and also suggests that the market does not agree with the ALM manager's assessment of where rates will be three months from now!), the price the bank must pay for reducing uncertainty, the lower spread return. Alternatively, the bank could lend in the six-month period, funding initially in the three-month, and buy an interest-rate cap with a ceiling rate of 6.60% and pegged to Libor, the rate at which the bank can actually fund its book.

Although simplistic, these scenarios serve to illustrate what is possible, and indeed there are many other strategies that could be adopted. The approaches described in the last option show how derivative instruments can be used actively to manage the banking book, and the cost that is associated with employing them.

Liquidity and gap management

We noted in Chapter 5 that the simplest approach to ALM is to match assets with liabilities. For a number of reasons, which include the need to meet client demand and to maximise return on capital, this is not practical and banks must adopt more active ALM strategies. One of the most important of these is the role of the gap, and gap management. This term describes the practice of varying the asset and liability gap in response to expectations about the future course of interest rates and the shape of the yield curve. Simply put, this means increasing the gap when interest rates are expected to rise, and decreasing it when rates are expected to decline. The gap here is the difference between floating-rate assets and liabilities, but gap management must also be pursued when one of these elements is fixed rate.

Such an approach is of course an art and not a science. Gap management assumes that the ALM manager is proved to be correct in his or her prediction of the future direction of rates and the yield curve.[5] Views that turn out to be incorrect can lead to an unexpected widening or narrowing of the gap spread, and losses. The ALM manager must choose the level of trade-off between risk and return.

Gap management also assumes that the profile of the banking book can be altered with relative ease. This is not always the case, and even today may still present problems, although the evolution of a liquid market in off-balance sheet interest-rate derivatives has eased this problem somewhat. Historically it has always been difficult to change the structure of the book, as many loans cannot be liquidated instantly and fixed-rate assets and liabilities cannot be changed to floating-rate ones. Client relationships must also be observed and maintained – this is a key banking issue. For this reason it is much more common for ALM managers to use off-balance sheet products when dynamically managing the book. For example, FRAs can be used to hedge gap exposure, while interest-rate swaps are used to alter an interest basis from fixed to floating, or vice-versa. The last strategy presented in Example 6.1 presented, albeit simplistically, the use that could be made of derivatives. The widespread use of derivatives has enhanced the opportunities available to ALM managers, as well as the flexibility with which the banking book can be managed, but it has also contributed to the increase in competition and the reduction in margins and bid–offer spreads.

Interest-rate risk and source: Banking book

The Banking book

Traditionally, ALM has been concerned with the Banking book. The conventional techniques of ALM were developed for application to a bank's banking book; that is, the lending and deposit-taking transactions. The core banking activity will generate either an excess of funds, when the receipt of deposits outweighs the volume of lending the bank has undertaken, or a shortage of funds, when the reverse occurs. This mismatch is balanced via financial transactions in the wholesale market. The Banking book generates both interest-rate and liquidity risks, which are then monitored and managed by the ALM desk. Interest-rate risk is the risk that the bank suffers losses due to adverse movements in market interest rates. Liquidity risk is the risk that the bank cannot generate sufficient funds when required; the most extreme version of this is when there is a "run" on the bank, and the bank cannot raise the funds required when depositors withdraw their cash.

Note that the asset side of the Banking book, which is the loan portfolio, also generates credit risk.

The ALM desk will be concerned with risk management that focuses on the quantitative management of the liquidity and interest-rate risks inherent in a Banking book. The major areas of ALM include:

- *measurement and monitoring of liquidity and interest-rate risk.* This includes setting up targets for earnings and volume of transactions, and setting up and monitoring interest-rate risk limits;
- *funding and control of any constraints on the balance sheet.* This includes liquidity constraints, debt policy and *capital adequacy* ratio and solvency;
- *hedging of liquidity and interest-rate risk.*

Interest-rate risk

Put simply, interest-rate risk is defined as the potential impact, adverse or otherwise, on the net asset value of a financial institution's balance sheet and earnings resulting from a change in interest rates. Risk exposure exists whenever there is a maturity date mismatch between assets and liabilities, or between principal and interest cash flows. Interest-rate risk is not necessarily a negative thing; for instance, changes in interest rates that increase the net asset value of a banking institution would be regarded as positive. For this reason, active ALM seeks to position a banking book to gain from changes in rates. The Bank for International Settlements (BIS) splits interest-rate risk into two elements: *investment risk* and *income risk*. The first risk type is the term for potential risk exposure arising from changes in the market value of fixed interest-rate cash instruments and off-balance sheet instruments, and is also known as *price risk*. Investment risk is perhaps best exemplified by the change in value of a plain vanilla bond following a change in interest rates, and from Chapter 4 we know that there is an inverse relationship between changes in rates and the value of such bonds (see Example 4.1). Income risk is the risk of loss of income when there is a non-synchronous change in deposit and funding rates, and it this risk that is known as gap risk.

ALM covering the formulation of interest-rate risk policy is usually the responsibility of what is known as the asset–liability committee or ALCO, which is made up of senior management personnel including the Finance Director and the heads of Treasury and Risk Management. ALCO sets bank policy for balance sheet management and the likely impact on revenue of various scenarios that it considers may occur. The size of ALCO will depend on the complexity of the balance sheet and products traded, and the amount of management information available on individual products and desks.

The process employed by ALCO for ALM will vary according to the particular internal arrangement of the institution. A common procedure involves a monthly presentation to ALCO of the impact of different interest-rate scenarios on the balance sheet. This presentation may include:

- an analysis of the difference between the actual net interest income (NII) for the previous month and the amount that was forecast at the previous ALCO meeting. This is usually presented as a gap report, broken by maturity buckets and individual products;
- the result of discussion with business unit heads on the basis of the assumptions used in calculating forecasts and impact of interest-rate changes; scenario analysis usually assumes an unchanging book position between now and one month later, which is essentially unrealistic;
- a number of interest-rate scenarios, based on assumptions of (a) what is expected to happen to the shape and level of the yield curve, and (b) what may happen to the yield curve; for example, extreme scenarios. Essentially, this exercise produces a value for the forecasted NII due to changes in interest rates;
- an update of the latest actual revenue numbers.

Specific new or one-off topics may be introduced at ALCO as circumstances dictate; for example, the presentation of the approval process for the introduction of a new product or business line.

Sources of interest-rate risk

Assets on the balance sheet are affected by absolute changes in interest rates, as well as increases in the volatility of interest rates. For instance, fixed-rate assets will fall in value in the event of a rise in rates, while funding costs will rise. This decreases the margins available. We noted that the way to remove this risk was to lock in assets with matching liabilities; however, this is not only not always possible, but also sometimes undesirable, as it prevents the ALM manager from taking a view on the yield curve. In a falling interest-rate environment, deposit-taking institutions may experience a decline in available funds, requiring new funding sources that may be accessed at less favourable terms. Liabilities are also impacted by a changing interest-rate environment.

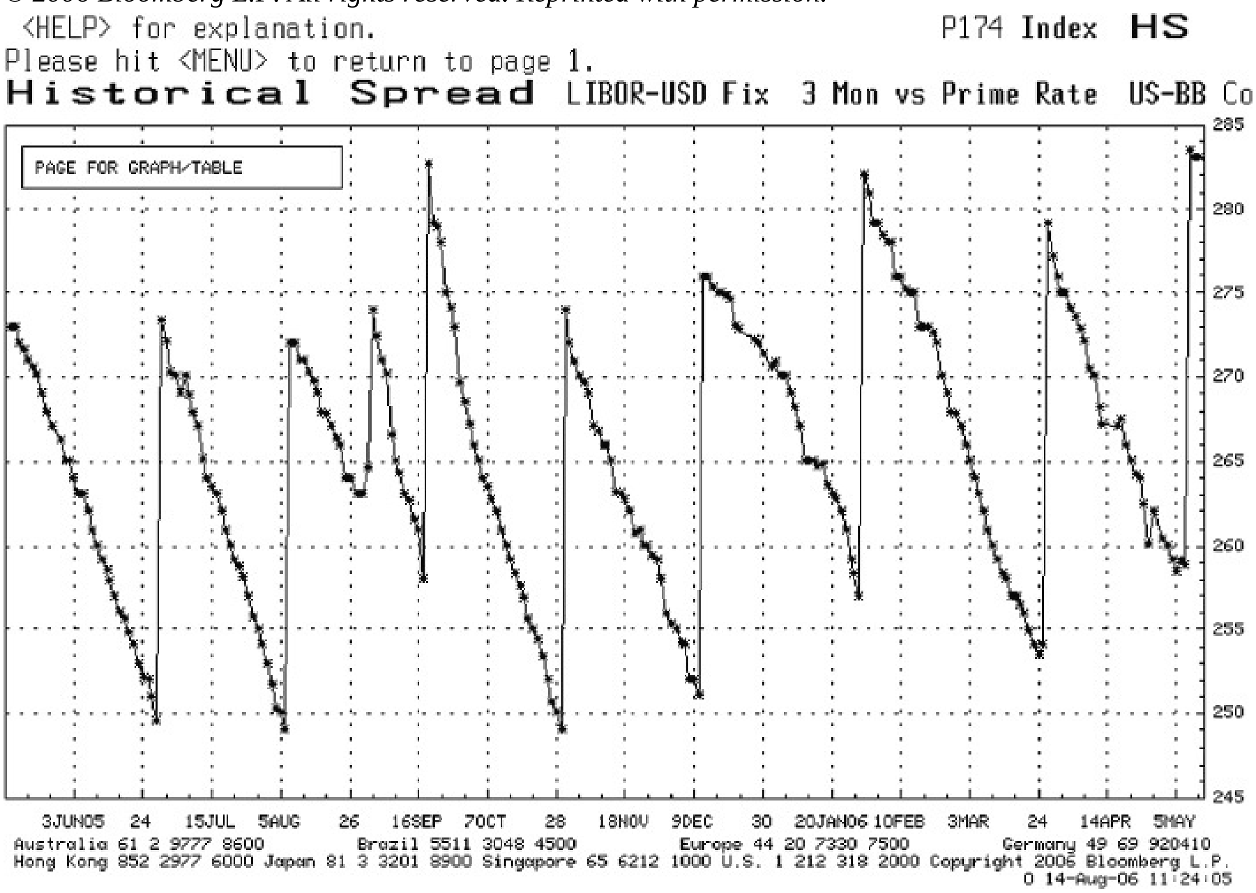
There are five primary sources of interest-rate risk inherent in an ALM book, which are described below.

Gap risk is the risk that revenue and earnings decline as a result of changes in interest rates, due to the difference in the maturity profile of assets, liabilities and off-balance sheet instruments. Another term for gap risk is *mismatch risk.* An institution with gap risk is exposed to changes in the level of the yield curve, a so-called *parallel shift*, or a change in the shape of the yield curve or *pivotal shift.* Gap risk is measured in terms of short-or long-term risk, which is a function of the impact of rate changes on earnings for a short or long period. Therefore the maturity profile of the book, and the time to maturity of instruments held on the book, will influence whether the bank is exposed to short-term or long-term gap risk.

Yield curve risk is the risk that non-parallel or pivotal shifts in the yield curve cause a reduction in NII. The ALM manager will change the structure of the book to take into account their views on the yield curve. For example, a book with a combination of short-term and long-term asset-or liability-maturity structures[6] is at risk from a yield curve inversion, sometimes known as a *twist* in the curve.

Basis risk arises from the fact that assets are often priced off one interest rate, while funding is priced off another interest rate. Taken one step further, hedge instruments are often linked to a different interest rate to that of the product they are hedging. In the US market the best example of basis risk is the difference between the prime rate and Libor. Term loans in the United States are often set at prime, or a relationship to prime, while bank funding is usually based on the Eurodollar market and linked to Libor. However, the prime rate is what is known as an "administered" rate and does not change on a daily basis, unlike Libor. While changes in the two rates are positively correlated, they do not change by the same amount, which means that the spread between them changes regularly. This results in the spread earned on a loan product changing over time. Figure 6.1 illustrates the change in spread during 2005–2006.

Figure 6.1 Change in spread between the 3-month prime rate and 3-month Libor 2005–06.



Another risk for deposit-taking institutions such as clearing banks is ***run-off risk,*** associated with the non-interest bearing liabilities (NIBLs) of such banks. The level of interest rates at any one time represents an opportunity cost to depositors who have funds in such facilities. However, in a rising interest-rate environment, this opportunity cost rises and depositors will withdraw these funds, available at immediate notice, resulting in an outflow of funds for the bank. The funds may be taken out of the banking system completely; for example, for investment in the stock market. This risk is significant and therefore sufficient funds must be maintained at short notice, which is an opportunity cost for the bank itself.

Many banking products entitle the customer to terminate contractual arrangements ahead of the stated maturity term; this is sometimes referred to as ***option risk.*** This is another significant risk as products such as CDs, cheque account balances and demand deposits can be withdrawn or liquidated at no notice, which is a risk to the level of NII should the option inherent in the products be exercised.

Gap and net interest income

We noted earlier that gap is a measure of the difference in interest-rate sensitivity of assets and liabilities that revalue at a particular date, expressed as a cash value. Put simply it is:

(6.1) $$Gap = A_{ir} - L_{ir}$$

where A_{ir} and L_{ir} are the interest-rate sensitive assets and interest-rate-sensitive liabilities. Where $A_{ir} > L_{ir}$ the banking book is described as being *positively gapped,* and when $A_{ir} < L_{ir}$ the book is said to be *negatively gapped.* The change in NII is given by:

(6.2) $$\Delta NII = Gap \times \Delta r$$

where r is the relevant interest rate used for valuation. The NII of a bank that is positively gapped will increase as interest rates rise, and will decrease as rates decline. This describes a banking book that is asset sensitive; the opposite, when a book is negatively gapped, is known as liability sensitive. The NII of a negatively gapped book will increase when interest rates decline. The value of a book with zero gap is immune to changes in the level of interest rates. The shape of the banking book at any one time is a function of customer demand, the treasury manager's operating strategy, and view of future interest rates.

Gap analysis is used to measure the difference between interest-rate-sensitive assets and liabilities, over specified time periods. Another term for this analysis is *periodic gap,* and the common expression for each time period is maturity *bucket.* For a commercial bank the typical maturity buckets are:

- 0–3 months;
- 3–12 months;
- 1–5 years;
- > 5 years.

Another common approach is to group assets and liabilities by the buckets or grid points of the *Riskmetrics* VaR methodology (see Chapter 17). Any combination of time periods may be used, however. For instance, certain US commercial banks place assets, liabilities and off-balance sheet items in terms of *known maturities, judgemental maturities* and *market-driven maturities.* These are defined as:

- *known maturities:* fixed-rate loans and CDs;
- *judgemental maturities:* passbook savings accounts, demand deposits,

credit cards, non-performing loans;

- *market-driven maturities:* option-based instruments such as mortgages, and other interest-rate sensitive assets.

The other key measure is *cumulative gap*, defined as the sum of the individual gaps up to one-year maturity. Banks traditionally use the cumulative gap to estimate the impact of a change in interest rates on NII.

Assumptions of gap analysis

A number of assumptions are made when using gap analysis, assumptions that may not reflect reality in practice. These include:

- the key assumption that interest rate changes manifest themselves as a parallel shift in the yield curve; in practice, changes do not occur as a parallel shift, giving rise to basis risk between short-term and long-term assets;
- the expectation that contractual repayment schedules are met; if there is a fall in interest rates, prepayments of loans by borrowers who wish to refinance their loans at lower rates will have an impact on NII Certain assets and liabilities have option features that are exercised as interest rates change, such as letters of credit and variable rate deposits; early repayment will impact a bank's cash flow;
- that repricing of assets and liabilities takes place in the mid-point of the time bucket;
- the expectation that all loan payments will occur on schedule; in practice, certain borrowers will repay the loan earlier.

Recognised weaknesses of the gap approach include:

- no incorporation of future growth, or changes in the asset–liability mix;
- no consideration of the time value of money;
- arbitrary setting of time periods.

Limitations notwithstanding, gap analysis is used extensively. Gup and Brooks (1993, pp. 59) state the following reasons for the continued popularity of gap analysis:

- it was the first approach introduced to handle interest-rate risk, and provides reasonable accuracy;
- the data required to perform the analysis are already compiled for the purposes of regulatory reporting;
- the gaps can be calculated using simple spreadsheet software;
- it is easier (and cheaper) to implement than more sophisticated techniques;
- it is straightforward to demonstrate and explain to senior management and shareholders.

Although there are more sophisticated methods available, gap analysis remains in widespread use.

The ALM desk

The ALM desk or unit is a specialised business unit that fulfils a range of functions. Its precise remit is a function of the type of the activities of the financial institution that it is a part of. Let us consider the main types of activities that are carried out.

If an ALM unit has a profit target of zero, it will act as a cost centre with a responsibility to minimise operating costs. This would be consistent with a strategy that emphasises commercial banking as the core business of the firm, and where ALM policy is concerned purely with hedging interest-rate and liquidity risk.

The next level is where the ALM unit is responsible for minimising the cost of funding. That would allow the unit to maintain an element of exposure to interest-rate risk, depending on the view that was held as to the future level of interest rates. As we noted above, the core banking activity generates either an excess or shortage of funds. To hedge away all of the excess or shortage, while removing interest-rate exposure, has an opportunity cost associated with it since it eliminates any potential gain that might arise from movements in market rates. Of course, without a complete hedge, there is an exposure to interest-rate risk. The ALM desk is responsible for monitoring and managing this risk, and of course is credited with any cost savings in the cost of funds that arise from the exposure. The saving may be measured as the difference between the funding costs of a full hedging policy and the actual policy that the ALM desk adopts. Under this policy, interest-rate risk limits are set which the ALM desk ensures the bank's operations do not breach.

The final stage of development is to turn the ALM unit into a profit centre, with responsibility for optimising the funding policy within specified limits. The limits may be set as *gap* limits, VaR limits or by another measure, such as level of earnings volatility. Under this scenario the ALM desk is responsible for managing all financial risk.

The final development of the ALM function has resulted in it taking on a more active role. The previous paragraphs described the three stages of development that ALM has undergone, although all three versions are part of the "traditional" approach. Practitioners are now beginning to think of ALM as extending beyond the risk management field, and responsible for adding value to the net worth of the bank, through proactive positioning of the book and hence, the balance sheet. That is, in addition to the traditional function of managing liquidity risk and interest-rate risk, ALM should be concerned with managing the regulatory capital of the bank and with actively positioning the balance sheet to maximise profit. The latest developments mean that the there are now financial institutions that run a much more sophisticated ALM operation than that associated with a traditional banking book.

Let us review now the traditional and developed elements of an ALM function.

Traditional ALM

Generally, a bank's ALM function has in the past been concerned with managing the risk associated with the banking book. This does not mean that this function is now obsolete, rather that additional functions have now been added to the ALM role. There are a large number of financial institutions that adopt the traditional approach; indeed, the nature of their operations would not lend themselves to anything more. We can summarise the role of the traditional ALM desk as follows:

Interest-rate risk management.

This is the interest-rate risk arising from the operation of the banking book. It includes net interest income sensitivity analysis, typified by maturity gap and duration gap analysis, and the sensitivity of the book to parallel changes in the yield curve. The ALM desk will monitor the exposure and position the book in accordance with the limits as well as its market view. Smaller banks, or subsidiaries of banks that are based overseas, often run no interest-rate risk; that is, there is no short gap in their book. Otherwise the ALM desk is responsible for hedging the interest-rate risk or positioning the book in accordance with its view.

Liquidity and funding management.

There are regulatory requirements that dictate the proportion of banking assets that must be held as short-term instruments. The liquidity book in a bank is responsible for running the portfolio of short-term instruments. The exact make-up of the book is however the responsibility of the ALM desk, and will be a function of the desk's view of market interest rates, as well as its opinion on the relative value of one asset over another. For example, it may decide to move some assets into short-dated government bonds, above what it normally holds, at the expense of high-quality CDs, or vice-versa.

Reporting on hedging of risks.

The ALM fulfils a senior management information function by reporting on a regular basis on the extent of the bank's risk exposure. This may be in the form of a weekly hardcopy report, or via some other medium.

Setting up risk limits.

The ALM unit will set limits, implement them and enforce them, although it is common for an independent "middle office" risk function to monitor compliance with limits.

Capital requirement reporting.

This function involves the compilation of reports on capital usage and position limits as a percentage of capital allowed, and the reporting to regulatory authorities.

All financial institutions will carry out the activities described above.

Example 6.2: Gap analysis

Maturity gap analysis measures the cash difference or *gap* between the absolute values of the assets and liabilities that are sensitive to movements in interest rates. Therefore the analysis measures the relative interest-rate sensitivities of the assets and liabilities, and thus determines the risk profile of the bank with respect to changes in rates. The *gap ratio* is given as (6.3):

$$\text{Gap ratio} = \frac{\text{Interest-rate sensitive assets}}{\text{Interest-rate sensitive liabilities}} \quad (6.3)$$

and measures whether there are more interest-rate sensitive assets than liabilities. A gap ratio higher than one for example, indicates that a rise in interest rates will increase the NPV of the book, thus raising the return on assets at a rate higher than the rise in the cost of funding. This also results in a higher income spread. A gap ratio lower than one indicates a rising funding cost. *Duration gap* analysis measures the impact on the net worth of the bank due to changes in interest rates by focusing on changes in market value of either assets or liabilities. This is because duration measures the percentage change in the market value of a single security for a 1% change in the underlying yield of the security (strictly speaking, this is *modified duration* but the term for the original "duration" is now almost universally used to refer to modified duration). The duration gap is defined as (6.4):

$$\text{Duration gap} = \text{Duration of assets} - w(\text{Duration of liabilities}) \quad (6.4)$$

where w is the percentage of assets funded by liabilities. Hence, the duration gap measures the effects of the change in the net worth of the bank. A higher duration gap indicates a higher interest rate exposure. As duration only measures the effects of a linear change in the interest rate – that is, a parallel shift yield curve change – banks with portfolios that include a significant amount of instruments with elements of optionality, such as callable bonds, asset-backed securities and convertibles, also use the *convexity* measure of risk exposure to adjust for the inaccuracies that arise in duration over large yield changes.

Developments in ALM

A greater number of financial institutions are enhancing their risk management function by adding to the responsibilities of the ALM function. These have included enhancing the role of the head of Treasury and the ALCO, using other risk exposure measures such as the option-adjusted spread and VaR, and integrating the traditional interest-rate risk management with credit risk and operational risk. The increasing use of credit derivatives has facilitated this integrated approach to risk management.

The additional roles of the ALM desk can include:

- using the VaR tool to assess risk exposure;
- integrating market risk and credit risk;
- using new *risk-adjusted* measures of return;
- optimising portfolio return;
- proactively managing the balance sheet; this includes giving direction on the securitisation of assets (removing them from the balance sheet), hedging credit exposure using credit derivatives, and actively enhancing returns from the liquidity book, such as entering into stock lending and repo.

An expanded ALM function will by definition expand the role of the Treasury function and the ALCO. This may see the Treasury function becoming active “portfolio managers” of the bank’s book. The ALCO, traditionally composed of risk managers from across the bank as well as the senior member of the ALM desk or liquidity desk, is responsible for assisting the head of Treasury and the Finance Director in the risk management process. In order to fulfil the new enhanced function the Treasurer will require a more strategic approach to his or her function, as many of the decisions with running the bank’s entire portfolio will be closely connected with the overall direction that the bank wishes to take. These are Board-level decisions.

Liquidity and interest-rate risk

The liquidity gap

Liquidity risk arises because a bank's portfolio will consist of assets and liabilities with different sizes and maturities. When assets are greater than resources from operations, a funding gap will exist that needs to be sourced in the wholesale market. When the opposite occurs, the excess resources must be invested in the market. The differences between the assets and liabilities is called the *liquidity gap.* For example, if a bank has long-term commitments that have arisen from its dealings and its resources are exceeded by these commitments, and have a shorter maturity, there is both an immediate and a future deficit. The liquidity risk for the bank is that, at any time, there are not enough resources, or funds available in the market, to balance the assets.

Liquidity management has several objectives; possibly the most important is to ensure that deficits can be funded under all foreseen circumstances, and without incurring prohibitive costs. In addition there are regulatory requirements that force a bank to operate certain limits, and state that short-term assets be in excess of short-run liabilities, in order to provide a safety net of highly liquid assets. Liquidity management is also concerned with funding deficits and investing surpluses, with managing and growing the balance sheet, and with ensuring that the bank operates within regulatory and in-house limits. In this section we review the main issues concerned with liquidity and interest-rate risk.

The liquidity gap is the difference, at all future dates, between assets and liabilities of the banking portfolio. Gaps generate liquidity risk. When liabilities exceed assets, there is an excess of funds. An excess does not of course generate liquidity risk, but it does generate interest-rate risk, because the present value of the book is sensitive to changes in market rates. When assets exceed liabilities, there is a funding deficit and the bank has long-term commitments that are not currently funded by existing operations. The liquidity risk is that the bank requires funds at a future date to match the assets. The bank is able to remove any liquidity risk by locking in maturities, but of course there is a cost involved as it will be dealing at longer maturities.[7]

Gap risk and limits

Liquidity gaps are measured by taking the difference between outstanding balances of assets and liabilities over time. At any point a positive gap between assets and liabilities is equivalent to a deficit, and this is measured as a cash amount. The *marginal gap* is the difference between the changes of assets and liabilities over a given period. A positive marginal gap means that the variation of value of assets exceeds the variation of value of liabilities. As new assets and liabilities are added over time, as part of the ordinary course of business, the gap profile changes.

The gap profile is tabulated or charted (or both) during and at the end of each day as a primary measure of risk. For illustration, a tabulated gap report is shown in Table 6.2 on page 266 and is an actual example from a UK banking institution. It shows the assets and liabilities grouped into maturity *buckets* and the net position for each bucket. It is a snapshot today of the exposure, and hence funding requirement of the bank for future maturity periods.

Table 6.2 Example gap profile: UK bank

	Time periods											
	Total		0–6 months		6–12 months		1–3 years		3–7 years		7+ years	
Assets	40,533	6.17%	28,636	6.08%	3,801	6.12%	4,563	6.75%	2,879	6.58%	654	4.47%
Liabilities	40,533	4.31%	30,733	4.04%	3,234	4.61%	3,005	6.29%	2,048	6.54%	1,513	2.21%
Net cumulative positions	0	1.86%	(2,097)		567		1,558		831		(859)	
Margin on total assets:			2.58%									
Average margin on total assets:			2.53%									

Table 6.2 is very much a summary report, because the maturity gaps are very wide. For risk management purposes the buckets would be much narrower; for instance, the period between zero and 12 months might be split into 12 different maturity buckets. An example of a more detailed gap report is shown in Table 6.3 on pages 268–9, which is from another UK banking institution. Note that the overall net position is zero, because this is a balance sheet and therefore, not surprisingly, it balances. However, along the maturity buckets or grid points there are net positions which are the gaps that need to be managed.

Table 6.3 Detailed gap profile: UK bank

ASSETS	Total (£m)	Up to 1 month	1–3 months	3–6 months	6 months to 1 year
Cash & interbank loans	2,156.82	1,484.73	219.36	448.90	3.84
CDs purchased	1,271.49	58.77	132.99	210.26	776.50
FRNs purchased	936.03	245.62	586.60	12.68	26.13
Bank bills	314.35	104.09	178.36	31.90	0.00
Other loans	13.00	0.00	1.00	0.00	0.00
Debt securities/gilts	859.45	0.00	25.98	7.58	60.05
Fixed-rate mortgages	4,180.89	97.72	177.37	143.13	964.98
Variable & capped rate mortgages	14,850.49	14,850.49	0.00	0.00	0.00
Commercial loans	271.77	96.62	96.22	56.52	0.86
Unsecured lending and leasing	3,720.13	272.13	1,105.20	360.03	507.69
Other assets	665.53	357.72	0.00	18.77	5.00
	29,239.95	17,567.91	2,523.06	1,289.77	2,345.05
Swaps	9,993.28	3,707.34	1,462.32	1,735.59	1,060.61
FRAs	425.00	0.00	50.00	0.00	220.00
Futures	875.00	0.00	300.00	0.00	175.00
TOTAL	40,533.24	21,275.24	4,335.38	3,025.36	3,800.66
LIABILITIES (£m)					
Bank deposits	3,993.45	2,553.85	850.45	233.03	329.06
CDs issued	1,431.42	375.96	506.76	154.70	309.50
CP & Euro	508.46	271.82	128.42	108.21	0.00
Subordinated debt	275.00	0.00	0.00	0.00	0.00
Eurobonds + other	2,582.24	768.75	1,231.29	121.94	53.86
Customer deposits	17,267.55	15,493.65	953.60	311.70	340.50
Other liabilities (incl capital/reserves)	3,181.83	1,336.83	0.00	0.00	741.72
	29,239.96	20,800.86	3,670.52	929.58	1,774.64
Swaps	9,993.28	1,754.70	1,657.59	1,399.75	1,254.24
FRAs	425.00	0.00	150.00	70.00	55.00
Futures	875.00	0.00	0.00	300.00	150.00
TOTAL	40,533.24	22,555.56	5,478.11	2,699.33	3,233.89
Net Positions	0.00	−1,351.09	−1,234.54	265.58	583.48

1–2 years	2–3 years	3–4 years	4–5 years	5–6 years	6–7 years	7–8 years	8–9 years	9–10 years	10+ years
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
92.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45.48	0.00	0.00	19.52	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.00	1.00	0.00	0.00	2.00	2.00	0.00	0.00	0.00
439.06	199.48	26.81	100.50	0.00	0.00	0.00	0.00	0.00	0.00
1,452.91	181.86	661.36	450.42	22.78	4.30	3.65	3.10	2.63	14.67
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.16	1.12	3.64	8.85	1.06	0.16	0.17	0.16	4.23	0.00
694.86	400.84	195.19	79.98	25.45	14.06	10.03	10.44	10.82	33.42
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	284.03
2,734.43	783.31	888.00	659.26	49.28	20.53	15.85	13.71	17.68	332.12
344.00	146.50	537.60	649.00	70.00	5.32	200.00	75.00	0.00	0.00
5.00	150.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
400.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3,483.43	1,079.81	1,425.60	1,308.26	119.28	25.84	215.85	88.71	17.68	332.12
21.07	1.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
60.00	20.00	3.50	1.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	200.00	75.00	0.00	0.00
9.77	13.16	150.43	150.53	0.00	7.51	0.00	0.00	0.00	75.00
129.10	6.60	24.90	0.00	7.50	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,103.28
219.93	40.76	178.83	156.53	7.50	7.51	200.00	75.00	0.00	1,178.28
1,887.97	281.44	905.06	770.52	15.76	6.48	7.27	8.13	13.06	31.30
150.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
425.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,682.90	322.20	1,083.90	927.05	23.26	13.99	207.27	83.13	13.06	1,209.58
929.10	803.46	341.70	404.88	104.28	11.85	8.58	5.57	4.62	–877.45

Limits on a banking book can be set in terms of gap limits. For example, a bank may set a six-month gap limit of £10 million. The net position of assets and maturities expiring in six months' time could then not exceed £10 million. An example of a gap limit report is shown at Figure 6.2 on page 270, with the actual net gap positions shown against the gap limits for each maturity. Again this is an actual limit report from a UK banking institution.

Figure 6.2 Gap limit report

	0–6 months				1–3 years		3–7 years				7–10 years			
Time periods														
Individual	0–1	1–3	3–6	6–12	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10	10+ years
Cumulative	0–6 months				1–3 years		3–7 years				7–10 years			
Current gaps														
Individual	0	0	0	710	–520	771	417	484	104	7	4	2	2	–117
Cumulative	–1,864				251		1,011				9			
Limits														
Individual (+/–)				+/–1250	–2000	+/–1000	+1000–200	+1000–200	+250–100	+200–75	+/–50	+/–25	+/–25	–125
Cumulative	+500 to –2500				+750 to –1000		2,000				+100			
Excess	0				0		0				0			

The maturity gap can be charted to provide an illustration of net exposure, and an example is shown in Figure 6.3 on page 270, from yet another UK banking institution. In some firms' reports both the assets and the liabilities are shown for each maturity point, but in our example only the net position is shown. This net position is the gap exposure for that maturity point. A second example, used by the overseas subsidiary of a Middle Eastern commercial bank, which has no funding lines in the interbank market and so does not run short positions, is shown in Figure 6.4 on page 271, while the gap report for a UK high-street bank is shown in Figure 6.5 on page 271. Note the large short gap under the maturity labelled "non-int"; this stands for *non-interest bearing liabilities* and represents the balance of current accounts (cheque or "checking" accounts), which are funds that attract no interest and are in theory very short-dated (because they are demand deposits, so may be called at instant notice).

Figure 6.3 Gap maturity profile in graphical form

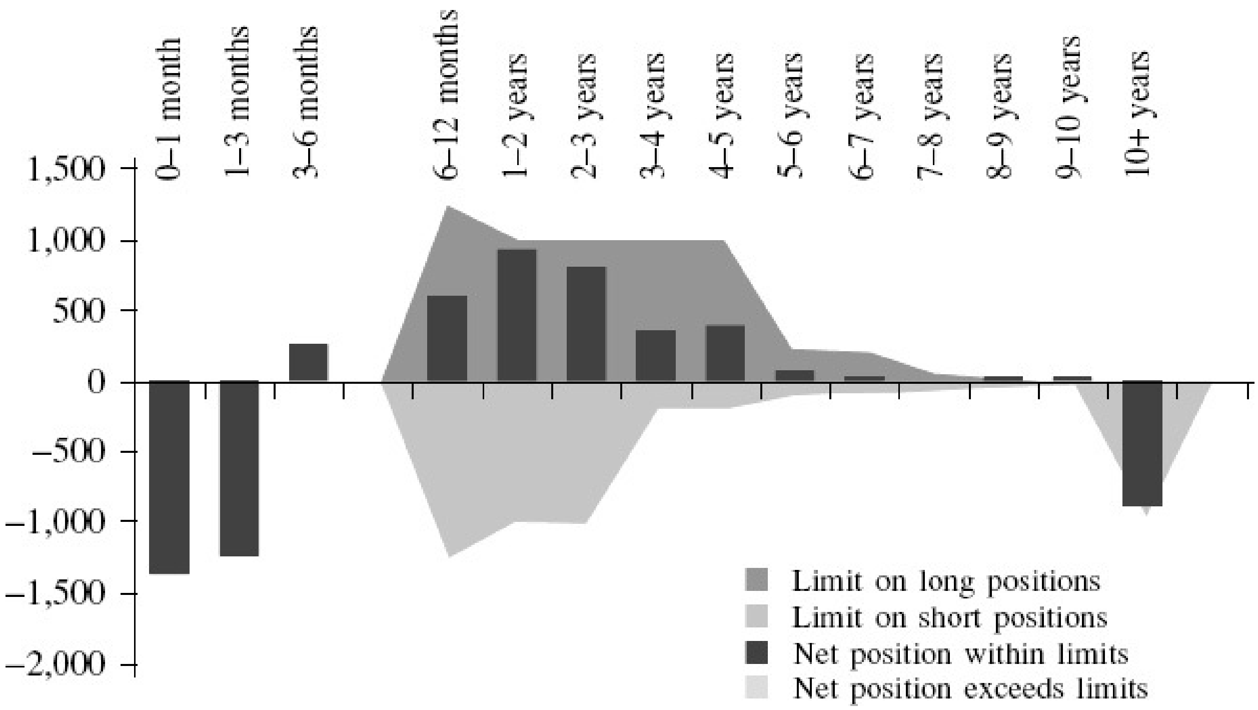


Figure 6.4 Gap maturity profile, bank with no short funding allowed

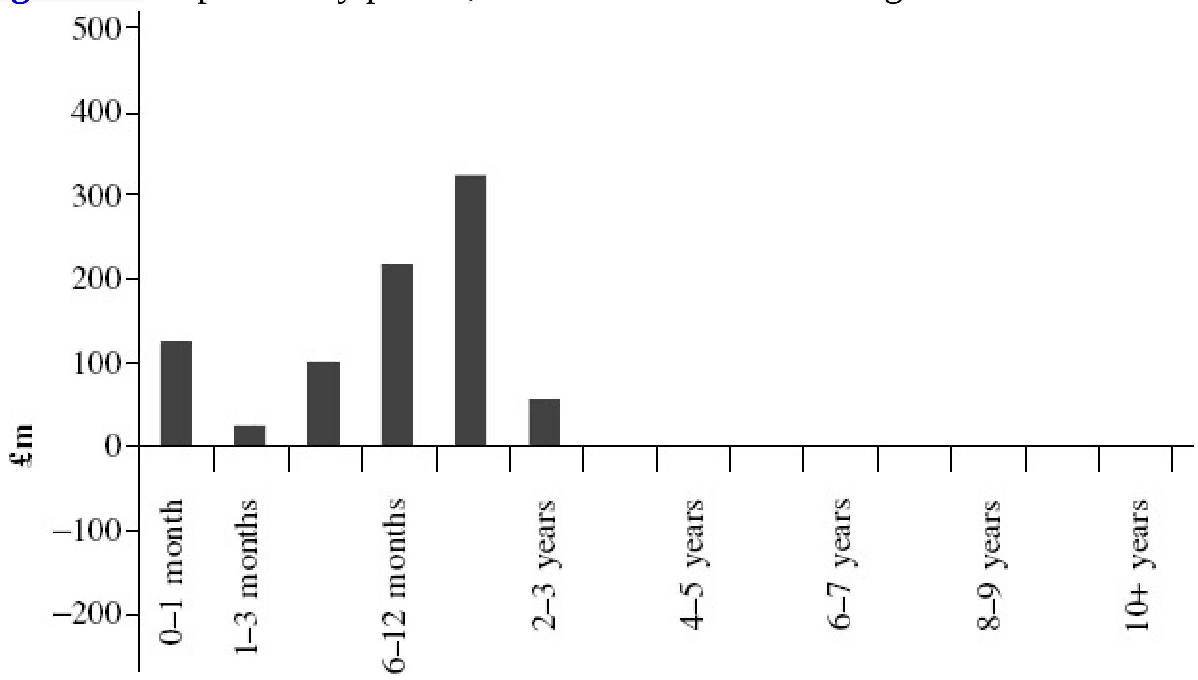
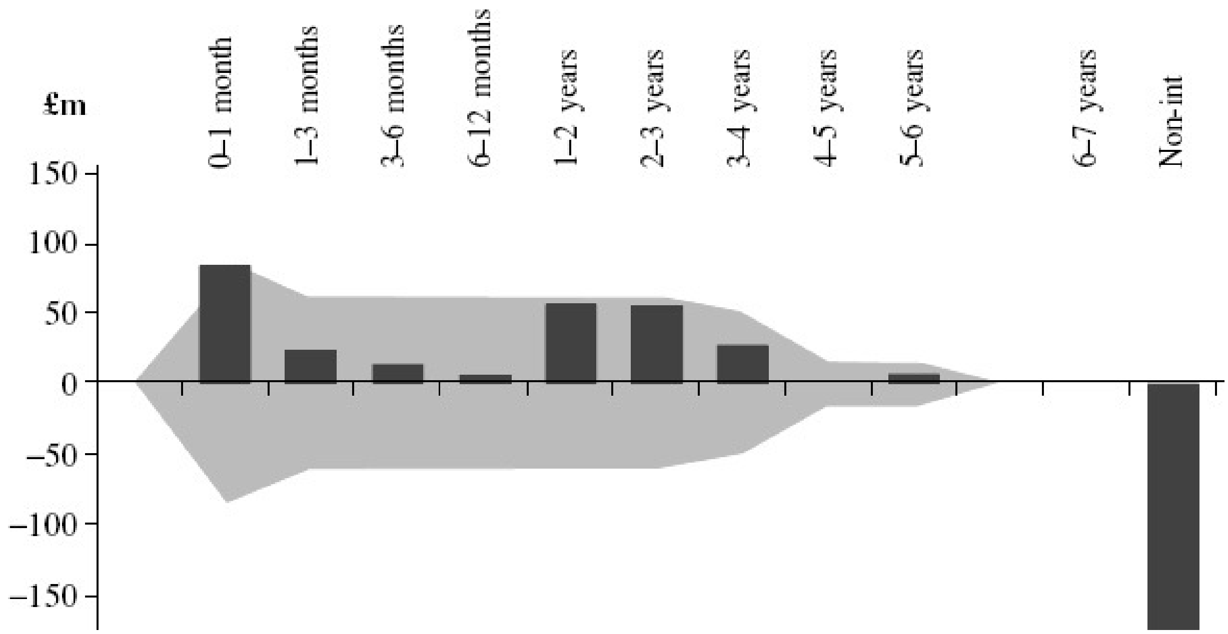


Figure 6.5 Gap maturity profile, UK high-street bank



Gaps represent cumulative funding required at all dates. The cumulative funding is not necessarily identical to the new funding required at each period, because the debt issued in previous periods is not necessarily amortised at subsequent periods. The new funding between, for example, months 3 and 4 is not the accumulated deficit between months 2 and 4 because the debt contracted at month 3 is not necessarily amortised at month 4. Marginal gaps may be identified as the new funding required or the new excess funds of the period that should be invested in the market. Note that all the reports are snapshots at a fixed point in time and the picture is of course a continuously moving one. In practice the liquidity position of a bank cannot be characterised by one gap at any given date, and the entire gap profile must be used to gauge the extent of the book's profile.

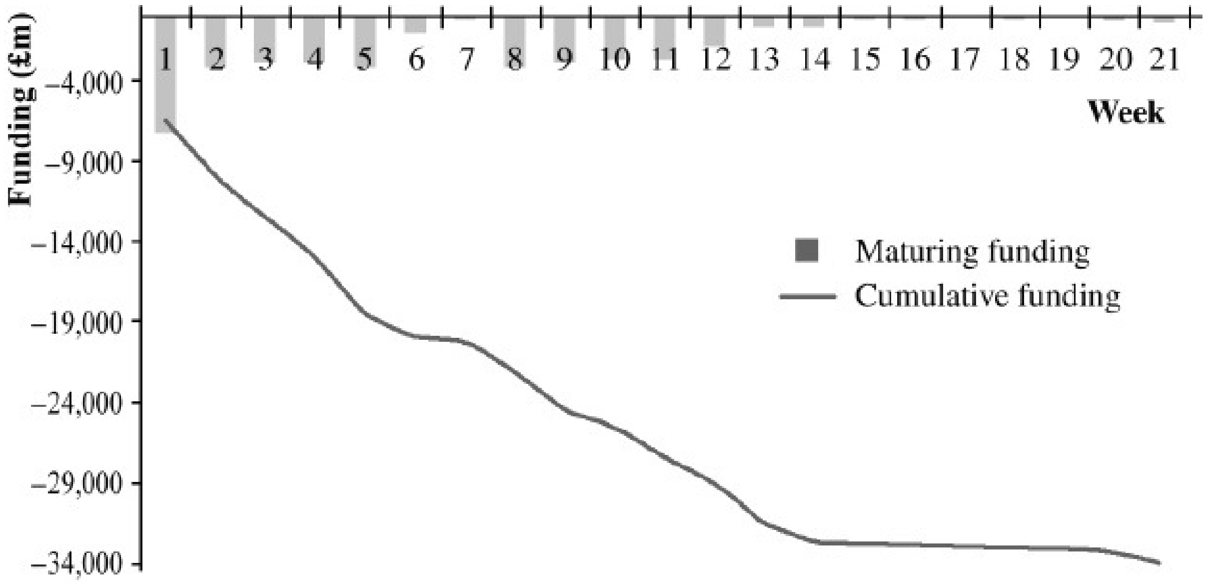
The liquidity book may decide to match its assets with its liabilities. This is known as *cash matching* and occurs when the time profiles of both assets and liabilities are identical. By following such a course the bank can lock in the spread between its funding rate and the rate at which it lends cash, and run a guaranteed profit. Under cash matching, the liquidity gaps will be zero. Matching the profile of both legs of the book is done at the overall level; that is, cash matching does not mean that deposits should always match loans. This would be difficult as both result from customer demand, although an individual purchase of, say, a CD can be matched with an identical loan. Nevertheless, the bank can elect to match assets and liabilities once the net position is known, and keep the book matched at all times. However, it is highly unusual for a bank to adopt a cash matching strategy.

Liquidity management

The continuous process of raising new funds or investing surplus funds is known as liquidity management. If we consider that a gap today is funded, thus balancing assets and liabilities and squaring-off the book, the next day a new deficit or surplus is generated that also has to be funded. The liquidity management decision must cover the amount required to bridge the gap that exists the following day, as well as position the book across future dates in line with the bank's view on interest rates. Usually in order to define the maturity structure of debt a target profile of resources is defined. This may be done in several ways. If the objective of ALM is to replicate the asset profile with resources, the new funding should contribute to bringing the resources profile closer to that of the assets; that is, more of a matched book looking forward. This is the lowest risk option. Another target profile may be imposed on the bank by liquidity constraints. This may arise if, for example the bank has a limit on borrowing lines in the market so that it could not raise a certain amount each week or month. For instance, if the maximum that could be raised in one week by a bank is £10 million, the maximum period liquidity gap is constrained by that limit. The ALM desk will manage the book in line with the target profile that has been adopted, which requires it to try to reach the required profile over a given time horizon.

Figure 6.6 is a liquidity analysis for a UK bank, showing the maturity of funding going forward and where liquidity requirements arise.

Figure 6.6 Liquidity analysis – example of UK bank profile of maturity of funding



Managing the banking book's liquidity is a dynamic process, as loans and deposits are known at any given point, but new business will be taking place continuously and the profile of the book looking forward must be continuously re-balanced to keep it within the target profile. There are several factors that influence this dynamic process, the most important of which are reviewed below.

Demand deposits

Deposits placed on demand at the bank, such as current accounts (known in the United States as "checking accounts") have no stated maturity and are available on demand at the bank. Technically they are referred to as "non-interest-bearing liabilities" because the bank pays no or very low rates of interest on them, so they are effectively free funds. The balance of these funds can increase or decrease throughout the day without any warning, although in practice the balance is quite stable. There are a number of ways that a bank can choose to deal with these balances. These are:

- to group all outstanding balances into one maturity bucket at a future date that is the preferred time horizon of the bank, or a date beyond this. This would then exclude them from the gap profile. Although this is considered unrealistic because it excludes the current account balances from the gap profile, it is nevertheless a fairly common approach;
- to rely on an assumed rate of amortisation for the balances, say 5% or 10% each year;
- to divide deposits into stable and unstable balances, of which the core deposits are set as a permanent balance. The amount of the core balance is set by the bank based on a study of the total balance volatility pattern over time. The excess over the core balance is then viewed as very short-term debt. This method is reasonably close to reality as it is based on historical observations;
- to make projections based on observable variables that are correlated with the outstanding balances of deposits. For instance, such variables could be based on the level of economic growth plus an error factor based on the short-term fluctuations in the growth pattern.

Pre-set contingencies

A bank will have committed lines of credit, the utilisation of which depends on customer demand. Contingencies generate outflows of funds that are by definition uncertain, as they are contingent upon some event; for example, the willingness of the borrower to use a committed line of credit. The usual way for a bank to deal with these unforeseen fluctuations is to use statistical data based on past observation to project a future level of activity.

Prepayment options of existing assets

Where the maturity schedule is stated in the terms of a loan, it may still be subject to uncertainty because of prepayment options. This is similar to the prepayment risk associated with a mortgage-backed bond. An element of prepayment risk renders the actual maturity profile of a loan book to be uncertain; banks often calculate an “effective maturity schedule” based on prepayment statistics instead of the theoretical schedule. There are also a range of prepayment models that may be used, the simplest of which use constant prepayment ratios to assess the average life of the portfolio. The more sophisticated models incorporate more parameters, such as one that bases the prepayment rate on the interest rate differential between the loan rate and the current market rate, or the time elapsed since the loan was taken out.

Interest cash flows

Assets and liabilities generate interest cash inflows and outflows, as well as the amortisation of principal. The interest payments must be included in the gap profile as well.

Interest-rate gap

The interest-rate gap is the standard measure of the exposure of the banking book to interest-rate risk. The interest-rate gap for a given period is defined as the difference between fixed-rate assets and fixed-rate liabilities. It can also be calculated as the difference between interest-rate sensitive assets and interest-rate liabilities. Both differences are identical in value when total assets are equal to total liabilities, but will differ when the balance sheet is not balanced. This only occurs intra-day, when, for example, a short position has not been funded yet. The general market practice is to calculate interest-rate gap as the difference between assets and liabilities. The gap is defined in terms of the maturity period that has been specified for it.

The convention for calculating gaps is important for interpretation. The "fixed-rate" gap is the opposite of the "variable-rate" gap when assets and liabilities are equal. They differ when assets and liabilities do not match and there are many reference rates. When there is a deficit, the "fixed-rate gap" is consistent with the assumption that the gap will be funded through liabilities for which the rate is unknown. This funding is then a variable-rate liability and is the bank's risk, unless the rate has been locked in beforehand. The same assumption applies when the banks run a cash surplus position, and the interest rate for any period in the future is unknown. The gap position at a given time bucket is sensitive to the interest rate that applies to that period.

The gap is calculated for each discrete time bucket, so there is a net exposure for, say, 0–1 month, 1–3 months and so on. Loans and deposits do not, except at the time of being undertaken, have precise maturities like that, so they are "mapped" to a time bucket in terms of their relative weighting. For example, a £100 million deposit that matures in 20 days' time will have most of its balance mapped to the three-week time bucket, but a smaller amount will also be allocated to the two-week bucket. Interest-rate risk is measured as the change in present value of the deposit, at each grid point, given a 1 basis point change in the interest rate. So a £10 million one-month CD that was bought at 6.50% will have its present value move upwards if on the next day the one-month rate moves down by a basis point.

The net change in present value for a 1 basis point move is the key measure of interest-rate risk for a banking book and this is what is usually referred to as a “gap report”, although strictly speaking it is not. The correct term for such a report is a “PVBP” or “DV01” report, which are acronyms for “present value of a basis point” and “dollar value of a 01 [1 basis point]” respectively. The calculation of interest-rate sensitivity assumes a *parallel shift* in the yield curve; that is, that every maturity point along the term structure moves by the same amount (here one basis point) and in the same direction. An example of a PVBP report is given in Table 6.4, split by different currency books, but with all values converted to sterling.

Table 6.4 Banking book PVBP grid report

	1 day	**1 week**	**1 month**	**2 months**	**3 months**	**6 months**	**12 months**	**2 years**
GBP	8,395	6,431	9,927	8,856	(20,897)	(115,303)	(11,500)	(237,658)
USD	1,796	(903)	10,502	12,941	16,784	17,308	(13,998)	(18,768)
Euro	1,026	1,450	5,105	2,877	(24,433)	(24,864)	(17,980)	(9,675)
Total	11,217	6,978	25,534	24,674	(28,546)	(122,859)	(43,478)	(266,101)

	3 years	**4 years**	**5 years**	**7 years**	**10 years**	**15 years**	**20 years**	**30 years**
GBP	(349,876)	(349,654)	5,398	(5,015)	(25,334)	(1,765)	(31,243)	(50,980)
USD	(66,543)	(9,876)	(1,966)	237	2,320	(5,676)	(1,121)	0
Euro	(11,208)	(3,076)	1,365	1,122	3,354	(545)	(440)	(52)
Total	(427,627)	(362,606)	4,797	(3,656)	(19,660)	(7,986)	(32,804)	(51,032)

GBP total: (1,160,218); USD total: (56,963); Euro total: (75,974); Grand total: (1,293,155)
All figures in £.

The basic concept in the gap report is the NPV of the banking book, which is introduced in Appendix 6.1. The PVBP report measures the difference between the market values of assets and liabilities in the banking book. To calculate NPV we require a discount rate, and it represents a *mark-to-market* of the book. The rates used are always the zero-coupon rates derived from the government bond yield curve, although some adjustment should be made to this to allow for individual instruments.

Gaps may be calculated as differences between outstanding balances at one given date, or as differences of variations of those balances over a time period. A gap number calculated from variations is known as a *margin gap*. The cumulative margin gaps over a period of time, plus the initial difference in assets and liabilities at the beginning of the period are identical to the gaps between assets and liabilities at the end of the period.

The interest-rate gap differs from the liquidity gap in a number of ways; note that:

- whereas for liquidity gap all assets and liabilities must be accounted for, only those that have a fixed rate are used for the interest-rate gap;
- the interest-rate gap cannot be calculated unless a period has been defined because of the fixed-rate/variable-rate distinction. The interest-rate gap is dependent on a maturity period and an original date.

The primary purpose in compiling the gap report is to determine the sensitivity of the interest margin to changes in interest rates. As we noted earlier the measurement of the gap is always “behind the curve” as it is a historical snapshot; the actual gap is a dynamic value as the banking book continually undertakes day-to-day business.

Portfolio modified duration gap

From Chapter 4 we know that modified duration measures the change in the market price of a financial instrument that results from a given change in market interest rates. The duration gap of a net portfolio value is a measure of the interest-rate sensitivity of a portfolio of financial instruments and is the difference between the weighted-average duration of assets and liabilities, adjusted for the net duration of any off-balance sheet instruments. Hence it measures the percentage change in the net portfolio value that is expected to occur if interest rates change by 1%.

The net portfolio value, given by the NPV of the book, is the market value of assets *A* minus the market value of the liabilities *L*, plus or minus the market value *OBS* of off-balance sheet instruments, shown by (6.5):

(6.5) $NPV = A - L \pm \text{OBS}.$

To calculate the duration gap of the NPV, we obtain the modified duration of each instrument in the portfolio and weight this by the ratio of its market value to the net value of the portfolio. This is done for assets, liabilities and off-balance sheet instruments. The modified duration of the portfolio is given by (6.6):

(6.6) $MD_{NPV} = MD_A - MD_l \pm MD_{OBS}.$

The modified duration of the NPV may be used to estimate the expected change in the market value of the portfolio for a given change in interest rates, shown by (6.7):

(6.7) $\Delta NPV = NPV' - MD_{NPV} \times \Delta r.$

It is often problematic to obtain an accurate value for the market value of every instrument in a banking book. In practice book values often are used to calculate the duration gap when market values are not available. This may result in inaccurate results when actual market values differ from book values by a material amount.

The other points to note about duration gap analysis are:

- the analysis uses modified duration to calculate the change in NPV and therefore provides an accurate estimate of price sensitivity of instruments for only small changes in interest rates. For a change in rates of more than, say, 50 basis points the sensitivity measure given by modified duration will be significantly in error;

- the duration gap analysis, like the maturity gap model, assumes that interest rates change in a parallel shift, which is clearly unrealistic.

As with the maturity gap analysis, the duration gap is favoured in ALM application because it is easily understood and summarises a banking book's interest-rate exposure in one convenient number.

Critique of the traditional approach

Traditionally, the main approach of ALM is concentrated on the interest sensitivity and NPV sensitivity of a bank's loan/deposit book. The usual interest sensitivity report is the maturity gap report, which we reviewed briefly earlier. The maturity gap report is not perfect, however, and can be said to have the following drawbacks:

- the repricing intervals chosen for gap analysis are ultimately arbitrary, and there may be significant mismatches within a repricing interval. For instance, a common repricing interval chosen is the one-year gap and the 1–3-year gap; there are (albeit extreme) circumstances when mismatches would go undetected by the model. Consider a banking book that is composed solely of liabilities that reprice in one month's time, and an equal cash value of assets that reprice in 11 months' time. The one-year gap of the book (assuming no other positions) would be zero, implying no risk to net interest income. In fact, under our scenario the net interest income is significantly at risk from a rise in interest rates;
- maturity gap models assume that interest rates change by a uniform magnitude and direction. For any given change in the general level of interest rates, however, it is more realistic for different maturity interest rates to change by different amounts, what is known as a non-parallel shift;
- maturity gap models assume that principal cash flows do not change when interest rates change. Therefore it is not possible effectively to incorporate the impact of options embedded in certain financial instruments. Instruments such as mortgage-backed bonds and convertibles do not fall accurately into a gap analysis, as only their first-order risk exposure is captured.

Notwithstanding these drawbacks, the gap model is widely used as it is easily understood in the commercial banking and mortgage industry, and its application does not require a knowledge of sophisticated financial modelling techniques.

The cost of funding

Banks can choose to set up their Treasury function as either a cost centre or a profit centre. Most of the discussion up to now has assumed a profit centre arrangement, with the Treasury desk also responsible for market-making of money market instruments and being expected to position the bank's ALM requirement and trade money markets to profit. Some institutions set the Treasury function up simply to arrange the firm's funding requirement, so that it is not expected to generate profit.

In such an arrangement, the question arises as what the Treasury desk should charge the firm's lines of business for their funds. Consider a broker–dealer firm that operated the following lines of business:

- a corporate bond market-making desk;
- an equity derivatives trading desk;
- an investment portfolio that holds ABS, MBS and CDO securities for the medium term;
- a business that offers structured derivatives products, on a leveraged basis, to clients that wish to invest in hedge fund of funds or other alternative assets.

Each of these lines of business will have a different funding requirement; for example, the market-making desk would expect to have a frequent turnover of its portfolio and so its liquidity profile would be fairly short-dated. It could be funded using short-term borrowing, no more than one-week to one-month, with much funding on an overnight to one-week basis. The client-focused business would have a longer-dated asset profile, and so should be funded using a mixture of short-, medium-and long-dated funds. Assuming a positive-sloping yield curve, the term structure effect means that the client-focused business would have a higher cost of funds. However, the Treasury desk would not fund each desk separately (it could, but that would be inefficient and wasteful of resources). Hence, what charge should be made to the desks for their funds?

One option is for banks to use a weighted-average cost (WAC or WACC) of funds, sometimes called a "blended" or "pooled" rate, and this rate is passed on to the whole firm.

The cost of borrowing

There are two approaches with regard to the transfer price for loans. The first approach refers to existing assets and liabilities, and charges a cost for each loan as a proportion of the total. The second, and more common approach, is to define an optimum funding solution and use this as the cost of funds. In practice this will be the blended rate.

Using the existing resources has the appeal of simplicity. However, it raises the problems we encountered at the start of this section: each type of resource has a different cost. We could define a maturity term for all assets and match each term loan to assets of identical maturity. But this is not effective in practice. For instance, if an asset can be identified that has a precise maturity profile, then one can fund it to matching dates, either with one loan or a set of loans that all roll off in order until the final maturity date. But to do this for every asset would be impractical.

Hence a “weighted-average cost of capital” (WACC) is used.

The blended cost of funds

For fixed-rate loans, the cost of funds is explicit, but when more than one loan is taken out, the funding cost will depend on the combination of amounts borrowed and their respective maturity dates. For instance, consider a funding arrangement for USD100 that is comprised of:

- 40 borrowed for two years;
- 60 borrowed for one year.

The relevant interest rates are the zero-coupon interest rates for one-and two-year loans. The transfer price to use for the overall funding of 100 in the first 12 months is the average cost of the funds of these two loans. It is in fact given by the discount rate that would equate the present value of the future values of each loan equal to the original amount borrowed. The future value is of course the maturity amount, which is the original principal plus interest. To be strictly accurate, we assume that the loans are zero-coupon loans and the interest rates charged are zero-coupon interest rates.

The future cash flows on the above arrangement are:

- 60 $(1 + r_1)$ in year 1;
- 40 $(1 + r_2)^2$ in year 1 and year 2.

So the WACC is given by the rate *rw* such that:

$$100 = 60(1 + r_1)/(1 + rw) + 40(1 + r_2)^2 / (1 + rw)^2$$

This discount rate will obviously lie somewhere between r_1 and r_2. A “back of the envelope” solution to this can be to calculate a linear approximation of the formula above, namely:

$$100 = 60(1 + r_1 - rw) + 40(1 + 2r_2 - 2rw)$$

$$rw = (60 \times r_1 + 40 \times 2 \times r_2) / (60 + 2 \times 40).$$

The rate *rw* is the weighted average of the two rates r_1 and r_2, which we took to be the one-and two-year zero-coupon rates respectively. The weighting used refers to the size of the loan in proportion to the total and its maturity. As a rough rule of thumb, a one-year rate rolled over in a two-tear period would be weighed at twice the two-year one. If we imagine that r_1 is 4% and r_2 is 5%, then *rw* in this case will be nearer to r_2, because it is the longest-dated loan, but pulling in the other direction is the fact that the one-year loan in our example was for a larger sum.

In practice, even very large commercial banks and investment banks calculate their WACC as the daily interest payment on each loan outstanding, added together, and then divided by the total nominal amount of all loans.

We illustrate the concept of the WACC in practical fashion in Table 6.5 on pages 284–5. This shows a USD500 million funding requirement that has been arranged as three loans, namely:

Table 6.5 Weighted-average borrowing cost calculation, with three hypothetical loans

WACC calculation

			0.002777778
			Amount of interest (accrued)
			1
			o/n
Term (days)		Interest rate % pa (Libor fix)	Amount of interest
1 o/n	200,000,000	1.05%	5,833.33
7 1wk	200,000,000	1.07%	5,944.44
90 3mth	100,000,000	1.15%	3,194.44
	500,000,000		1.078%
			14,972.22
		Period	1
			0.0030%
		Overall cost of funds – WAC measure	1.146%
		Total interest	1,432,055.56
			0.002777778
			Amount of interest (accrued)

SAME CALCULATION – as above – but using the effective cost of funds

			1
			o/n
Term (days)		WAC rate	Amount of interest
1 o/n	200,000,000	1.1456%	6,364.69
7 1wk	200,000,000	1.1456%	6,364.69
90 3mth	100,000,000	1.1456%	3,182.35
	500,000,000		1.146%
			15,911.73
		Period	1
			0.0032%
		Overall cost of funds	1.146%
			1,432,055.56

0.01944444	0.25			
7	90			
1wk	3mth			
–	–	1	0	0
41,611.11	–	1	1	0
22,361.11	287,500.00	1	1	1
1.097%	1.150%	500,000,000.00	300,000,000.00	100,000,000.00
63,972.22	287,500.00	366,444.44		
6	83			
0.0183%	0.2651%	0.2864%		

0.01944444	0.25			
7	90			
1wk	3mth			
–	–	1	0	0
44,552.84	–	1	1	0
22,276.42	286,411.11	1	1	1
1.146%	1.146%	500,000,000.00	300,000,000.00	100,000,000.00
66,829.26	286,411.11	369,152.10		
6	83			
0.0191%	0.2641%	0.2864%		

- overnight USD200 million at 1.05%;
- one-week loan of USD200 million at 1.07%;
- three-month loan of USD100 million at 1.15%.

The spreadsheet shows the calculation of the WACC on a more scientific basis than the "back of the envelope" approach, as it takes into account the term structure effect of the loans (as we go further out along the term structure, we pay a higher rate of interest). However, the result is very close to the simple approach. The WACC for these three loans is shown to be 1.146%.

For students, repeat the spreadsheet in Table 6.6 on pages 286–7 with the formulas used in each cell shown instead of the value.

[Table 6.6](#) WACC calculation showing Excel formula

Cell	B	C	D	E	F	G	H
3					=F4/360	=G5/360	=H5/360
4					Amount of interest (accrued)		
5					1	7	90
6					o/n	1wk	3mth
7	Term (days)		Interest rate %pa	Amount of interest (Libor fix)			
8	1	o/n	200,000,000	1.05%	=$E8*(F$5/360)*$D8 *IF(F$5>$B8,0,1)	=$E8*(G$5/360)*$D8 *IF(G$5>$B8,0,1)	=$E8*(H$5/360)*$D8 *IF(H$5>$B8,0,1)
9	7	1wk	200,000,000	1.07%	=$E9*(F$5/360)*$D9 *IF(F$5>$B9,0,1)	=$E9*(G$5/360)*$D9 *IF(G$5>$B9,0,1)	=$E9*(H$5/360)*$D9 *IF(H$5>$B9,0,1)
10	90	3mth	100,000,000	1.15%	=$E10*(F$5/360)*$D10 *IF(F$5>$B10,0,1)	=$E10*(G$5/360)*$D10 *IF(G$5>$B10,0,1)	=$E10*(H$5/360)*$D10 *IF(H$5>$B10,0,1)
11							
12			=SUM(D8:D10)		=(SUM(F$8:F$10)/K12) *360/F$5	=(SUM(G$8:G$10)/L12) *360/G$5	=(SUM(H$8:H$10)/M12) *360/H$5
13					=SUM(F8:F10)	=SUM(G8:G10)	=SUM(H8:H10)
14				Period	=F5-E5	=G5-F5	=H5-G5
15							
16					=F12*F14/360	=G12*G14/360	=H12*H14/360
17							
18	Overall cost of funds – WAC measure				=I16*360/90		
19							
20				Total interest	=F18*90/360*D12		
21							
22					=F24/360	=G24/360	=H24/360
23					Amount of interest (accrued)		
24	SAME CALCULATION – as above – but using the effective cost of funds						
25					o/n	1wk	3mth
26	Term (days)			WAC rate	Amount of interest		
27	1	o/n	200,000,000	=$F$18	=$E27*(F$5/360)*$D27 *IF(F$5>$B27,0,1)	=$E27*(G$5/360)*$D27 *IF(G$5>$B27,0,1)	=$E27*(H$5/360)*$D27 *IF(H$5>$B27,0,1)
28	7	1wk	200,000,000	=$F$18	=$E28*(F$5/360)*$D28 *IF(F$5>$B28,0,1)	=$E28*(G$5/360)*$D28 *IF(G$5>$B28,0,1)	=$E28*(H$5/360)*$D28 *IF(H$5>$B28,0,1)
29	90	3mth	100,000,000	=$F$18	=$E29*(F$5/360)*$D29 *IF(F$5>$B29,0,1)	=$E29*(G$5/360)*$D29 *IF(G$5>$B29,0,1)	=$E29*(H$5/360)*$D29 *IF(H$5>$B29,0,1)
30							
31			500,000,000		=(SUM(F27:F29)/K31) *360/F$5	=(SUM(G27:G29)/L31) *360/G$5	=(SUM(H27:H29)/M31) *360/H$5
32					=SUM(F27:F29)	=SUM(G27:G29)	=SUM(H27:H29)
33				Period	=F24-E24	=G24-F24	=H24-G24
34							
35					=F31*F33/360	=G31*G33/360	=H31*H33/360
36							
37				Overall cost of funds	=I35*360/90		
38							
39					=F37*90/360*D31		

I	J	K	L	M
		=IF(F8<>0,1,0)	=IF(G8<>0,1,0)	1
		=IF(F9<>0,1,0)	=IF(G9<>0,1,0)	1
		=IF(F10<>0,1,0)	=IF(G10<>0,1,0)	1
		=SUMPRODUCT (K8:K10,$D$8:$D$10)	=SUMPRODUCT (L8:L10,$D$8:$D$10)	=SUMPRODUCT (M8:M10,$D$8:$D$10)
=SUM(F13:H13)				
=SUM(F16:H16)				
		1	7	90
		1	1	1
		1	1	1
		1	1	1
		=SUMPRODUCT (K27:K29,$D$8:$D$10)	=SUMPRODUCT (L27:L29,$D$8:$D$10)	=SUMPRODUCT (M27:M29,$D$8:$D$10)
=SUM(F32:H32)				
=SUM(F35:H35)				

Example 6.3: Position management

Starting the day with a flat position, a money market interbank desk transacts the following deals:

1. £100 million borrowing from 16/9/99 to 7/10/99 (3 weeks) at 6.375%;
2. £60 million borrowing from 16/9/99 to 16/10/99 (1 month) at 6.25%;
3. £110 million loan from 16/9/99 to 18/10/99 (32 days) at 6.45%.

The desk reviews its cash position and the implications for refunding and the interest-rate risk, bearing in mind the following:

- There is an internal overnight rollover limit of £40 million (net).
- The bank's economist feels more pessimistic about a rise in interest rates than most others in the market, and has recently given an internal seminar on the dangers of inflation in the United Kingdom as a result of recent increases in the level of average earnings.
- Today there are some important figures being released including inflation (CPI) data. If today's CPI figures exceed market expectations, the dealer expects a tightening of monetary policy by *at least* 0.50% almost immediately.
- A broker's estimate of daily market liquidity for the next few weeks is one of low shortage, with little central bank intervention required, and hence low volatilities and rates in the overnight rate.
- Brokers' screens indicate the following term repo rates:

O/N	6.350%–6.300%
1 week	6.390%–6.340%
2 week	6.400%–6.350%
1 month	6.410%–6.375%
2 month	6.500%–6.450%
3 month	6.670%–6.620%

- The indication for a 1v2 FRA is:

1v2 FRA	6.680%–6.630%

- The quote for an 11-day forward borrowing in three weeks' time (the "21v32 rate") is 6.50% bid. The book's exposure looks like this:

What courses of action are open to the desk, bearing in mind that the book needs to be squared off such that the position is flat each night?

Possible solutions

Investing early surplus

From a cash management point of view, the desk has a £50 million surplus from 16/9 up to 7/10. This needs to be invested. It may be able to negotiate a 6.31% loan with the market for an overnight term, or a 6.35% term desposit for one week to 6.38% for one month.

The overnight roll is the most flexible but offers a worse rate, and if the desk expects the overnight rate to remain both low and stable (due to forecasts of low market shortages), it may not opt for this course of action.

However, it may make sense from an interest-rate risk point of view. If the desk agrees with the bank's economist, it should be able to benefit from rolling at higher rates soon – possibly in the next three weeks. Therefore it may not want to lock in a term rate now, and the overnight roll would match this view. However, it exposes them to lower rates, if their view is wrong, which will limit the extent of the positive funding spread. The market itself appears neutral about rate changes in the next month, but appears to factor in a rise thereafter.

The forward "gap"

Looking forward, the book is currently on course to exceed the £40 million overnight position limit on 7/10, when the refunding requirement is £50 million. The situation gets worse on 16/10 (for two days) when the refunding requirement is £110 million. The desk needs to fix a term deal before those dates to carry it over until 18/10 when the funding position reverts to zero. A borrowing from 7/10 to 18/10 of £50 million will reduce the rollover requirement to within limit.

However, given that interest rates will rise, should the Treasury desk wait until the 7th to deal in the cash? Not if it has a firm view. It may end up paying as much as 6.91% or higher for the funding (after the 0.50% rate rise). So it would be better to transact now a forward starting repo to cover the period, thus locking in the benefits obtainable from today's yield curve. The market rate for a 21×32 day repo is quoted at 6.50%. This reflects the market's consensus that rates may rise in about a month's time. However, the desk's own expectation is of a larger rise, hence its own logic suggests trading in the forward loan. This strategy will pay dividends if their view is right, as it limits the extent of funding loss.

An alternative means of protecting the interest-rate risk alone is to *buy* a 1v2 month FRA for 6.68%. This does not exactly match the gap, but should act as an effective hedge. If there is a rate rise, the book gains from the FRA profit. Note that the cash position still needs to be squared off. Should the desk deal before or after the inflation announcement? That is, of course, down to it, but most dealers like, if at all possible, to sit tight ahead of releases of key economic data.

Generic ALM policy for different banks

The management of interest-rate risk is a fundamental ingredient of commercial banking. Bank shareholders require comfort that interest-rate risk is measured and managed in a satisfactory manner. A common approach to risk management involves the following:

- the preparation and adoption of a high-level interest-rate risk policy at managing board level; this sets general guidelines on the type and extent of risk exposure that can be taken on by the bank;
- setting limits on the risk exposure levels of the banking book; this can be by product type, desk, geographic area and so on, and will be along the maturity spectrum;
- actively measuring the level of interest-rate risk exposure at regular, specified intervals;
- reporting to senior management on general aspects of risk management, risk exposure levels, limit breaches and so on;
- monitoring of risk management policies and procedures by an independent "middle office" risk function.

The risk management approach adopted by banks will vary according to their specific markets and appetite for risk. Certain institutions will have their activities set out or proscribed for them under regulatory rules. For instance, building societies in the United Kingdom are prohibited from trading in certain instruments under the regulator's guidelines.[8] In this section we present, purely for the purposes of illustration, the ALM policies of three hypothetical banks, called Bank S, Bank M and Bank L. These are respectively, a small banking entity with assets of £500 million, a medium-sized bank with assets of £2.5 billion and a large bank with assets of £10 billion. The following serves to demonstrate the differing approaches that can be taken according to the environment that a financial institution operates in.

ALM policy for Bank S (assets = £500 million)

The aim of the ALM policy for Bank S is to provide guidelines on risk appetite, revenue targets and rates of return, as well as risk management policy. Areas that may be covered include capital ratios, liquidity, asset mix, rate-setting policy for loans and deposits, and investment guidelines for the banking portfolio. The key objectives should include:

- to maintain capital ratios at the planned minimum, and to ensure safety of the deposit base;
- to generate a satisfactory revenue stream, both for income purposes and to further protect the deposit base.

The responsibility for overseeing the operations of the bank to ensure that these objectives are achieved is lodged with the ALM Committee. This body monitors the volume and mix of the bank's assets and funding (liabilities), and ensures that this asset mix follows internal guidelines with regard to banking liquidity, capital adequacy, asset base growth targets, risk exposure and return on capital. The norm is for the committee to meet on a monthly basis; at a minimum the membership of the committee will include the finance director, head of Treasury and risk manager. For a bank the size of Bank S the ALM committee membership will possibly be extended to the chief executive, the head of the loans business and the chief operating officer.

As a matter of course the committee will wish to discuss and review the following on a regular basis:

- overall macroeconomic conditions;
- financial results and key management ratios, such as share price analysis and rates of return on capital and equity;
- the bank's view on the likely direction of short-term interest rates;
- the current lending strategy, and suggestions for changes to this, as well as the current funding strategy;
- any anticipated changes to the volume and mix of the loan book, and that of the main sources of funding; in addition, the appropriateness or otherwise of alternative sources of funding;
- suggestions for any alteration to the bank's ALM policy;
- the maturity gap profile and anticipated and suggested changes to it.

The committee will also wish to consider the interest rates offered currently on loans and deposits, and whether these are still appropriate.

Interest-rate sensitivity is monitored and confirmed as lying within specified parameters; these parameters are regularly reviewed and adjusted if deemed necessary according to changes in the business cycle and economic conditions. Measured using the following ratio:

$$A_{ir} / L_{ir}$$

typical risk levels would be expected to lie between 90–120% for the maturity period 0–90 days, and between 80–110% for the maturity period over 90 days and less than 365 days.

Put simply, the objective of Bank S would be to remain within specified risk parameters at all times, and to maintain as consistent a level of earnings as possible (and one that is immune to changes in the stage of the business cycle).

ALM policy for Bank M (assets = £2.5 billion)

Bank M is our hypothetical “medium-sized” banking institution. Its ALM policy would be overseen by an ALCO. Typically, the following members of senior management would be expected to be members of the ALCO:

- deputy chief executive
- finance director
- head of retail banking
- head of corporate banking
- head of Treasury
- head of risk management
- head of internal audit

together with others such as product specialists who are called to attend as and when required. The finance director will often chair the meeting.

The primary responsibilities of the Bank M ALCO are detailed below.

Objectives

The ALCO is tasked with reviewing the bank's overall funding strategy. Minutes are taken at each meeting, and decisions taken are recorded on the minutes and circulated to attendees and designated key staff. ALCO members are responsible for undertaking regular reviews of the following:

- minutes of the previous meeting;
- the ratio of the interest-rate-sensitive assets to liabilities, gap reports, risk reports and the funding position;
- the bank's view on the expected level of interest rates, and how the book should be positioned with respect to this view; and related to this, the ALCO view on anticipated funding costs in the short-and medium-term;
- stress testing in the form of "what if?" scenarios, to check the effect on the Banking book of specified changes in market conditions; and the change in parameters that may be required if there is a change in market conditions or risk tolerance;
- the current interest rates for loans and deposits, to ensure that these are in accordance with the overall lending and funding strategy;
- the maturity distribution of the liquidity book (expected to be comprised of T-bills, CDs and very short-dated government bonds); the current liquidity position and the expected position in the short and medium term.

As the ALCO meets on a regular monthly basis, it may not be the case that every aspect of their responsibility is discussed at every meeting; the agenda is set by the chair of the meeting in consultation with committee members. The policies adopted by ALCO should be dynamic and flexible, and capable of adaptation to changes in operating conditions. Any changes will be made on agreement of committee members. Generally, any exceptions to agreed policy can only be with the agreement of the CEO and ALCO itself.

Interest-rate risk policy

The objective will be to keep earnings volatility resulting from an upward or downward move in interest rates to a minimum. To this end, at each ALCO meeting members will review risk and position reports and discuss these in the light of the risk policy. Generally, the six-month and 12-month A_{ir}/L_{ir} cumulative ratio will lie in the range of 90–110%. A significant move outside this range will most likely be subject to corrective action. The committee will also consider the results of various scenario analyses on the book, and if these tests indicate a potential earnings impact of greater than, say, 10%, instructions may be given to alter the shape and maturity profile of the book.

Liquidity policy

A primary responsibility of the ALCO is to ensure that an adequate level of liquidity is maintained at all times. We define liquidity as:

> *... the ability to meet anticipated and unanticipated operating cash needs, loan demand, and deposit withdrawals, without incurring a sustained negative impact on profitability.*
>
> *Gup and Brooks (1993), p. 238*

Generally, a Bank M-type operation would expect to have a target level for loans to deposits of around 75–85%, and a loans to core deposits ratio of 85–95%. The loan/deposit ratio is reported to ALCO and reviewed on a monthly basis, and a reported figure significantly outside these ranges (say, by 5% or more) will be reviewed and asked to be adjusted to bring it back into line with ALCO policy.

ALM policy for Bank L (assets = £10 billion)

The management policy for ALM at a larger entity will build on that described for a medium-sized financial institution. If Bank L is a group company, the policy will cover the consolidated balance sheet as well as individual subsidiary balance sheets; the committee will provide direction on the management of assets and liabilities, and the off-balance sheet instruments used to manage interest-rate and credit risk. A well-functioning management process will be proactive and concentrate on direction in response to anticipated changes in operating conditions, rather than reactive responses to changes that have already taken place. The primary objectives will be to maximise shareholder value, with target returns on capital of 15–22%.

The responsibility for implementing and overseeing the ALM management policy will reside with the ALCO. The ALCO will establish the operating guidelines for ALM, and review these guidelines on a periodic basis. The committee will meet on a more frequent basis than would be the case for Bank M, usually on a fortnightly basis. As well as this, it will set policies governing liquidity and funding objectives, investment activities and interest-rate risk. It will also oversee the activities of the investment banking division. The head of the ALM desk will prepare the interest-rate risk sensitivity report and present it to the ALCO.

Interest-rate risk management

The ALCO will establish an interest-rate risk policy that sets direction on acceptable levels of interest-rate risk. This risk policy is designed to guide management in the evaluation of the impact of interest-rate risk on the bank's earnings. The extent of risk exposure is a function of the maturity profile of the balance sheet, as well as the frequency of repricing, the level of loan prepayments and funding costs. Managing interest-rate risk is, in effect, the adjustment of risk exposure upwards or downwards, which will be in response to ALCO's views on the future direction of interest rates. As part of the risk management process the committee will monitor the current risk exposure and duration gap, using rate sensitivity analysis and simulation modelling to assess whether the current level of risk is satisfactory.

Measuring interest-rate risk

Notwithstanding the widespread adoption of VaR as the key market risk measurement tool, funding books such as repo books continue to use the gap report as a key measure of interest-rate risk exposure. This enables ALCO to view the risk sensitivity along the maturity structure. Cumulative gap positions, and the ratio of assets revaluation to liabilities revaluation, are calculated and compared to earnings levels on the current asset/liability position. Generally, the 90-day, six-month and one-year gap positions are the most significant points along the term structure at which interest-rate risk exposure is calculated. The ratio of gap to earnings assets will be set at the ±15% to ±20% level.

As it is a traditional duration-based approach, gap reporting is a static measure that measures risk sensitivity at one specific point in time. It for this reason that banks combine a VaR measure as well, or only use VaR. We discuss the VaR measure in Chapter 17.

Simulation modelling

Simulation modelling is a procedure that measures the potential impact on the banking book, and hence earnings levels, of a user-specified change in interest rates and/or a change in the shape of the book itself. This process enables senior management to gauge the risk associated with particular strategies. Put simply the process is to:

- construct a "base" balance sheet and income statement as the starting point (this is derived from the current shape of the banking book, and any changes expected from current growth trends that have been projected forward);
- assess the impact on the balance sheet of changes under selected scenarios; these might be no change in rates; a 100 basis point and 250 basis point upward parallel shift in the yield curve; a 100 basis point and 250 basis point downward parallel shift; a 25 basis point steepening and flattening of the yield curve, between the three-month and the three-year maturity points; a combination of a parallel shift with a pivotal shift at a selected point; an increase or decrease in three-month T-bill yield volatility levels; and a 20 basis point change in swap spreads;
- compare the difference in earnings resulting from any of the scenarios to the anticipated earnings stream under the current environment.

Generally, the committee will have set guidelines about the significance of simulation results; for example, there may be a rule that a 100 basis point change in interest rates should not impact NII by more than 10%. If results indicate such an impact, ALCO will determine if the current risk strategy is satisfactory or whether adjustments are necessary.

Securitisation

It is common for ALM units in banks to take responsibility for a more proactive balance sheet management role, and *securitisation* is a good example of this. Securitisation is a process undertaken by banks both to realise additional value from assets held on the balance sheet, as well as to remove them from the balance sheet entirely, thus freeing up lending lines. Essentially it involves selling assets on the balance sheet to third-party investors. In principle the process is straightforward, as assets that are sold generate cash flows in the future, which provide the return to investors who have purchased the securitised assets. To control the risk exposure for investors, the uncertainty associated with certain asset cash flows is controlled or re-engineered, and there are a range of ways that this may be done.

For balance sheet management one of the principal benefits of securitisation is to save or reduce capital charges through the sale of assets. The other added benefit of course is that the process generates additional return for the issuing bank; therefore, securitisation is not only a method by which capital charges may be saved, but an instrument in its own right that enables a bank to increase its return on capital.

The securitisation process

For an introduction to asset-backed instruments readers should refer to recent literature such as Fabozzi and Choudhry (2004). In this section we consider the implications of securitisation from the point of view of asset and liability management. The subject is considered in greater detail in Part IV.

The basic principle of securitisation is to sell assets to investors, usually through a medium known as a special purpose vehicle (SPV) or some other intermediate structure, and to provide the investors with a fixed or floating-rate return on the assets they have purchased; the cash flows from the original assets are used to provide this return. It is rare, though not totally unknown, for the investors to buy the assets directly, instead a class of securities is created to represent the assets and the investors purchase these securities. The most common type of assets that are securitised include mortgages, car loans, and credit card loans. However, in theory virtually any asset that generates a cash flow that can be predicted or modelled may be securitised. The vehicle used is constructed so that securities issued against the asset base have a risk-return profile that is attractive to the investors that are being targeted.

To benefit from diversification asset types are usually pooled, and this pool then generates a range of interest payments, principal repayments and principal prepayments. The precise nature of the cash flows is uncertain because of the uncertainty of payment and prepayment patterns, and also because of the occurrence of loan defaults and delays in payment. However, the pooling of a large number of loans means that cash flow fluctuation can be ironed out to a large extent, sufficient to issues notes against. The cash flows generated by the pool of assets are re-routed to investors through a dedicated structure, and a credit rating for the issue is usually requested from one or more of the private credit agencies. Most asset-backed securities carry investment-grade credit ratings, up to triple-A or double-A, mainly because of various credit insurance facilities that are set up to guarantee the bonds. The securitisation structure disassociates the quality of the original cash flows from the quality of the flows accruing to investors. In many cases the original borrowers are not aware that the process has occurred and notice no difference in the way their loan is handled. The credit rating on the securitisation issue has no bearing on the rating of the selling bank and often will be different.

Benefits of securitisation

Securitising assets produces a double benefit for the issuing bank. Those assets which are sold to investors generate a saving in the cost of required capital for the bank, as they are no longer on the balance sheet, so the bank's capital requirement is reduced. Second, if the credit rating of the issued securities is higher than that of the originating bank, there is a potential gain in the funding costs of the bank. For example, if the securities issued are triple-A rated, a double-A-rated bank will have lower funding costs for those securities. The bank benefits from paying a lower rate on the borrowed funds than if it had borrowed those funds directly in the market. This has led to strong growth in, for example, the specialised "credit card" banks in the United States, where banks such as Capital One, First USA and MBNA Bank have benefited from triple-A-rated funding levels and low capital charges. It is doubtful if such banks could have grown as rapidly as they did without securitisation. Although there is a cost associated with securitising assets, which include the direct issue transaction costs and the cost of running the payment structure, these are outweighed by the benefits obtained from the process.

The major benefit of securitisation is reduced funding costs. Several factors influence such costs. These include:

- the lower cost of funds due to the enhanced credit rating of the issued bonds. The extent of this gain is a function of current spreads in the market and the current rating of the originating bank, and will fluctuate in line with market conditions;
- the saving in capital charges obtained from reducing the size of assets on the balance sheet. This decreases the minimum earnings required to ensure an adequate return for shareholders, in effect improving return on capital at a stroke.

The costs of the process include:

- those associated with setting up the issuing structure, and subsequently the payment mechanism that channels cash flows to investors. These costs are a function of the structure and risk of the original assets; the higher the risk of the original assets, the higher the cost of insuring the cash flows for investors;
- the legal costs of origination, plus operating costs and servicing costs.

However, the reduction in funding costs obtained as a result of securitisation should significantly outweigh the cost of the process itself. In order to determine whether a securitisation is feasible, as well as the impact on the return on capital, the originating bank will conduct a cost and benefit analysis prior to embarking on the process. This is frequently the responsibility of the ALM unit.

Example 6.4: Securitisation transaction: Illustration of economics

We illustrate the impact of securitising the balance sheet with a hypothetical example from ABC Bank plc. The bank has a mortgage book of £100 million, and under Basel I the regulatory weight for this asset is 50%. The capital requirement is therefore £4 million (that is, 8% × 0.5% × £100 million). The capital is comprised of equity, estimated to cost 25% and subordinated debt, which has a cost of 10.2%. The cost of straight debt is 10%. The ALM desk reviews a securitisation of 10% of the asset book, or £10 million. The loan book has a fixed duration of 20 years, but its effective duration is estimated at seven years, due to refinancings and early repayment. The net return from the loan book is 10.2%.

The ALM desk decides on a securitised structure that is made up of two classes of security, subordinated notes and senior notes. The subordinated notes will be granted a single-A rating due to their higher risk, while the senior notes are rated triple-A. Given such ratings the required rate of return for the subordinated notes is 10.61%, and that of the senior notes is 9.80%. The senior notes have a lower cost than the current balance sheet debt, which has a cost of 10%. To obtain a single-A rating, the subordinated notes need to represent at least 10% of the securitised amount.

The costs associated with the transaction are the initial cost of issue and the yearly servicing cost, estimated at 0.20% of the securitised amount. The summary information is given at Table 6.7.

Table 6.7 ABC Bank plc mortgage loan book and securitisation proposal

ABC Bank plc	
Current funding	
Cost of equity	25%
Cost of subordinated debt	10.20%
Cost of debt	10%
Mortgage book	
Net yield	10.20%
Duration	7 years
Balance outstanding	100 million
Proposed structure	
Securitised amount	10 million
Senior securities:	
Cost	9.80%
Weighting	90%
Maturity	10 years
Subordinated notes:	
Cost	10.61%
Weighting	10%
Maturity	10

Maturity	10 years
Servicing costs	0.20%

A bank’s cost of funding is the average cost of all the funds it employed. The funding structure in our example is capital 4%, divided into 2% equity at 25%, 2% subordinated debt at 10.20%, and 96% debt at 10%. The weighted funding cost *F* therefore is:

$$F_{\text{balance sheet}} = 96\% \times 10\% + ((8\% \times 50\%) \times (25\% \times 50\%) + (10.20\% \times 50\%)) = 10.30\%.$$

This average rate is consistent with the 25% before-tax return on equity given at the start. If the assets do not generate this return, the received return will change accordingly, since it is the end result of the bank’s profitability. As currently the assets generate only 10.20%, they are currently performing below shareholder expectations. The return actually obtained by shareholders is such that the average cost of funds is identical to the 10.20% return on assets. We may calculate this return to be:

$$\text{Asset return} = 10.20\% = (96\% \times 10\%) + 8\% \times 50\% \times (ROE \times 50\% + 10.20\% \times 50\%).$$

Solving this relationship we obtain an ROE of 19.80%, which is lower than shareholder expectations. In theory the bank would find it impossible to raise new equity in the market because its performance would not compensate shareholders for the risk they are incurring by holding the bank’s paper. Therefore any asset that is originated by the bank would have to be securitised, which would also be expected to raise the shareholder return. The ALM desk proceeds with the securitisation, issuing £9 million of the senior securities and £1 million of the subordinated notes. The bonds are placed by an investment bank with institutional investors. The outstanding balance of the loan book decreases from £100 million to £90 million. The weighted assets are therefore £45 million. Therefore the capital requirement for the loan book is now £3.6 million, a reduction from the original capital requirement of £400,000, which can be used for expansion in another area, a possible route for which is given in Table 6.8.

Table 6.8 Impact of securitisation on the balance sheet

Outstanding balances	Value (£m)	Capital required (£m)
Initial loan book	100	4
Securitised amount	10	0.4
Senior securities	9	Sold
Subordinated notes	1	Sold
New loan book	90	3.6
Total asset	90	
Total weighted assets	45	3.6

The benefit of the securitisation is the reduction in the cost of funding. The funding cost as a result of securitisation is the weighted cost of the senior notes and the subordinated notes, together with the annual servicing cost. The cost of the senior securities is 9.80%, while the subordinated notes have a cost of 10.61% (for simplicity here we ignore any differences in the duration and amortisation profiles of the two bonds). This is calculated as:

$$(90\% \times 9.80\%) + (10\% \times 10.61\%) + 0.20\% = 10.08\%.$$

This overall cost is lower than the target funding cost obtained direct from the balance sheet, which was 10.30%. This is the quantified benefit of the securitisation process. Note that the funding cost obtained through securitisation is lower than the yield on the loan book. Therefore the original loan can be sold to the SPV structure, issuing the securities for a gain.

Appendix

Appendix 6.1: NPV and Value-at-Risk (VaR)

The NPV of a banking book is an appropriate target of interest-rate policy because it captures all future cash flows and is equal to the discounted value of future margins when the discount rate is the cost of all debt. The sensitivity of the NPV is derived from the duration of the assets and liabilities. Therefore we may write the change in NPV as below:

(A6.1.1) $$\frac{\Delta NPV}{\Delta r} = \left(\frac{1}{(1+r)}\right)(-D_A MV_A + D_L MV_L)$$

where D_A is the duration of assets and MV_A is the market value of assets. (A6.1.1) is applicable when only one interest rate is used for reference. The sensitivity with respect to the interest rate r is known. It is then possible to derive the VaR from these simple relationships above. With one interest rate we are interested in the maximum variation of the NPV that results from a change in the reference interest rate. The volatility of the NPV can be derived from its sensitivity and from the interest-rate volatility. If we set S_r as the sensitivity of the NPV with respect to the interest rate r, the volatility of the NPV is given by:

(A6.1.2) $$\sigma(NPV) = S_r \times \sigma(r).$$

Once the volatility is known, the maximum change at a given confidence level is obtained as a multiple of the volatility. The multiple is based on assumptions with respect to the shape of the distribution of interest rates. Under a curve of the normal distribution, a multiple of 1.96 provides the maximum expected change at a 2.5% two-tailed confidence level, so that we are able to say that the VaR of the book is as given by:

(A6.1.3) $$\text{VaR} = 1.96 \times S_r \times \sigma(r).$$

Where there is more than one interest rate, the variation of the NPV can be approximated as a linear combination of the variations due to a change of each interest rate. This is written as:

(A6.1.4) $$NPV = S_r \times \Delta r + S_s \times \Delta s + S_t \times \Delta t + L$$

where *r, s* and *t* are the different interest rates. Since all interest rate changes are uncertain, the volatility of the NPV is the volatility of a sum of random variables. Deriving the volatility of this sum requires assumptions on correlations between interest rates.

This problem is identical to the general problem of measuring the market risk of a portfolio when bearing in mind that its change in market value arises as a result of changes generated by the random variations of market parameters. The main concern is to calculate the volatility of the mark-to-market value of the portfolio, expressed as the sum of the random changes of the mark-to-market values of the various individual transactions. These random changes can be interdependent, in the same way that the underlying market parameters are. The volatility of the value of the portfolio depends upon the sensitivities of individual transactions, upon the volatilities of the individual market parameters and also upon their interdependency, if any exists. The methodology that calculates this volatility is known as *delta-VaR*. This is based on the delta sensitivity of the portfolio to changes in market interest rates.

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[1] In this chapter the term *liquidity* is used to refer to funding liquidity.

[2] *The Economist*, 30 October 1999.

[3] For instance, in the US banking sector the terms on deposit accounts were fixed by regulation, and there were restrictions on the geographic base of customers and the interest rates that could be offered. Interest-rate volatility was also low. In this environment, ALM consisted primarily of asset management, in which the bank would use depositors’ funds to arrange the asset portfolio that was most appropriate for the liability portfolio. This involved little more than setting aside some of the assets in non-interest reserves at the central bank authority and investing the balance in short-term securities, while any surplus outside of this would be lent out at very short-term maturities.

[4] The marketability definition of liquidity is also important in ALM. Less liquid financial instruments must offer a yield premium compared to liquid instruments.

[5] Or, is proved to be correct at least three times out of five!

[6] This describes a *barbell* structure, but this is really a bond market term.

[7] This assumes a conventional upward-sloping yield curve.

[8] This is the UK Financial Services Authority, which was established as a “super regulator” for all financial market activities in 2000, through a merger of all the industry-specific regulatory authorities.

CHAPTER 10

The Determinants of the Swap Spread and Understanding the Term Premium

In the previous chapter we looked in detail at the yield curve. An important hedging tool in ALM operations is the interest-rate swap, which is described in detail in Chapter 14. In this chapter, we consider an important issue for interest-rate analysis, the swap spread. Specifically, we look at the spread of the swap curve over the government bond yield curve and the relationship between the two yield curves. This subject is important because the swap spread is an indicator value in the market, as well as an indicator of the overall health of the economy. Understanding the determinants of the swap spread is important for ALM practitioners for this reason.

In the second part of this chapter we look at a related area: the magnitude of the term premium. Given "normal" market conditions, what should the extent of the term premium of the (under normal conditions positively sloping) yield curve be? We also consider the impact of macro-level geopolitical factors on the swap spread.

The determinants of the swap spread

Interest-rate swaps, which are described in Chapter 14, are an important ALM and risk management tool in banking markets. The rate payable on a swap represents bank risk, if we assume that a swap is paying (receiving) the fixed swap rate on one leg and receiving (paying) Libor-flat on the other leg. If one of the counterparties is not a bank, then either leg is adjusted to account for the different counterparty risk; usually the floating leg will have a spread added to Libor. We can see that this produces a swap curve that lies above the government bond yield curve, if we compare Figure 10.1 with Figure 10.2. Figure 10.1 is the USD swap rates page from Tullett & Tokyo brokers, and Figure 10.2 is the US Treasury yield curve, both as at 3 July 2006. The higher rates payable on swaps represents the additional risk premium associated with bank risk compared to government risk. The spread itself is the number of basis points the swap rate lies above the equivalent-maturity government bond yield, quoted on the same interest basis.

Figure 10.1 Tullet & Tokyo brokers USD interest-rate swaps page on Bloomberg, as at 3 July 2006

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10:10 **TULLETT & TOKYO** PAGE 1 / 2

USD Swaps	Bid	Ask	Time	USD Swaps	Bid	Ask	Time
IMM SWAPS				19) 15 Year	5.7380	5.7780	1:46
1) 1st	5.6900	5.7100	10:08	20) 20 Year	5.8060	5.8460	1:46
2) 2nd	5.6580	5.6790	10:08	21) 25 Year	5.8080	5.8490	3:02
3) 3rd	5.6150	5.6350	10:10	22) 30 Year	5.7740	5.8150	1:46
4) 4th	5.5800	5.6000	10:01	SEMI-ANNUAL SWAPS			
ANNUAL SWAPS				23) 2 Year	5.6310	5.6710	7/03
5) 1 Year	5.6770	5.6970	9:36	24) 3 Year	5.6120	5.6520	7/03
6) 2 Year	5.6240	5.6650	7/03	25) 4 Year	5.6210	5.6610	7:16
7) 3 Year	5.6070	5.6480	7/03	26) 5 Year	5.6410	5.6810	0:01
8) 4 Year	5.6180	5.6590	7:16	27) 6 Year	5.6600	5.7000	0:01
9) 5 Year	5.6390	5.6790	0:01	28) 7 Year	5.6770	5.7170	0:01
10) 6 Year	5.6560	5.6970	0:01	29) 8 Year	5.6910	5.7310	0:01
11) 7 Year	5.6740	5.7150	0:01	30) 9 Year	5.7080	5.7480	0:01
12) 8 Year	5.6890	5.7300	0:01	31) 10 Year	5.7270	5.7670	7:40
13) 9 Year	5.7070	5.7470	0:01	32) 11 Year	5.7370	5.7770	0:01
14) 10 Year	5.7250	5.7650	7:40	33) 12 Year	5.4570	5.4970	1:46
15) 11 Year	5.7350	5.7760	0:01	34) 13 Year	5.7620	5.8020	0:01
16) 12 Year	5.4520	5.4920	1:46	35) 14 Year	5.7720	5.8120	0:01
17) 13 Year	5.7610	5.8020	0:01	LIVE Treasury Mid-Yields &			
18) 14 Year	5.7700	5.8110	0:01	Treasury Swap Spreads -> SMKR<GO>			

Figure 10.2 US Treasury yield curve as at 3 July 2006

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YIELD CURVE – US TREASURY ACTIVES Page 2/2

DATE 7/ 4/06

	DESCRIPTION	PRICE	SRC	UPDATE	YIELD	HEDGED YIELD
3MO	1) B 0 09/28/06	B 4.8900	BGN	4:00	5.0158	5.0158
6MO	2) B 0 12/28/06	B 5.0700	BGN	4:00	5.2711	5.2711
1YR	3)					
2YR	4) T 5 1/8 06/30/08	B 99.9063	BGN	4:00	5.1748	5.1748
3YR	5) T 4 7/8 05/15/09	B 99.2969	BGN	4:00	5.1400	5.1400
4YR	6)					
5YR	7) T 5 1/8 06/30/11	B100.0625	BGN	4:00	5.1104	5.1104
6YR	8)					
7YR	9)					
8YR	10)					
9YR	11)					
10YR	12) T 5 1/8 05/15/16	B 99.7813	BGN	4:00	5.1527	5.1527
15YR	13)					
20YR	14)					
30YR	15) T 4 1/2 02/15/36	B 89.4531	BGN	4:00	5.2017	5.2017
1MO	16) B 0 07/27/06	B 4.5500	BGN	4:00	4.6261	4.6261

To change price source for securities, use <FMPS>.

To change price source for swaps, use <XDF>.

Yields are based on STANDARD settlement and are Conventional

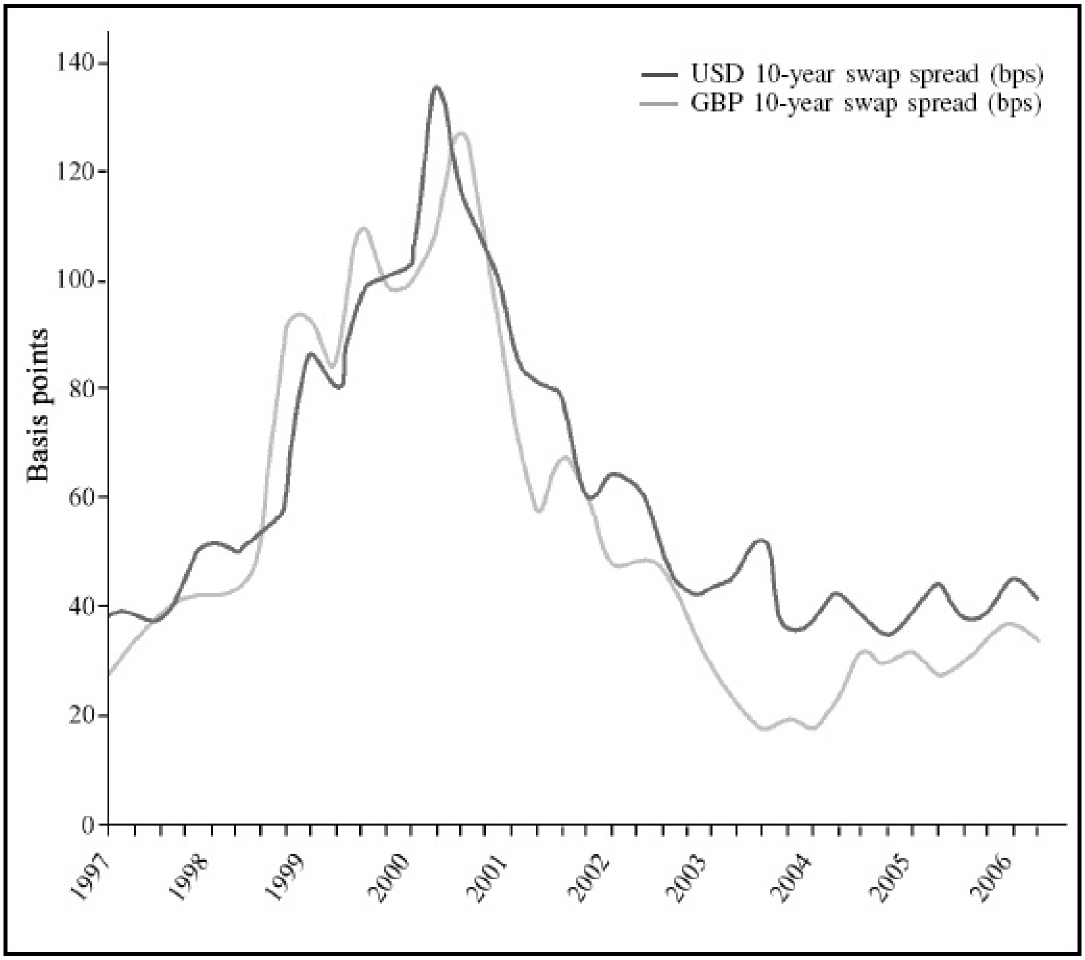
In theory, the swap spread represents only the additional credit risk of the interbank market above the government market. However, as the spread is variable, it is apparent that other factors influence it. An ALM desk will want to be aware of these factors, because they influence swap rates. Swaps are an important risk hedging tool, if not the most important, for banks so it becomes necessary for practitioners to have an appreciation of what drives swap spreads.

Historical pattern

If we plot swap spreads over the last ten years, we note that they have tightened in the last five years or so. Figure 10.3 on page 454 shows the spread for USD and GBP for the period 1997 to the first quarter of 2006.

Figure 10.3 USD and GBP interest-rate swap spreads over government curve, 1997–2006

Yield source: Bloomberg L.P.



We see that spreads have reduced in recent years. The highest spread for both currencies was reached during 2000, when the 10-year sterling swap spread peaked at around 140 basis points above the gilt yield. The tightest spreads were reached during 2003, when the 10-year sterling spread reached around 15 basis points towards the end of that year. At the beginning of 2006 sterling spreads were still lower than the 10-year average of 55 basis points. This implies that the perceived risk premium for the capital markets has fallen.

Note how the change in spread levels coincides with macro-level factors and occurrences. For instance, spreads have moved in line with:

- the Asian currency crisis of 1997;
- the Russian government bond default and collapse of the Long Term Capital Management (LTCM) hedge fund in 1998;
- the "dot.com" crash in 2000;
- the subsequent loosening of monetary policy after the dot.com crash and the events of 9/11.

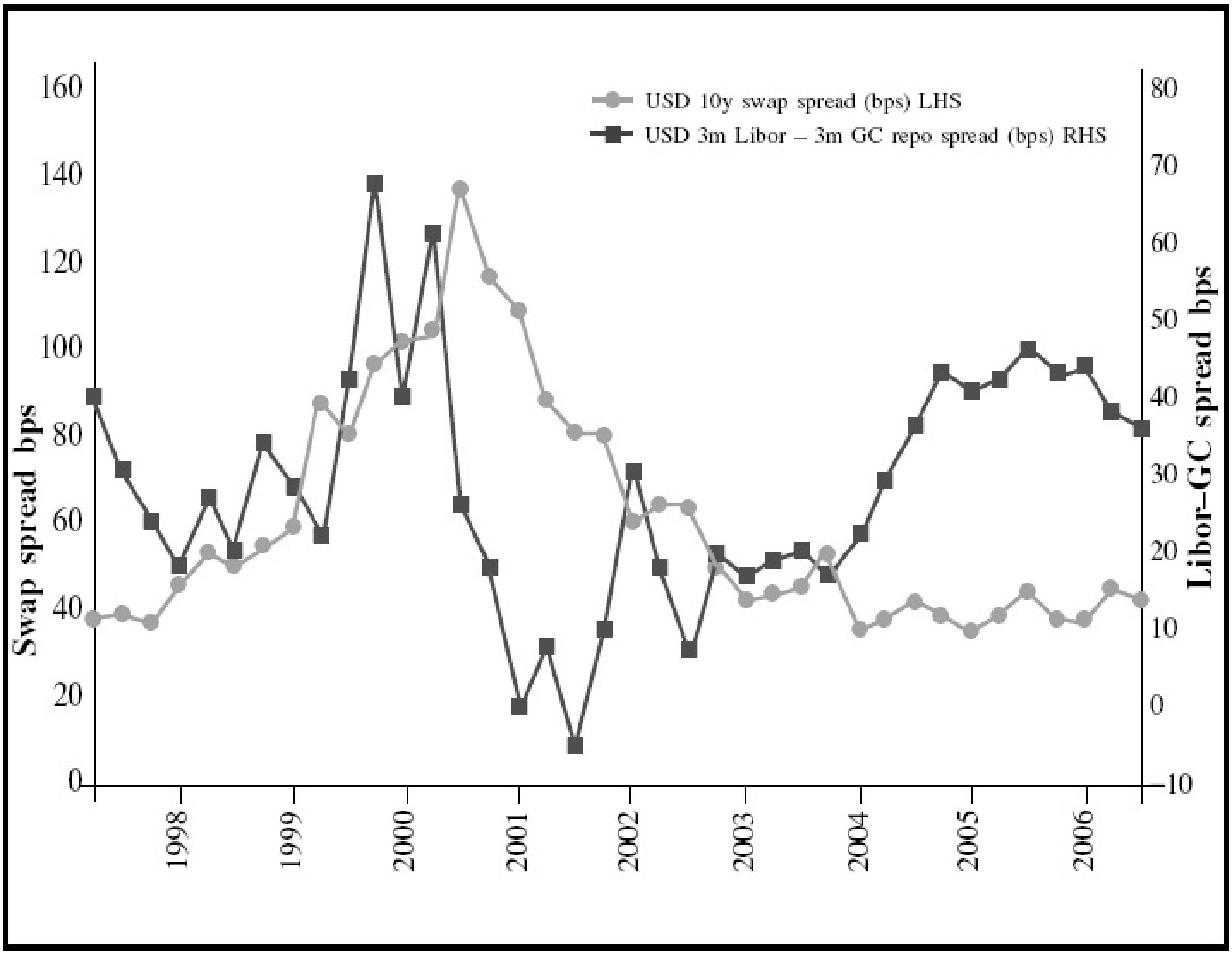
This indicates to us, if just superficially, that swap spreads react to macro-level factors that are perceived by the market to affect their business risk, credit risk and liquidity risk. Spreads also reflect supply and demand, as well as the absolute level of base interest rates.

Determinants of the spread

We have already noted that in theory the swap spread, representing interbank counterparty risk, should reflect only the market's perception of bank risk over and above government risk. Bank risk is captured in the Libor rate – the rate paid by banks on unsecured deposits to other banks.[1] So in other words, the swap spread is meant to adequately compensate against the risk of bank default. The Libor rate is the floating-rate paid against the fixed rate in the swap transaction, and moves with the perception of bank risk. As we implied in the previous section though, it would appear that other factors influence the swap spread. We can illustrate this better by comparing the swap spread for 10-year quarterly paying swaps with the spread between 3-month Libor and the 3-month general collateral (GC)) repo rate. The GC rate is the risk-free borrowing rate, whereas the Libor rate represents bank risk again. In theory, the spread between 3-month Libor and the GC rate should therefore move closely with the swap spread for quarterly resetting swaps, as both represent bank risk. A look at Figure 10.4 on page 456 shows us that this is not the case. Figure 10.4 compares the two spreads in the US dollar market, but we do not need to calculate the correlation or the R^2 for the two sets of numbers. Even on cursory observation we can see that the correlation is not high. Therefore we conclude that other factors, in addition to perceived bank default risk, drive one or both spreads. These other factors influence swap rates and government bond yields, and hence the swap spread, and we consider them below.

Figure 10.4 Comparison of USD 10-year swap spread and 3-month Libor-GC repo spread

Yield source: Bloomberg L.P.



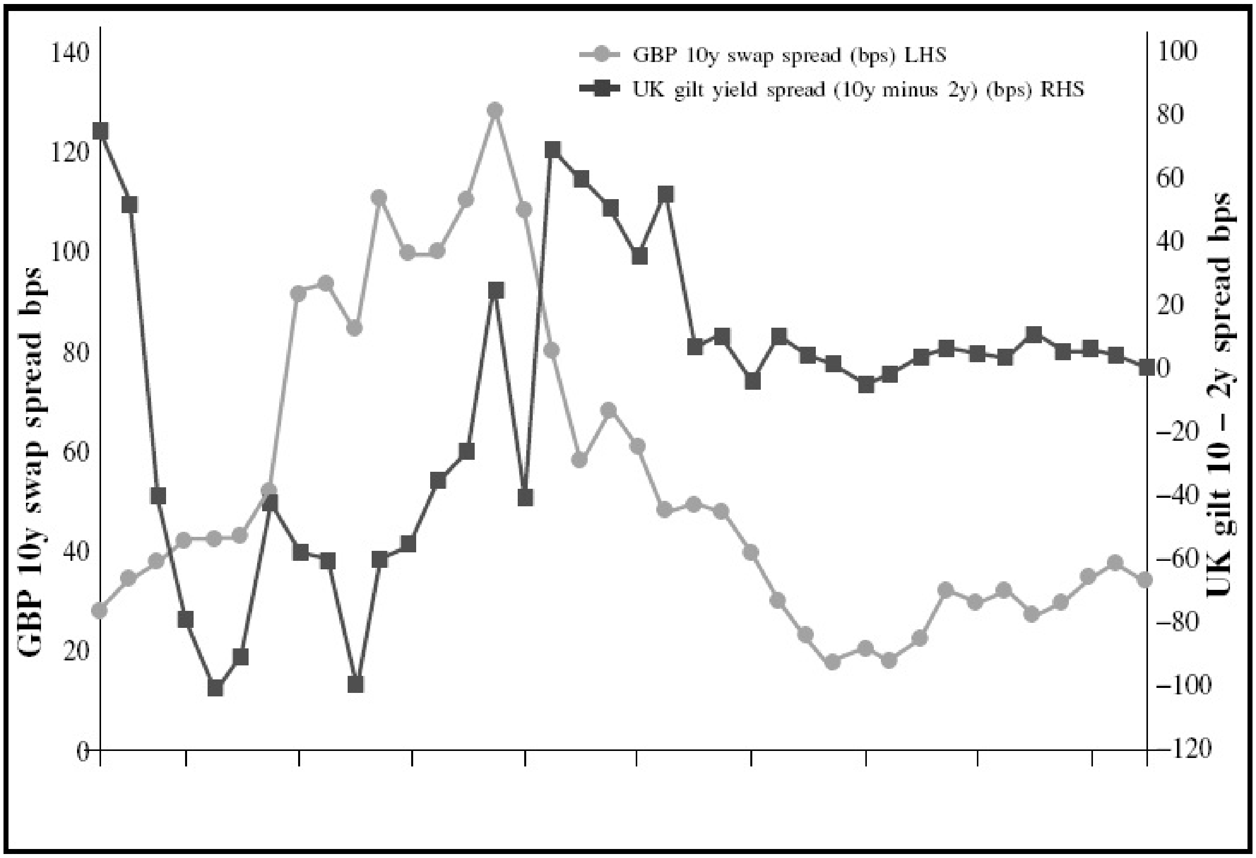
Level and slope of the yield curve

The magnitude of the swap spread is influenced by the absolute level of base interest rates. If the base rate is 10%, so that the government short-term rate is around 10%, with longer-term rates being recorded higher, the spread tends to be greater than that seen if the base rate is 5%. The shape of the yield curve has even greater influence. When the curve is positively sloping, under the expectations hypothesis (see Chapter 9) investors will expect future rates to be higher; hence, floating-rates are expected to rise. This would suggest the swap spread will narrow. The opposite happens if the yield curve inverts.

Figure 10.5 shows the GBP 10-year swap spread compared to the GBP gilt yield curve spread (10-year gilt yield minus 2-year yield). We see that the slope of the curve has influenced the swap spread; as the slope is narrowing, swap spreads are increasing and vice-versa.

Figure 10.5 GBP swap spreads and gilt spreads compared 1997–2006

Yield source: Bloomberg L.P.



Supply and demand

The swap spread is influenced greatly by supply and demand for swaps. For example, greater trading volume in cash market instruments increases the need for hedging instruments, which will widen swap spreads. The best example of this is corporate bond issuance; as volumes increase, the need for underwriters to hedge issues increases. However, greater bond issuance also has another impact, as issuers seek to swap their fixed-rate liabilities to floating-rate. This also increases demand for swaps.

Market volatility

As suggested by Figure 10.3, swap spreads widen during times of market volatility. This may be in times of market uncertainty (for example, the future direction of base rates or possible inversion of the yield curve) or in times of market shock such as 9/11. In some respects spread widening during periods of volatility reflects the perception of increased bank default risk. It also reflects the "flight to quality" that occurs during times of volatility or market correction: this is the increased demand for risk-free assets such as government bonds that drives their yields lower and hence swap spreads wider.

Government borrowing

The level of government borrowing influences government bond yields, so perforce it will also impact swap spreads. If borrowing is viewed as being in danger of getting out of control, or the government runs persistently large budget deficits, government bond yields will rise. All else being equal, this will lead to narrowing swap spreads.

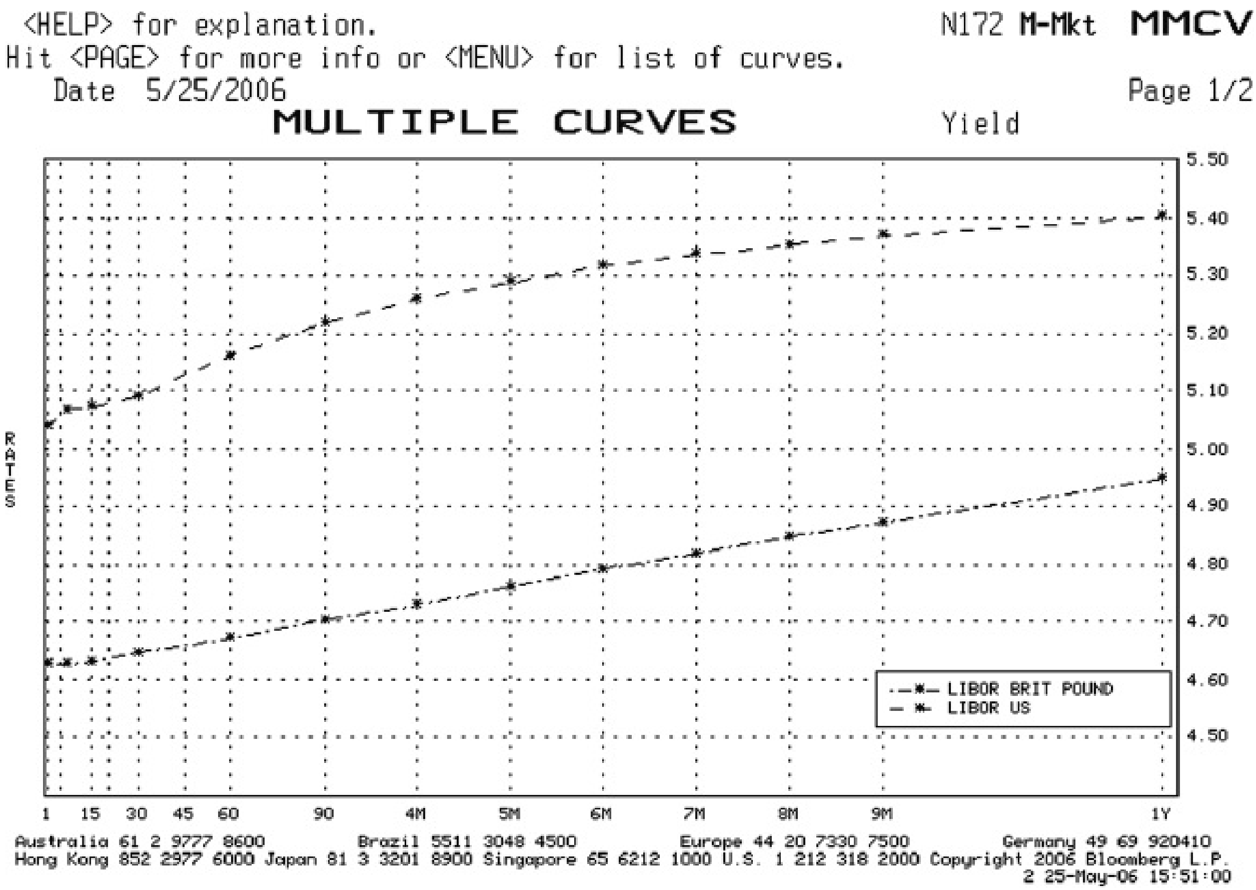
We can see then that a number of factors influence swap spreads. An ALM or Treasury desk should be aware of these and assess them because the swap rate represents a key funding and hedging rate for a bank.

The term premium

The magnitude of the term premium

From our reading of Chapter 9 we know that a positively sloping yield curve is to be expected under transparent, liquid market conditions. A combination of the expectations hypothesis, the liquidity premium and the inflation premium explains why this is so; longer-dated assets yield a higher return than shorter-dated assets. Thus in most circumstances we expect the one-month rate to be higher than the one-week rate, and the three-month rate to be higher than both the one-week and the one-month rates. This is confirmed in Figure 10.6, which shows the Libor curves for USD and sterling on 25 May 2006.

Figure 10.6 USD and GBP curves in Bloomberg; as at 25 May 2006



We expect that the rate on a longer term will be higher than that on a shorter-term, unless we have an inverted yield curve. This is because under most circumstances lenders demand a higher return for longer-dated loans as compensation for the increased inflation and credit risk exposure of longer-dated assets. But what should the magnitude of this term premium be? By how much more should a three-month deposit pay compared to a one-month deposit?

The answer to this question is not fixed, and is a function of a number of factors. In a developed economy that is not subject to high inflation, the most important of these factors is probably future interest-rate expectations. If we allow for this factor, we can conclude that a reasonable term premium under “normal” market conditions for the three-month rate compared to the central bank base rate is in the order of between 12 and 20 basis points. We choose the three-month rate because it is traded on a liquid futures contract (the Eurodollar and short-sterling contracts for USD and GBP respectively and the Euribor contract for the euro) and so we can analyse the market’s forward rate expectations for this tenor deposit. But the basic principles will apply to any maturity. Of course, there is no such thing as a “normal” market condition, the term premium will fluctuate daily and always reflect the interaction of a number of factors.

Illustration

On 25 May 2005 we observe the following rates for USD:

Fed funds rate (overnight):	3.00%
Three-month Libor fix:	3.31%.

The three-month rate is 31 basis points above the overnight rate.

The same rates for pounds sterling are:

BoE base rate:	4.75%
Three-month Libor fix:	4.87%.

The three-month rate here is at a much lower spread, only 12 basis points.

Fast-forwarding one year later to 25 May 2006, we observe the following rates:

Fed funds rate (overnight):	5.00%
Three-month Libor fix:	5.22%

BoE base rate:	4.50%
Three-month Libor fix:	4.705%.

The spreads here are 22 basis points for USD and 20.5 basis points for sterling.

We need to look at market expectations for an explanation of these term premiums. In May 2005 the market was expecting a continuation of the gradual, "measured"[2] interest raises, in clips of 25 basis points, at each meeting of the Federal Reserve.[3] This is reflected in the positively sloping yield curve for USD money markets, as shown in Figure 10.7. It is confirmed in Figure 10.8, a graph of the Fed Funds rate for the period May 2005–May 2006, which shows that the rate was moved upwards by 25 basis points at every Fed meeting up until the one on 10 May 2006, which raised the rate to 5.00%. Lenders will require the premium to reflect the expectations of higher interest rates – hence the three-month term premium in May 2005 was 31 basis points. Figure 10.9 on page 462 shows the USD three-month Libor rate history for the same period.

Figure 10.7 Positively sloping USD money market curves, as at 25 May 2006

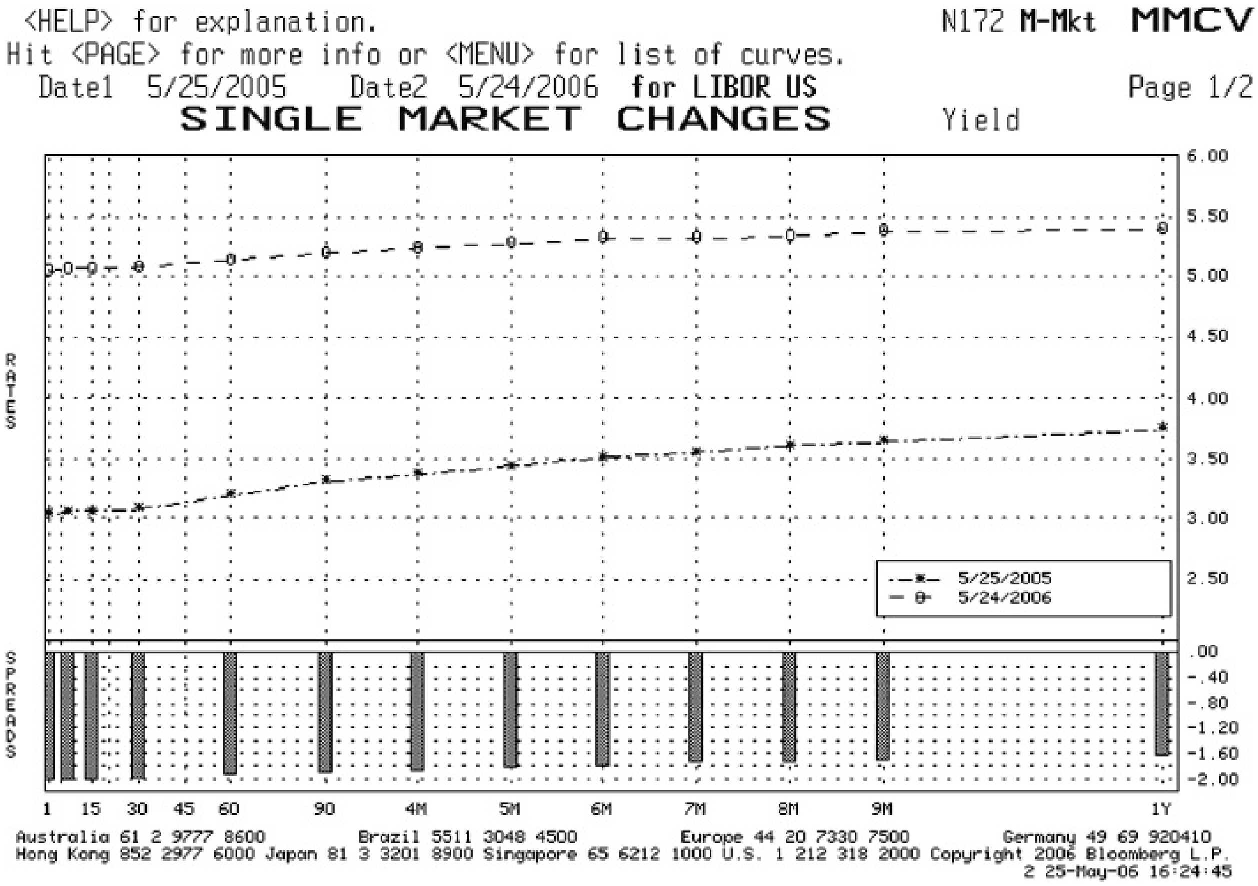


Figure 10.8 Fed Funds rate for May 2005–May 2006

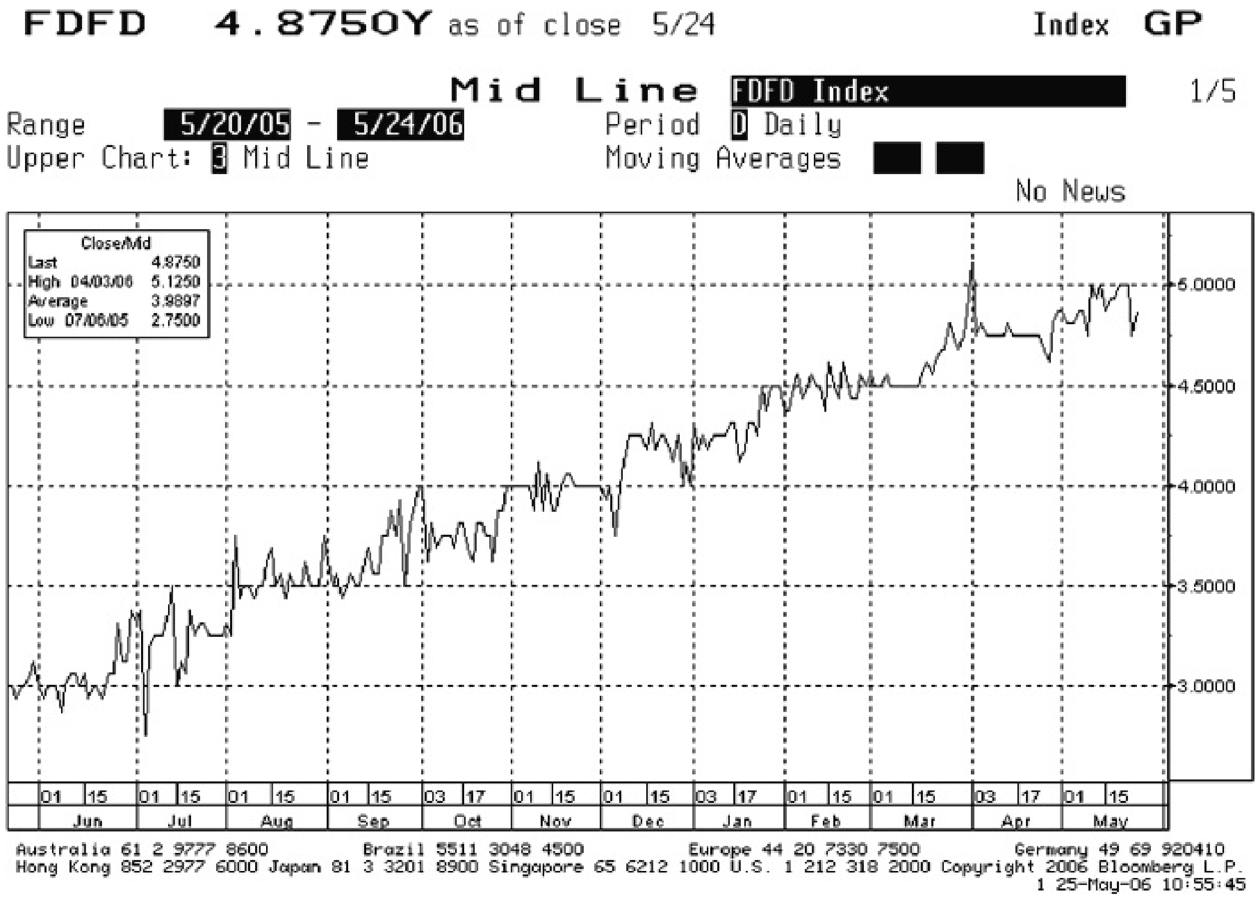


Figure 10.9 USD 3-month Libor rate, May 2005–May 2006

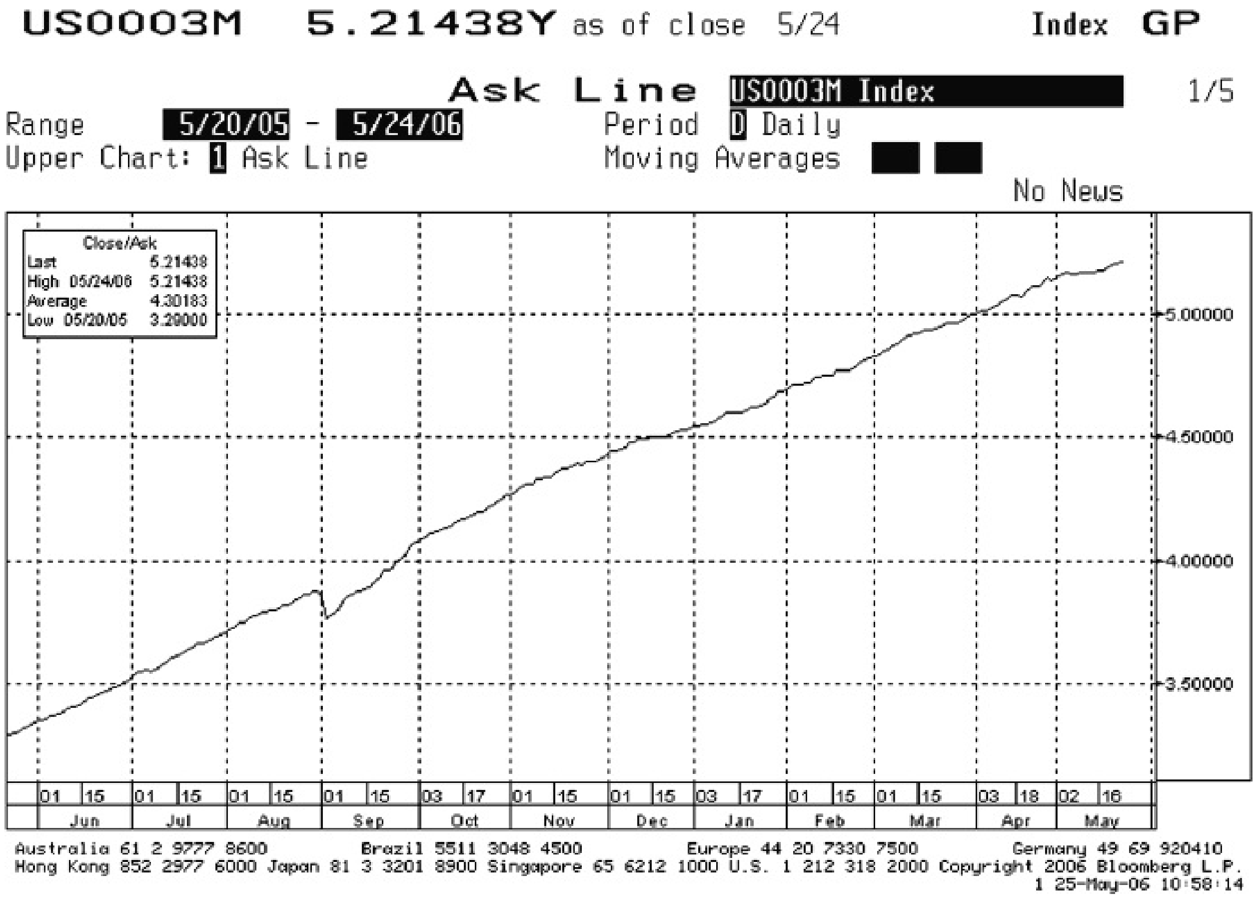


Figure 10.10 FOMC rate-setting history, 2005–2006

FOMC N172 n Govt FOMC

FOMC ANNOUNCEMENT DATES

Historical Change In Monetary Policy and Yield Curve Reaction

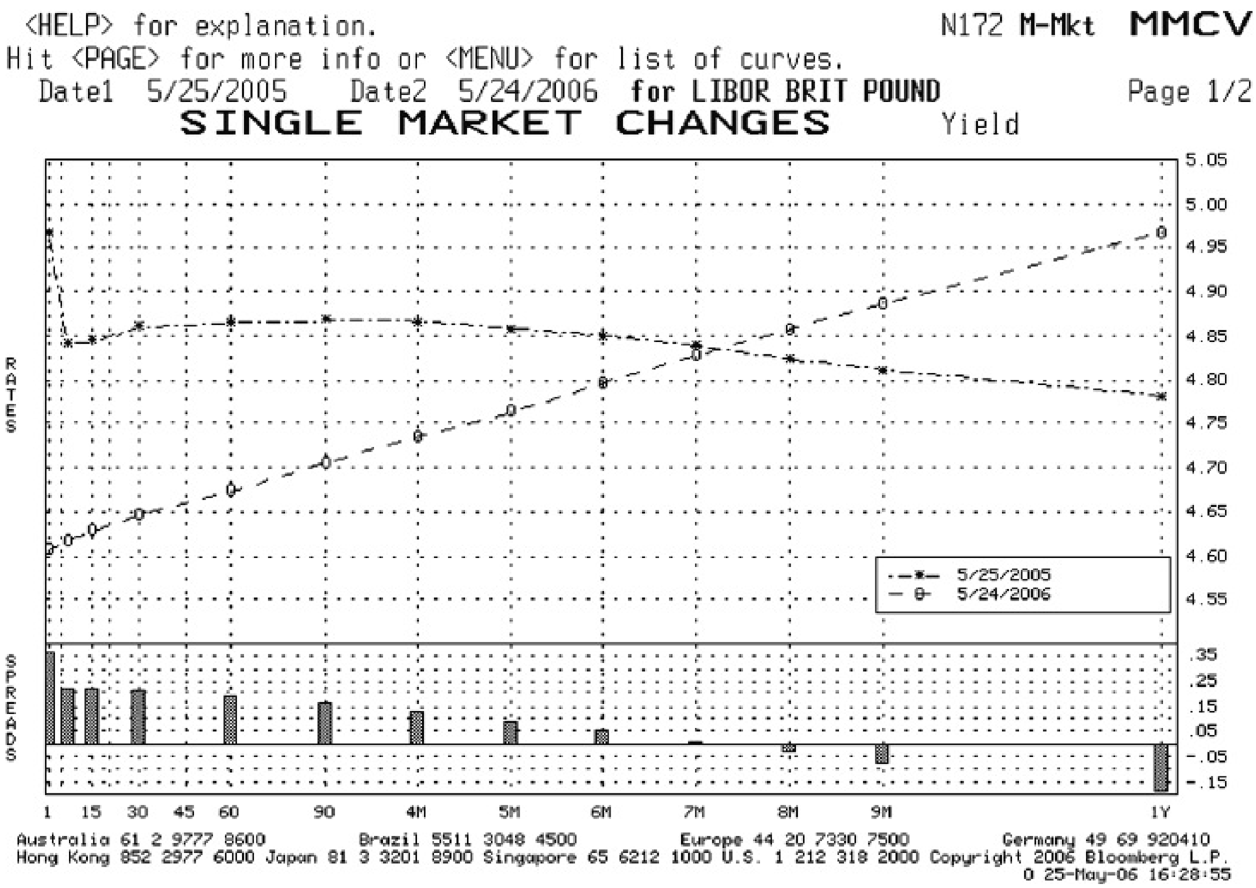
	2005 FOMC Schedule of Meetings					2006 FOMC Schedule of Meetings			
	Date	Rate %	Risk Assessment (Growth/Prices)	Time		Date	Rate %	Risk Assessment (Growth/Prices)	Time
	Start	2.25	Balanced			Start	4.25		
1)	Feb 02	2.50	Balanced	2:17	9)	Jan 31	4.50	Balanced	2:14
2)	Mar 22	2.75	Balanced	2:17	10)	Mar 28	4.75	Balanced	2:17
3)	May 03	3.00	Balanced	2:16	11)	May 10	5.00	Data Dependent	2:17
4)	Jun 30	3.25	Balanced	2:15	12)	Jun 29	-.--		-:--
5)	Aug 09	3.50	Balanced	2:17	13)	Aug 08	-.--		-:--
6)	Sep 20	3.75	Balanced	2:17	14)	Sep 20	-.--		-:--
7)	Nov 01	4.00	Balanced	2:18	15)	Oct 24	-.--		-:--
8)	Dec 13	4.25	Balanced	2:13	16)	Dec 12	-.--		-:--

Other Fed Related Options and Functions

17) US TREASURIES DAILY YIELD CURVE
18) 2000-2006 FOMC STATEMENTS
19) 1996-2006 FOMC MINUTES RELEASES
20) FEDERAL RESERVE <FOMC> WEBSITE
21) FED SPEECH CALENDAR
22) HISTORICAL RATES AND BIAS
23) FED FUNDS FUTURES
24) TOP FED NEWS - FEDU <GO>
25) FOMC DESCRIPTION - FOMM <GO>
26) CENTRAL BANK RATES - CBRT <GO>
* CLICK ON ANNOUNCEMENT FOR CORRESPONDING SURVEY

Contrast the situation with pound sterling. In May 2005, the prevailing market sentiment was that the next move in base rates would be downwards. This is shown in the money market yield curve for 25 May 2005, which shows an inverted curve at Figure 10.11.

Figure 10.11 GBP money market curves, 2005–2006



Note that the curve slopes gently upwards before then inverting, implying that the market expected the cut in rates to be in a period more than three months from now. However, the term premium was only 12 basis points, reflecting the negative curve. Figures 10.12 and 10.13 show the rates histories for the BoE base rate and GBP three-month Libor.

Figure 10.12 GBP base rate history, May 2005-May 2006

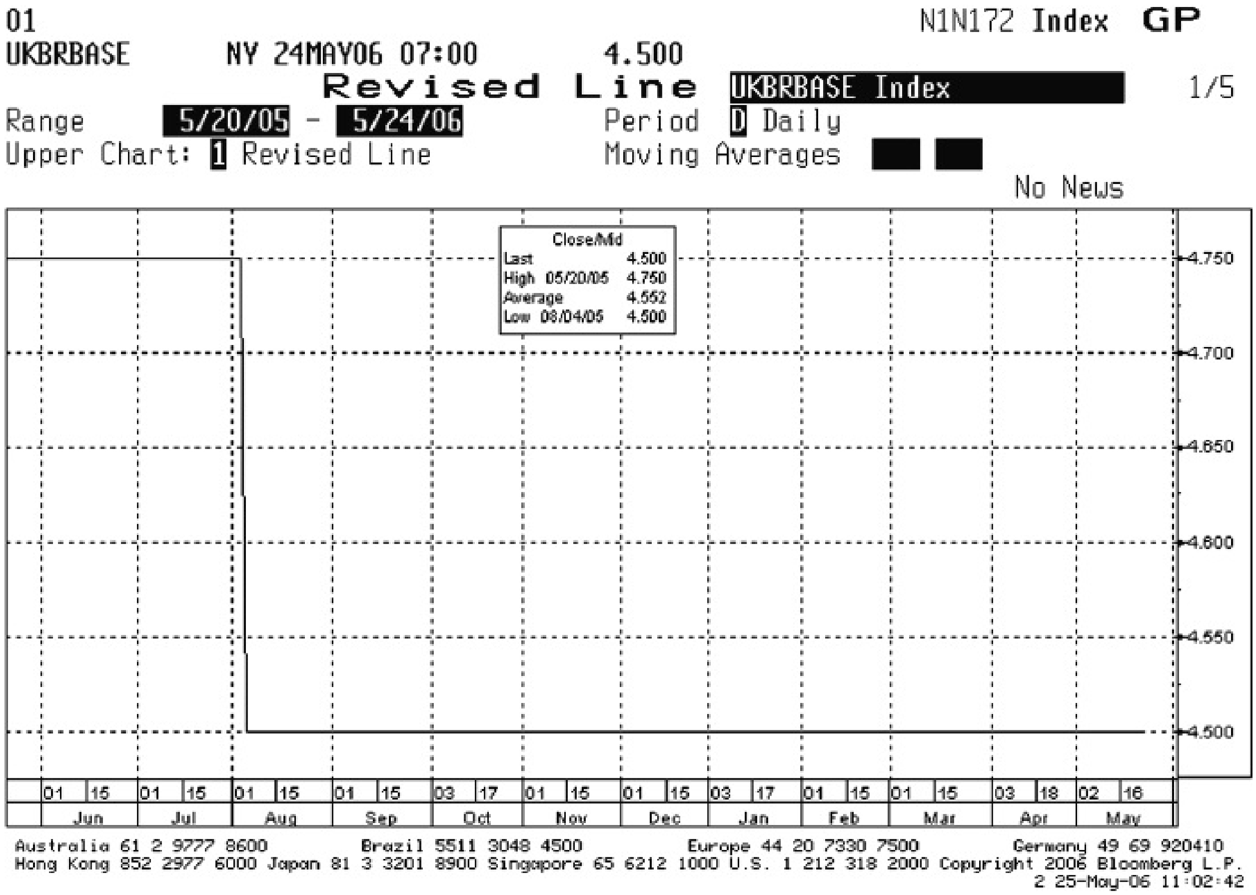


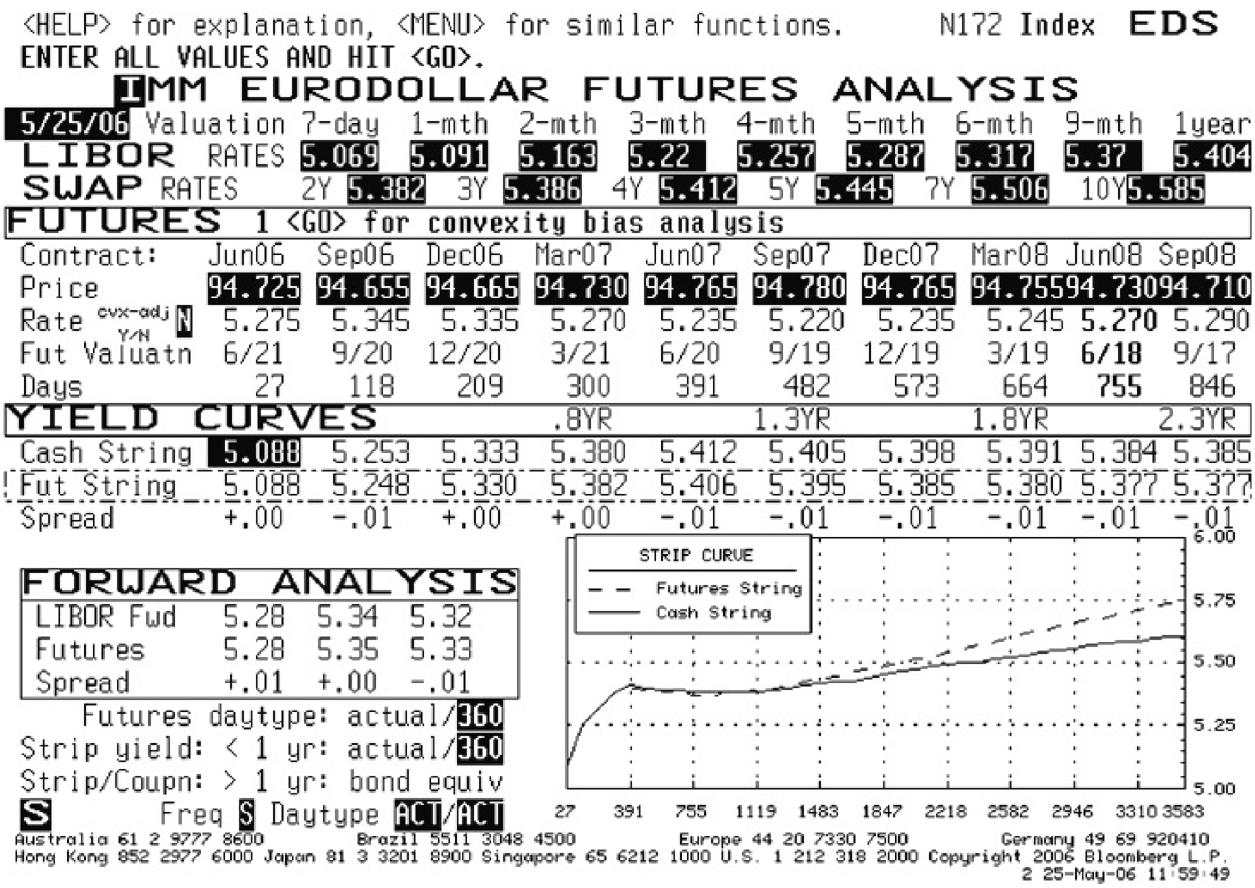
Figure 10.13 GBP 3-month Libor history, May 2005-May 2006

So we see that the term premium reflects the market expectations of future rates, and in an environment where the expectations are for higher rates the premium will be higher. The opposite applies where the expectation is for lower base rates.

This begs the question, what should the term premium be in a “neutral” interest-rate environment. That is, what should a lender demand for term funds lent out when the market does not expect rates to be stable over the next 12 months and not move up or down?

We can look at the 90-day money futures contracts for an idea of when this is the case. In May 2006, the outlook for base rates in USD and GBP was fairly stable. In the United States, the consenus was that rates would either top out at 5.00% or be raised one more time to 5.25% at the 29 June 2006 FOMC meeting. This is shown by the Eurodollar curve, which gives us the market expecations for forward 3-month deposit rates. Figure 10.14 shows the Eurodollar curve as at 25 May 2006.

Figure 10.14 Eurodollars futures curve, as at 25 May 2006



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ENTER ALL VALUES AND HIT <GO>.

IMM EURODOLLAR FUTURES ANALYSIS

5/25/06	Valuation	7-day	1-mth	2-mth	3-mth	4-mth	5-mth	6-mth	9-mth	1year
LIBOR	RATES	5.069	5.091	5.163	5.22	5.257	5.287	5.317	5.37	5.404

SWAP RATES 2Y 5.382 3Y 5.386 4Y 5.412 5Y 5.445 7Y 5.506 10Y 5.585

FUTURES 1 <GO> for convexity bias analysis

Contract:	Jun06	Sep06	Dec06	Mar07	Jun07	Sep07	Dec07	Mar08	Jun08	Sep08
Price	94.725	94.655	94.665	94.730	94.765	94.780	94.765	94.755	94.730	94.710
Rate cvx-adj Y/N N	5.275	5.345	5.335	5.270	5.235	5.220	5.235	5.245	5.270	5.290
Fut Valuatn	6/21	9/20	12/20	3/21	6/20	9/19	12/19	3/19	6/18	9/17
Days	27	118	209	300	391	482	573	664	755	846

YIELD CURVES				.8YR		1.3YR		1.8YR		2.3YR
Cash String	5.088	5.253	5.333	5.380	5.412	5.405	5.398	5.391	5.384	5.385
Fut String	5.088	5.248	5.330	5.382	5.406	5.395	5.385	5.380	5.377	5.377
Spread	+.00	-.01	+.00	+.00	-.01	-.01	-.01	-.01	-.01	-.01

FORWARD ANALYSIS

LIBOR Fwd	5.28	5.34	5.32
Futures	5.28	5.35	5.33
Spread	+.01	+.00	-.01

Futures daytype: actual/360
Strip yield: < 1 yr: actual/360
Strip/Coupn: > 1 yr: bond equiv
S Freq S Daytype ACT/ACT

Figure 10.15 shows the Libor fix for the same day.

Figure 10.15 BBAM Libor fixing as at 25 May 2006

200<GO>to view this page in Launchpad N299 Govt BBAM

BRITISH BANKERS'
ASSOCIATION Page 1 of 4

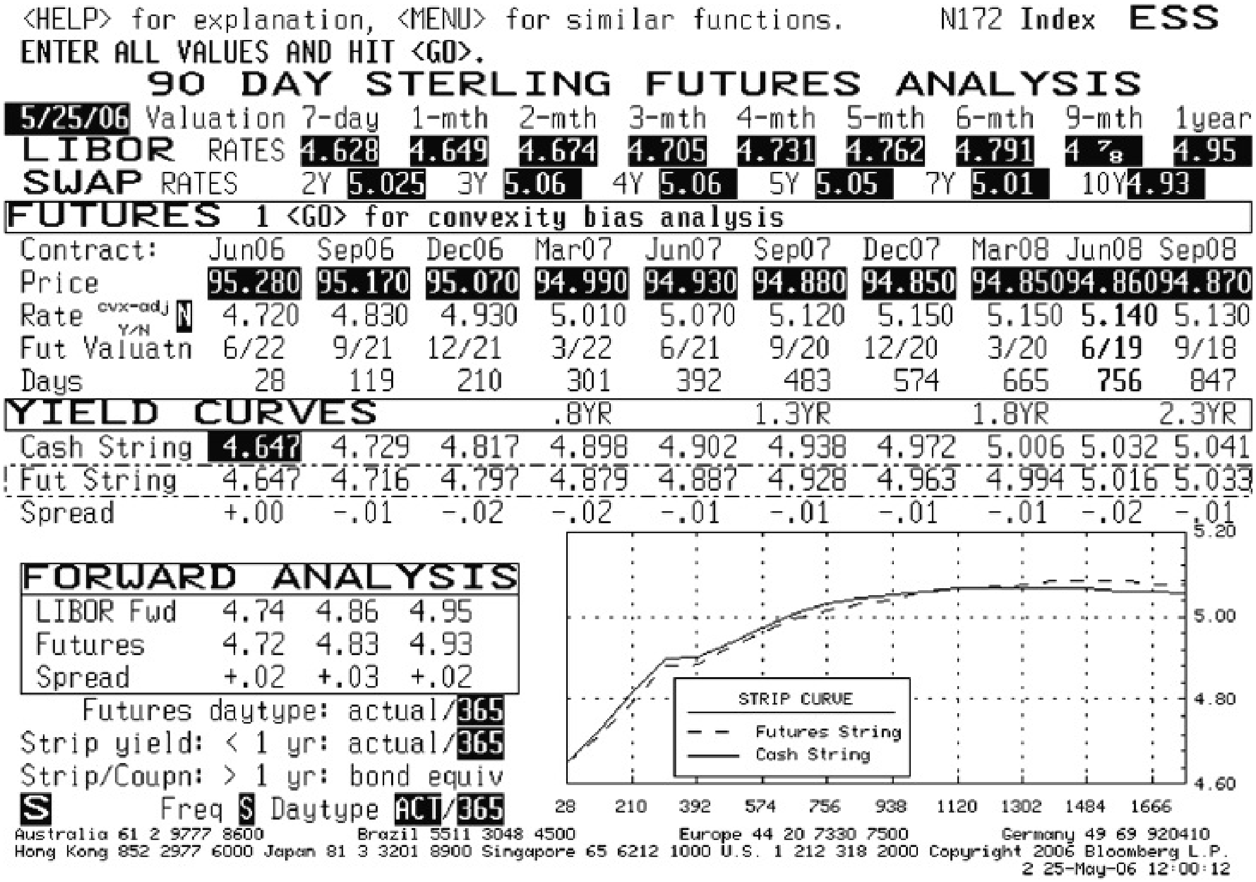
05/25 10:58 GMT [REUTERS] [BBA LIBOR RATES] Telerate Successor Page 3750
[25/05/06] RATES AT 11:00 LONDON TIME 25/05/2006 Alternative to LIBOR01

CCY	USD	GBP	CAD	EUR	JPY	EUR 365
O/N	5.04250	4.62500	4.25000	2.61250	SN0.13625	2.64878
1WK	5.06875	4.62750	4.26667	2.62688	0.14000	2.66336
2WK	5.07375	4.63375	4.27000	2.63875	0.14500	2.67540
1MO	5.09063	4.64938	4.27333	2.75388	0.15125	2.79213
2MO	5.16313	4.67375	4.28167	2.86000	0.20750	2.89972
3MO	5.22000	4.70500	4.29167	2.91125	0.27000	2.95168
4MO	5.25688	4.73125	4.29500	2.96050	0.31000	3.00162
5MO	5.28750	4.76250	4.29917	3.01513	0.34625	3.05701
6MO	5.31688	4.79125	4.31167	3.05850	0.37938	3.10098
7MO	5.33663	4.81750	4.31667	3.09850	0.41000	3.14153
8MO	5.35313	4.84625	4.32167	3.14000	0.44188	3.18361
9MO	5.37038	4.87500	4.33000	3.18088	0.47688	3.22506
10MO	5.38350	4.90313	4.34000	3.21138	0.50688	3.25598
11MO	5.39175	4.92500	4.34667	3.24513	0.53938	3.29020
12MO	5.40375	4.95000	4.35750	3.27525	0.57438	3.32074

We see that the curve is essentially flat. The market expectations for 90-day money range from 5.275% in June 2006 to 5.235% in June 2007. This implies that fair value in a stable rate environment is roughly 22 basis points for US dollars.[4]

The scenario in the United Kingdom is slightly different. Figure 10.16, the short-sterling curve for 25 May 2006, shows an expectation of rising base rates in the following 12 months. We see that the expected 90-day Libor fix for June 2006 is 4.72%, compared to 5.070% for June 2007. In the case of sterling there is possibly greater uncertainty compared to the United States, which was approaching the end of an obvious rising rates cycle. In the United Kingdom, only a few months previously there was commentary that the next move in rates would be down (rates had been stable since the cut to 4.50% in August 2005). This uncertainty is perhaps reflected in the term premium of 20.5 basis points – we suggest that a greater level of certainty (of the next move being a rise in rates) would have translated into a greater term premium, as we saw with USD in May 2005. Notice also how the rest of the curve is very flat after that – the June 2008 forward rate is 5.14%, a difference of only 7 basis points from the rate implied by the June 2007 contract. This is not really meaningful since rate changes these days are usually effected in 25 basis point clips.

Figure 10.16 Short sterling futures curves as at 25 May 2006



In a stable interest rate environment then, we would suggest that the 90-day term premium would be between 15 and 20 basis points. This can be considered fair value. Considering the forward rates implied in Figures 10.14 and 10.16 (EDS and ESS), if we had a firm view in either direction, we would trade the contracts to reflect this. If we expect the base rate to be different at the time of the futures contract expiry, in our analysis we should logically build in a term premium to reflect this expected base rate, together with any further rate move expectations that we ourselves have.

The Fed Funds – Libor term premium[5]

We continue the discussion on the expected size of the term premium with a look at the USD Federal Funds rate (“Fed Funds”) against the 1-month and 3-month USD Libor rate. Fed Funds is the US dollar base rate, and in a neutral interest-rate movement environment we would expect a spread of around 10–15 basis points for the 1-month rate and 20–25 basis points for the 3-month rate. That this is not always the case reflects the fact that the term premium is also a function of interest-rate expectations and the current shape of the yield curve. To illustrate, let us consider the spread history for the 10-year period 1996–2006.

To begin with, Table 10.1 shows the pattern of all USD rates as at 7 September 2006. The money market rates are for a 1-month term, and the bond yields are 10-year terms. We observe that the term (and credit) structure is conventionally positive. This is not always so.

Table 10.1 USD rates as at 7 September 2006

Source: Bloomberg L.P.

One-month rates	
Treasury Bill	4.9469
CD	5.345
CP	5.24
Repo	5.22
10-year yields	
US Treasury	4.789
USD Swap	5.33
AAA	5.4387
A	5.6494
BBB	6.1196
B	8.2282

That USD Libor rates are closely correlated to the Fed Funds rate would appear to be apparent from Figure 10.17, the rates spread history for the period 1996–2006. Figure 10.18 on page 470 shows high positive R^2 values for the 1-month and 3-month Libor rates when regressed against the Fed Funds rate.

Figure 10.17 Fed Funds and USD Libor rates history, 1996–2006

Source: Bloomberg L.P.

Pattern of Federal Funds, 1−m Libor and 3−m Libor rates over time (quarterly, 1996–2000)

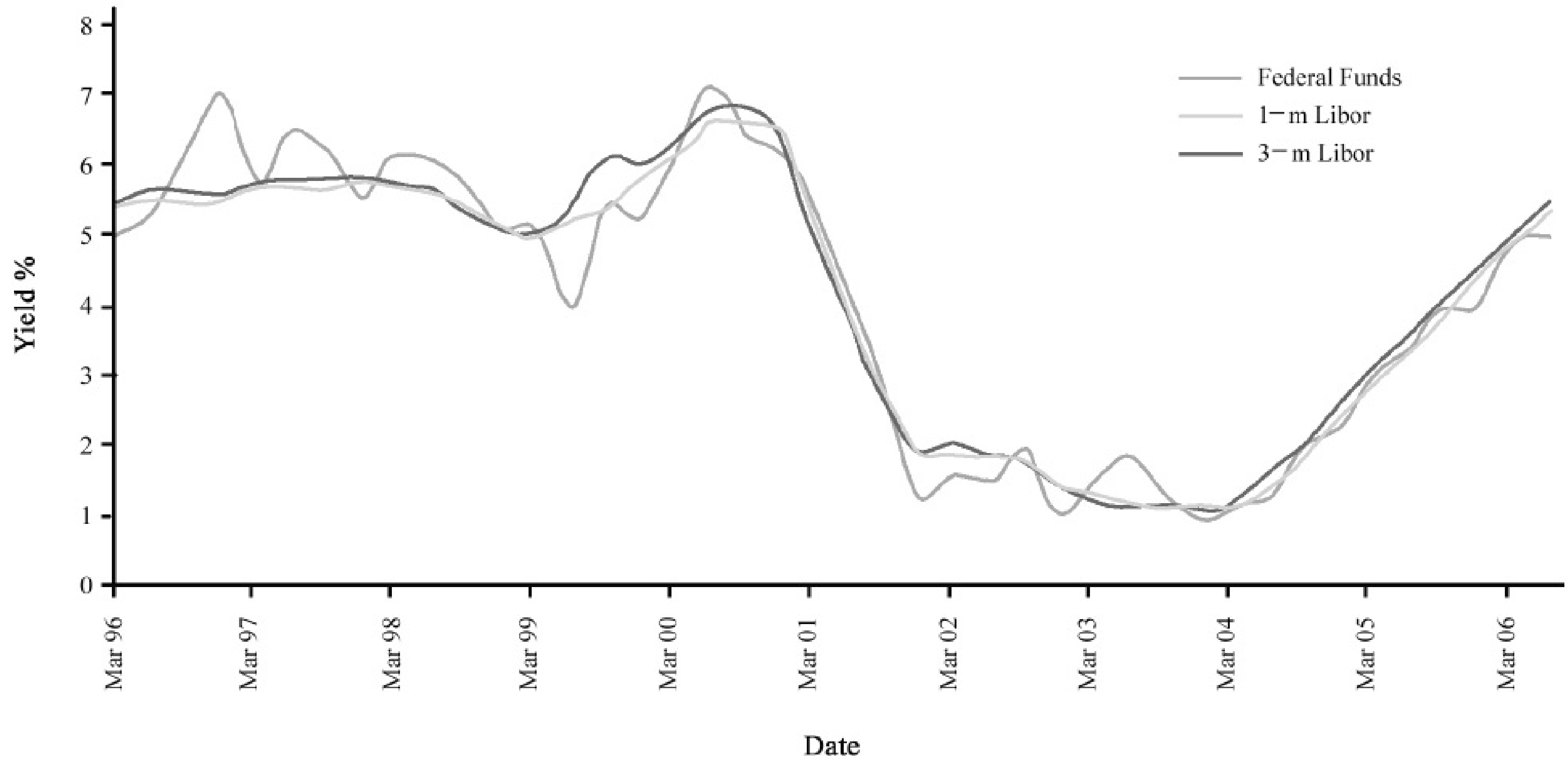
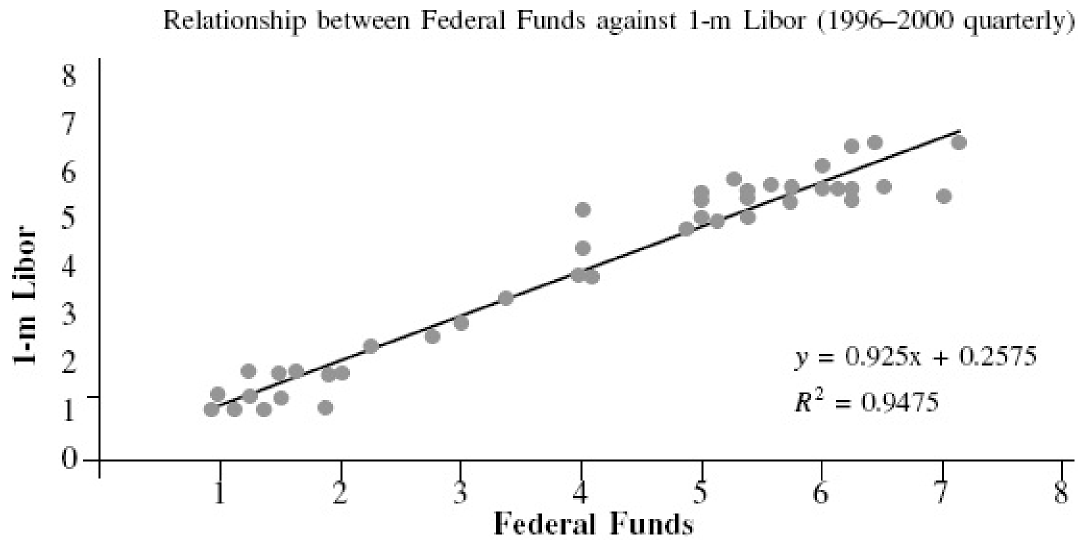
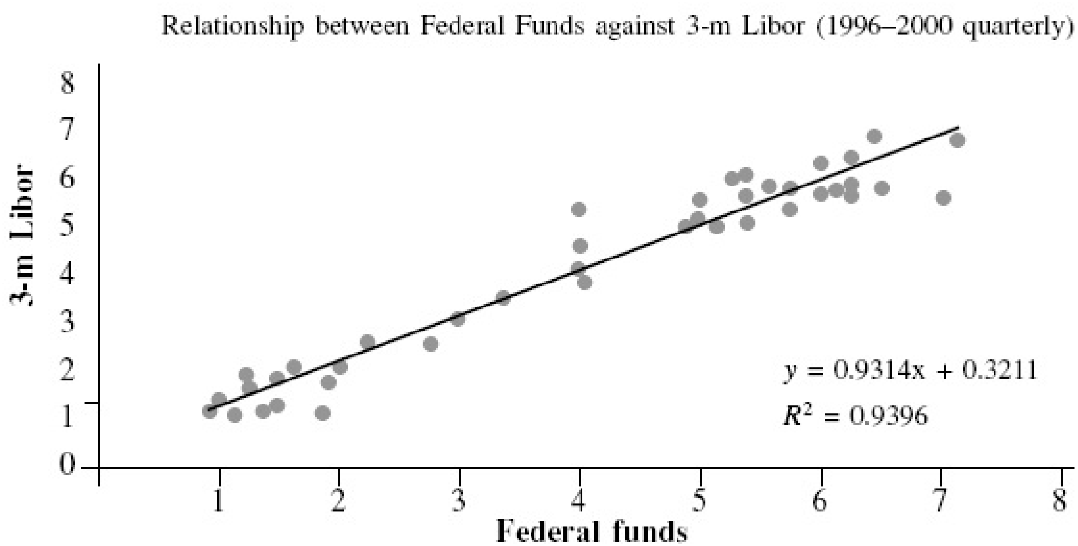


Figure 10.18 Relationship between 1-m and 3-m USD Libor to Fed Funds rate, 1996–2006

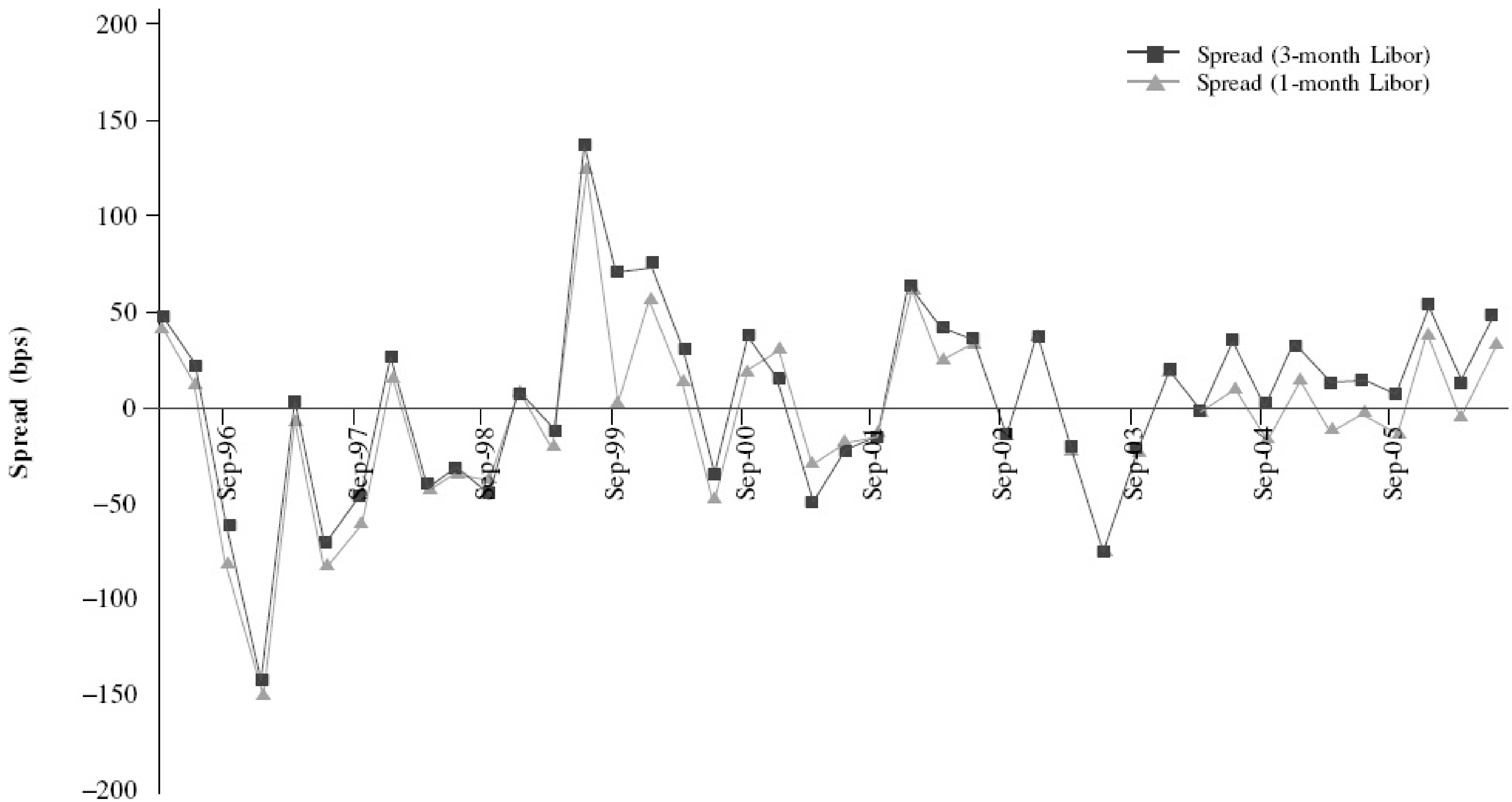




However, the term premium is not always the expected spread, and sometimes is very narrow, or even negative. The size of the premium fluctuates considerably during the period under observation, as shown at Figure 10.19. This reminds us of the importance of taking into consideration the current shape of the yield curve and the market's interest rate expectation when we analyse the term premium and our view on where this is likely to go in the near future. Incidentally, as Figure 10.19 might suggest, long-term predictions should always be taken with a pinch of salt!

Figure 10.19 USD 1-month and 3-month Libor spread against Fed Funds, 1996–2006

Source: Bloomberg L.P.


Spread (3-month Libor)
Spread (1-month Libor)
Spread (bps)
200
150
100
50
0
−50
−100
−150
−200
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05

The term premium during 2006 was within reasonable expectation, and this is not surprising as the market was still in a rising interest-rate environment, with the Fed continuing its “measured” pattern of steady 25 basis point rate rises. The average spread during 2006, up to September of that year, was 11 basis points for 1-month Libor and 32 basis points for 3-month Libor (see Table 10.2). However during the period 1996–2006 this average spread varied considerably. We conclude that while there is a reasonable expectation of what the term premium for funds should be, this expectation should allow for considerable variation.

Table 10.2 1-month and 3-month USD Libor average yearly spread, 1996–2006

Source: Bloomberg L.P.

Year	Yearly average (1-month Libor spread)	Yearly average (3-month Libor spread)
1996	−43.95	−34.57
1997	−32.81	−23.14
1998	−27.21	−27.46
1999	41.15	67.56
2000	3.52	11.42
2001	0.22	−6.28
2002	21.16	24.94
2003	−25.69	−24.52
2004	1.84	16.98
2005	2.22	21.56
2006	11.95	32.26

Impact of macro-level economic and political factors on swap spreads

Banks are an important part of the global economic system, if not the most important part. It goes without saying therefore that the efficient management of a bank’s assets and liabilities feeds directly into overall economic development and national wellbeing. The Treasury or ALM desk of a bank must perforce have a keen understanding of macro-level economic factors, and the overall geopolitical situation, because this drives swap spreads and the term premium. It is worth considering the impact of these factors, in general terms, on spreads and the overall level of interest rates because the ALM desk will need to take them into account as part of its strategy. Also, geopolitical events often arrive unannounced – for example, the Iraqi invasion of Kuwait in 1990, the attack on the World Trade Centre in New York (“9/11”), and the conflict between Israel and Lebanese Hezbollah guerrillas in July 2006. An ability to work effectively under the circumstances prevailing in such occurrences is crucial to efficient ALM.

Events that impact the financial markets at a macro level are often termed market “shocks” or external geopolitical events. Such events invariably result in higher market volatility. The immediate impact of this is a market sell-off and a “flight to quality”, which is when investors move out of higher risk assets such as equities and emerging market sovereign bonds and into risk-free assets such as US Treasuries and UK gilts. This is an almost knee-jerk reaction as investors become more risk-averse.

Swap spreads, which we define as the spread between fixed-rate on a interest-rate swap over the yield of the government bond of similar maturity, reflect the market perception about the general health of the economy and its future prospects, as well as the overall macro-level geopolitical situation. Because the swap curve is an indicator of interbank credit quality, the swap spread can be taken to be the market perception of the health and prospects of the interbank market specifically and the bank sector generally.

Speaking generally, swap spreads widen during periods of increased market volatility. By implication a flight-to-quality should be reflected in a widening of the spread. This is expected because investors’ new risk aversion manifests itself in lower government bond yields, arising from higher demand for government bonds. However, on occasion this analysis might be overly simplistic, because other micro-level factors will still be in play and can be expected to influence market rates. How can we consider the interaction between government yields, swap rates and possible influences on the swap spread?

The research team at HBOS produced a report[6] that suggests a novel way for us to analyse this, and we summarise their findings here with permission. We require an indicator of market volatility; one measure of this for the US dollar market is the VIX index. The VIX index is produced by the Chicago Board Options Exchange (CBOE) and is a proxy measure of market volatility. It uses a weighted average of implied volatilities to calculate an estimate of future volatility. An increase in the level of the index indicates increased market volatility.

We illustrate the relationship between geopolitical events and the magnitude of the swap spread by looking at the correlation between the US dollar 10-year swap spread and the VIX index. Table 10.3 shows – as expected – a positive correlation between the VIX index and the swap spread during a period of both economic events, as well as macro-level geopolitical events. For instance, the period covers the 9/11 events as well as the Ford and GM credit-rating downgrades of 2005. There is a notable exception for the period September 2001 to March 2002, when there is a negative correlation. This is our first indication that the relationship is not as simplistic as we might think. Although the geopolitical situation was negative, with the events of 9/11 leading to the US war in Afghanistan, suggesting that swap spreads should widen, this was also a period of successive cuts in the US base interest rate (the "Fed rate"). During this time the swap rate fell by more than 100 basis points as the Fed rate was cut by 175 basis points. So here we observe that the impact of specific financial market factors was greater than macro-level geopolitical issues. Generally though, we observe the strong positive correlation between the swap spread the volatility index.

Table 10.3 Correlation between the USD 10-year swap spread and the CBOE VIX index and the 10-year US Treasury yield and the CBOE VIX index

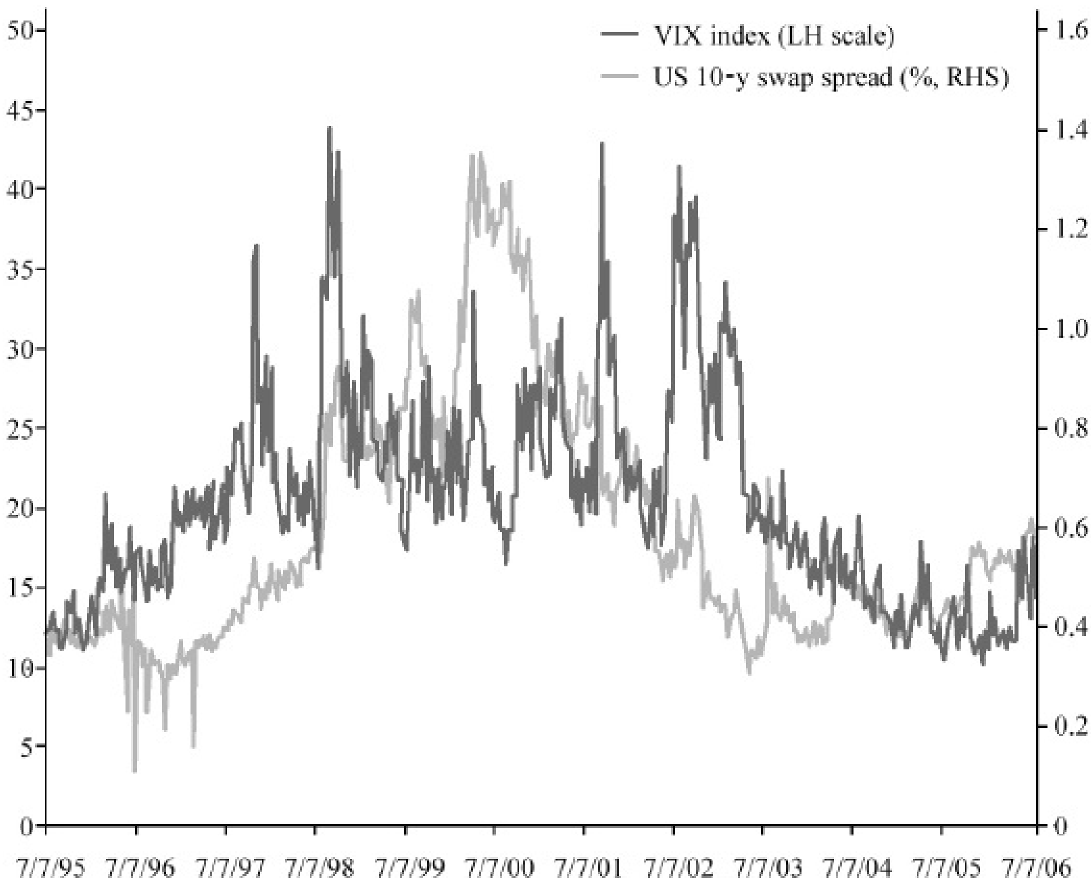
Source: HBOS. Reproduced with permission.

Event	**Correlation between VIX and 10-year swap spread**	**Correlation between VIX and 10-year US Treasury yield**
Asian currency crisis (1997–1998)	0.71	−0.52
LTCM and Russian debt default (Jun.–Sept. 1998)	0.90	−0.78
9/11 to Afghan war (Sept. 2001–Mar. 2002)	−0.17	−0.67
Iraq War (Mar–May 2003)	0.54	−0.08
Ford and GM credit rating downgrade (Mar–May 2005)	0.38	−0.53

Figure 10.20 is a chart of the spread to the level of the VIX index

Figure 10.20 VIX index versus US 10-year swap spread

Source: HBOS. Reproduced with permission.

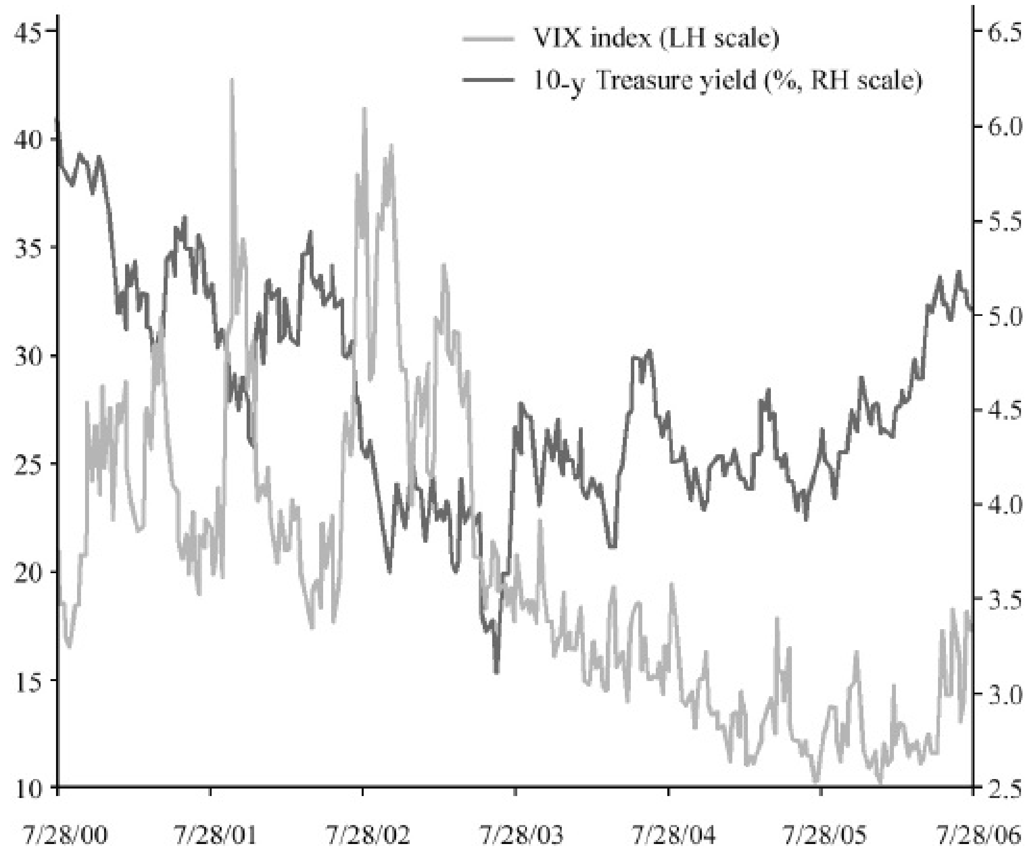


By the same analysis, we can expect a negative correlation between the US Treasury yield and the VIX index level. This is generally borne out in Table 10.3. However, as with the case of the swap spread correlation, we see an occasion when other factors impact the correlation value. The low negative value for the period in 2003 leading up to and after the second Iraq war shows other factors influencing the Treasury yield. The authors of the HBOS report suggest that the flight-to-quality had taken place before the war actually began and was fully priced-in to Treasury yields.

Figure 10.21 on page 476 illustrates the lower government bond yields that are observed at times of higher market volatility.

Figure 10.21 VIX index versus US 10-year Treasury

Source: HBOS. Reproduced with permission.



The purpose of the foregoing has been to illustrate how the swap spread interacts with macro-level geopolitical factors. However, even during periods of high market tension, characterised by high levels of market volatility, the swap spread will respond also to more micro-level financial factors. ALM practitioners need to be aware of the nature of this interaction, and allow for this in their strategy and planning.

[1] In theory. In fact, banks are more likely to pay Li-mid to other banks, and the biggest banks pay Libid. But we can safely ignore this for the purposes of our discussion here.

[2] This was the US Federal Reserve's own term to describe its rate-setting policy. Figure 10.10 on page 462 shows the extent of this measured approach, with steady 25 basis point hikes from June 2004 through to June 2006.

[3] The Federal Reserve's Open Market Committee (FOMC), which sets the USD base rate, meets every six weeks or so.

[4] The curve was a reasonably accurate predictor: the Fed Funds rate was indeed raised to 5.25% at the June FOMC meeting, and maintained at this rate

through the rest of 2006.

[5] With thanks to Nick Wallis, University of Nottingham Business School, for his assistance with preparing the charts in this section.

[6] "Geopolitics Returns to the Limelight", in *Economics Perspectives*, 8 August 2006 (HBOS Treasury Services). With thanks to Mark Miller at HBOS in London for his generous assistance.

CHAPTER 11

Introduction to Relative Spread Analysis

We conclude Part II with a look at relative value analysis. This may seem slightly out of place in this book, especially in Part II, but we cover this subject here because actually we feel it is closely related to the previous two chapters. That makes an understanding of it vital to efficient ALM practice.

In Chapter 10 we discussed the determinants of the swap spread, as well as the expected magnitude of the money market term premium. The swap spread is a measure of the level of swap rates over and above risk-free rates. As such it is in essence the term Libor rate (beyond the 12-month term, the point at which formal Libor fixes end). This rate feeds into a bank's cost of funding, the rate at which it can hedge interest-rate exposure. To meet the target rate of return objectives, assets generally need to earn a spread over this cost of funding. For instance, it is common for bank Treasury desks to maintain a book of FRNs for liquidity purposes. In some cases a portion of the bank's capital may be invested in such bonds. The book will be required to meet a target rate of return, which might be *x* basis points above the cost of capital. This requires that the Treasury desk assess the relative spread earned by the FRN book (and individual FRNs) over the bank's funding costs. Hence, relative spreads analysis becomes important to the Treasury desk. This is only one example. There are many applications of this analysis; as a result, it is necessary to include an introduction to this subject here.

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 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 YTM 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 credit default swaps (CDS), investors consider the cash-CDS spread as well, which is known as the *basis*.

Credit derivatives are introduced in Chapter 16 of this book; readers also may wish to read the author's book on credit derivatives (Choudhry 2004b) as well as his paper on the CDS basis (Choudhry 2004a).

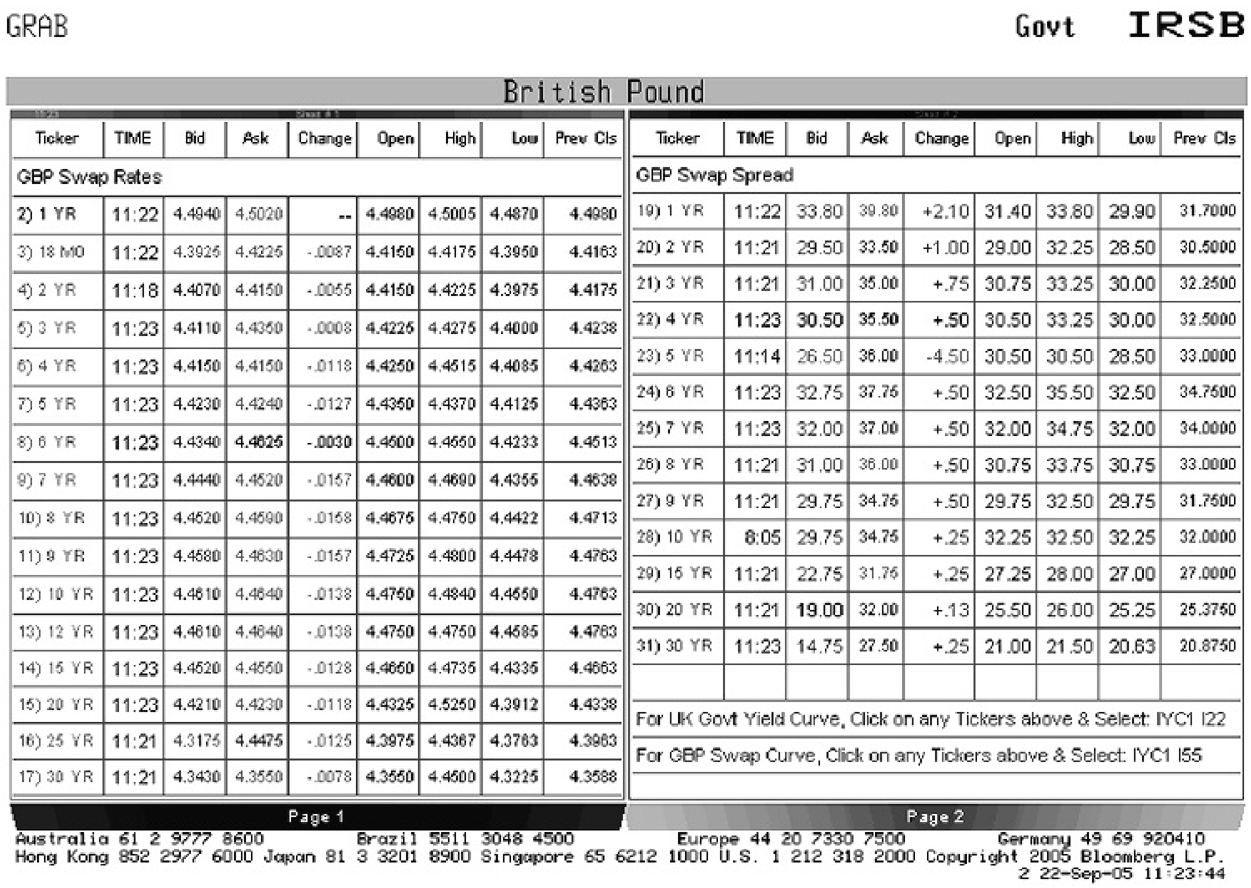
The spread that is selected is an indication of the relative value of the bond, and a measure of its credit risk. The greater the perceived risk, the greater the spread should be. This is best illustrated by the credit structure of interest rates, which will (generally) show AAA-and AArated bonds trading 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 swap and Treasury spread, asset swap spread, Z-spread, and cash-CDS 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 interbank 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 simply the yield of the bond minus the swap rate for the appropriate maturity swap. Figure 11.1 shows Bloomberg page IRSB for pounds sterling 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 five-year and six-year swap rates.

Figure 11.1 Bloomberg page IRSB for pounds sterling, showing GBP swap rates and swap spread over UK gilts, 10 August 2005


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	4.5020	--	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	11:18	4.4070	4.4150	-.0055	4.4150	4.4225	4.3975	4.4175
5) 3 YR	11:23	4.4110	4.4350	-.0008	4.4225	4.4275	4.4000	4.4238
6) 4 YR	11:23	4.4150	4.4150	-.0118	4.4250	4.4515	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	4.4340	4.4625	-.0030	4.4500	4.4550	4.4233	4.4513
9) 7 YR	11:23	4.4440	4.4520	-.0157	4.4600	4.4690	4.4355	4.4638
10) 8 YR	11:23	4.4520	4.4590	-.0158	4.4675	4.4760	4.4422	4.4713
11) 9 YR	11:23	4.4580	4.4630	-.0157	4.4725	4.4800	4.4478	4.4763
12) 10 YR	11:23	4.4610	4.4640	-.0138	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	4.4520	4.4550	-.0128	4.4660	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	4.4367	4.3763	4.3963
17) 30 YR	11:21	4.3430	4.3550	-.0078	4.3550	4.4500	4.3225	4.3588

Page 1

Ticker	TIME	Bid	Ask	Change	Open	High	Low	Prev Cls
GBP Swap Spread								
19) 1 YR	11:22	33.80	39.80	+2.10	31.40	33.80	29.90	31.7000
20) 2 YR	11:21	29.50	33.50	+1.00	29.00	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	35.50	+.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	37.76	+.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	34.76	+.50	29.75	32.50	29.75	31.7500
28) 10 YR	8:05	29.75	34.76	+.25	32.25	32.50	32.25	32.0000
29) 15 YR	11:21	22.75	31.76	+.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

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).

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, it is usually dropped in favour of the asset-swap spread, which we look at later in this section.

Of course, 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.

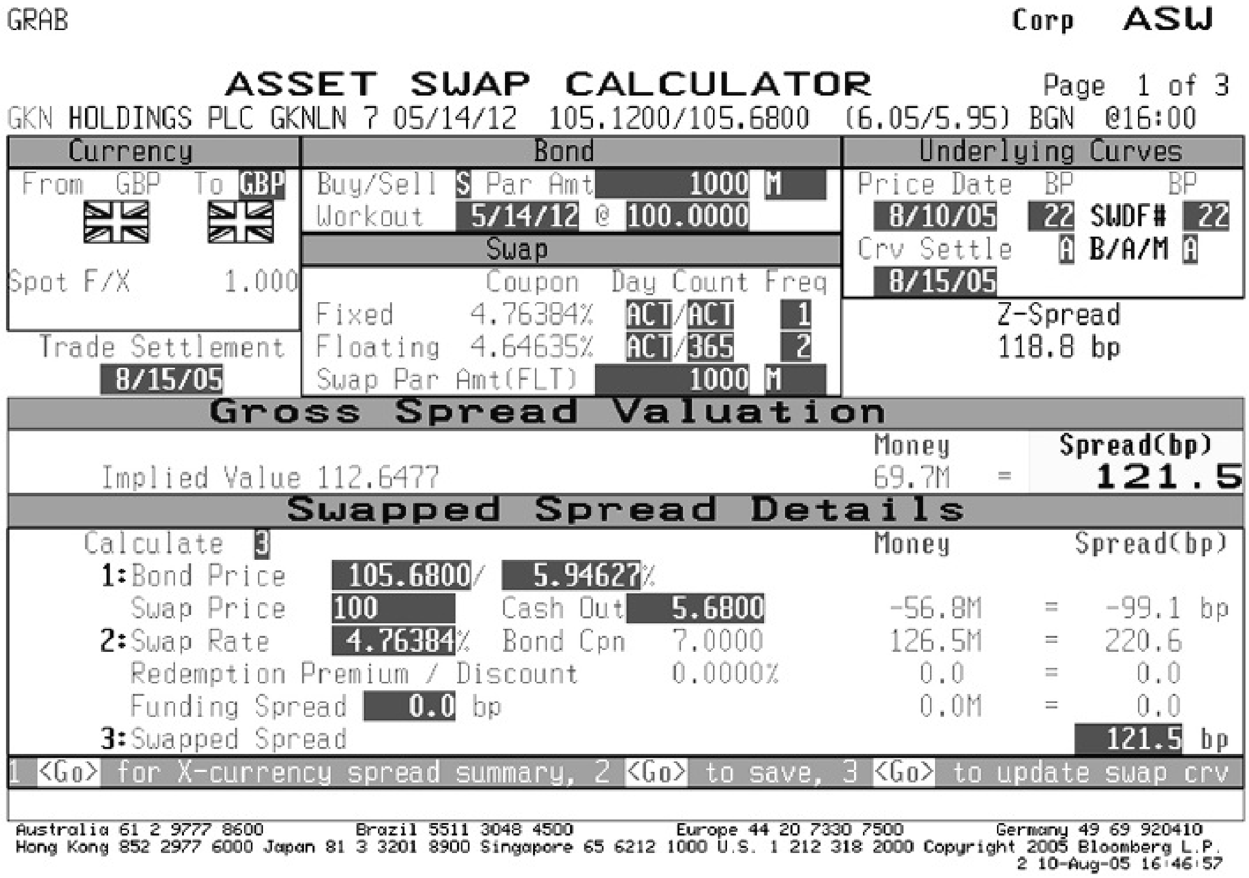
Asset-swap spread

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 (see Choudhry *et al.* 2001). This spread is the asset-swap spread and is a function of the credit risk of the bond over and above interbank credit risk.[1] Asset swaps may be transacted at par or at the bond's market price, usually par. 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 (see Chapter 9). 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.[2]

Figure 11.2 shows the Bloomberg screen ASW for a GBP-denominated bond, GKN Holdings 7% 2012, as at 10 August 2005. We see that the asset-swap spread is 121.5 basis points. 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 the 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.

Figure 11.2 Bloomberg page ASW for GKN bond, 10 August 2005



Z-spread

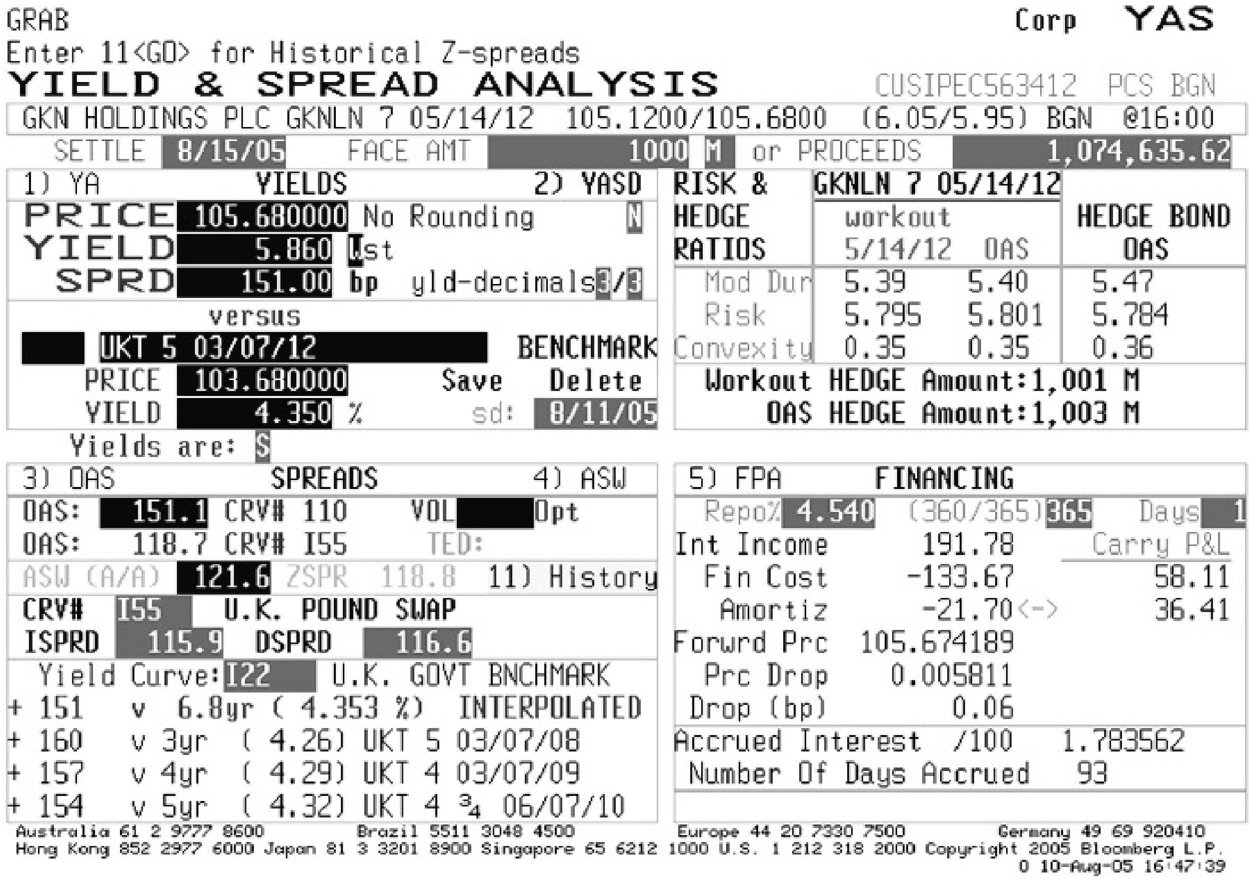
The conventional approach for analysing an asset swap uses the bond's YTM in calculating the spread. The assumptions implicit in the YTM calculation (see Chapter 4) make this spread problematic for relative value analysis, so market practitioners use what is termed the Z-spread instead. The Z-spread 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 a 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.

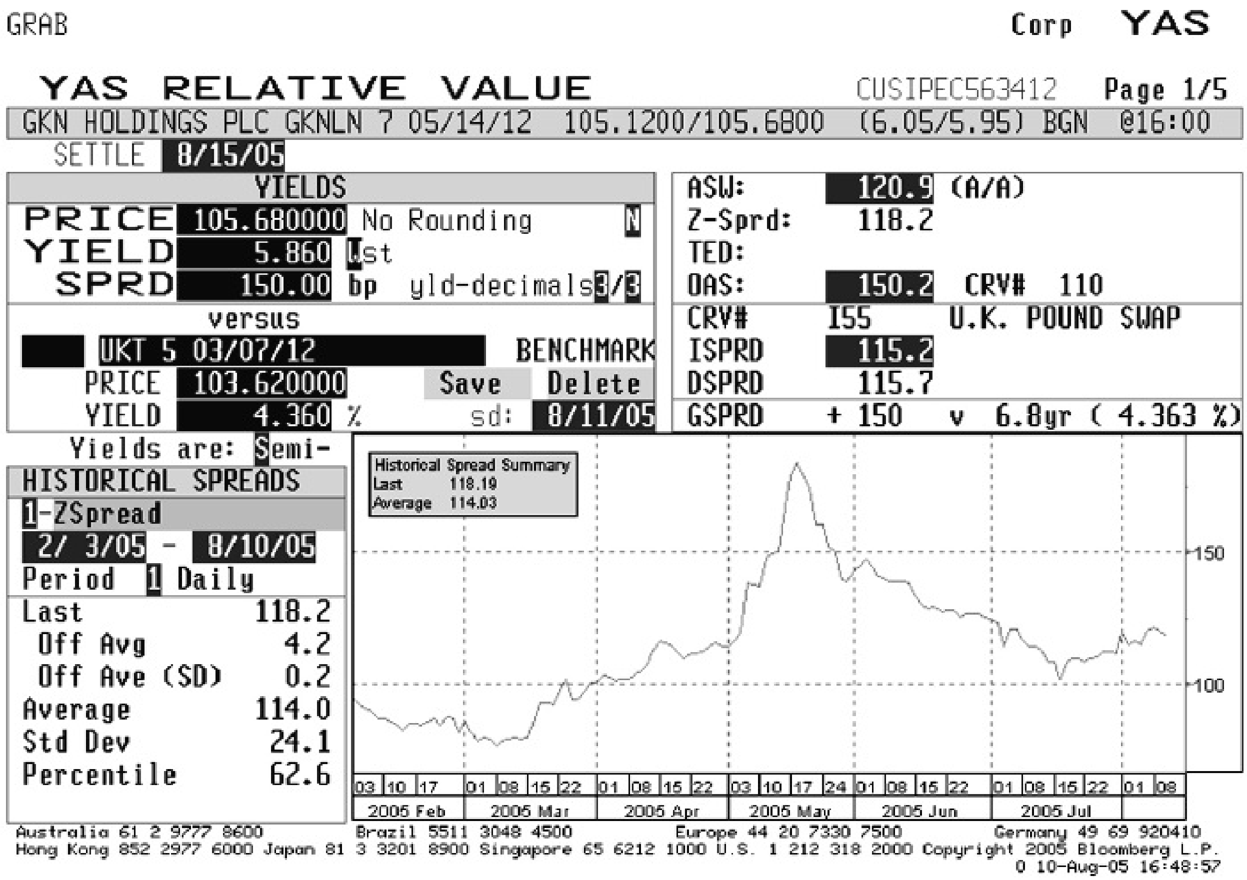
Figure 11.3 is the Bloomberg screen YAS for the same bond shown in Figure 11.2, as at the same date. It shows a number of spreads for the bond. The main spread of 151.00 basis points is the spread over the government yield curve. This is an interpolated spread, as can be seen lower down the screen, with the appropriate benchmark bond identified. We see that the asset-swap spread is 121.6 basis points, while the Z-spread is 118.8 basis points. When undertaking relative value analysis, for instance if making comparisons against cash funding rates or the same company name CDS, it is this lower spread that should be used.[3]

Figure 11.3 Bloomberg page YAS for GKN bond, 10 August 2005



The same screen can be used to check spread history. This is shown in [Figure 11.4](#), the Z-spread graph for the GKN bond for the six months prior to our calculation date.

[Figure 11.4](#) Bloomberg page YAS for GKN bond, 10 August 2005 showing Z-spread history



Z-spread is closely related to the bond price, as shown by equation (11.1),

$$P = \sum_{i=1}^{n}\left[\frac{C_i + M_i}{(1 + ((Z + S_i + T_i)/m))^i}\right] \quad \textbf{(11.1)}$$

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 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 11.5. This is done using a hypothetical bond, the XYZ plc 5% of June 2008, a three-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 basis points, while the Z-spread is 19.4 basis points. In practice the difference between these two spreads is rarely this large.

Figure 11.5 Calculating the Z-spread, hypothetical 5% 2008 bond issued by XYZ pic

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 fomula =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							

Continued from pp. 455

25								
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 cash flows 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							

For the readers' benefit we also show the Excel formula in Figure 11.5. 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.

Cash-CDS basis

The basis is the difference between a bond's asset-swap spread, or alternatively its Z-spread, and the CDS price for the same bond issuer. So the basis is given by:

$$B = D - I$$

where D is the CDS price. Where $D - 1 > 0$ it is a positive basis; the opposite is a negative basis.

Figure 11.6 shows page G <go> on Bloomberg, set up to show the Z-spread and CDS price history for the GKN 2012 bond, for the period March–September 2005. We can select the "Table" option to obtain the actual values, which can then be used to plot the basis. This is shown in Figure 11.7 on page 488, for the period 22 August to 22 September 2005. Notice how the basis was always negative during August–September; we see from Figure 11.7 that earlier in the year the basis had briefly been positive. Changes in the basis give rise to arbitrage opportunities between the cash and synthetic markets. This is discussed in greater detail in Choudhry (2004b).

Figure 11.6 Bloomberg graph using screen G <go>, plot of asset-swap spread and CDS price for GKN bond, April-September 2005

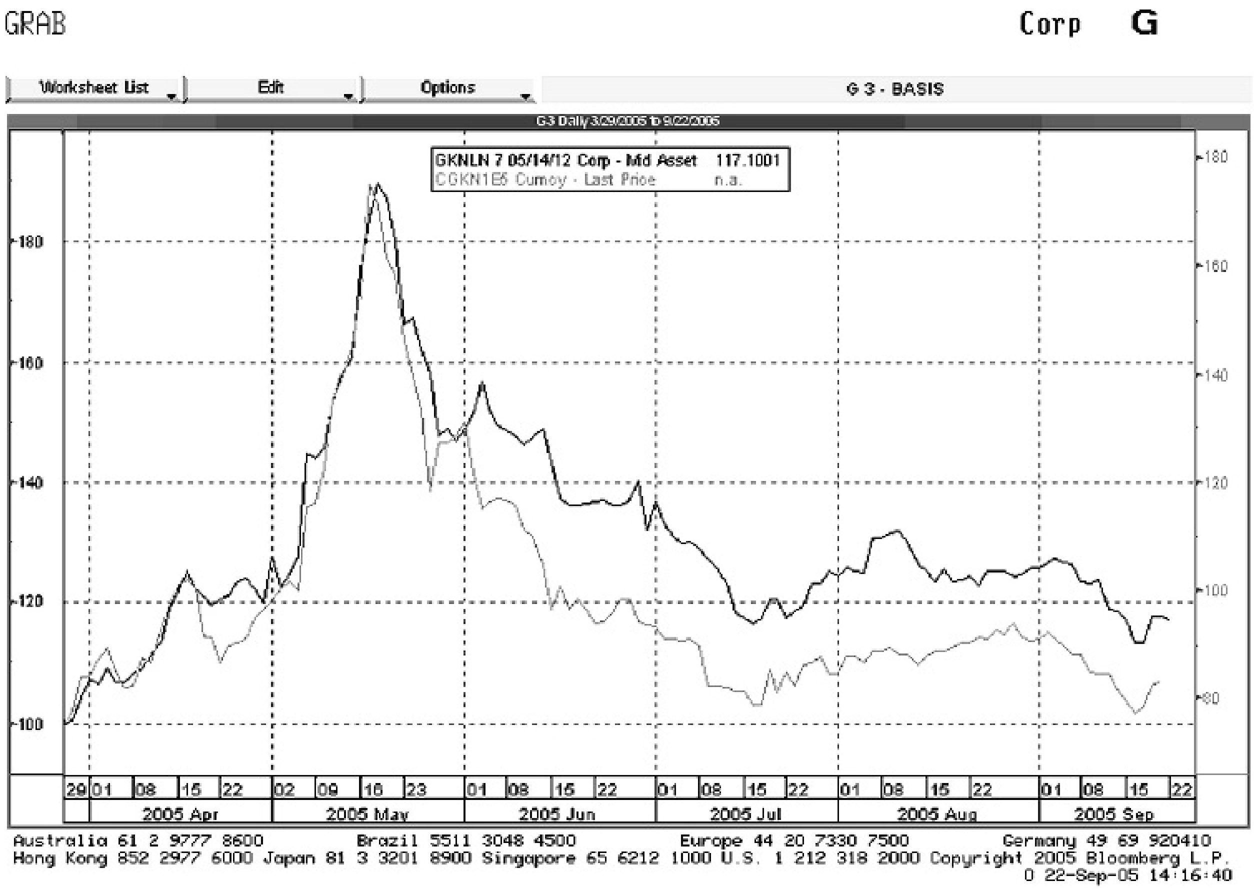
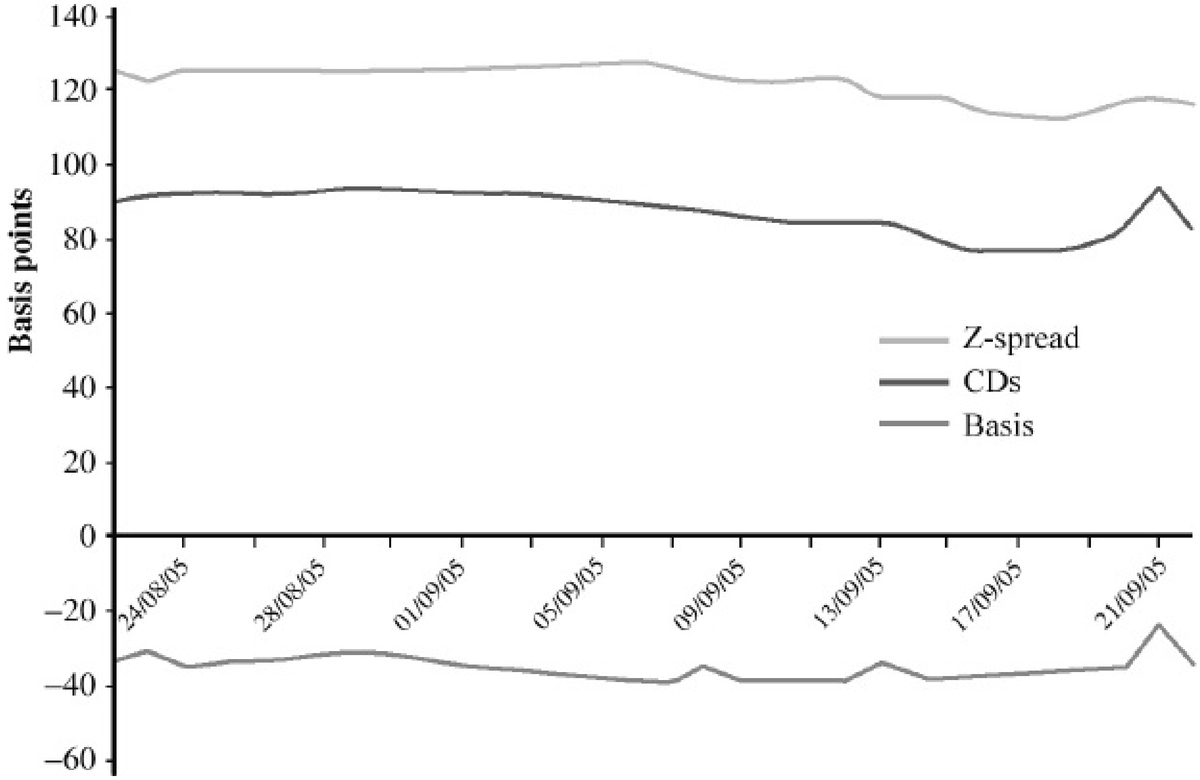


Figure 11.7 GKN bond, CDS basis during August-September 2005

Data source: Bloomberg L.P.



A wide range of factors drive the basis, which are described in detail in Choudhry (2004a). The existence of a non-zero basis has implications for the 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, if the basis is positive the investor may wish to hold the asset synthetically, by selling protection using a credit default swap. 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.

Thus, we see that market practitioners have a range of spreads to use when performing their relative value analysis.

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[1] This is because in the interbank 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.yieldcurve.com

[2] Bloomberg refers to this spread as the Gross Spread.

[3] On the date in question the 10-year CDS for this reference entity was quoted as 96.8 basis points, which is an example of a negative basis, in this case of −22 basis points.

PART III

Financial Instruments, Applications and Hedging

In Part III we drill down into the banking discipline, with a look at specific instruments. We look in detail at hedging instruments, both for interest-rate risk and credit risk. So we consider interest-rate derivatives such as futures, forward rate agreements (FRAs) and interest-rate swaps. We also look at credit derivatives, and introduce credit risk and credit value-at-risk. The use of these instruments for hedging applications is described and illustrated. Much ALM practice revolves around hedging risk exposure, making use of the instruments we discuss in the following chapters.

We begin, however, with a detailed look at repo, which warrants its own chapter separate to our earlier chapter on money market instruments.

CHAPTER 17

Value-at-Risk (VaR) and Credit VaR

In this chapter, we review the main risk-measurement tool used in banking, known as Value-at-Risk (VaR). ALM managers up to ALCO level consider the bank's interest-rate risk exposure, and to a certain extent its credit risk exposure, on a regular basis. Their review takes into account both the business lines' adherence to the set exposure limits, as well as whether the limits themselves are at the correct level to enable the bank to achieve its objectives. Although many smaller banks employ the modified duration method to measure interest-rate risk exposure, more and more banks are moving to a VaR-based calculation of risk exposure. Hence it is important for ALM managers to be aware of the VaR measure.

This chapter looks at the three main methodologies used to calculate VaR, as well as some of the key assumptions used in the calculations, including those on the normal distribution of returns, volatility levels and correlations. We also discuss the use of the VaR methodology with respect to credit risk.

Introducing Value-at-Risk

The introduction of VaR as an accepted methodology for quantifying market risk and its adoption by bank regulators 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 JPMorgan launched RiskMetrics™.

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. We can define VaR 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*.

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 may be seen as 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 a measure of the volatility of a firm's banking or trading book. A portfolio containing assets that have a high level of volatility has a higher risk than one containing assets with a lower level of volatility. The VaR measure seeks to quantify in a single measure the potential losses that may be suffered by a portfolio.

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. It is important to be aware of what precisely VaR attempts to capture and what it clearly makes no attempt to capture. Also, VaR is not “risk management”. A risk-management department may choose to use a VaR-measurement system in an effort to quantify a bank’s risk exposure; however, the application itself is merely a tool. Implementing such a tool in no way compensates for inadequate procedures and rules in the management of a trading book.

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 −1.645 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.

Further discussion on characteristics of the normal distribution is given in Appendix 17.1.

Calculation methods

The three traditional methods for calculating VaR are:

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

We consider each of these in turn.

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 is 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 arguably the simplest. The three main assumptions behind correlation (normally distributed returns, constant correlations and 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 one-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.

Correlation

Measures of correlation between variables are important to banks that 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 −1 to +1, 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, (17.1) 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.

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

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 in (17.2):

(17.2) $$Cov = \frac{\sum_{i=1}^{n} (xi - \bar{x})(yi - \bar{y})}{(n - 1)}$$

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 in (17.3):

(17.3) $$\rho = Cov \frac{(1,2)}{\sigma_1 \times \sigma_2}$$

where σ is the standard deviation of each asset.

Equation (17.1) 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 will depend to an extent on the correlation between its constituents.

It should be apparent that 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 will be wider and flatter, as there will be 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 will be moving in the same direction. However, under most market scenarios, using correlations to reduce the risk of a portfolio is considered satisfactory practice, and the VaR number for a diversified portfolio will be lower than that for an undiversified portfolio.

Simple VaR calculation

To calculate the VaR for a single asset, we would 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. This can be checked from standard normal tables. 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 × 0.0199 or 0.032736. The portfolio has a market value of £10 million, so the VaR of the portfolio is 0.032736 × 10,000,000 or £327,360. So this figure is the maximum loss the portfolio may sustain over one year for 95% of the time.

We may extend this analysis to a two-stock portfolio. In a two-asset portfolio, we stated in (17.1) that there is a relationship that enables us to calculate the volatility of such a portfolio; this expression is used to calculate the VaR, and is shown in (17.4):

(17.4) $$VaR_{port} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\sigma_1\sigma_2\rho_{1,2}}$$

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

$\rho_{1,2}$ is the correlation coefficient between the two assets.

In a two-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 will 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, then, it is more logical to use an undiversified VaR measure.

Although the description given here is very simple, it nevertheless explains what is the essence 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 will have 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 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 feel the bank requires.

Matrix calculation of variance–covariance VaR

Consider the following hypothetical portfolio, invested in two assets, as shown in Table 17.1(i). 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 are then calculated as the logarithm of the price relatives. The mean and standard deviation of the returns are then calculated using standard statistical formulas. This would then give the standard deviation of daily price relatives, 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.

Table 17.1(i) Two-asset portfolio VaR

D	E	F	G	H
		Asset		
8		Bond 1	Bond 2	
9	Standard deviation	11.83%	17.65%	
10	Portfolio weighting	60%	40%	
11	Correlation coefficient			0.647
12	Portfolio value			$10,000,000.00
13	Confidence level			95%
14				
15	Portfolio variance			0.016506998
16	Standard deviation			12.848%
17				
18	95% c.i. standard deviations			1.644853627
19				
20	Value-at-Risk			0.211330072
21	Value-at-Risk £			$2,113,300.72
22				

The standard equation (shown in (17.4)) is used to calculate the variance of the portfolio, using the standard deviations of the individual assets 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 £2,113,300.72. The Excel formulas are shown in Table 17.1(ii).

Table 17.1(ii) Spreadsheet formulas for Table 17.1(i)

D	E	F	G	H
		Asset		
8		Bond 1	Bond 2	
9	Standard deviation	11.83%	17.65%	
10	Portfolio weighting	60%	40%	
11	Correlation coefficient			0.647
12	Portfolio value			$10,000,000.00
13	Confidence level			95%
14				
15	Portfolio variance			=F9^2*F10^2+G9^2*G10^2 +2*F9*F10*G9*G10
16	Standard deviation			=H15^0.5
17				
18	95% c.i. standard deviations			=NORMSINV(H13)
19				
20	Value-at-Risk			=H18*H16
21	Value-at-Risk £			=H20*H12
22				

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 many assets, the method we described above becomes unwieldy. 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 Figure 17.1. Note that the multiplication of matrices carries with it some unique rules; readers who are unfamiliar with matrices should refer to a standard mathematics textbook.

Figure 17.1 Matrix variance–covariance calculation for a two-asset portfolio shown in Table 17.1

	Variance matrix		**Correlation matrix**			
			Bond 1	Bond 2	**VC matrix**	
Bond 1	11.83%	0	1	0.647	0.1183	0.07654
Bond 2	0	17.65%	0.647	1	0.114196	0.1765
	VC matrix		**Variance matrix**		**VCV matrix**	
	0.1183	0.07654	11.83%	0	0.013995	0.013509
	0.114196	0.1765	0	17.65%	0.013509	0.031152
	Weighting matrix		VCV matrix		WVCV	
	60%	40%	0.013995	0.013509	0.013801	0.020566
			0.013509	0.031152		
	WVCV		W		WVCVW	
	0.013801	0.020566	60%		0.016507	
			40%			
				Standard deviation	0.12848	

As shown in Figure 17.1, using the same two-asset portfolio described, we can set a 2x2 matrix with the individual standard deviations inside; this is labelled the “variance” matrix. The standard deviations are placed on the horizontal axis of the matrix, and a zero entered in the other cells. The second matrix is the correlation matrix, and the correlation of the two assets is placed in cells corresponding to the other asset. That is why a “1” is placed in the other cells, as an asset is said to have a correlation of 1 with itself. The two matrices are then multiplied to produce another matrix, labelled “VC” in Figure 17.1.[1]

The VC matrix is then multiplied with the V matrix to obtain the variance–covariance matrix or VCV matrix. This shows the variance of each asset; for Bond 1 this is 0.01399, which is expected, as that is the square of its standard deviation, which we were given at the start. The matrix also tells us that Bond 1 has a covariance of 0.0135 with Bond 2. We then set up a matrix of the portfolio weighting of the two assets, and this is multiplied by the VCV matrix. This produces a 1x2 matrix, which we need to change to a single number, so this is multiplied by the W matrix, reset as a 2x1 matrix, which produces the portfolio variance. This is 0.016507. The standard deviation is the square root of the variance, and is 0.1284795 or 12.848%, which is what we obtained before. In our illustration it is important to note the order in which the matrices were multiplied, as this will obviously affect the result. The volatility matrix contains the standard deviations along the diagonal, and zeros are entered in all the other cells. So if the portfolio we were calculating has 50 assets in it, we would require a 50x50 matrix and enter the standard deviations for each asset along the diagonal line. All the other cells would have a zero in them. Similarly for the weighting matrix; this is always one row, and all the weights are entered along the row. To take the example just given, the result would be a 1x50 weighting matrix.

The matrix method for calculating the standard deviation is more effective than the first method we described, because it can be used for a portfolio containing a large number of assets. In fact, this is exactly the methodology used by RiskMetrics™ and the computer model used for the calculation will be set up with matrices containing the data for hundreds, if not thousands, of different assets.

The variance–covariance method captures the diversification benefits of a multi-product portfolio because of the correlation coefficient matrix used in the calculation. For instance, if the two bonds in our hypothetical portfolio had a negative correlation, the VaR number produced would be lower. To apply it, a bank would require data on volatility and correlation for the assets in its portfolio. These data are actually available from the RiskMetrics™ website (and other sources), so a bank does not necessarily need its own data. It may wish to use its own datasets, however, should it have them, to tailor the application to its own use. The advantages of the variance–covariance methodology are that:

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

The drawbacks of the variance–covariance 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. We will review this later in the chapter. 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 in a bank.

Mapping

The cornerstone of the variance–covariance methodology is the requirement for data on volatilities and correlations for assets in the portfolio. The RiskMetrics™ dataset does not contain volatilities for every maturity possible, as that would require a value for very period from one day to over 10,950 days (30 years) and longer, and correlations between each of these days. This would result in an excessive amount of calculation. Rather, volatilities are available for set maturity periods, and these are shown in Table 17.2.

Table 17.2 RiskMetrics™ grid points

RiskMetrics grid points
1 month
3 months
6 months
1 year
2 years
3 years
4 years
5 years
7 years
9 years
10 years
15 years
20 years
30 years

If a bond is maturing in six years' time, its redemption cash flow will not match the data in the RiskMetrics™ dataset, so it must be mapped to two periods; in this case, being split to the five-year and seven-year grid point. This is done in proportions so that the original value of the bond is maintained once it has been mapped. More importantly, when a cash flow is mapped, it must split in a manner that preserves the volatility characteristic of the original cash flow. Therefore, when mapping cash flows, if one cash flow is apportioned to two grid points, the share of the two new cash flows must equal the present value of the original cash flows, and the combined volatility of the two new assets must be equal to that of the original asset. A simple demonstration is given in Example 17.1.

Example 17.1: Cash flow mapping

A bond trading book holds £1 million nominal of a gilt strip that is due to mature in precisely six years' time. To correctly capture the volatility of this position in the bank's RiskMetrics™ VaR estimate, the cash flow represented by this bond must be mapped to the grid points for five years and seven years, the closest maturity buckets for which the RiskMetrics™ dataset holds volatility and correlation data. The present value of the strip is calculated using the six-year zero-coupon rate, which RiskMetrics™ obtains by interpolating between the five-year rate and the seven-year rate. The details are shown in Table 17.3.

Table 17.3 Bond position to be mapped to grid points

Gilt strip nominal (£):	1,000,000
Maturity (years):	6
5-year zero-coupon rate:	5.35%
7-year zero-coupon rate:	5.50%
5-year volatility:	24.50%
7-year volatility:	28.95%
Correlation coefficient:	0.979
Lower period:	5
Upper period:	7

Note that the correlation between the two interest rates is very close to 1. This is expected because five-year interest rates generally move very closely in line with seven-year rates.

We wish to assign the single cash flow to the five-year and seven-year grid points (also referred to as vertices). The present value of the bond, using the six-year interpolated yield, is £728,347. This is shown in Table 17.4, which also uses an interpolated volatility to calculate the volatility of the six-year cash flow. However, we wish to calculate a portfolio volatility based on the apportionment of the cash flow to the five-year and seven-year grid points. To do this, we need to use a weighting to allocate the cash flow between the two vertices. In the hypothetical situation used here, this presents no problem because six years falls precisely between five years and seven years. Therefore, the weightings are 0.5 for year 5 and 0.5 for year 7. If the cash flow had fallen in a less obvious maturity point, we would have to calculate the weightings using the formula for portfolio variance. Using these weightings, we calculate the variance for the new "portfolio", containing the two new cash flows, and then the standard deviation for the portfolio. This gives us a VaR for the strip of £265,853.

Table 17.4 Cash flow mapping and portfolio variance

Interpolated yield:	0.05425
Interpolated volatility:	0.26725
Present value:	728,347.0103
Weighting 5-year grid point:	0.5
Weighting 7-year grid point:	0.5
Variance of portfolio:	0.070677824
Standard deviation:	0.265853012
VaR£:	265,853

Confidence intervals

Many models estimate VaR at a given confidence interval, under normal market conditions. This assumes that market returns generally follow a random pattern but one that approximates over time to a normal distribution. The level of confidence at which the VaR is calculated will depend on the nature of the trading book's activity and what the VaR number is being used for. The market risk amendment to the Basel capital accord stipulates a 99% confidence interval and a 10-day holding period if the VaR measure is to be used to calculate the regulatory capital requirement. However, certain banks prefer to use other confidence levels and holding periods; the decision on which level to use is a function of the asset types in the portfolio, the quality of market data available and the accuracy of the model itself, which will have been tested over time by the bank.

For example, a bank may view a 99% confidence interval as providing no useful information, as it implies that there should only be two or three breaches of the VaR measure over the course of one year. That would leave no opportunity to test the accuracy of the model until a longer period of time had elapsed and, in the meantime, the bank would be unaware if the model were generating inaccurate numbers. A 95% confidence level implies that the VaR level is being exceeded around one day each month, if a year is assumed to contain 250 days.[2] If a VaR calculation is made using 95% confidence, and a 99% confidence level is required for, say, regulatory purposes, we need to adjust the measure to take account of the change in standard deviations required. For example, a 99% confidence interval corresponds to 2.32 standard deviations, while a 95% level is equivalent to 1.645 standard deviations. Thus, to convert from 95% confidence to 99% confidence, the VaR figure is divided by 1.645 and multiplied by 2.32.

In the same way, there may be occasions when a firm will wish to calculate VaR over a different holding period to that recommended by the Basel rules. The holding period of a portfolio's VaR calculation should represent the period of time required to unwind the portfolio; that is, sell off the assets on the book. A 10-day holding period is recommended but would be unnecessary for a highly liquid portfolio; for example, one holding government bonds.

To adjust the VaR number to fit it to a new holding period we simply scale it upwards or downwards by the square root of the time period required. For example, a VaR calculation measured for a 10-day holding period will be $\sqrt{10}$ times larger than the corresponding 1-day measure.

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 cutoff of the worst-case scenario. For example, to calculate the VaR at a 95% confidence level, the fifth 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 whose asset weightings frequently change, as another set of data would be necessary before a VaR number could be calculated.

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 of these is the Monte Carlo method. To calculate VaR using a Monte Carlo approach, a computer simulation is run 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, whose price behavior 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 program to reflect relationships.

Example 17.2: Portfolio volatilty using variance–covariance and simulation methods

A simple two-asset portfolio is composed of the following instruments:

	Gilt strip	**FTSE100 stock**
Number of units	£100 million	£5 million
Market value	£54.39 million	£54 million
Daily volatility	£0.18 million	£0.24 million

The correlation between the two assets is 20%. Using (17.4) we calculate the portfolio VaR as follows:

$$\text{Vol.} = \sqrt{s_{bond}^2 + s_{stock}^2 + 2s_{bond}s_{stock}r_{bond,stock}}$$

$$\text{Vol.} = \sqrt{0.18^2 + 0.24^2 + (2 \times 0.18 \times 0.24 \times 0.2)}$$

$$= 0.327.$$

We have ignored the weighting element for each asset because the market values are roughly equal. The calculation gives a portfolio volatility of £0.327 million. For a 95% confidence level VaR measure, which corresponds to 1.645 standard deviations (in a one-tailed test), we multiply the portfolio volatility by 1.645, which gives us a portfolio VaR of £0.538 million.

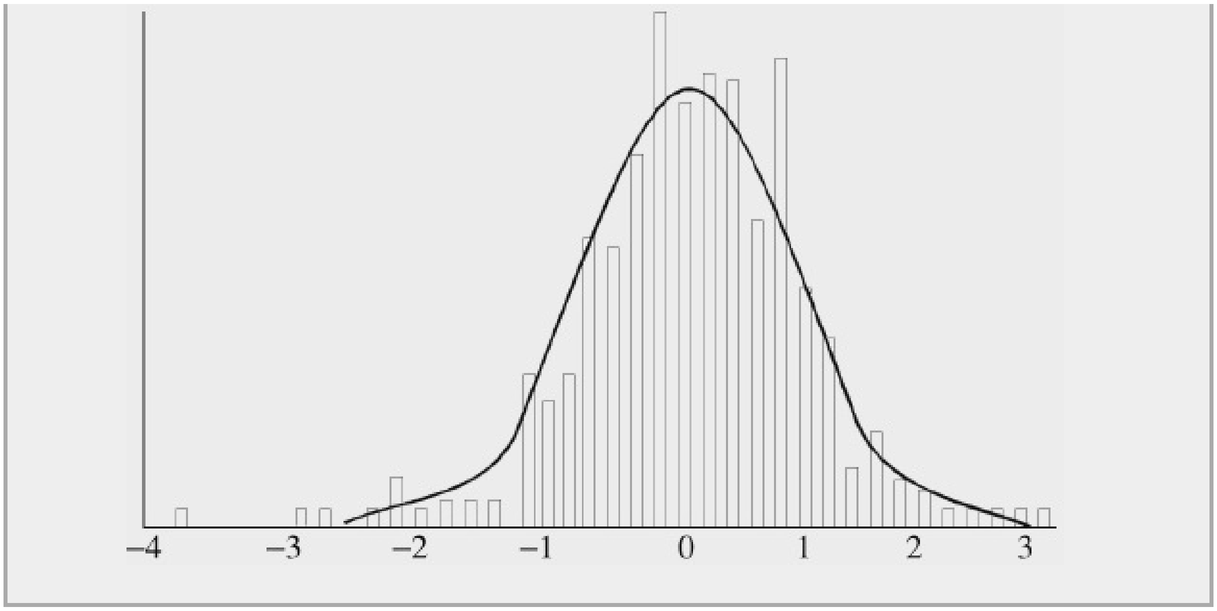
In a Monte Carlo simulation, we also calculate the correlation and volatilities of the portfolio. These values are used as parameters in a random-number simulation to throw out changes in the underlying portfolio value. These values are used to reprice the portfolio, and this value will be either a gain or loss on the actual mark-to-market value. This process is repeated for each random number that is generated. In Table 17.5 we show the results for 15 simulations of our two-asset portfolio. From the results we read off the loss level that corresponds to the required confidence interval.

Table 17.5 Monte Carlo simulation results

Simulation	Market value: bond	Market value: stock	Portfolio value	Profit/Loss
1	54.35	54.9	109.25	0.86
2	54.64	54.02	108.66	0.27
3	54.4	53.86	108.26	–0.13
4	54.25	54.15	108.4	0.01
5	54.4	54.17	108.57	0.18
6	54.4	54.03	108.43	0.04
7	54.31	53.84	108.15	–0.24
8	54.3	53.96	108.26	–0.13
9	54.46	54.11	108.57	0.18
10	54.32	53.92	108.24	–0.15
11	54.31	53.97	108.28	–0.11
12	54.47	54.08	108.55	0.16
13	54.38	54.03	108.41	0.02
14	54.71	53.89	108.6	0.21
15	54.29	54.05	108.34	–0.05

As the number of trials is increased, the results from a Monte Carlo simulation approach those of the variance–covariance measure. This is shown in Figure 17.2.

Figure 17.2 The normal approximation of returns



VaR for fixed-income instruments

Perhaps the most straightforward instruments to which VaR can be applied are foreign-exchange and interest-rate instruments such as money market products, bonds, forward-rate agreements and swaps. In this section, we review the calculation of VaR for a simple portfolio of bonds.

Sample bond portfolio

Table 17.6 details the bonds that are in our portfolio. For simplicity, we assume that all the bonds pay an annual coupon and have full years left to maturity. In order to calculate the VaR, we first need to value the bond portfolio itself. The bonds are valued by breaking them down into their constituent cash flows; the present value of each cash flow is then calculated, using the appropriate zero-coupon interest rate. Note from Figure 17.3 on page 852 that the term structure is inverted.

Table 17.6 Sample three-bond portfolio

	Bond 1	Bond 2	Bond 3
Nominal value	10,000,000	3,800,000	9,700,000
Coupon	5%	7.25%	6%
Maturity	5	7	2

Figure 17.3 Term structure used for valuation

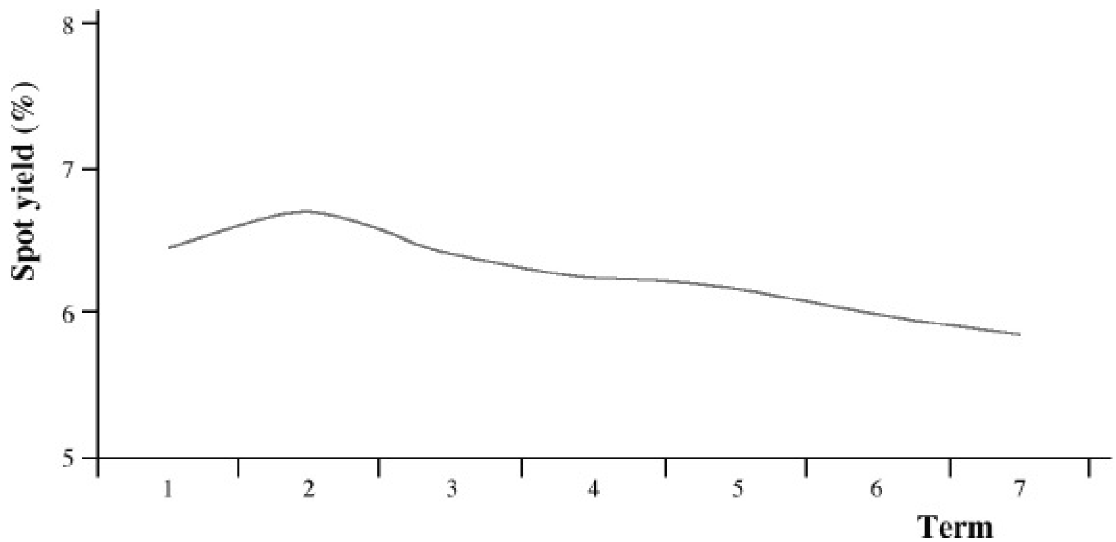


Table 17.7 on page 852 shows the present values for each of the cash flows. The total portfolio value is also shown.

Table 17.7 Bond portfolio valuation

Period	Cash flows: Bond 1	Bond 2	Bond 3	Zero-coupon rates	Discount factor	Present values		
1	500,000	275,500	582,000	6.45	0.939408173	469,704	258,807	546,736
2	500,000	275,500	10,282,000	6.7	0.878357191	439,179	241,987	9,031,269
3	500,000	275,500		6.4	0.830185447	415,093	228,716	
4	500,000	275,500		6.25	0.784664935	392,332	216,175	
5	10,500,000	275,500		6.18	0.740945722	7,779,930	204,131	
6		275,500		5.98	0.705759136		194,437	
7		4,075,500		5.87	0.670794678		2,733,824	
					Totals	9,496,238	4,078,077	9,578,004
				Portfolio value		23,152,319		

We then use the volatility for each period rate to calculate the VaR. The volatility levels for our hypothetical currency are relatively low in this example. The VaR for each maturity period is then obtained by multiplying the total present value of the cash flows for that period by its volatility level. This is shown in Table 17.8. By adding together all the individual values, we obtain an undiversified VaR for the portfolio. The total VaR is £1.77 million, for a portfolio with a market value of £23.1 million.

Table 17.8 Bond portfolio undiversified VaR

Period	Cash flows	Present value	Volatility	VaR
1	1,357,500.00	1,275,246.59	0.0687	87,609.44
2	11,057,500.00	9,712,434.64	0.0695	675,014.21
3	775,500.00	643,808.81	0.07128	45,890.69
4	775,500.00	608,507.66	0.0705	42,899.79
5	10,775,500.00	7,984,060.63	0.08501	678,724.99
6	275,500.00	194,436.64	0.08345	16,225.74
7	4,075,500.00	2,733,823.71	0.08129	222,232.53
			Undiversified VaR	1,768,597.39

The figure just calculated is the undiversified VaR for the bond portfolio. To obtain the diversified VaR for the book, we require the correlation coefficient of each interest rate with the other interest rates (the correlation will be very close to unity, although the shorter-dated rates will be closer in line with each other than they will be with long-dated rates). We may then use the standard variance–covariance approach, using a matrix of the undiversified VaR values and a matrix with the correlation values. However, the diversification benefit of a portfolio of bonds will be small, mainly because their volatilities will be closely correlated.

Forward-rate agreements

The VaR calculation for a FRA follows the principles reviewed in the previous section. An FRA is a notional loan or deposit for a period starting at some point in the future; in effect, it is used to fix a borrowing or lending rate. The derivation of an FRA rate is based on the principle of what it would cost for a bank that traded one to hedge it; this is known as the "breakeven" rate. So a bank that has bought 3v6 FRA (referred to as a "threes-sixes FRA") has effectively borrowed funds for three months and placed the funds on deposit for six months. Therefore, an FRA is best viewed as a combination of an asset and a liability, and that is how one is valued. So a long position in a 3v6 FRA is valued as the present value of a three-month cash flow asset and the present value of a six-month cash flow liability, using the three-month and six-month deposit rates. The net present value is taken, of course, because one cash flow is an asset and the other a liability.

Consider a 3v6 FRA that has been dealt at 5.797%, the three-month forward–forward rate. The value of its constituent (notional) cash flows is shown in Table 17.9. The three-month and six-month rates are cash rates in the market, while the interest-rate volatilities have been obtained from RiskMetrics™. The details are summarised in Table 17.9.

Table 17.9 Undiversified VaR for a 3v6 FRA contract

Cash flow	Term (days)	Cash rate	Interest-rate volatilities	Present value	Undiversified VaR
10,000,000	91	5.38%	0.14%	9,867,765	13,815
−10,144,536	182	5.63%	0.21%	−9,867,765	20,722

The undiversified VaR is the sum of the individual VaR values, and is

£34,537. It has little value in the case of an FRA, however, and would overstate the true VaR, because an FRA is made up of a notional asset and liability, so a fall in the value of one would see a rise in the value of the other. Unless a practitioner was expecting three-month rates to go in an opposite direction to six-month rates, there is an element of diversification benefit. There is a high correlation between the two rates, so the more logical approach is to calculate a diversified VaR measure.

For an instrument such as an FRA, the fact that the two rates used in calculating the FRA rate are closely positively correlated will mean that the diversification effect will be to reduce the VaR estimate, because the FRA is composed notionally of an asset and a liability. From the values in Table 17.9, therefore, the six-month VaR is actually a negative value (if the bank had sold the FRA, the three-month VaR would have the negative value). To calculate the diversified VaR, then, requires the correlation between the two interest rates, which may be obtained from the RiskMetrics™ dataset. This is observed to be 0.87. This value is entered into a 2x2 correlation matrix and used to calculate the diversified VaR in the normal way. The procedure is:

- transpose the weighting VaR matrix, to turn it into a 2x1 matrix;
- multiply this by the correlation matrix;
- multiply the result by the original 1x2 weighting matrix;
- this gives us the variance; the VaR is the square root of this value.

The result is a diversified VaR of £11,051.

Interest-rate swaps

To calculate a variance–covariance VaR for an interest-rate swap, we use the process described earlier for an FRA. There are more cash flows that go to make up the undiversified VaR, because a swap is essentially a strip of FRAs. In a plain vanilla interest-rate swap, one party pays on a fixed-rate basis on an annual or semi-annual basis, and receives floating-rate interest, while the other party pays floating-rate interest payments and receives fixed-rate interest. Interest payments are calculated on a notional sum, which does not change hands, and only interest payments are exchanged. In practice, it is the net difference between the two payments that is transferred.

The fixed rate on an interest-rate swap is the breakeven rate that equates the present value of the fixed-rate payments to the present value of the floating-rate payments. As the floating-rate payments are linked to a reference rate such as

Libor, we do not know what they will be, but we use the forward rate applicable to each future floating payment date to calculate what it would be if we were to fix it today. The forward rate is calculated from zero-coupon rates today. A “long” position in a swap is to pay fixed and receive floating, and is conceptually the same as being short in a fixed-coupon bond and being long in a floating-rate bond. In effect, the long is “borrowing” money, so a rise in the fixed rate will result in a rise in the value of the swap. A “short” position is receiving fixed and paying floating, so a rise in interest rates results in a fall in the value of the swap. This is conceptually similar to a long position in a fixed-rate bond and a short position in a floating-rate bond.

Describing an interest-rate swap in conceptual terms of fixed-and floating-rate bonds gives some idea as to how it is treated for VaR purposes. The coupon on a floating-rate bond is reset periodically in line with the stated reference rate, usually Libor. Therefore, the duration of a floating-rate bond is very low, and conceptually the bond may be viewed as being the equivalent of a bank deposit, which receives interest payable at a variable rate. For market-risk purposes,[3] the risk exposure of a bank deposit is nil, because its present value is not affected by changes in market interest rates. Similarly, the risk exposure of a floating-rate bond is very low and to all intents and purposes its VaR may be regarded as zero. This leaves only the fixed-rate leg of a swap to measure for VaR purposes.

Table 17.10 shows the fixed-rate leg of a five-year interest-rate swap. To calculate the undiversified VaR, we use the volatility rate for each term interest rate; this may be obtained from RiskMetrics™. Note that the RiskMetrics™ dataset supports only liquid currencies; for example, data on volatility and correlation is not available for certain emerging-market economies. We show the VaR for each payment; the sum of all the payments constitutes the undiversified VaR. We then require the correlation matrix for the interest rates, and this is used to calculate the diversified VaR. The weighting matrix contains the individual term VaR values, which must be transposed before being multiplied by the correlation matrix.

Table 17.10 Fixed-rate leg of five-year interest-rate swap and undiversified VaR

Pay date	Swap rate	Principal (£)	Coupon (£)	Coupon present value (£)	Volatility	Undiversified VaR
7-Jun-00	6.73%	10,000,000	337,421	327,564	0.05%	164
7-Dec-00	6.73%	10,000,000	337,421	315,452	0.05%	158
7-Jun-01	6.73%	10,000,000	335,578	303,251	0.10%	303
7-Dec-01	6.73%	10,000,000	337,421	294,898	0.11%	324
7-Jun-02	6.73%	10,000,000	335,578	283,143	0.20%	566
9-Dec-02	6.73%	10,000,000	341,109	277,783	0.35%	972
9-Jun-03	6.73%	10,000,000	335,578	264,360	0.33%	872
8-Dec-03	6.73%	10,000,000	335,578	256,043	0.45%	1,152
7-Jun-04	6.73%	10,000,000	335,578	248,155	0.57%	1,414
7-Dec-04	6.73%	10,000,000	337,421	242,161	1.90%	4,601
					Total	**10,528**

Using the volatilities and correlations supplied by RiskMetrics™, the diversified VaR is shown to be £10,325. This is very close to the undiversified VaR of £10,528. This is not unexpected because the different interest rates are very closely correlated.

Using VaR to measure market-risk exposure for interest-rate products enables a risk manager to capture non-parallel shifts in the yield curve, which is an advantage over the traditional duration measure and interest-rate gap measure. Therefore, estimating a book's VaR measure is useful not only for the trader and risk manager, but also for senior management, who by using VaR will have a more accurate idea of the risk-market exposure of the bank. VaR methodology captures pivotal shifts in the yield curve by using the correlations between different maturity interest rates. This reflects the fact that short-term interest rates and long-term interest rates are not perfectly positively correlated.

Derivative products and VaR

The variance–covariance methodology for calculating VaR is considered adequate for trading books that contain mostly products that have a linear payoff profile. This covers money market interest-rate instruments; however, the price/yield relationship for bonds exhibits a curved relationship, which gives rise to the convexity property. A trading book with convex instruments will have an added convexity risk exposure, and while most VaR methodologies are able to capture convexity risks adequately, an adjustment to the basic calculation has to be made. Such an adjusted measure is known as the *delta–gamma VaR*. Option products, however, have a non-linear payoff profile, and it is more difficult to capture risks associated with option trading books using the variance–covariance approach. In this section we review the delta–gamma approach and its application to bonds and options.

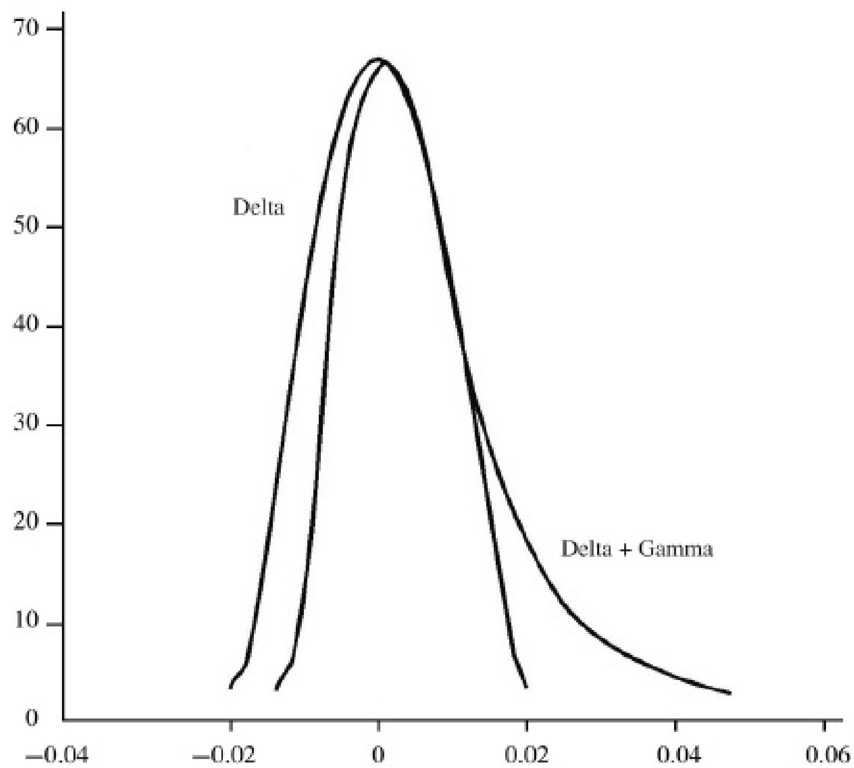
Option gamma

The gamma measurement for an option is conceptually similar to convexity for a bond. Convexity is a measure of the error made in using modified duration; that is, the curvature of the price/yield relationship. Gamma is the second derivative of an option's delta, so in effect it measures the same thing as convexity. As with convexity, it is important for traders to be aware of the gamma exposure of their books, as at a high gamma level, even very small changes in the price of the underlying asset may lead to substantial mark-to-market losses. A trader who writes options, whether put or call options, is effectively short gamma.

The gamma effect on an option book cannot be captured accurately by most VaR models. This is because the relationship between gamma and the price of the underlying asset is non-linear. To approximate the VaR measure for an option book, a *delta–gamma* calculation is made, and although it is still not completely accurate, it is a better estimate than the conventional delta-normal approach. However, although intuitively delta–gamma is similar to the convexity adjustment for a bond portfolio, it is not as good an approximation as the convexity measure. This is because behaviour of an option is more unpredictable than that of a bond. A bond instrument may be broken down into a series of zero-coupon bonds, so that volatility and other data maybe adjusted for convexity with relative ease. This is not as easy for options, and becomes particularly acute as an option approaches maturity. For example, an at-the-money option will experience extreme movement in its gamma as it approaches maturity, in a way that is unpredictable. It is difficult to capture this effect in a VaR model. Nevertheless, the delta–gamma measure is recognised as a close approximation of option book risk, short of using simulation-type VaR models.

The gamma effect has an impact on the distribution of returns from an option book. This transforms the distribution from normal to one with slightly skewed tails, as illustrated by Figure 17.4.

Figure 17.4 Delta + gamma effect



To illustrate the gamma adjustment, consider a position in a bond instrument and a put option on foreign exchange. The details are set out in Table 17.11. The interest-rate and FX volatility and correlation data may be obtained from RiskMetrics™. Using these, we calculate the undiversified VaR in the normal manner, multiplying the market value of the instrument by the volatility value to obtain VaR. For the option, we also multiply the value and the volatility by the delta (that is, 1,507,000 × 0.54 × 6.10%). The delta adjustment is required because the price of the option does not move “tick-for-tick” with the underlying asset, but by 0.54 for each unit change in the underlying asset. The undiversified VaR is 49,641.

Table 17.11 Hypothetical portfolio and undiversified VaR

Bond nominal:	2,000,000
Maturity (years):	2
Market value:	1,507,000
Volatility:	1.60%
Undiversified VaR:	24,112
Nominal value FX option:	1,507,000
Delta:	0.54
Gamma:	3.9
FX volatility:	6.10%
Undiversified VaR:	49,641
Correlation coefficient:	−0.31

To calculate the undiversified VaR we require the portfolio variance, which would normally be done in the conventional way using matrices; here there are only two assets so we may use the standard variance equation. The square root of this is the VaR, which is calculated as:

$$Var_{port} = \sqrt{24{,}112^2 + 49{,}641^2 + (2 \times -0.31 \times 24{,}112 \times 49{,}641)}$$

$$= 41{,}498.$$

Although the undiversified VaR is more realistic a measure, it will not take into account the gamma effect of the option. Previously we allowed for the delta of the option, which was used to modify the volatility level, which changed from 6.10% to 3.294%. The gamma adjustment is made by using Equation (36.5) in Choudhry (2001), which in this case gives a gamma adjustment of 0.7256%. The delta–gamma approximation for the volatility is therefore 2.568%. Multiplying this by the weighting (the option value) we have a new diversified VaR for the option of 38,700. If we use the same portfolio variance equation we obtain a delta–gamma adjusted diversified VaR of 27,488.

The delta–gamma adjustment is only an approximation of an option book's gamma risk exposure, and it is not as close as a convexity adjustment. This is due mainly to the unpredictable behaviour of gamma as an option approaches maturity, more so if it is at-the-money.

Stress testing

Risk-measurement models and their associated assumptions are not without limitation. It is important to understand what will happen should some of the model's underlying assumptions break down. Stress testing is a process whereby a series of scenario analyses or simulations are carried out to investigate the effect of extreme market conditions on the VaR estimates calculated by a model. It is also an analysis of the effect of violating any of the basic assumptions behind a risk model. If carried out efficiently, stress testing will provide clearer information on the potential exposures at risk due to significant market corrections, which is why the Basel Committee recommends that it be carried out.

Simulating stress

There is no standard way to undertake stress testing. It is a means of experimenting with the limits of a model. It is also a means to measure the residual risk which is not effectively captured by the formal risk model, thus complementing the VaR framework. If a bank uses a confidence interval of 99% when calculating its VaR, the losses on its trading portfolio due to market movements should not exceed the VaR number on more than one day in 100. For a 95% confidence level the corresponding frequency is one day in 20, or roughly one trading day each month. The question to ask is "What are the expected losses on those days?" Also, what can an institution do to protect itself against these losses? Assuming that returns are normally distributed provides a workable daily approximation for estimating risk, but when market moves are more extreme these assumptions no longer add value. The 1% of market moves that are not used for VaR calculations include events such as the October 1987 crash, the bond market collapse of February 1994 and the Mexican peso crisis at the end of 1994. In these cases, market moves were much larger than any VaR model could account for; in fact, the October 1987 crash was a 20-standard deviation move. Under these circumstances, correlations between markets also increase well above levels normally assumed in models.

An approach used by risk managers is to simulate extreme market moves over a range of different scenarios. One method is to use Monte Carlo simulation. This allows dealers to push the risk factors to greater limits. For example, a 99% confidence interval captures events up to 2.33 standard deviations from the mean asset-return level. A risk manager can calculate the effect on the trading portfolio of a 10-standard deviation move. Similarly, risk managers may want to change the correlation assumptions under which they normally work. For instance, if markets all move down together, something that happened in Asian markets from the end of 1997 and emerging markets generally from July 1998 after the Russian bond technical default, losses will be greater than if some markets are offset by other negatively correlated markets.

Only by pushing the bounds of the range of market moves that are covered in the stress-testing process can financial institutions have an improved chance of identifying where losses might occur and, therefore, a better chance of managing their risk effectively.

Stress testing in practice

For effective stress testing, a bank has to consider non-standard situations. The Basel policy group has recommended certain minimum standards in respect of specified market movements. The parameters chosen are considered large moves to overnight marks, and include:

- parallel yield-curve shifts of 100 basis points up and down;
- steepening and flattening of the yield curve (two-year to 10-year) by 25 basis points;
- increase and decrease in three-month yield volatilities by 20%;
- increase and decrease in equity index vales by 10%;
- increase and decrease in the swap spread by 20 basis points.

These scenarios represent a starting point for a framework for routine stress testing.

Banks agree that stress testing must be used to supplement VaR models. The main problem appears to be difficulty in designing appropriate tests. The main issues are:

- difficulty in "anticipating the unanticipated";
- adopting a systematic approach, with stress testing carried out by looking at past extremes and analysing the effect on the VaR number under these circumstances;
- selecting 10 scenarios based on past extreme events and generating portfolio VaRs based on reruns of these scenarios.

The latest practice is to adapt stress tests to suit the particular operations of a bank itself. On the basis that one of the main purposes of stress testing is to provide senior management with accurate information concerning the extent of a bank's potential risk exposure, more valuable data will be gained if the stress test is particularly relevant to the bank. For example, an institution such as Standard Chartered Bank, which has a relatively high level of exposure to exotic currencies, may design stress tests that take into account extreme movements in, say, regional Asian currencies. A mortgage book holding option positions only to hedge its cash book – say, one of the former UK building societies that subsequently converted to banks – may have no need for excessive stress testing on, perhaps, the effect of extreme moves in derivatives liquidity levels.

Issues in stress testing

It is to be expected that extreme market moves will not be captured in VaR measurements. The calculations will always assume that the probability of events such as the Mexican peso devaluation are extremely low when analysing historical or expected movements of the currency. Stress tests need to be designed to model for such occurrences. Back-testing a firm's qualitative and quantitative risk-management approach for actual extreme events often reveals the need to adjust reserves, increase the VaR factor, adopt additional limits and controls, and expand risk calculations. With back-testing, a firm will take, say, its daily VaR number, which we will assume is computed to 95% degree of confidence. The estimate will be compared to the actual trading losses suffered by the book over a 20-day period and, if there is a significant discrepancy, the firm will need to go back to its model and make adjustments to parameters. Frequent and regular back-testing of the VaR model's output with actual trading losses is an important part of stress testing. To conduct back-testing efficiently, a firm would need to be able to strip out its intra-day profit-and-loss figures, so it could compare the actual change in p&l to what was forecast by the VaR model.

The procedure for stress testing in banks usually involves:

- creating hypothetical extreme scenarios;
- computing corresponding hypothetical p&ls.

One method is to imagine *global* scenarios. If one hypothesis is that the euro appreciates sharply against the dollar, the scenario needs to consider any related areas, such as the effect, if any, on the Swiss franc and Norwegian krone rate, or the effect on the yen and on interest rates. Another method is to generate many *local* scenarios and so consider a few risk factors at a time. For example, given an FX option portfolio a bank might compute the hypothetical p&l for each currency pair under a variety of exchange rate and implied volatility scenarios. There is then the issue of amalgamating the results: one way would be to add the worst-case results for each of the sub-portfolios, but this ignores any portfolio effect and cross-hedging. This may result in an over-estimate that is of little use in practice.

Nevertheless, stress testing is one method to account for the effect of extreme events that occur more frequently than would be expected were asset returns to follow a true normal distribution. For example, five standard-deviation moves in a market in one day have been observed to occur twice every 10 years or so, which is considerably more frequent than given by a normal distribution. Testing for the effects of such a move gives a bank an idea of its exposure under these conditions.

VaR methodology for 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 in this period. The growth in credit exposures and the rise of complex instruments have led to a need for more sophisticated risk-management techniques to measure credit risk.

Modelling credit risk

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

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

This allows portfolio effects – the benefits of diversification and risks of concentration – to be quantified.

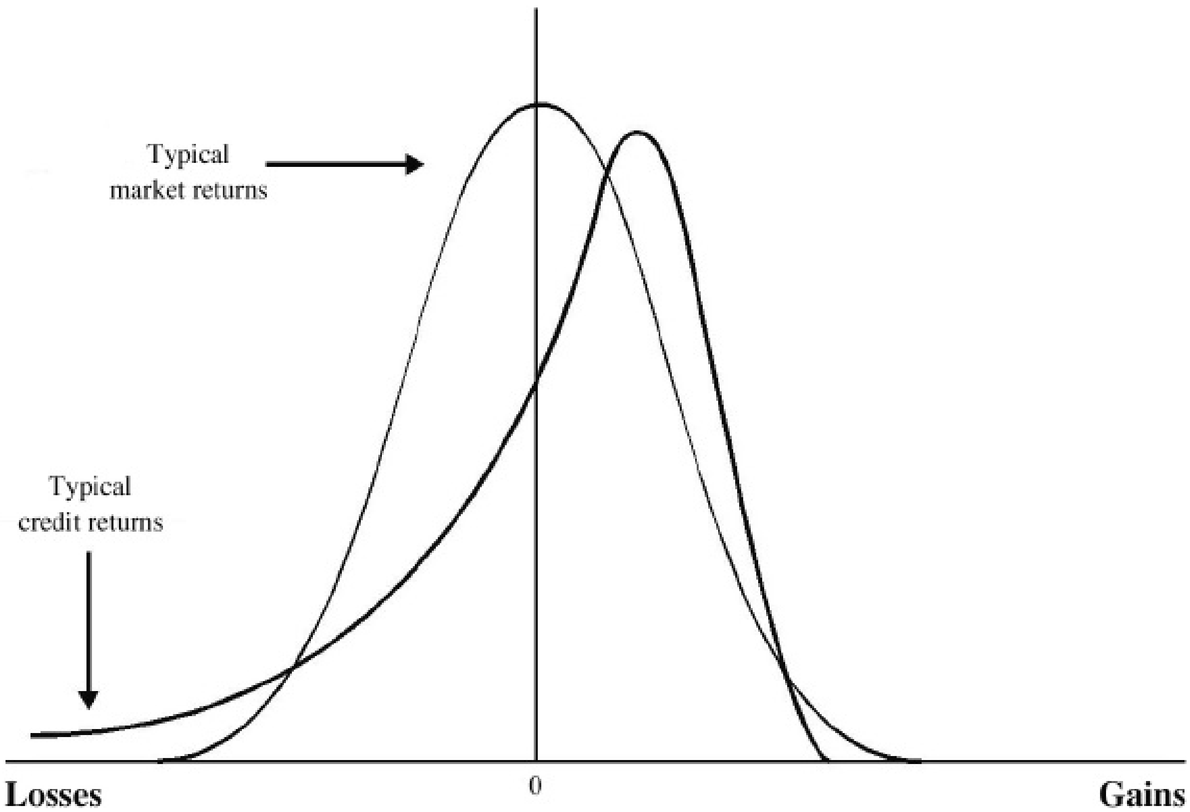
The portfolio risk of an exposure is determined by four factors:

- size of the exposure;
- maturity of the exposure;
- probability of default of the obligor;
- systematic 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 from market risk. Typically, market-return distributions are assumed to be relatively symmetrical and approximated by normal distributions. In credit portfolios, value changes will be relatively small upon 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 17.5.

Figure 17.5 Comparison of distribution of market returns and credit returns



This difference in risk profiles does not prevent us from assessing risk on a comparable basis. Analytical 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 such distributions that may arise from the current portfolio. This considers the question of what the expected loss is for a given confidence level;
- 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. There are two approaches:

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

The constant time horizon is similar to the CreditMetrics™ approach developed by JPMorgan 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 portfolio managers.

Data inputs

Modelling credit risk requires certain data inputs. These include:

- 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.

We now consider two methodologies used for measuring credit VaR, the CreditMetrics™ model and the CreditRisk+ model.

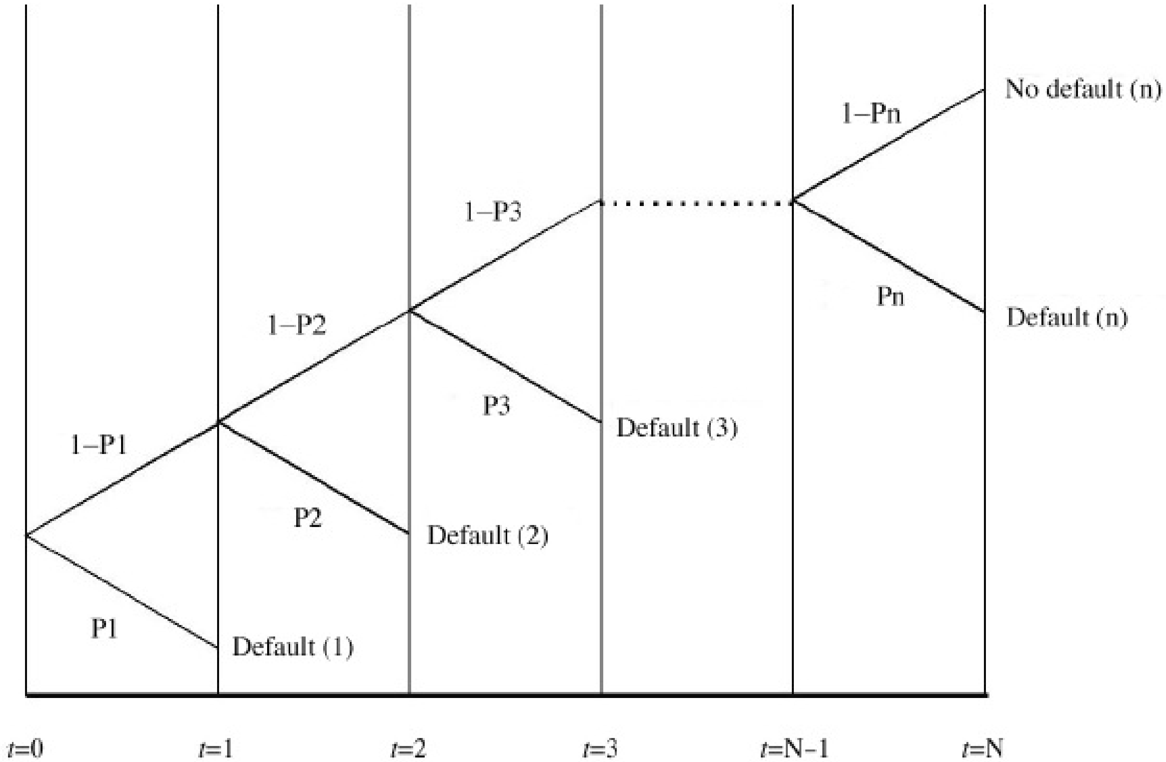
CreditMetrics™

CreditMetrics™ is JPMorgan’s portfolio model for analysing credit risk, and provides an estimate of VaR due to credit events caused by upgrades, downgrades and default.

Methodology

There are two main frameworks in use for quantifying credit risk. One approach considers only two states: default and no default. This model constructs a binomial tree of default versus no default outcomes until maturity. This approach is shown in Figure 17.6.

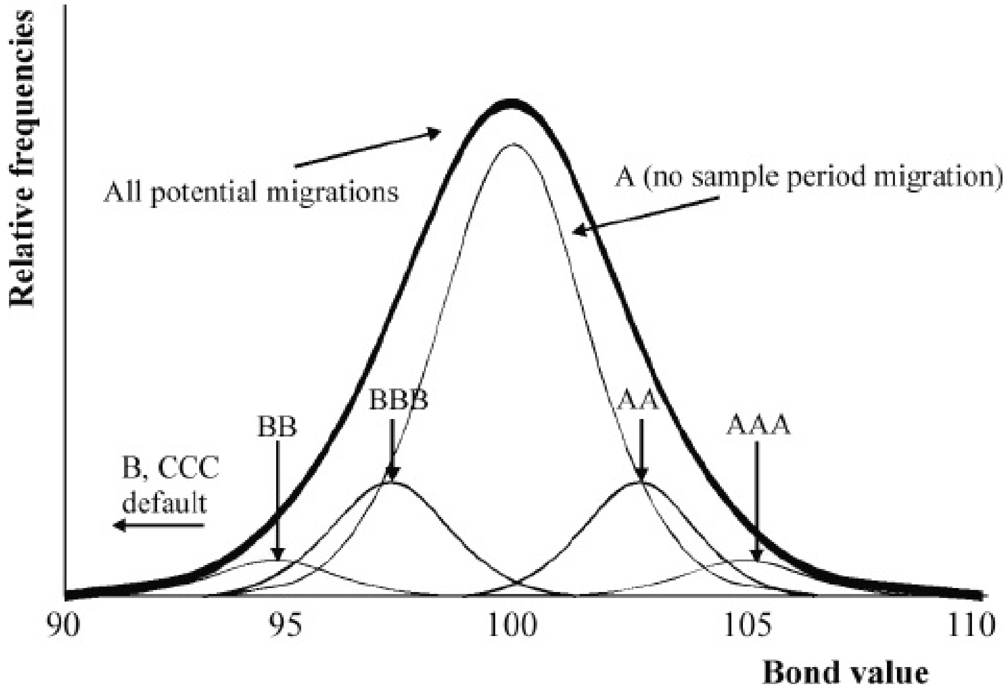
Figure 17.6 A binomial model of credit risk



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 to proxy 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 17.7, bonds within each credit rating category have volatility of value due to day-to-day credit-spread fluctuations. The figure 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.

Figure 17.7 Distribution of credit returns by rating



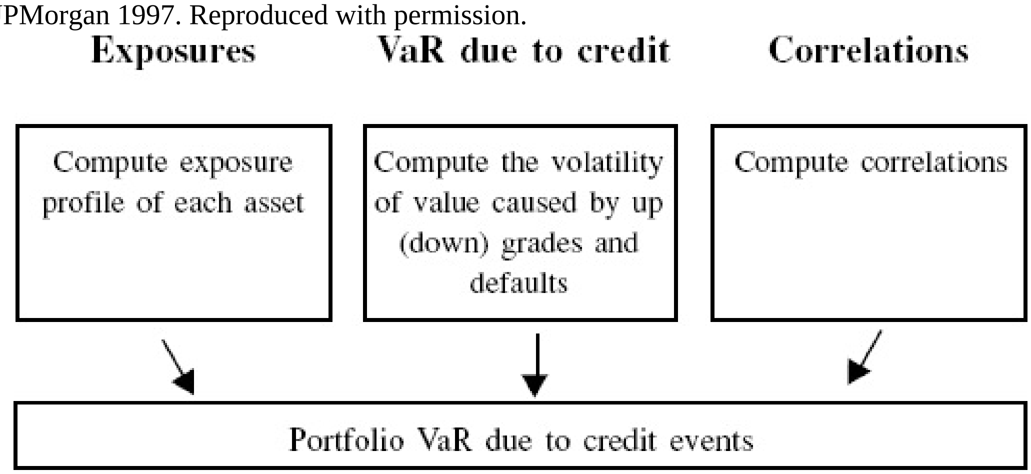
Time horizon

CreditMetrics™ adopts a one-year risk horizon. The justification given in its technical document[4] 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-adjustment procedures with this in mind.

The steps involved in CreditMetrics™ measurement methodology are shown in Figure 17.8 on page 868.

Figure 17.8 Analytics road map for CreditMetrics™

Source: JPMorgan 1997. Reproduced with permission.



The elements in each step are:

Exposures

- user portfolio
- market volatilities
- exposure distributions

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

The CreditMetrics™ methodology assesses individual and portfolio VaR due to credit 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 market-driven 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(down)grades 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 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 horizon can be by either (i) the seniority of the exposure, which determines its recovery rate in case of default, or (ii) the forward zero-coupon curve (spot curve) for each credit-rating category that determines the revaluation upon up(down)grade;
- the probabilities from the two steps above are combined to calculate volatility of value due to credit-quality changes.

Step 3 – Correlations

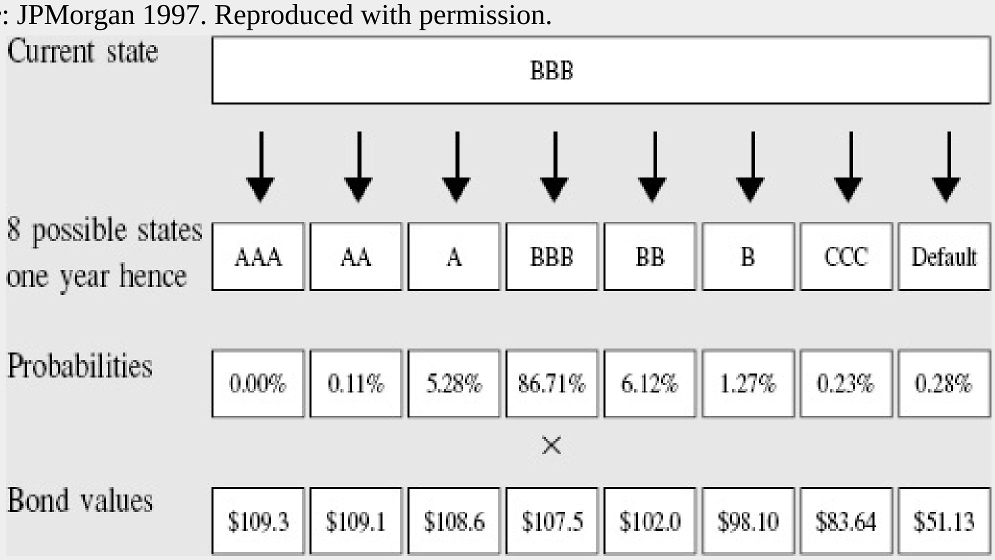
Individual value distributions for each exposure are combined to give a portfolio result. To calculate the portfolio value from the volatility of individual asset values requires estimates of correlation in credit-quality changes. CreditMetrics™ itself allows for different approaches to estimating correlations,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

Example 17.3: Credit-rating migration: Illustration of a probability-step calculation

An example of calculating the probability step is illustrated in Figure 17.9. The probabilities of all possible credit events on an instrument's value must be established first. Given this data, the volatility of value due to credit-quality changes for this one position can be calculated. The process is shown in Figure 17.9.

Figure 17.9 Constructing the distribution value for a BBB-rated bond

Source: JPMorgan 1997. Reproduced with permission.



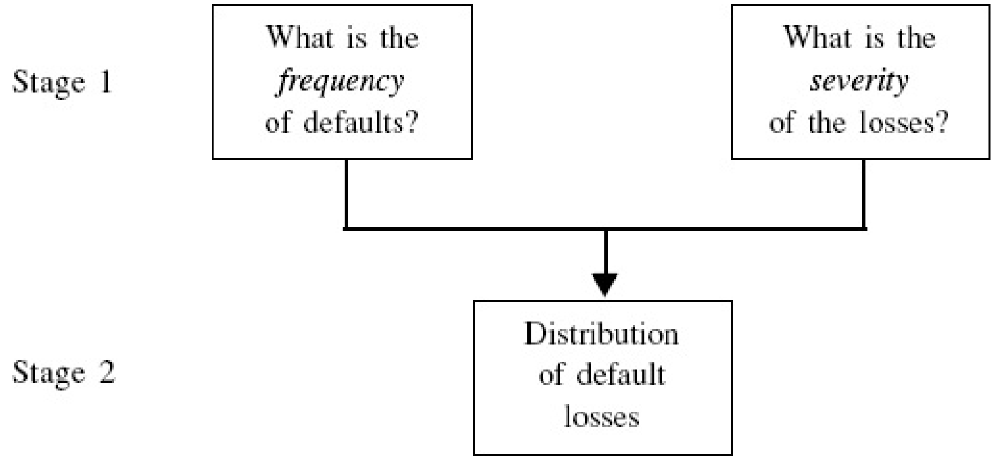
CreditRisk+

CreditRisk+ was developed by Credit Suisse First Boston and can, in theory, handle all instruments that give rise to credit exposure including bonds, loans commitments, letters of credit and derivative instruments. We provide a brief description of its methodology here.

Modelling process

CreditRisk+ uses a two-stage modelling process as illustrated in Figure 17.10.

Figure 17.10 CreditRisk+ modelling process



CreditRisk+ considers the distribution of the number of default events in a time period such as one year, within a portfolio of obligors having a range of different annual probabilities of default.

The annual probability of default of each obligor can be determined by its credit rating and then mapping between default rates and credit ratings. A default rate can then be assigned to each obligor (an example of what this would look like is shown in Table 17.12 on page 872). Default rate volatilities can be observed from historic volatilities.

Table 17.12 One-year default rates (%)

Credit rating	One-year default rate (%)
Aaa	0.00
Aa	0.03
A	0.01
Baa	0.12
Ba	1.36
B	7.27

Correlation and background factors

Default correlation affects the variability of default losses from a portfolio of credit exposures. CreditRisk+ incorporates the effects of default correlations by using default-rate volatilities and sector analysis.

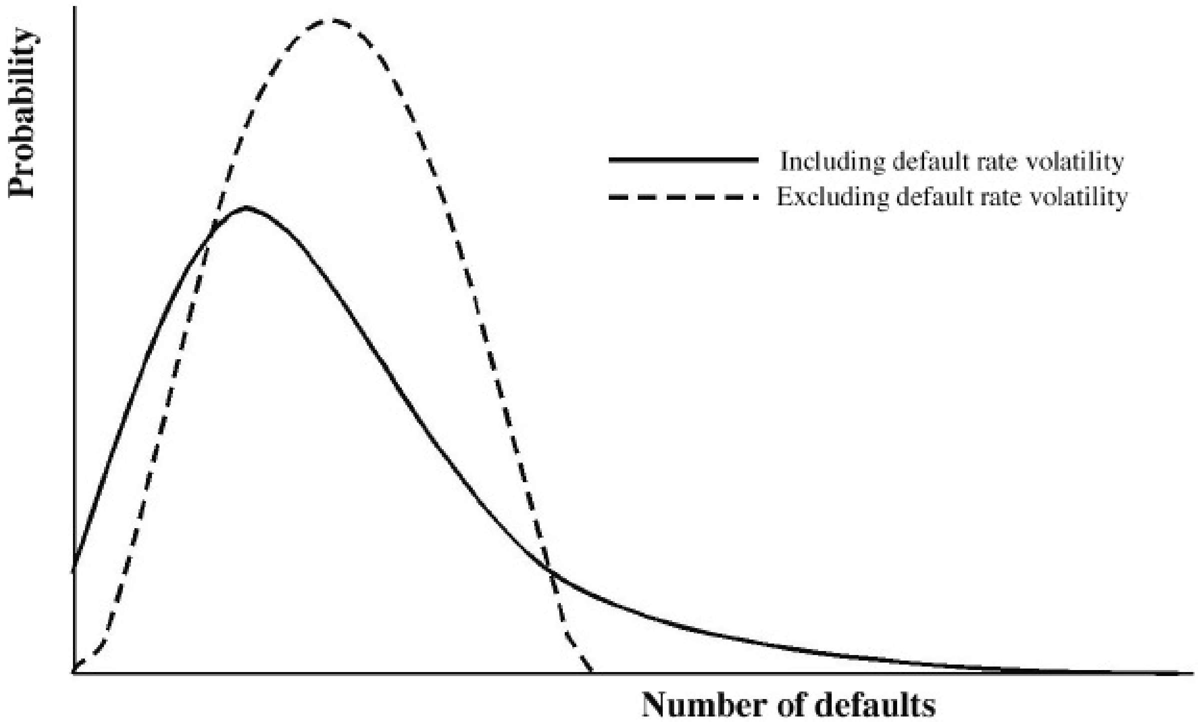
Unsurprisingly enough, it is not possible to forecast the exact occurrence of any one default or the total number of defaults. Often there are background factors that may cause the incidence of default events to be correlated, even though there is no causal link between them. For example, an economy in recession may give rise to an unusually large number of defaults in one particular month, which would increase the default rates above their average level. CreditRisk+ models the effect of background factors by using default-rate volatilities rather than by using default correlations as a direct input. Both distributions give rise to loss distributions with fat tails.

There are background factors that affect the level of default rates. For this reason, it is useful to capture the effect of concentration in particular countries or sectors. CreditRisk+ uses a sector analysis to allow for concentration. Exposures are broken down into an obligor-specific element independent of other exposures, as well as non-specific elements that are sensitive to particular factors such as countries or sectors.

Distribution of the number of default events

CreditRisk+ models the underlying default rates by specifying a default and a default-rate volatility. This aims to take account of the variation in default rates. The effect of using volatility is illustrated in Figure 17.11, which shows the distribution of default rates generated by the model when rate volatility is varied. The distribution becomes skewed to the right when volatility is increased.

Figure 17.11 CreditRisk+ distribution of default events



This is an important result and demonstrates the increased risk represented by an extreme number of default events. By varying the volatility in this way, CreditRisk+ is attempting to model for real-world shock in much the same way that market-risk VaR models aim to allow for the fact that market returns do not follow exact normal distributions, as shown by the incidence of market crashes.

Applications of Credit VaR

One purpose of a risk-management system is to direct and prioritise actions. When considering risk-mitigating actions, there are various features of risk worth targeting, including obligors having:

- the largest absolute exposure;
- the largest percentage level of risk (volatility);
- the largest absolute amount of risk.

A CreditMetrics™-type methodology helps to identify these areas and allows the risk manager to prioritise risk-mitigating action.

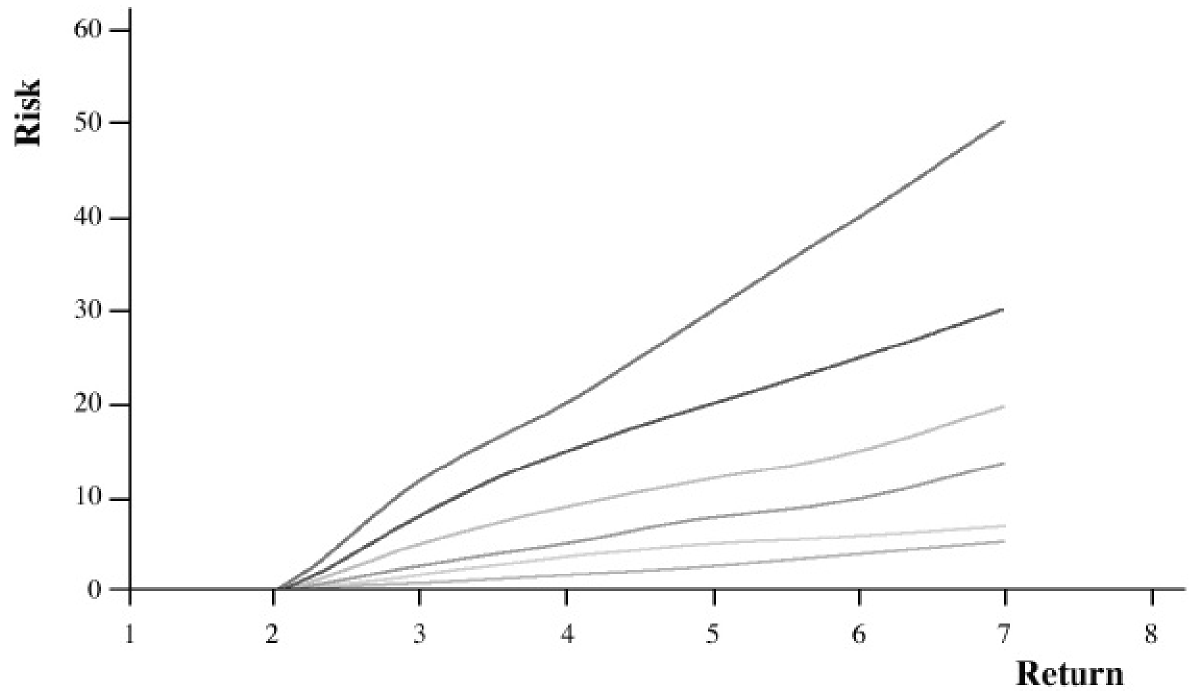
Exposure limits

Within bank trading desks, credit-risk limits are often based on intuitive, but arbitrary, exposure amounts. This is not a logical approach because resulting decisions are not risk-driven. Limits should ideally be set with the help of a quantitative analytical framework.

Risk statistics used as the basis of VaR methodology can be applied to limit setting. Ideally, such a quantitative approach should be used as an aid to business judgment and not as a stand-alone limit-setting tool.

A credit-risk committee considering limit setting can use several statistics such as marginal risk and standard deviation or percentile levels. Figure 17.12 illustrates how marginal risk statistics can be used to make credit limits sensitive to the trade-off between risk and return. The lines in Figure 17.12 represent risk/return trade-offs for different credit ratings, all the way from AAA to BBB. The diagram shows how marginal contribution to portfolio risk increases geometrically with the exposure size of an individual obligor, noticeably so for weaker credits. To maintain a constant balance between risk and return, proportionately more return is required with each increment of exposure to an individual obligor.

Figure 17.12 Size of total exposure to obligor – risk/return profile



Standard credit limit setting

Standard credit-limit setting

In order to equalise a firm’s risk appetite between obligors as a means of diversifying its portfolio, a credit-limit system could aim to have a large number of exposures with equal expected losses. The expected loss for each obligor can be calculated as default rate × (exposure amount – expected recovery).

This means that individual credit limits should be set at levels that are inversely proportional to the default rate corresponding to the obligor rating.

Concentration limits

Concentration limits identified by CreditRisk+-type methodologies have the effect of trying to limit the loss from identified scenarios and are used for managing "tail" risk.

Integrating credit-risk and market-risk functions

It is logical for banks to integrate credit-risk and market-risk management for the following reasons:

- the need for comparability between returns on market and credit risk;
- the convergence of risk-measurement methodologies;
- the transactional interaction between credit and market risk;
- the emergence of hybrid-credit and market-risk product structures.

The objective is for returns on capital to be comparable for businesses involved in credit and market risk, to aid strategic allocation of capital.

Example 17.4: Firm-wide integrated risk management

Assume that at the time of annual planning a bank's lending manager says his department can make £5 million over the year if they can increase their loan book by £300 million, while the trading manager says they can also make £5 million if the position limits are increased by £20 million.

Assuming that capital restrictions will allow only one option to be chosen, which should it be? The ideal choice is the one giving the higher return on capital, but the bank needs to work out how much capital is required for each alternative. This is a quantitative issue that calls for the application of similar statistical and analytical methods to measure both credit and market risk, if one is compare like with like.

With regard to the loan issue, the expected return is the mean of the distribution of possible returns. Since the revenue side of a loan – that is, the spread – is known with certainty, the area of concern is the expected credit-loss rate. This is the mean of the distribution of possible loss rates, estimated from historical data based on losses experienced with similar quality credits.

In the context of market-price risk, the common-denominator measure of risk is volatility (the statistical standard deviation of the distribution of possible future price movements). To apply this to credit risk, the decision-maker therefore needs to take into account the standard deviation of the distribution of possible future credit-loss rates, thereby comparing like with like.

We have shown that as VaR was being adopted as a market-risk measurement tool, the methodologies behind it were steadily applied to the next step along the risk continuum, that of credit risk. Market events, such as bank trading losses in emerging markets and the meltdown of the LTCM hedge fund in summer 1998, have illustrated the interplay between credit risk and market risk. The ability to measure market and credit risk in an integrated model would allow for a more complete picture of the underlying risk exposure. (We would add that adequate senior management understanding and awareness of a third type of risk – liquidity risk – would almost complete the risk-measurement picture).

Market-risk VaR measures can adopt one of the different methodologies available; in all of them there is a requirement for the estimation of the distribution of portfolio returns at the end of a holding period. This distribution can be assumed to be normal, which allows for analytical solutions to be developed. The distribution may also be estimated using historical returns. Finally, a Monte Carlo simulation can be used to create a distribution based on the assumption of certain stochastic processes for the underlying variables. The choice of methodology is often dependent on the characteristics of the underlying portfolio, plus other factors. For example, risk managers may wish to consider the degree of leptokurtosis in the underlying asset-returns distribution, the availability of historical data or the need to specify a more sophisticated stochastic process for the underlying assets. The general consensus is that Monte Carlo simulation, while the most IT-intensive methodology, is the most flexible in terms of specifying an integrated market and credit model.

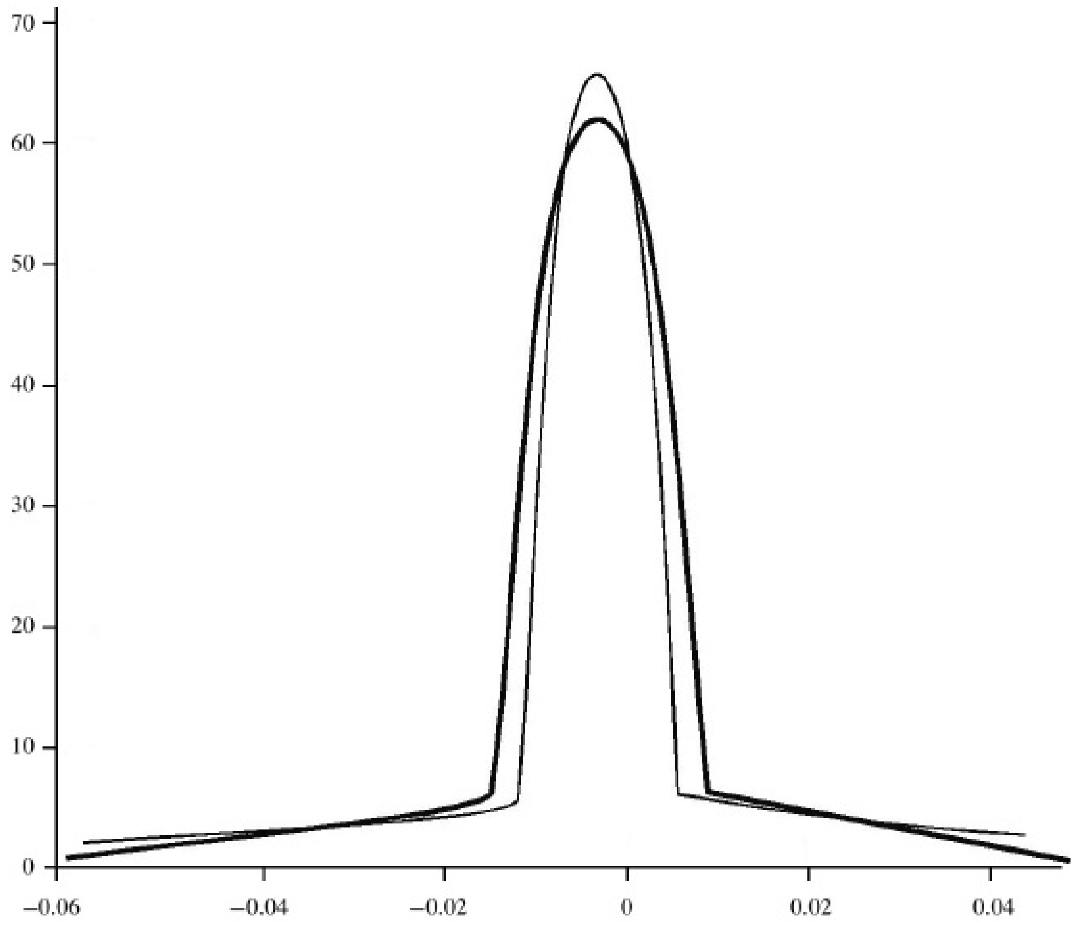
The preceding paragraphs in this section have shown that credit-risk measurement models generally fall into two categories. The first category includes models that specify an underlying process for the default process. In these models, firms are assumed to move from one credit rating to another with specified probabilities. Default is one of the potential states that a firm could move to. The CreditMetrics™ model is of this type. The second type of model requires the specification of a stochastic process for firm value. Here, default occurs when the value of the firm reaches an externally specified barrier. In both models, when the firm reaches default, the credit exposure is impacted by the recovery rate. Again market consensus would seem to indicate that the second type of methodology, the firm value model, most easily allows for development of an integrated model that is linked not only through correlation but also the impact of common stochastic variables.

Appendix

Appendix 17.1: Assumption of normality

The RiskMetrics™ assumption of conditional multivariate normality is open to criticism that financial series tend to produce “fat tails” (leptokurtosis). That is, in reality there is a greater occurrence of non-normal returns than would be expected for a purely normal distribution. This is shown in Figure A17.1. There is evidence that fat tails are a problem for calculations. The RiskMetrics™ technical document defends its assumptions by pointing out that if volatility changes over time there is a greater likelihood of incorrectly concluding that the data are not normal when in fact they are. In fact, conditional distribution models can generate data that possess fat tails.

Figure A17.1 Leptokurtosis



Higher moments of the normal distribution

The skewness of a price data series is measured in terms of the third moment about the mean of the distribution. If the distribution is symmetric, the skewness is zero. The measure of skewness is given by:

$$\textbf{(A17.1)} \quad \frac{\frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^3}{S^3} .$$

The kurtosis describes the extent of the peak of a distribution; that is, how peaked it is. It is measured by the fourth moment about the mean. A normal distribution has a kurtosis of three. The kurtosis is given by:

$$\textbf{(A17.2)} \quad \frac{\frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^4}{S^4} .$$

Distributions with a kurtosis higher than three are commonly observed in asset-market prices and are called leptokurtic. A leptokurtic distribution has higher peaks and fatter tails than the normal distribution. A distribution with a kurtosis lower than three is known as platykurtic.

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[1] Microsoft Excel has a function for multiplying matrices that may be used for any type of matrix. The function is “=MMULT()” typed in all the cells of the product matrix.

[2] For the 99% confidence level, 250 × 1% = 2.5 days in one year, while 95% confidence is 250 × 5% or 12.5 days.

[3] We emphasise for *market-risk* purposes; the credit-risk exposure for a floating-rate bond position is a function of the credit quality of the issuer.

[4] JPMorgan (1997), *Introduction to CreditMetrics*™, JPMorgan & Co.

PART IV

Funding and Balance Sheet Management using Securitisation and Structured Credit Vehicles

Securitisation is an important and well-established technique employed by banks for ALM purposes. By using securitisation, banks have been able to grow their businesses much more quickly than would otherwise have been possible. In Part IV we consider the subject as well as look in detail at the securities and structures that result from the technique, which include asset-backed commercial paper conduits (ABCP), asset-backed securities (ABS), mortgage-backed securities (MBS), collateralised debt obligations (CDO) and structured investment vehicles (SIV). There are separate chapters for these products, as well as a chapter on different types of structured funding vehicles, which are often used by non-bank financial institutions as well as banks.

For beginners we introduce here the main concepts, from the point of view of the bank ALM practitioner.

Introduction

Securitisation is when an institution's loans (assets) are removed from its balance sheet and packaged together as one large loan, and then "sold" on to an investor, or series of investors, who then receive the interest payments due on the assets until they are redeemed. The purchasers of the securitised assets often have no recourse to the original borrowers; in fact, the original borrowers are not usually involved in the transaction or any of its processes.

Securitisation was introduced in the US market in 1970 and this market remains the largest for asset-backed bonds. The earliest examples of such bonds were in the US mortgage market, where residential mortgage loans made by a *thrift* (building society) were packaged together and sold on to investors who received the interest and principal payments made by the borrowers of the original loans. The process benefited the original lender in a number of ways. One key benefit was that removing assets from the balance sheet reduced risk exposure for the bank and enhanced its liquidity position.

The effects of these benefits are increased with the maturity of the original loans. For example, in the case of mortgage loans, the term to maturity can be up to 25 years, perhaps longer. The bulk of these loans are financed out of deposits that can be withdrawn on demand, or at relatively short notice. In addition it is often the case that as a result of securitisation, the packaged loans are funded at a lower rate than that charged by the original lending institution. This implies that the bundled loans can be sold off at a higher value than the level at which the lending institution valued them. Put another way, securitising loans adds value to the loan book and it is the original lender that receives this value. Another benefit is that as a result of securitisation, the total funding available to the lending institution may well increase due to its access to capital markets; in other words, the firm becomes less dependent on its traditional deposit base. And finally, by reducing the level of debt on the lending institution's balance sheet, securitisation can improve the firm's gearing ratio.

Securitisation was introduced in the UK market in 1985. A number of institutions were established for the purpose of securitising mortgages and other assets such as car loans and credit card debt. These included the National Home Loans Corporation, Mortgage Funding Corporation and First Mortgage Securities. Since then the technique has been widely used by banks as a standard tool in balance sheet capital management and asset-liability management.

Asset-backed securities

Asset-backed securities (ABS) are the bonds that are created by securitisation. The ABS notes are sold to a diverse group of investors, and are rated by the credit rating agencies on the basis of a number of factors. These factors include the quality of the collateral pool, as well as any other features, known as credit enhancements, that are part of the securitisation. However, the credit rating is independent of the credit quality of the originating institution.

Note tranching

The notes issued in a securitisation represent the liability side of the transaction, against the underlying assets. More than one class of securities is issued, a process known as *tranching*. Tranched notes exhibit different risk-reward features because they rank in order of seniority. Hence they have different credit ratings as well as different coupons. The most junior note is usually not rated, and is also known as the *equity piece*. This note is usually retained by the originator, and is the first to suffer loss if the asset collateral pool experiences loss. A good analogy for the equity note is the excess payable by the insured party for an insurance policy. By accepting this excess, the insured party reduces his premium; likewise, the equity holder is able to lower the rate payable by the issuer.

Underlying assets

Virtually any asset that carries a present and/or future cash flow can be securitised, and a very wide variety of assets can be securitised. Assets that have been securitised in the past include:

- residential and commercial mortgages;
- real-estate investment trusts;
- consumer debt including credit card receivables, auto-loans and student loans;
- bank assets such as corporate loans, non-performing loans, and small-and medium-sized enterprise (SME) loans;
- commercial lease receivables, such as office equipment leases and aircraft leases;
- trade receivables;
- cash flow revenue from public houses, nursing homes, airports, hospitals and museums;
- whole businesses, which is the securitisation of an entire company's operating assets and cash flow.

In theory any asset that generates cash is one that can be securitised. One-off transactions of esoteric assets that fall outside the above categories are not uncommon.

Administrator and servicer

ABS transactions require the services of third parties in a way that plain vanilla bonds do not. Servicing is the process of administering the underlying assets, including collecting interest and redemption payments, following up late payments and passing funds on to the SPV. The servicer in a deal is usually the originator.

Structural features

A wide variety of structural features are employed in the ABS market. These include:

- pass-through: this is when redemption payments on underlying assets are passed straight through to noteholders. Most asset classes are amortising; that is, the principal amount is paid down over a period of time. Also, assets such as mortgages are usually paid down some time ahead of their legal maturity date. When this happens the redemption payments are used to pay down note principal values, as and when they come in. It is not possible to know with certainty when these pay-downs will happen, as it depends on the speed of repayment of the assets. Models are used to estimate the time of this prepayment;
- overcollateralisation: this is the process of issuing notes to a lower nominal value than the value of the underlying assets. For example, a USD500 million pool of bank loans being securitised to back an issue of USD475 million of notes;
- subordination: in the ABS market, this is the level of debt that is junior to any particular tranche of note. For example, if an ABS transaction consists of A, B, C and D notes, the subordination of the B note is the amount of debt in the C and D notes. Subordinated debt is paid down only after the due amount on senior notes has been paid;
- revolving structures: this is an arrangement often used in the securitisation of short-dated asset classes, such as credit card debt or equipment receivables. In such structures, assets are purchased on a rolling basis, with note issue proceeds being used to purchase new assets, the cash flows from which are used to pay note interest. When the revolving period is over, the principal is used to pay down notes on an amortising basis;
- credit enhancement: this is the provision of various facilities designed to provide investor comfort with regard to the notes' credit risk. These include a bank liquidity line and overcollateralisation, as well as a cash reserve account and the excess interest spread generated by the difference in interest rates on assets and liabilities.

From the point of view of a bank originator, it is important to understand how securitisation can be used as part of balance sheet management and as a funding tool. It is also necessary to be aware of the features of a transaction that would make it attractive to investors, such that the deal can be placed at the rate of interest that makes it worthwhile to the bank.

Part IV of this book begins with an introduction to the key concepts of securitisation, and the motivations behind it. It then looks at specific deal types, including ABS, MBS, CDOs and SIVs. We also look at structured funding vehicles, which are transactions used to raise funding as well as diversify funding sources.

CHAPTER 18

Introduction to Securitisation[1]

Securitisation is an important ALM tool for banks. 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 also illustrate the process with an hypothetical case study.

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 ALM, 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 tradeable 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 the assets in question are actually sold to a separate legal company, known as a special purpose vehicle (SPV).[2] 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

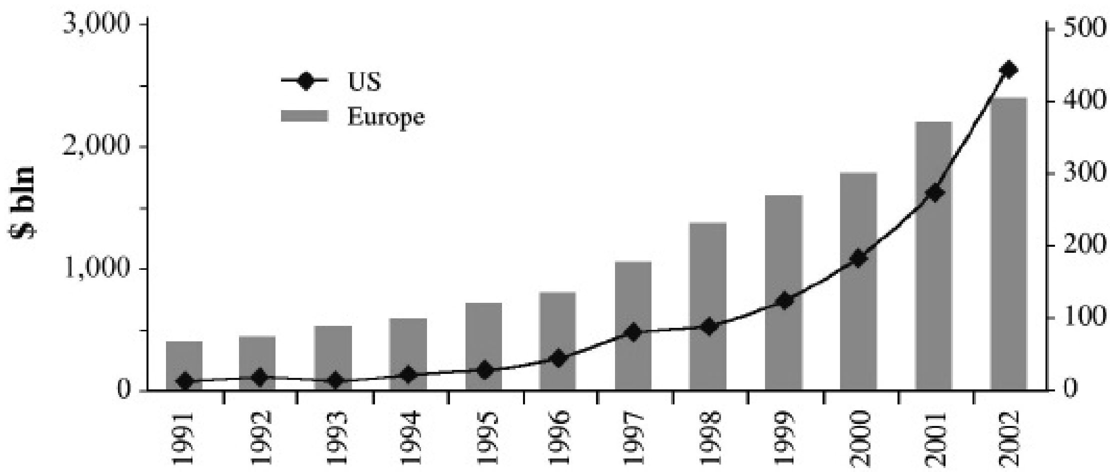
institution are transformed into a package of securities backed by these assets, through careful packaging, credit enhancements, liquidity enhancements and structuring.

The process of securitisation creates *asset-backed bonds.* 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 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 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.

Figure 18.1 shows the growth in securitisation markets during the 1990s.

Figure 18.1 Asset-backed securities, notional amounts outstanding

Sources: BBA, ISMA, Federal Reserve.



Market participants

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 and 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 impact on the original assets is minimised.

This last is often the responsibility of a trustee. The issuer trustee is responsible for looking after the interests of bondholders. Its roles include:

- representing the interests of investors (noteholders);
- monitoring the transaction and issuer to see if any violation of the deal covenants has occurred;
- enforcing the rights of the noteholders in the event of bankruptcy.

The security trustee is responsible for undertaking the following duties:

- holding the security interest in the underlying collateral pool;
- liaising with the manager of the underlying collateral;
- acting under the direction of the note trustee in the event of default.

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 may also involve 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 triple-A grade.

Example 18.1: Special purpose vehicles

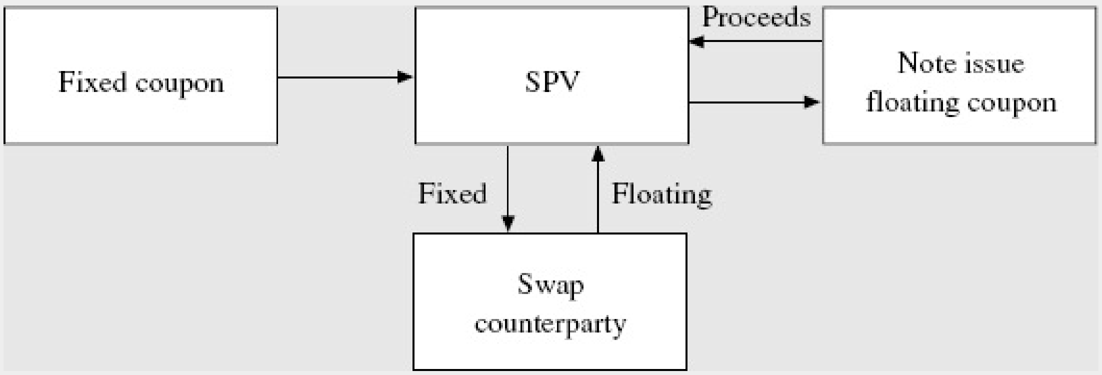
The key to undertaking securitisation is the special purpose vehicle or SPV. They are also known as special purpose entities (SPE) or special purpose companies (SPC). They are distinct legal entities that act as the “company” through which a securitisation is undertaken. They act as a form of repackaging vehicle, used to transform, convert or create risk structures that can be accessed by a wider range of investors. Essentially they are a 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[3].

To secure favourable tax treatment, SPVs are frequently incorporated in offshore business centres such as Jersey or the Cayman Islands, or in jurisdictions that have set up SPV-friendly business legislation such as Ireland or The Netherlands. The choice of location for an SPV is dependant on a number of factors as well as taxation concerns, such as operating costs, legal requirements and investor considerations.[4] The key issue is taxation however; the sponsor will want 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. In other words, the SPV must be set up as a tax-neutral entity.

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 gains an exposure to the original asset swap albeit indirectly. This is illustrated in Figure 18.2.

Figure 18.2 Asset swap package securitised and economic effect sold on by SPV



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 untradeable assets such as residential mortgages into tradeable 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. Unlike CLNs issued by originators direct, CLNs issue 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. Yet another type of SPV-issued CLN references a third-party bond or bonds that are not used by the SPV, but to which its returns are linked;
- transforming illiquid assets 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 tradeable 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 the Bank of New York or Citibank, or a specialist Trust company such as Wilmington Trust. In the euromarkets, SPVs are often incorporated as companies instead of Trusts.

After the Enron episode, when SPVs were seen to be used to assist fraudulent activity, accounting rules were changed to the extent that banking groups must now consolidate all legal entities into one set of accounts. Under the US accounting rule, Fin 46 R, banks that report their result under US GAAP are required to consolidate SPVs, including ABCP and other securitisation SPVs. However, it is possible to avoid the consolidation requirement if the originator can show that the first-loss piece in a transaction has been sold or otherwise transferred to a genuine third-party. This is an incentive for banks to not retain the equity tranche in a securitisation; there are also advantages to so doing under the Basel II regime (see Chapter 27).

The SPV-consolidation issue is also relevant in Europe, where it is required under International Accounting Standards (ISA) rules. Again, in some cases consolidation of an SPV into the group accounts may be avoidable if the first-loss piece in the deal is held by a third party.

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;
- where 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 receivable 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, all of which form part of bank ALM to one degree or another:

- 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 the cost of funding, and (iii) reduce maturity mismatches.

The market for asset-backed securities is large, with an estimated size of USD1,000 billion invested in ABS issues worldwide annually, of which USD 150 billion is in the European market alone.[5] 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 United Kingdom a former building society turned bank, Northern Rock pic, has taken advantage of securitisation to back its growing share of the UK residential mortgage market. Securitising assets also allows a bank to diversify its funding mix. Banks generally do not wish to be reliant on a single or just 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, interbank 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 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 interbank 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.

As stipulated in the Bank for International Settlements (BIS) capital rules,[6] 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 become effective from 2007 or 2008 (depending on jurisdiction). However, the Basel I rules, which have been in place since 1988 (and effective from 1992), have been a driving force behind 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.[7]

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.

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 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 asset-backed securities 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 a AA-rated corporate bond and be exposed to "event risk" associated with the issuer, investors can gain exposure to, say, 100 pooled assets with a collective AA rating. These pooled assets will clearly have lower concentration risk.

Investors also benefit from the superior ratings migration of structured finance securities over vanilla Eurobonds. This is shown in Figure 18.3, which is Moody's annual ratings transition matrix for June 2006.

Figure 18.3 Moody's annual ratings transition matrix, June 2006

Source: Moody's. Reproduced with permission.

Structured Finance securities

	Aaa	Aa	A	Baa	Ba	B	Caa or below
Aaa	99.82%	0.15%	0.03%	0.00%	0.00%	0.00%	0.00%
Aa	6.07%	93.31%	0.48%	0.07%	0.05%	0.02%	0.00%
A	1.60%	4.75%	92.56%	0.88%	0.16%	0.03%	0.02%
Baa	0.20%	0.71%	3.69%	93.79%	0.98%	0.54%	0.09%
Ba	0.09%	0.04%	0.35%	3.44%	93.44%	1.76%	0.88%
B	0.18%	0.28%	0.09%	0.46%	3.04%	90.41%	5.54%
Caa or below	0.00%	0.00%	0.00%	0.00%	0.10%	0.41%	99.49%

Corporate bonds

	Aaa	Aa	A	Baa	Ba	B	Caa or below
Aaa	97.92%	1.04%	1.04%	0.00%	0.00%	0.00%	0.00%
Aa	0.12%	98.00%	1.88%	0.00%	0.00%	0.00%	0.00%
A	0.14%	2.67%	92.69%	4.15%	0.35%	0.00%	0.00%
Baa	0.00%	0.34%	5.19%	89.10%	4.00%	1.02%	0.34%
Ba	0.00%	0.18%	0.18%	7.49%	84.49%	6.95%	0.71%
B	0.00%	0.00%	0.26%	0.00%	11.67%	82.50%	5.57%
Caa or below	0.00%	0.00%	0.00%	0.36%	0.36%	27.65%	71.63%

Example 18.2 (i): Summary of motivations for undertaking securitisation

A summary of reasons why banks undertake securitisation is given below; many transactions fulfil a number of these objectives simultaneously:

- reducing and releasing regulatory capital;
- increasing RoE and RoA;
- increasing mortgage lending capacity, and growing asset books quicker than would be possible through the normal course of business;
- improving the bank's cost-to-income ratio;
- diversifying funding sources;
- increasing market share;
- preserving customer relationships with obligor clients whose assets are securitised;
- with regard to non-performing loan (NPL) assets:
    - transferring the risk associated with NPL assets
    - freeing up capital for employment elsewhere;
- providing positive research material for equity analysts.

Example 18.2 (II): Parties to the deal

Rating agencies

Rating agencies undertake due diligence on the transaction and assign the rating to the issued liabilities.

Lawyers

The originator, arranger and Trustee will assign external counsel to draft and review the legal documents that describe the deal.

Servicer/Administrator

The servicer administers the underlying assets in the portfolio. This includes monitoring of loans/bonds, collection of interest, enforcing late payments and producing statements. This role is often retained by the administrator, although third-party servicing firms also exist. The quality and reputation of the servicer is considered by the rating agencies when they assign the transaction rating.

Monoline insurer

A specialist class of investor, known as a monoline insurer, is available to provide a “wrap” or guarantee of the ABS notes, in return for a fee. This acts as a credit enhancement to the transaction, particularly if a AAA rating for the senior note is dependent on availability of a monoline insurance wrap.

Bank counterparty services

A transaction may require one, more or all of the following in its structure:

- interest-rate swap and/or FX swap, to hedge interest-rate and FX risk where there is a mismatch between the assets and liabilities of the vehicle;
- committed liquidity line, to be drawn on to cover principal and interest payments in the event that the SPV cannot make them;
- GIC, to act as a reserve in which the proceeds of note issuance are invested.

These services are provided by a bank or banks, which act as counterparty to the SPV.

Depositary

The depositary for a Eurobond issue is responsible for the safekeeping of securities. The common depositary is responsible for:

- representing Euroclear and Clearstream, and facilitating delivery-versus-payment of the primary market issue by collecting funds from the investors, taking possession of the temporary global note (which allows securities to be released to investors), and making a single payment of funds to the issuer;
- holding the temporary global note in safe custody, until it is exchanged for definitive notes or a permanent global note.

Trustee

An issuer may appoint a trustee to represent the interests of investors. In the event of default, the trustee is required to discharge its duties on behalf of bondholders. A trustee has a variety of powers and discretion, which are stated formally in the issue trust deed, and these include its duties in relation to the monitoring of covenants, and duties to bondholders.

Custodian

A custodian provides safekeeping services for securities belonging to a client. The client may be an institutional investor such as a pension fund, that requires a portfolio of securities in many locations to be kept in secure custody on their behalf. As well as holding securities, the custodian usually manages corporate actions such as dividend payments.

Example 18.2 (iii): ABS terminology

Master Trust

A legal structure that allows for repeat issuances of notes from the same vehicle, usually where the underlying asset pool that is being securitised is a revolving pool. Common for credit card ABS and residential MBS transactions.

Static pool

A pool of assets that does not change; that is, the assets in the pool at deal inception remain there to the end of the deal's life. There is no removal or addition of assets.

Soft bullet

A bond that has an expected redemption date, but this date is not its formal legal maturity. If the bond does not redeem on this date, it is not an event of default.

Pass-through

Where the repayments of underlying assets are used to redeem overlying bonds as and when they occurr. This creates uncertainty when determining weighted-average life (WAL) of the notes.

Sequential pay

A term referring to the process whereby senior bonds in the liability structure are redeemed fully, before amortisation of the junior note classes can begin.

Pro-rata

Senior and junior bonds are redeemed at the same time pro-rata. However, triggers are in place that kick in to revert to a sequential pay structure should the collateral pool performance deteriorate, such that it cannot support the liabilities in full.

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".

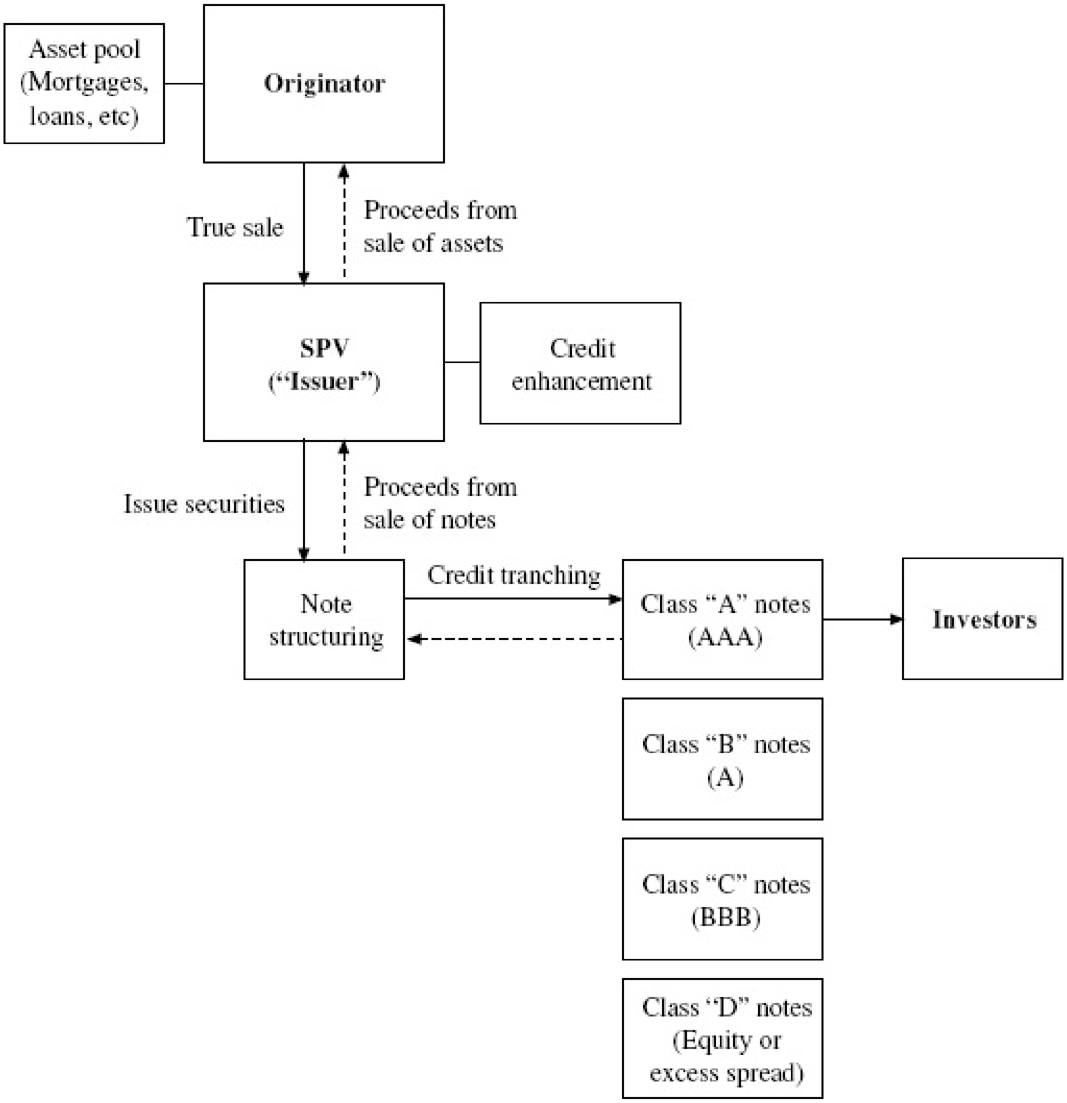
The securitisation process involves a number of participants. In the first instance there is the *originator*, the firm whose assets are being securitised. The most common process involves an *issuer* acquiring the assets from the originator. The issuer is usually a company that has been specially set 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 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 18.4 illustrates the process of securitisation in simple fashion.

Figure 18.4 The securitisation process



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 is 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.

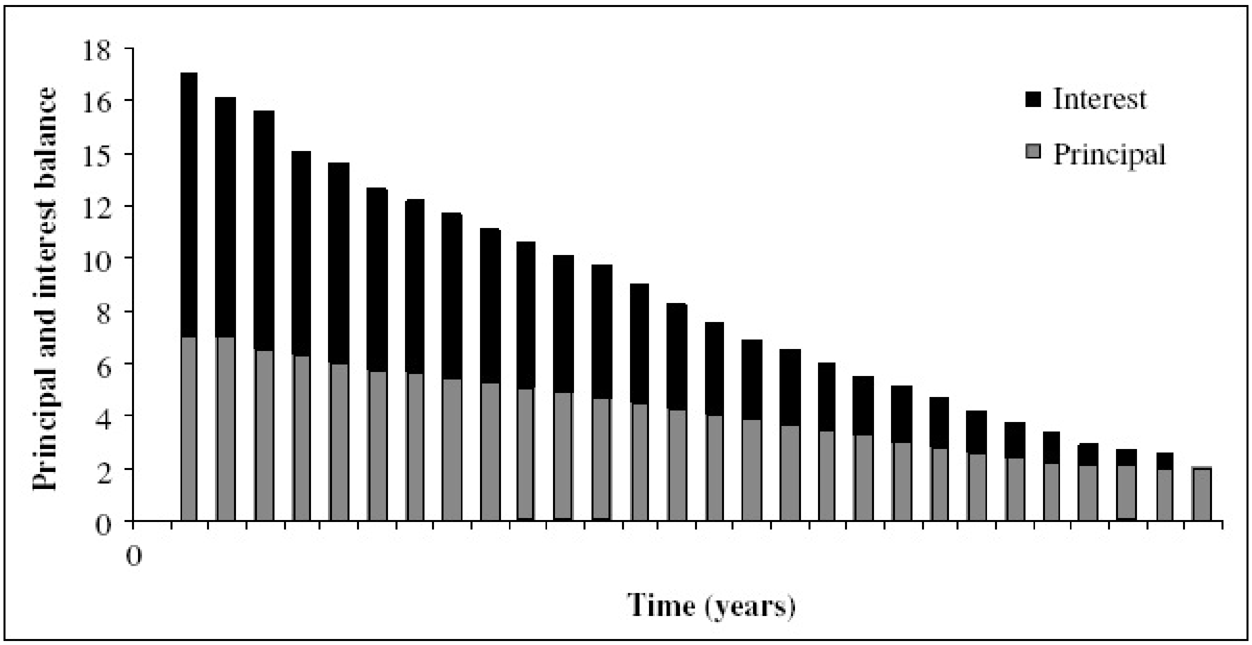
SPV structures

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 18.5. 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 prepayment assumptions, and any change in this prepayment speed will increase or decrease the rate at which principal is repaid to investors. Pass-through structures are commonly used in residential and commercial MBSs, and consumer loan ABS.

Figure 18.5 Amortising cash flow structure



Revolving structures

Revolving structures revolve the principal of the assets; that is, during the revolving period, principal collections are used to purchase new receivables which fulfill the necessary criteria. The structure is used for short-dated assets with a relatively high prepayment speed, such as credit card debt and auto-loans. During the amortisation period, principal payments are paid to investors either in a series of equal installments *(controlled amortisation)* or principal is “trapped” in a separate account until the expected maturity date and is 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 18.2, 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 in effect a bond) and is usually held by the originator.

Credit enhancement

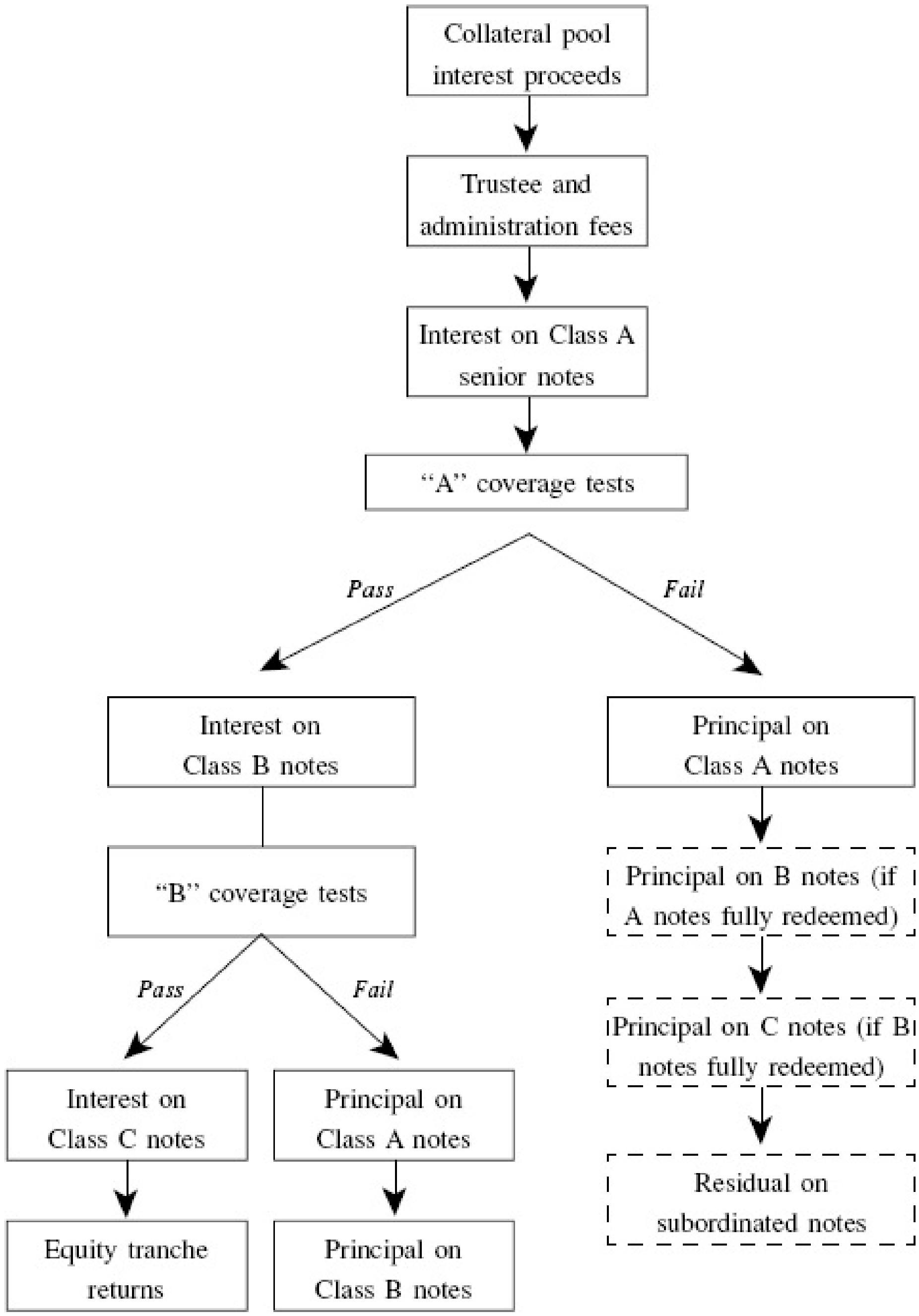
Credit enhancement refers to the group of measures that can be instituted as part of the securitisation process for ABS and MBS issues so that the credit rating of the issued notes meets investor requirements. The lower the quality of the assets being securitised, the greater the need for credit enhancement. 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 for a fee 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 for a fee 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 noteholders. 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 pre-determined 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.

Cash flow waterfall

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 18.6.

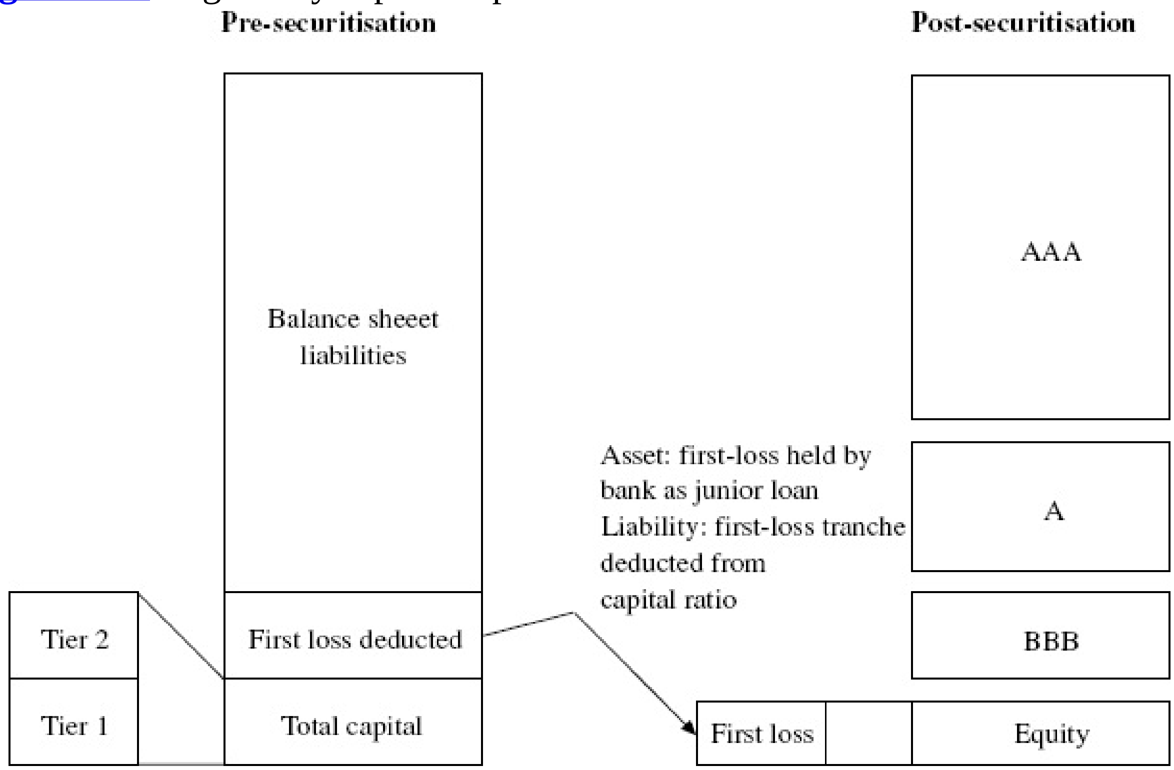
Figure 18.6 Cash flow waterfall (priority of payments)


Collateral pool interest proceeds
Trustee and administration fees
Interest on Class A senior notes
“A” coverage tests
Pass
Fail
Interest on Class B notes
Principal on Class A notes
“B” coverage tests
Principal on B notes (if A notes fully redeemed)
Pass
Fail
Principal on C notes (if B notes fully redeemed)
Interest on Class C notes
Principal on Class A notes
Residual on subordinated notes
Equity tranche returns
Principal on Class B notes

Impact on balance sheet

Figure 18.7 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 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%,[8] 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.

Figure 18.7 Regulatory capital impact of securitisation



Illustrating the process of securitisation: Airways No. 1 Limited

To illustrate the process of securitisation, we consider an 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.

Originator:	ABC Airways pic
Issuer:	“Airways No. 1 Ltd”
Transaction:	Ticket receivables airline future flow securitisation bonds, €200m three-tranche floating-rate notes, legal maturity 2010
	Average life 4.1 years
Tranches:	Class “A” note (AA), Libor plus [ ] bps[9]
	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.

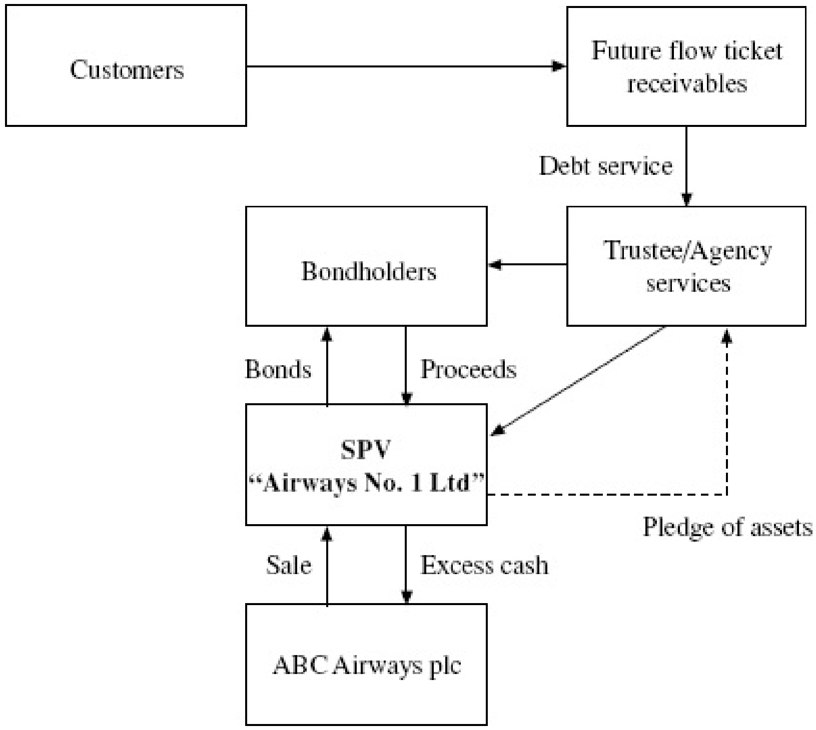
Marketing approach

The 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, let us assume the notes are marketed at around three-month Libor plus 70–80 basis points (AA note), 120–130 basis points (A note) and 260–270 basis points (BBB note). The notes are "benchmarked" against recent issues with similar underlying asset classes, as well as the spread level in the unsecured market of comparable issuer names.

Deal structure

The deal structure is shown in Figure 18.8.

Figure 18.8 Airways No. 1 Limited deal structure



The process leading to the issue of notes is as follows:

- ABC Airways plc sells its present and all future flow credit card 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 monoline 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 such as 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 takes 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 redesign 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.

Credit rating considerations

The originator in a securitisation will take a keen interest in the various factors that are of importance to the credit-rating agencies.[10] These factors must be met if the transaction is to be rated at the required level, otherwise it will be difficult to place the liabilities. We consider some of the key issues here.

True sale and ownership of assets

A prime consideration is that, in the event of default, the underlying assets are able to be liquidated and the proceeds used to repay noteholders. The true sale of the assets to the SPV, which then ring-fences them, ensures this. However, it also means that the assets must be able to be sold to the SPV and transferred into its ownership. If the assets cannot be sold easily in the traditional manner, such as hedge fund assets, then a synthetic securitisation may be more appropriate. In such a deal, typically the assets are referenced synthetically and cash flows from them transferred via means of a swap such as a total return swap.

Asset quality and loss rate

As part of the process of assigning a rating, the agencies will undertake due diligence on the asset pool. This includes reviewing the nature of the cash flows, the state of interest servicing payments to date, the status and ability to pay of the obligors. In their modelling process they will calculate probabilities of default for the assets. This includes looking at historical default rates and recovery rates. These two values are used to calculate a potential loss rate, which is of interest to investors.

The loss rate is calculated as follows: if the historical default rate is 1% and the recovery rate (RR) is 30%, then the loss rate is 0.7%. This rate states that for every $100 of assets, $1 will default. If $0.30 of this is recovered, then the ultimate loss is $0.70. Hence the loss rate is 0.7%.

Agencies will also be interested in the diversity of the asset pool, and its concentration among one borrower or one type of borrower.

Asset servicing

We noted earlier that in many, if not most, securitisation transactions the servicing function is retained by the originator. This is logical because the originator will be familiar with the obligors and the industry, and should be best placed to administer the assets. From the point of view of the credit rating agency, this is the best arrangement. If the servicing function is transferred to a third party, the rating agency will review this entity and assess its ability to undertake the servicing function. The assessment will consider the servicer's experience in the industry and other facets of its expertise. In some transactions, a back-up servicer is assigned to the deal, who is on stand-by to take over the role if necessary, for any reason.

Cash flow modelling[11]

The rating process will project cash flows for the deal, and hence determine the likelihood of the vehicle to meet its payment obligations. The obligations include not only the principal and interest payments on the notes, but also fees for third parties such as the Trustee, the sub-administrator, and the servicer – not to mention the fees of the rating agencies! Cash flow projections are based on assumptions about default and recovery rates.

The arranging bank will also undertake modelling for the deal, as they work towards putting together the final structure of the deal. There is a distinct difference in the objective of their modelling, in that they seek to structure to meet the rating agency requirements and so be assigned the rating they need. The rating agencies on the other hand run the deal mechanics through their model, which then produces a result based on these inputs. From the point of view of the arranging bank, there is further distinction between the two main types of structure: ABS/MBS and collateralised debt obligation (CDO). The models differ as follows:

- In a CDO model, cash flows are less of a concern. Instead the model is used to determine the final form of the underlying portfolio. The model runs various permutations on a subset of a pool of securities (bonds and/or loans) to achieve the necessary diversity and note spread. The diversity requirement is a rating agency consideration. The key objective is to construct the most efficient portfolio in order to enable the CDO to achieve the rating agency requirements at the lowest funding costs;

- In an ABS transaction, the originator is not concerned over-much with the portfolio: the portfolio is given and there is little quantifiable diversity. For example, the entire portfolio will be residential mortgages or credit card. The arrangers will be concerned with the cash flows to ensure they have the mechanics right, but the focus is on structuring around the mechanical obstacles that the portfolio brings. For example, if the deal is concerned with residential mortgages in a certain jurisdiction, then that jurisdiction may state that there is set-off risk (that is, customers can offset mortgage balances that belong to the SPV against current account deposits that do not).

Of these two deal types, probably the static balance sheet CDO is the closest to the ABS type in terms of modelling aspect.

Loan-to-value ratio

The loan-to-value (LTV) ratio is the ratio of the amount of the loan to the market value of the asset. The value of the asset is a market value, which can be estimated from secondary market trading of similar assets, or independently valued when it is sold to the SPV. An LTV ratio of 0.8 indicates that the value of the loan is 80% of the market value of the asset. The difference between the value of an asset and the loan amount is known as the "borrower's equity". If the LTV is below 1, this means that the borrower has positive equity in the asset and so is less likely to default. If the LTV is higher than 1 it means that the amount borrowed is above the market value of the asset and it may be advantageous to default. Rating agencies view LTV as an important indicator of the likelihood of default.

$$\text{Loan to value ratio} = \frac{\text{Loan amount}}{\text{Market value of the asset}}$$

Payment-to-income ratio

The payment-to-income ratio (PTI) is the ratio of the amount of the monthly loan interest payment to the income available each month to make the loan interest payment. A higher PTI means that a higher amount of a borrower's income needs to be set aside to meet the interest servicing.

A related ratio is the "debt service coverage ratio" (DSCR). This is the mortgaged property's net operating income as a percentage of the debt service cost. A low ratio is indicative of potential default as the income may not be sufficient to cover interest costs.

Case Study 18.1: Shipshape Residential Mortgages No. 1

Bristol & West plc is a former UK building society that is now part of the Bank of Ireland group. In October 2000, it issued £300 million of residential MBS through ING Barings. It was the third time that Bristol & West had undertaken a securitisation of part of its mortgage book. The Shipshape Residential Mortgages No. 1 was structured in the following way:

- a £285 million tranche senior note, rated Aaa by Moody's and Fitch IBCA, with an average life of 3.8 years and paying 25 basis points over three-month Libor;
- a Class "B" note of £9 million, rated A1 by Moody's and paying a coupon on 80 basis points over three-month Libor. These notes had an average life of 6.1 years;
- a junior note of £6 million nominal, rated triple-B by Moody's and with an average life of 6.8 years. These notes paid a coupon of 140 basis points over Libor.

Case Study 18.2: Fosse Securities No. 1 plc

This was the first securitisation undertaken by Alliance & Leicester pic, a former UK building society that converted into a commercial bank in 1997. The underlying portfolio was approximately 6,700 loans secured by first mortgages on property in the United Kingdom. The transaction was a £250 million securitisation via the SPV, named Fosse Securities No. 1 plc. The underwriter was Morgan Stanley Dean Witter, which placed the notes in November 2000. The transaction structure was:

- a senior Class "A" note with AAA/Aaa rating by Standard & Poor's and Moody's, which represented £235 million of the issue, with a legal maturity of November 2032;
- a Class "B" note rated Aa/Aa3 of nominal £5 million;
- a Class "C" note rated BBB/Baa2 of nominal £10 million.

The ratings agencies cited the strengths of the issue as:[12] the loans were *prime* quality; there was a high level of *seasoning* in the underlying asset pool, with an average age of 35 months; the average level of the loan-to-value ratio (LTV) was considered low, at 73.5%; and there were low average loan-to-income multiples among underlying borrowers.

Case Study 18.3: SRM Investment No. 1 Limited

Sveriges Bostadsfinansieringsaktiebolag (SBAB) is the Swedish state-owned national housing finance corporation. Its second-ever securitisation issue was the EUR1 billion SRM Investment

No. 1 Limited, issued in October 2000. The underlying asset backing was Swedish residential mortgage loans, with properties being mainly detached and semi-detached single-family properties. The issue was structured and underwritten by Nomura International.

The underlying motives behind the deal were that it allowed SBAB to:

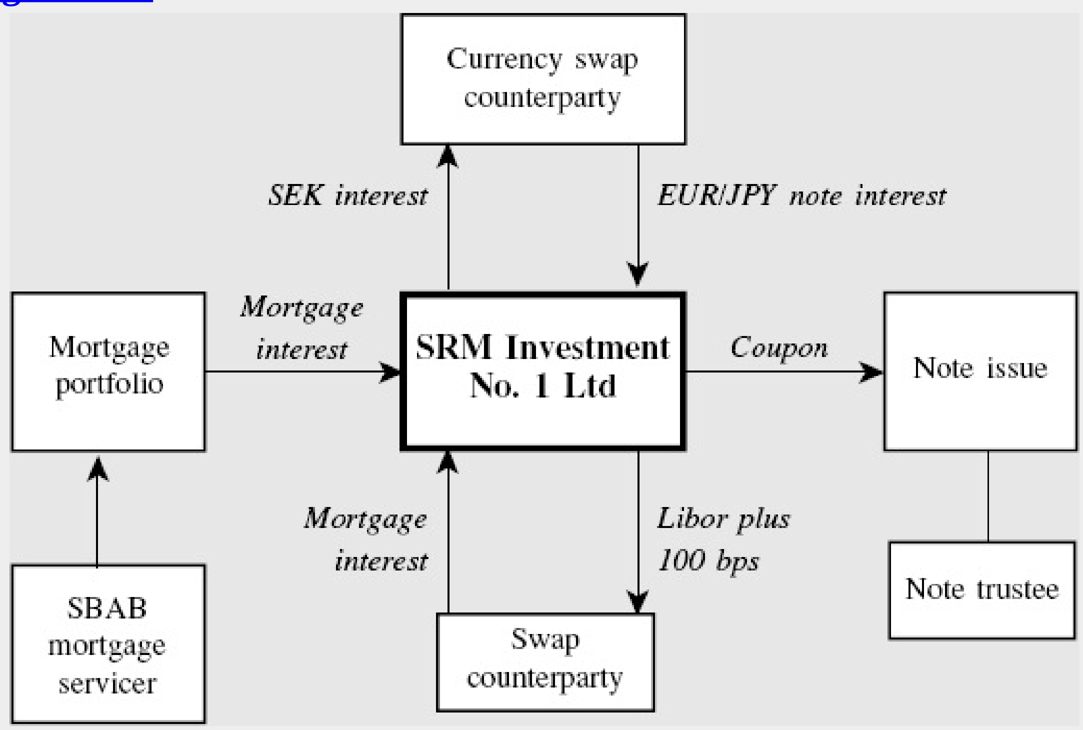
- reduce capital allocation, thereby releasing capital for further lending;
- remove part of its mortgage loan-book off the balance sheet;
- obtain a more diversified source for its funding.

The transaction was structured into the following notes:

- senior Class "A1" floating-rate note rated AAA/Aaa by S&P and Moody's, issue size EUR755 million, with a legal maturity date in 2057;
- senior Class "A2" fixed coupon note, rated AAA/Aaa and denominated in Japanese yen, incorporating a step-up facility, legal maturity 2057; issue size JPY20 billion;
- Class "M" floating-rate note rated A/A2, due 2057; issue size EUR20 million;
- Class "B" floating-rate note, rated BBB/Baa2, issue size EUR10 million.

The yen tranche reflects the targeting of a Japanese domestic investor base. On issue, the Class A1 notes paid 26 basis points over Euribor. The structure is illustrated in Figure 18.9.

Figure 18.9 SRM Investment No. 1 Limited



Structured finance securities such as RMBS issues have a different description page on the Bloomberg system compared to vanilla conventional bonds. This page details additional information of use to investors, such as pool factors. The pool factor is a value assigned to an ABS tranche that indicates how much of its original notional amount has been reduced since issue, due to prepayments of the underlying assets. If the pool factor, often referred to simply as the factor, of a note tranche is 0.9135, then one would multiply the notional amount of the note with the pool factor and the note dirty price to obtain the market value. On first issue, a note factor will be 1.0000, and this can be expected to reduce over time as early repayments of the underlying assets start to reduce the overlying note notional amounts. Figure 18.10 shows Bloomberg page DES for an issue in May 2005, Granite Master Issuer plc 2005-2 A1. The originator is Northern Rock plc. As it is the very early stages of the bond issue, the pool factor is still 1.0000. This issue pays USD coupon on a monthly basis.

Figure 18.10 Bloomberg page DES for Northern Rock plc RMBS issue, May 2005. Note pool factor of 1.000

Page N270 **Mtge** **DES**

Bloomberg 66 <GO> SECURITY DESCRIPTION Page 1 of 3

GRANM 2005-2 A1 3.6494% 6/20/30

CUSIP: 38741YAF6 Issuer: GRANITE MASTER ISSUER PLC NO "PRO-SUP"

Series 2005-2 Class A1 Mty 6/20/30

5) MBS: STEP,FLT

CURRENT		ORIGINAL ISSUE	
Aug05	975,000,000	USD	975,000,000
" Fact	1.000000000	WAL	0.9Yr @ 0
Aug05 Cpn	3.64938%	1st coupon	3.12401%
Next Paymt	8/22/05	1st paymnt	6/20/05
Rcd date	8/21/05	1st settle	5/25/05
Beg accrue	7/20/05	Dated date	5/25/05
End accrue	8/21/05	px 100-00	5/19/05
Next reset	8/20/05	1st reset	6/20/05
Class/Deal Pct N/A		Class/Deal Pct	3%

65) Personal Notes 14) Identifiers

4) FLOATER FORMULA
= 1xLIBOR01M
+4BP
No Cap
Flr=0.04% @0%
Monthly reset

Monthly PAYMENT
pays 20th day
0 day delay
accrues ACT/360

11) RATINGS

Fitch	AAA
MDY	Aaa
S&P	AAA EXP

CALLABLE
6) Lead Mgr: UBS
7) Trustee: BNY

1)	Aug05	Jul	Jun	May05
PSA	-	-	-	-
CPR	-	-	-	-
FACT	1.00	1.00	1.00	1.00
CPN	3.65	3.47	3.30	3.12

DTC Book Entry
DTC SameDay

See Page 3 for Comments. MinSize 100000 Incr 1000

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[1] This chapter was co-authored with Anuk Teasdale.

[2] An SPV is also referred to as a special purpose entity (SPE) or a special purpose company (SPC). See Example 18.1 on page 890 for more information on SPVs.

[3] 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.

[4] 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.

[5] *Source:* CSFB, *Credit Risk Transfer*, 2 May 2003.

[6] For further information on this see Chapter 26.

[7] We discuss first-loss later on.

[8] The minimum is 8%, but many banks prefer to set aside an amount well in excess of this minimum required level.

[9] The price spread is determined during the marketing stage, when the notes are offered to investors during a “roadshow”.

[10] These are Standard & Poor’s, Moody’s and FitchRatings. There are other agencies but in the capital markets it is invariably that at least one, and often all three, of these agencies will be retained to provide the rating. Their dominance is illustrated by the fact that many fund managers, especially money market funds, will not invest in a security unless it has an S&P rating.

[11] The author thanks Suleman Baig at Deutsche Bank AG in London for his generous help and input with this section.

[12] *Source: International Securitisation Review*, London, November 2000.

CHAPTER 19

Structured, Synthetic and Repackaged Funding Vehicles

Banks and financial institutions have an interest in setting up alternative funding arrangements, outside of normal bank lines or vanilla conduit structures such as commercial paper (CP) programmes, wherever these offer additional funding capacity, cheaper interest rates, funding source diversity or any combination of these. Another reason for setting up such alternatives is where an illiquid asset pool requires funding and cannot be repo'ed in the normal manner, either because it is low-rated or not easily transferable. Securitisation, and more recently synthetic securitisation, techniques allow banks to access funding sources outside the conventional avenues.

In this chapter we describe a number of different funding structures, the motivation behind all of which is to widen the opportunities for raising funds and assisting liquidity management. In some cases they also enable the funding of illiquid asset pools. We also introduce here the concept of synthetic securitisation, which does not involve the "true sale" of assets into an SPV. We will look at this again in subsequent chapters. We begin with a look at the application of securitisation to vanilla conduit structures, the asset-backed CP structure.

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 issue paper backed by the cash flows from specified assets, such as residential mortgages, car loans or commercial bank loans, as backing for an issue of short-term paper. The assets themselves are transferred from the original owner (the *originator)* to a specially created legal entity, the SPV.

Generally, securitisation is used as a funding instrument by companies for three main reasons: it offers lower cost funding compared to 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 lenders' return on assets or return on equity ratios; and it increases a borrowers' funding options.

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 type of entities, such as the Trust arms of banks such as Deutsche Bank and Bank of New York.

ABCP was discussed in detail in Chapter 3.

Evolution of ABCP programmes

As with conventional CP programmes, as ABCP 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.

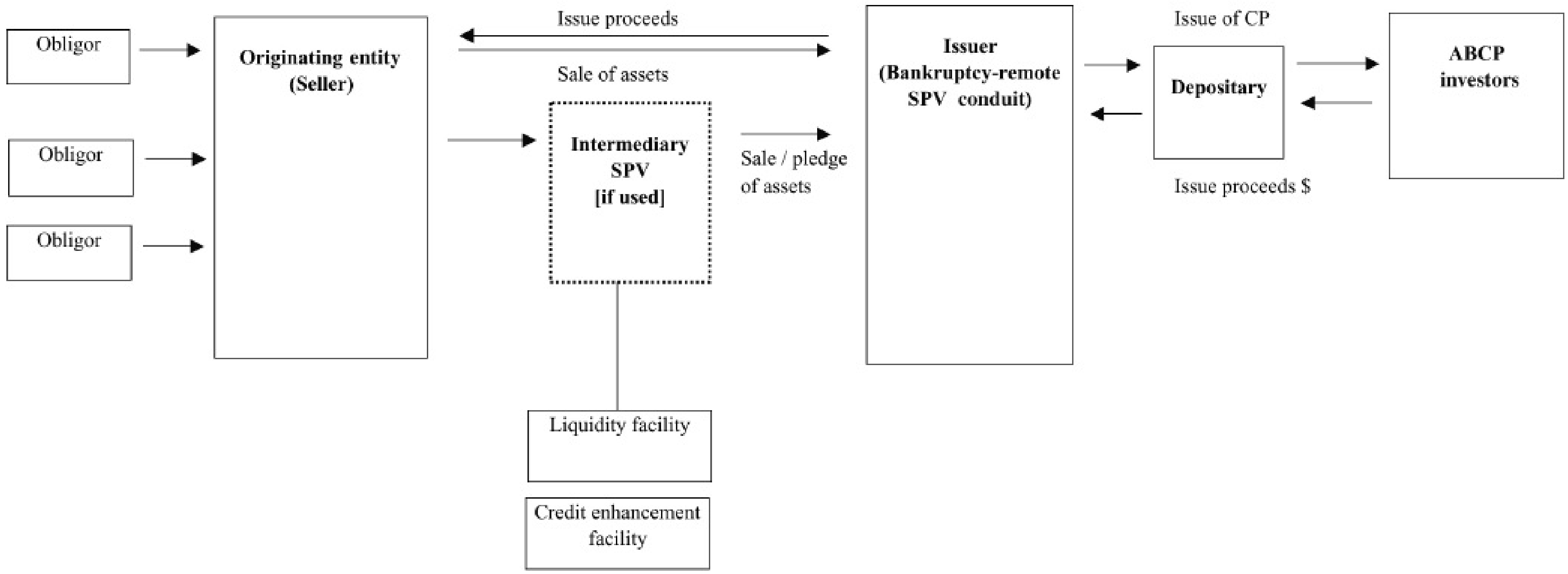
ABCP conduits have followed an evolutionary path thus:

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 MTNs, and 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 19.1 on page 924 shows a single-seller ABCP structure.

Figure 19.1 Single-seller ABCP conduit structure


Obligor
Obligor
Obligor
Originating entity
(Seller)
Issue proceeds
Sale of assets
Intermediary
SPV
[if used]
Sale / pledge
of assets
Liquidity facility
Credit enhancement
facility
Issuer
(Bankruptcy-remote
SPV conduit)
Issue of CP
Depositary
Issue proceeds $
ABCP
investors

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 provider is usually required by the credit ratings agencies to have a short-term rating of A−1/P−1/F−1.

A multi-seller conduit would have more than one seller into the conduit SPV.

Liquidity and credit enhancement

ABCP conduits require liquidity support to cover 100% of their outstanding CP for 364 days. A liquidity facility will guarantee a timely repayment of CP as it matures, and is vital because most conduits do not match the term structure of their assets and liabilities. Facilities are typically required to purchase assets, in accordance with a pre-specified formula. Generally, the facility will be called upon in the event of bankruptcy occurring with respect to the conduit, if it is otherwise unable to honour its liabilities as they fall due, or if the underlying assets become rated at Caa1 or lower by Moody’s, and CCC+ or lower by Standard & Poor’s and Fitch.

Liquidity support can be in the form of either a Liquidity Asset Purchase agreement (LAPA) or a Liquidity Loan agreement (LLA), which differ as follows:

- LAPA: the liquidity provider(s) purchase non-defaulted assets when called upon;
- LLA: the liquidity provider(s) lend money to the conduit in return for a security pledge over the underlying asset cash flows.

A liquidity facility also covers other risks such as dilution, hedging and legal issues.

Other forms of credit enhancement are also set in place. If it is transaction-specific, credit enhancement provides the first layer of protection against shortfalls from the underlying collateral on specific asset pools, typically in the form of over-collateralisation, excess spread, a bank LOC or surety bond. The main features are that they are maintained as protection against delinquencies, losses or dilution, and that reserves are generally based on a multiple of the seller’s historical delinquency, net losses and dilutions of the pool of assets.

If it is programme-wide, credit enhancement provides the second layer of protection coverage for repurchase of cash receivables or guarantee of losses on the receivables. It supplements the seller’s reserves, and will be used only after the seller’s reserves are depleted. Its main features are:

- it is calculated as a percentage of the entire ABCP conduit;
- it is mainly in the form of a LOC, surety bond, subordinated notes, cash collateral bank account, or a total return swap;
- traditional receivables and loan programmes sized at a minimum 5% of the total size and which fluctuate in accordance with the credit quality of the

asset pool.

Note that the enhancement for security arbitrage conduits and SIVs is usually at 0%, provided that the underlying assets are rated at AA-/Aa3/ AA-or better.

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.

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 the issue of extendible notes and structured liquidity notes, and through the issue of long-dated MTNs;
- use of derivative structures, such as TRSs, CDSs and CLNs;
- using monoline 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 10%–15%.

Another development in the United States and ECP 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 one-month or three-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 later in this chapter.

Committed liquidity line funding

This section could comfortably sit in a number of other chapters, including Chapter 3 and Chapter 12. We have placed it here however because it combines a plain vanilla instrument – the bank liquidity facility – with an element of repo, and is frequently attached to structured funding vehicles such as ABCP conduits and SIVs.

The standard bank liquidity line is a standing credit facility set up for a borrower that may be drawn on at any time. A commitment fee is charged annually on the entire line size, irrespective of whether any or all of the line is used. If the line is drawn on, this borrowing is then charged at the agreed rate. Lines are usually reviewed on an annual basis, so they represent a maximum 364-day facility. Longer-dated facilities can be agreed, but these attract a higher capital charge so the commitment fee will be higher. A structure offered by banks to clients that desire longer-term funding is the *evergreen* committed line, which is in theory a 364-day tenor, but which is formally "renewed" on a daily basis. This enables the borrower to view the line as longer-dated funding, because it is always 364 days away from maturity.

Under Basel I the capital charge for liquidity lines in the interbank market was nil provided the line had a maximum 364-day maturity. For lines of greater than 1-year maturity, the capital charge would be [50% × 20% × 8%] for the unused portion. Essentially, liquidity credit facilities attract 0% weighting if they have a tenor of one year or less. For credit lines with a tenor of more than one year, there is a 50% product weighting on the unused portion of the line. This product weighting is then to be combined with the counterparty risk, which is 20% for banking and credit institutions under Basel I. Under Basel II the counterparty risk weighting changes; for example, under the standardised approach it would depend on the counterparty's credit rating (see Chapter 27).

For structured finance counterparties such as ABCP conduits and SIV SPVs, it is common for any borrowings on the line to be collateralised. This turns the liquidity into a committed repo line. The repo is usually transacted under a GMRA agreement that is executed between the bank lender and the SPV.

Figure 19.2 on page 928 is a sample term sheet for a committed repo liquidity line between two interbank counterparties. We see that this facility has been set up to provide funding for real-estate assets, which we presume is a line of business that the borrower ("Global Bank") is involved in. The fact that a long-term facility has been offered enables ABC Securities Limited to lend at a relatively high rate, as interbank repo funding rates in 2006 would be considerably below Libor plus 18–20 basis points. However, we presume that as

Global Bank is seeking long fixed-term committed funding, it is willing to pay above-market rates for this facility. If the line is drawn on, Global Bank will provide collateral in the form of real-estate assets, at minimum loan-to-value (LTV) levels stated, and also with a haircut.

Figure 19.2 Committed repo liquidity line, term sheet

Committed Repo Liquidity Line
USD 2 billion standing collateralised loan facility
Indicative Terms and Conditions
[11 October 2006]

Line provider:	ABC Securities Limited.
Obligor:	Global Bank International Limited Global Bank Funding.
Instrument:	A standing liquidity facility, drawn down in the form of a collateralised loan as and when required by the borrower. The number of drawdowns outstanding at any time is unlimited on condition the aggregate outstanding balance is at or below the Principal Amount.
Maturity:	Two-year final maturity, to be reviewed on an annual basis at anniversary of execution date OR One-year evergreen facility renewed on rolling one-day basis
Loan tenor:	Between 7-day and 364-day, up to the date of the Maturity Date.
Status:	Ranks *parri passu*
Principal amount:	USD 2 billion
Commitment fee:	[6-7] basis points p.a.
Drawdown:	The facility drawdown will be in the form of a repo transaction executed under GMRA on a T+2 settlement basis.
Loan rate:	Libor plus [18-20] basis points.
Interest basis:	Fixed- or floating-rate.
Denominations:	The facility may be drawn down in USD, EUR, GBP, CHF, HKD, JPY, AUD, NZD, SGD, CAD, SEK, NOK, DKK and ZAR. For currencies for which no Libor fix is quoted, the official local market interbank fixing rate will be taken.
Collateral:	All drawdowns from the facility will be collateralised under the GMRA repo. Collateral will be in the form of commercial loans, real-estate loans, B Notes and Mezzanine notes. Underlying loans to be collateralised with commercial property or other real-estate, with maximum accepted LTV ratio of 80%.
Collateral report:	Asset summary to be provided for each pool of collateral at time of each drawdown.
Execution Date:	[ ] 2006.
Maturity Date:	[ ] 2008.
Haircut:	7% [Collateral LTV 50%-75%] 10% [Collateral LTV 75%-90%].

Security charge:	Repo will be executed via a Tri-Party Agent that will be responsible for settling cash and collateral on behalf of the lender and obligor.
Tri-Party Agent:	Trust Bank, New York.
Business Days:	London, New York, TARGET.
Redemption:	100% of the drawndown Principal Amount payable on the Maturity Date.
Guarantee:	Payment of the maturity value of all repo trades is guaranteed by Global Bank [A1/A].
Governing Law:	English.

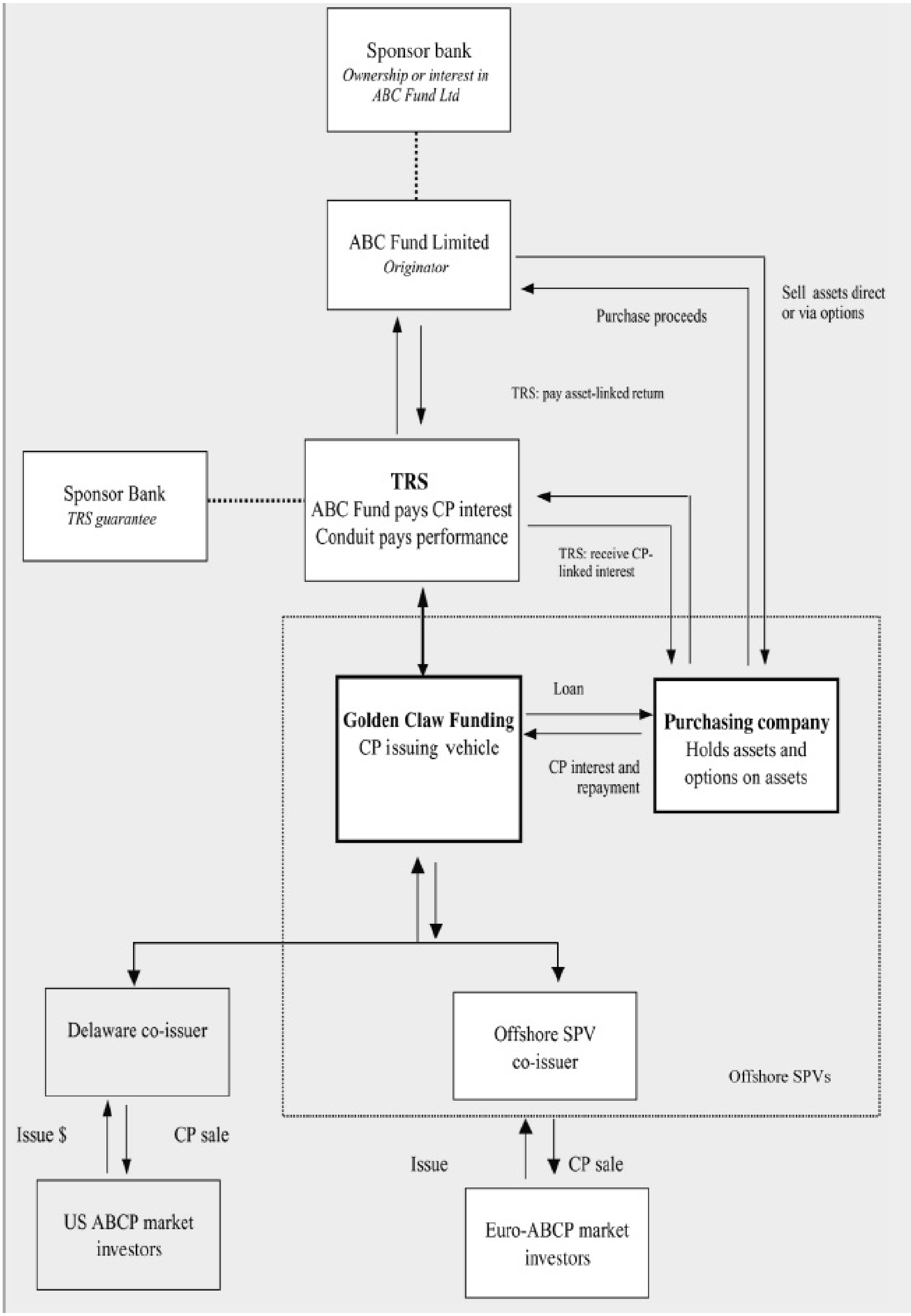
The synthetic ABCP conduit

The latest development in conduits 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 an hypothetical transaction, "Golden Claw Funding", which is a TRS-backed ABCP structure.

Example 19.1: Hypothetical case study: Golden Claw Funding

Figure 19.3 is a structure diagram for a synthetic ABCP vehicle that uses a TRS in its structure. It illustrates an hypothetical conduit, Golden Claw Funding Ltd, which issues paper into both the US CP market and the EuroCP 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.

Figure 19.3 Synthetic ABCP conduit, hypothetical deal "Golden Claw Funding"



Sponsor bank
Ownership or interest in ABC Fund Ltd
ABC Fund Limited
Originator
Purchase proceeds
Sell assets direct or via options
TRS: pay asset-linked return
Sponsor Bank
TRS guarantee
TRS
ABC Fund pays CP interest
Conduit pays performance
TRS: receive CP-linked interest
Loan
Golden Claw Funding
CP issuing vehicle
Purchasing company
Holds assets and options on assets
CP interest and repayment
Delaware co-issuer
Offshore SPV co-issuer
Offshore SPVs
Issue $
CP sale
Issue
CP sale
US ABCP market investors
Euro-ABCP market investors

The structure shown in Figure 19.3 has the following features:

- the CP issuance vehicle and the purchase company (PC) 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 ECP via an offshore SPV;
- proceeds of the CP issue are loaned to the PC, 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 an option called a zero-strike call (ZSC). (We describe ZSCs in Example 19.3.) If assets are purchased directly on to the balance sheet of the PC, 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 the PC, 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, the PC 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 PC 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 in Figure 19.3 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 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.

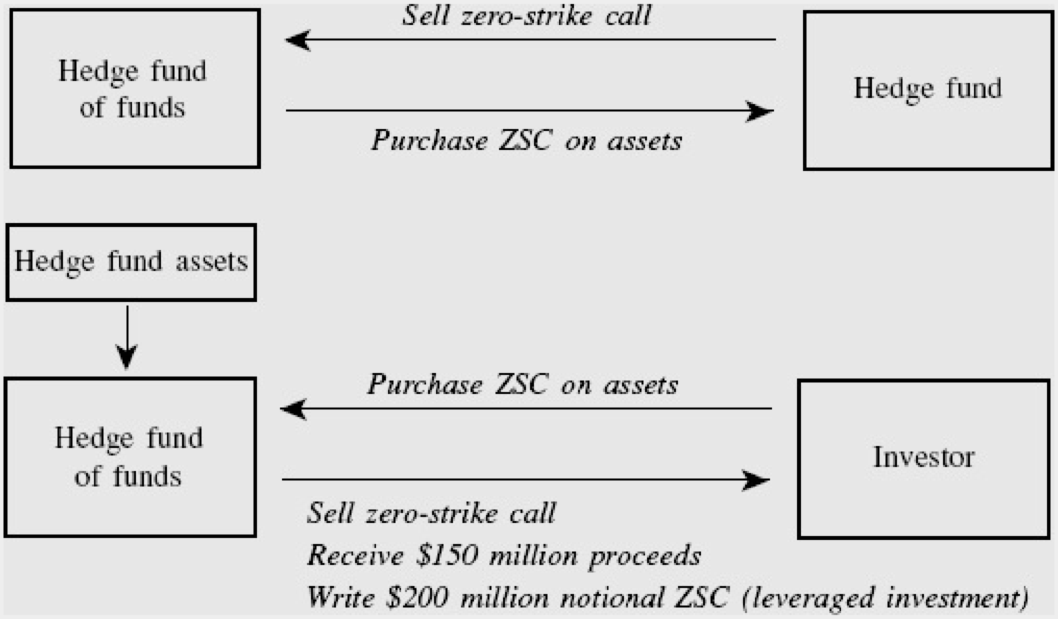
Example 19.2: Zero-strike calls

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 in Figure 19.4.

Figure 19.4 ZSC 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 will 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 equity 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, and is 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 issuer 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).
TRSs	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: (1) the interest payable on the CP issued to fund the related assets through maturity and (2) 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 (1) by the Issuer or the PC to the swap counterparty of market value increases of the related Assets and (2) 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 (1) pay the performance on the TRS reference asset to ABC Fund Limited and (2) 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 (1) pay proceeds equivalent to maturing CP interest and other costs, and (2) 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 the swap reset date), which will coincide with CP maturity payment date and swap maturity.
Issue mechanics	Golden Claw will issue CP on the trade date for settlement on T+2. Simultaneously, on T+0 PC will (1) enter into a loan with Golden Claw for the CP settlement proceeds, value date T+2, loan to expire on CP maturity date; (2) 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; and (3) 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 ABCP structure.

This type of 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 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 referenced notes to repay principal, or otherwise the TRS guarantor will need to cover the repayment.

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 stand-by liquidity back-up for the TRS in the event that it cannot roll over maturing CP. This service would be provided for a fee.

Example 19.3: “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 one-month CP at an all-in price of $99.50. These funds are lent by the vehicle to its purchase company, 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 the purchase company, which would then pay this, under the terms of the TRS, back to ABC Fund (in practice, this cash flow nets to zero so 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.

The basket total return swap

Simpler and more straightforward than the structure described in the previous section, a vanilla total return swap (TRS) may be used as a funding tool, but only where the reference assets are transferable and also able to be priced independently. Typically, this instrument is used 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 the assets that require funding are less liquid or indeed not really tradeable. These can include lower rated bonds, illiquid bonds such as certain ABS, MBS and CDO securities, and assets such as hedge fund shares.

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 holds 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 reset is usually employed, so that the TRS is repriced and cash flows 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 reset 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 reset 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 may also be desirable.

The broker-dealer can add or remove bonds from or to the basket at each reset date. When this happens the swap counterparty revalues 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. Figure 19.5 on pages 938–9 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 been swapped out to a TRS provider in a six-month, weekly reset TRS contract. The TRS bank has paid over the combined market value of the portfolio at a lending rate of 1.14125%. This represents one-week Libor plus 7 basis points. We assume the broker-dealer usually funds at above this level, and that this rate is an improvement on its normal funding. It is not unusual for this type of trade to be undertaken even if the funding rate is not an improvement, however, for diversification reasons.

Figure 19.5 Spreadsheet showing basket of bonds used in TRS funding trade

Market rates	
EUR/USD FX Rate	1.266550
US$ 1-w Libor	1.4055

Name	**Currency**	**Nominal value**	**Price**	**Accrued**
ABC Telecom	EUR	16,000,000	111.671%	0.8169%
XYZ Bank	USD	17,000,000	128.113%	1.7472%
XTC Utility	EUR	45,000,000	102.334%	0.3135%
SPG Corporation	EUR	30,000,000	100.32500	
Watty Exploited	USD	15,000,000	114.997%	0.7594%
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%	1-w Libor + 7 bps	

	Amount	FX rate	ISIN / CUSIP code	Market price	Accrued interest
	22,795,534.57	1.2666		111.6713875	0.81693989
	22,076,259.03	1.0000		128.113125	1.74722222
	58,845,000.00	1.2666		102.3337875	0.31352459
	30,000,325.00	1.2666		100.325	0
	17,363,503.12	1.0000		114.9973125	0.759375
	151,080,621.72				

We see from Figure 19.5 that the portfolio has a current market value of approximately USD 151,080,000. This value is lent to the broker-dealer in return for the bonds.

One week later the TRS is reset. We see from Figure 19.6 on pages 940–1, that the portfolio has increased in market value since the last reset. 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 USD33,526.

Figure 19.6 Spreadsheet showing basket of bonds at TRS reset date plus performance and interest payments due from each TRS counterparty

EUR/USD	**1.2431**			
Bond	**Curr**	**Nominal value**	**Price**	**Accrued**
ABC Telecom	EUR	16,000,000	111.5000%	0.78%
XYZ Bank	USD	17,000,000	125.0000%	1.58%
XTC Utility	EUR	45,000,000	113.0000%	0.28%
SPG Corporation	EUR	30,000,000	100.75	
Watty Exploited	USD	15,000,000	113.0620%	0.63%
Payments				
Interest				
Rate	1.14125%	1-w Libor + 7 bps		
Amount	151,080,000.00	151,113,526.12		
Interest payable	33,526.12			
Performance				
Old portfolio value	151,080,000.00			
New portfolio value	154,498,511.95			
Performance payment	**(3,418,511.95)**			
Swap ctpy pays	**(3,384,985.83)**	[if negative, swap counterparty pays; if positive, broker-dealer pays		
New loan				
Additions	0.00	Net payment		
New loan amount	**154,498,511.95**			
New interest rate	1.14875%			

Amount	FX	ISIN/CUSIP	Market price	Accrued
22,331,239	1.2431		111.5	0.77595628
21,518,931	1		125	1.58194444
63,369,825	1.2431		113	0.28278689
30,225,000	1.2431		100.75	
17,053,518.2	1		113.0619965	0.628125
154,498,511.95				

Old portfolio value: +151,080,951.67 US$
Interest rate: 1.14125%
Interest payable by broker-dealer +33,526.33 US$

New portfolio value: +154,498,511 US$
Performance: 3,418,511 US$

Figure 19.7 shows the basket after the addition of new bond, and the resultant change in portfolio value.

Figure 19.7 TRS basket value after addition of new bond

EUR/USD 1.228

Name	Curr	Nominal	Price	Accrued	Amount	FX	Isin	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	113.0000%	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%	0.00628125	17,053,518	1		113.061996	0.628125
Lloyd Cole Funding	USD	15,000,000	112.0923%	0.57%	16,899,628	1		112.092313	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		(16,899,628.12)							
Swap ctpy pays		(16,865,118.09)							
New loan									
Additions		16,899,628.12							
New loan amount		171,398,140.07							
New interest rate		1.22750%							

Structured funding vehicles: Repo conduit

As a result of their requirements for greater funding diversity, banks and financial institutions now make increasing use of cash structured vehicles to raise funds and generate liquidity. In this section we describe one of the latest structures worked on by the author in the US dollar and euro markets.

Securities repo conduit

There are various forms of a repo-based structured funding vehicle that provide efficient funding of a securities portfolio, known as a securities repo conduit. This is used to provide funding for a wide range of assets, including residential mortgages, commercial mortgages, structured finance securities such as student loan ABS, and existing conduit vehicles.[1] It is an on-balance sheet funding mechanism, and is similar to a CP conduit, but with added flexibility both on its asset and liability side. It provides access to the CP market but without the requirement of a back-up bank liquidity facility, because the conduit is supported by the pool of assets that are being financed. As such it enables the originator to reduce its reliance on CP and repo dealers, while also guaranteeing access to the market during times of market disruption.

Structure

The securities repo conduit is essentially a means by which an investment bank, via a separate legal entity or via its own balance sheet, will provide a "warehouse" funding vehicle for a client that wishes to finance a pool of assets.

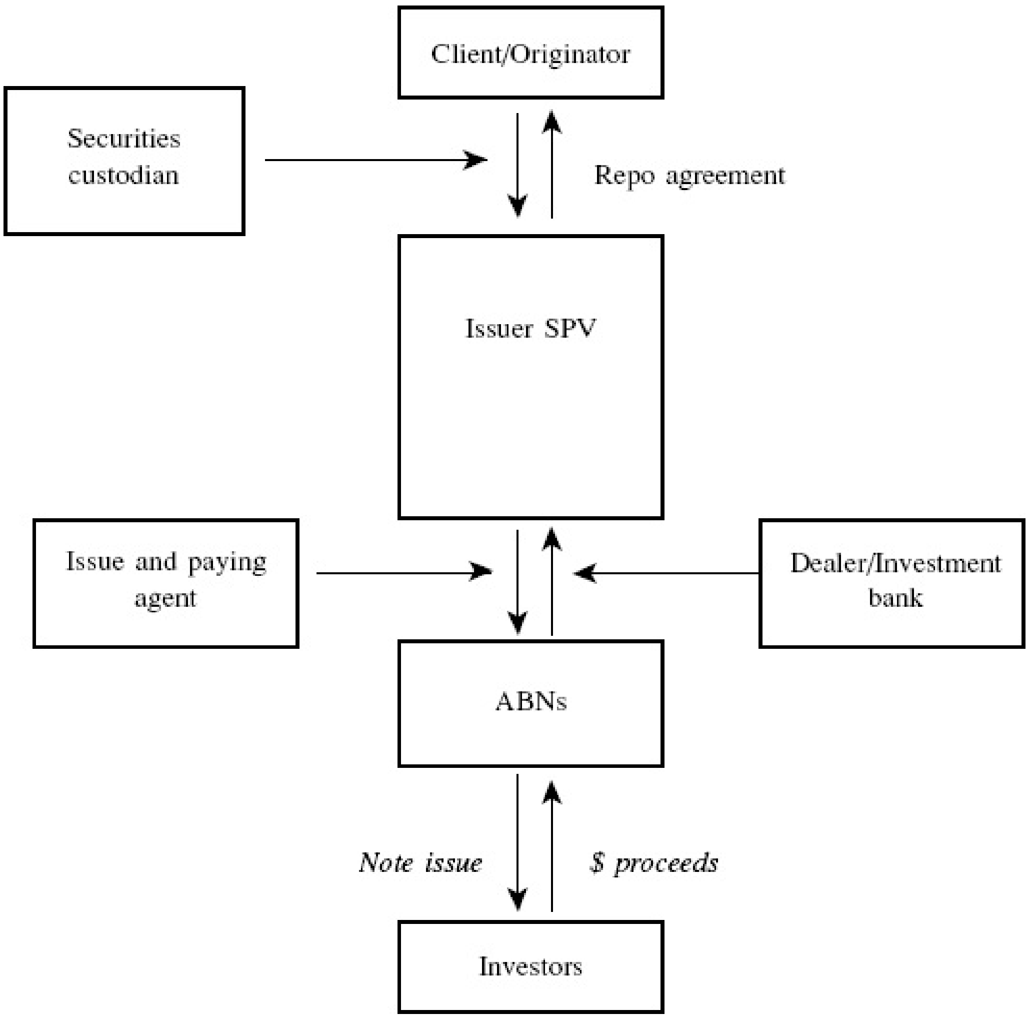
The structure is designed as follows: a separate legal entity (the SPV) is set up as a bankruptcy-remote funding vehicle, which is the issuer. Thereafter:

- the issuer issues short-term notes, termed loan notes or asset-backed loan notes (ABNs) that are issued at A−1/P−1/F−1 or better,[2] which are backed by repo agreements between it and the client entity;
- the client will repo securities out to the issuer, which act as the collateral for the ABNs. The amount of collateral will be equal to the value of notes issues plus an additional amount as credit enhancement;
- the repo provides sufficient funds to pay off the ABNs on maturity, with the repo and ABNs being set with identical maturities;
- the repo between the issuer and the client will allow for the repo securities (collateral) to be bankruptcy-remote from the fortunes of the client.

In effect the ABNs are a repo-backed funding issue rather than a pure asset-backed note issue. It is the repo that provides the security for the ABNs, rather than the underlying securities themselves. So the cash-flow patterns of the underlying securities, whatever type they are, are not strictly relevant to the security-backing of the ABN issue.

Figure 19.8 shows the structure diagram.

Figure 19.8 Securities repo conduit structure



The terms of an ABN issue might look something like this:

Instrument type:	Discount paper
Maturity:	30–270 days (USD); 364 days (EUR, GBP)
Legal final maturity:	[30] days after expected final maturity
Rate:	Libor minus [5–7] basis points (excluding dealer fee)
Repo terms:	Equal nominal value plus haircut Identical maturity date

The repo agreement is entered into simultaneously with any ABN issue, and is the security backing for the ABN.

Credit enhancement

A key element of securitisation technology is the concept of credit enhancement, which is set to achieve the required credit rating. A securities repo conduit will employ one or both methods of credit enhancement, namely over-collateralisation and a swap arrangement.

Through over-collateralisation, the market value of the securities assigned under the repo agreement is set at a higher level of the nominal value of the ABN issue. This value is the margin or "haircut". The size of the haircut is based on the following:

- credit quality of securities being repoed;
- overall market liquidity;
- historical price volatility of collateral securities.

The repo side of the transaction is marked-to-market on a regular basis and additional collateral will be called for if the haircut value falls during the term of the trade. An indication of the size of expected haircut for different classes of security is shown in Table 19.1, which outlines the levels described by Moody's.

Table 19.1 Example of haircut value for security type

Source: Moody's. Reproduced with permission.

Maturity	RMBS		CMBS		Credit card ABS		Manufactured housing	
	Aaa	Aa2	Aaa	Aa2	Aaa	Aa2	Aaa	Aa2
1 year	3.4%	3.9%	3.4%	4.1%	3.1%	3.7%	4.8%	5.6%
5 years	15.5%	16.3%	15.7%	17.8%	13.7%	15.5%	17.0%	22.1%
10 years	19.1%	21.2%	21.4%	24.3%	17.4%	19.6%	21.0%	26.5%

The other method of credit enhancement is a swap arrangement. Under this, a swap counterparty that is rated at least A−1+/P−1/F−1+ and AA−/AA−/Aa3 will be contracted to cover the market risk of the collateral. The swap is set for a fixed term, say three or five years; at all times the notional value of the swap will be equal to the total value of outstanding collateral in the repo facility. The maximum such size is the total issuance under the conduit.

The swap payment profile under a regular-setting market value swap is:

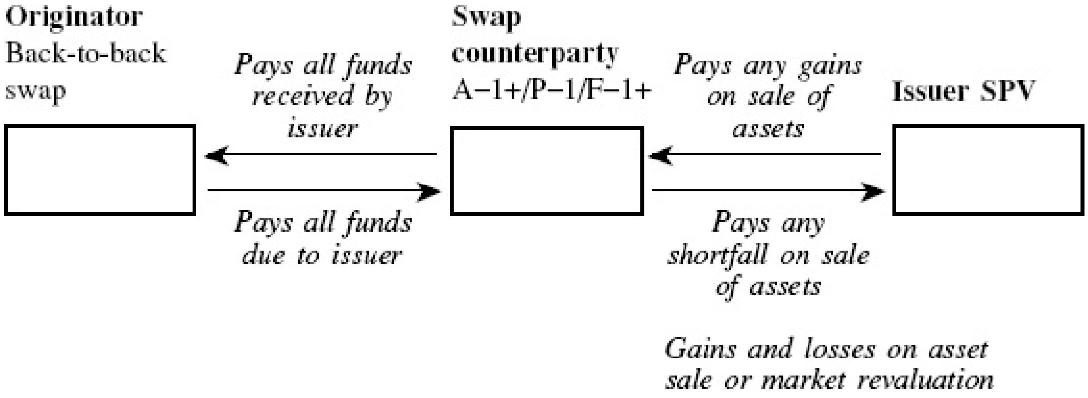
- the issuer pays to the swap counterparty any upside performance received from sale of securities;

- the swap counterparty pays to the issuer any shortfall in the market value of the securities incurred by the sale of said securities.

A mirror arrangement is put in place between the swap counterparty and both the originator and the issue.

The swap cash flows are shown in Figure 19.9.

Figure 19.9 Securities repo conduit, swap arrangement: structure of cash flows



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 tradeable.[3] Repacks were originally classed as "single-asset" or "multi-asset" repacks according to how many underlying securities they represented. A single-asset repack would be a repackaging of just one security. Multi-asset repacks contained a pool of securities and may be considered prototype CDOs. They are not strictly speaking securitisations in the true sense because there is no sale of the underlying securities into a bankruptcy-remote SPV.

In the synthetic market, investment banks have also structured repacks using credit derivatives. Often this will be done 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 requirements. 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 “tradeable” 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. Hence, a repack structure is usually similar in certain respects to a synthetic CDO and often targeted at the same class of investors.

Example deal structure

To illustrate the mechanics of a synthetic repack, we present an 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.

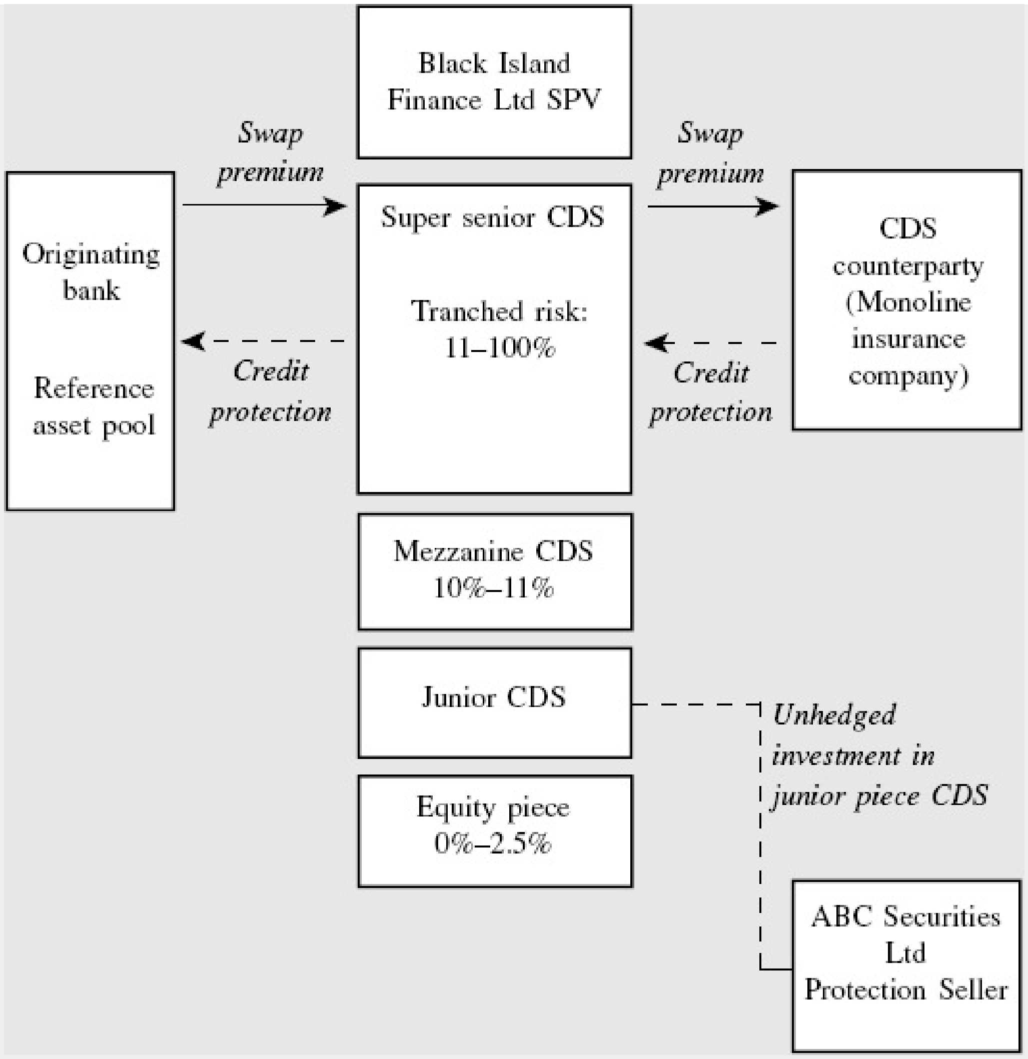
It is necessary to describe first the original synthetic CDO deal. We then consider the motivation behind and structure of the repack.

All names and situations quoted are of course fictitious.

Case Study 19.1: 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 credit default swaps to investors. Figure 19.10 shows the structure of Black Island Finance Ltd.

Figure 19.10 Black Island Finance Ltd, hypothetical unfunded synthetic CDO



The liabilities of the CDO are split into a series of credit default swaps (CDS), 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]

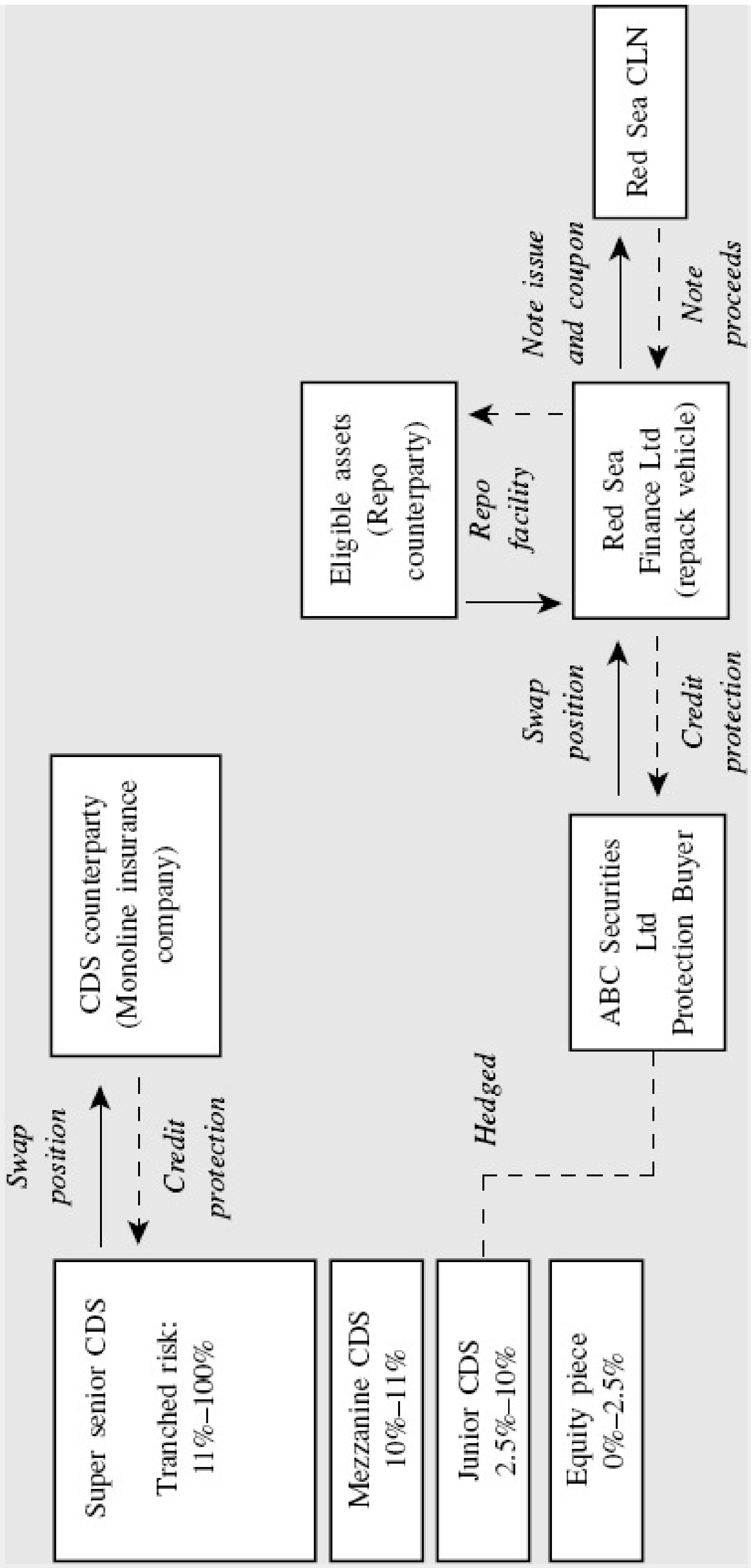
Synthetic repackage vehicle: Red Sea Finance Ltd

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'ed 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 19.11.

Figure 19.11 Red Sea Finance Ltd, hypothetical synthetic repack vehicle



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 earlier how TRSs can be used to obtain off-balance sheet funding of assets at close to Libor, and 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 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

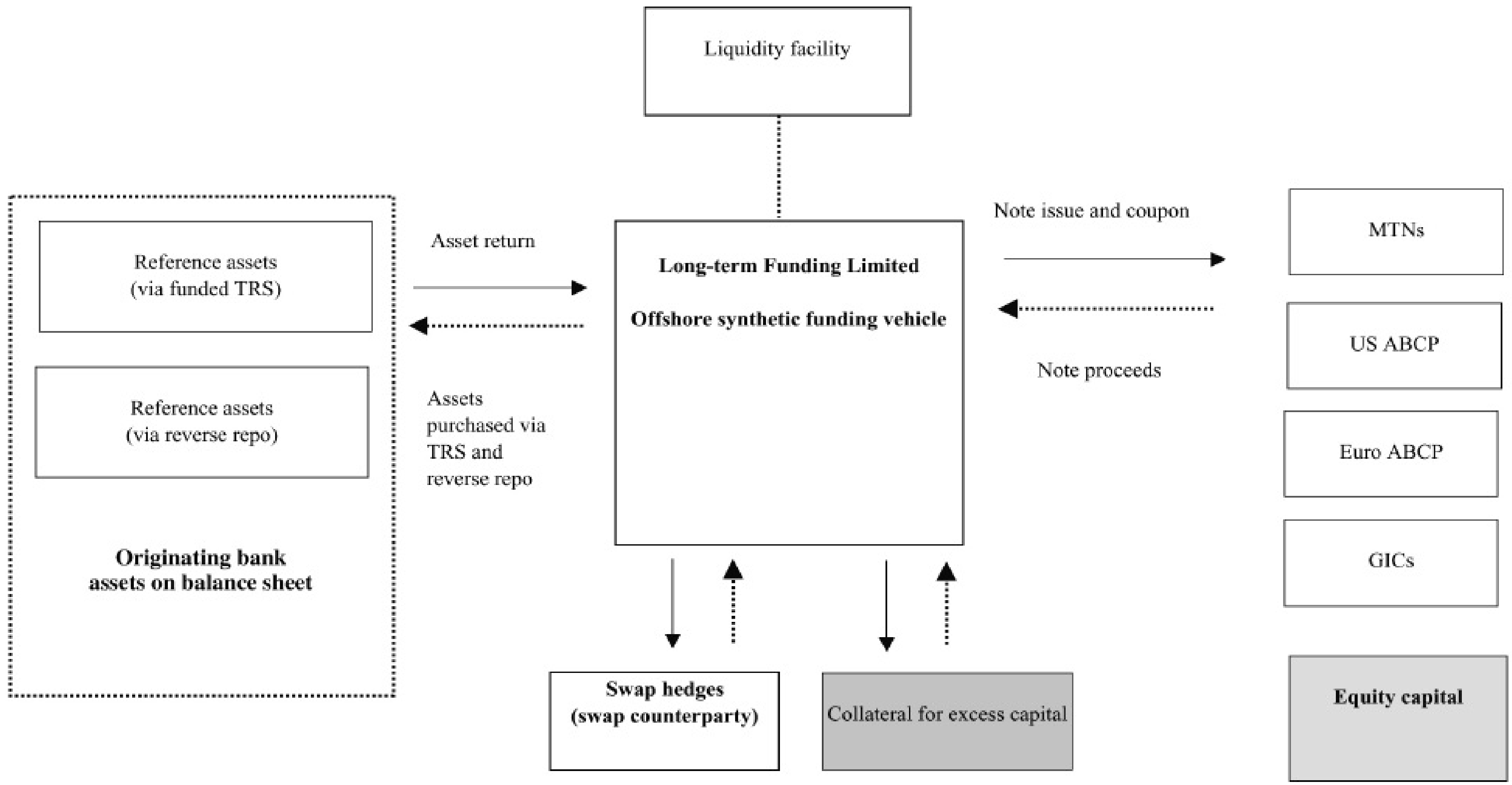
A commercial bank or investment bank can set up an offshore SPV that issues both CP and MTNs to fund underlying assets that are acquired synthetically. We describe this here, as “Long-term Funding Ltd”.

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:

- CP;
- MTNs;
- 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 19.12.

Figure 19.12 Long-term Funding Ltd, offshore synthetic funding vehicle



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)

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 interbank (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.

The types of assets and liabilities that can be held are described next.

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 form in the shape 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, RMBS and 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 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 one-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 and CDO vehicles.

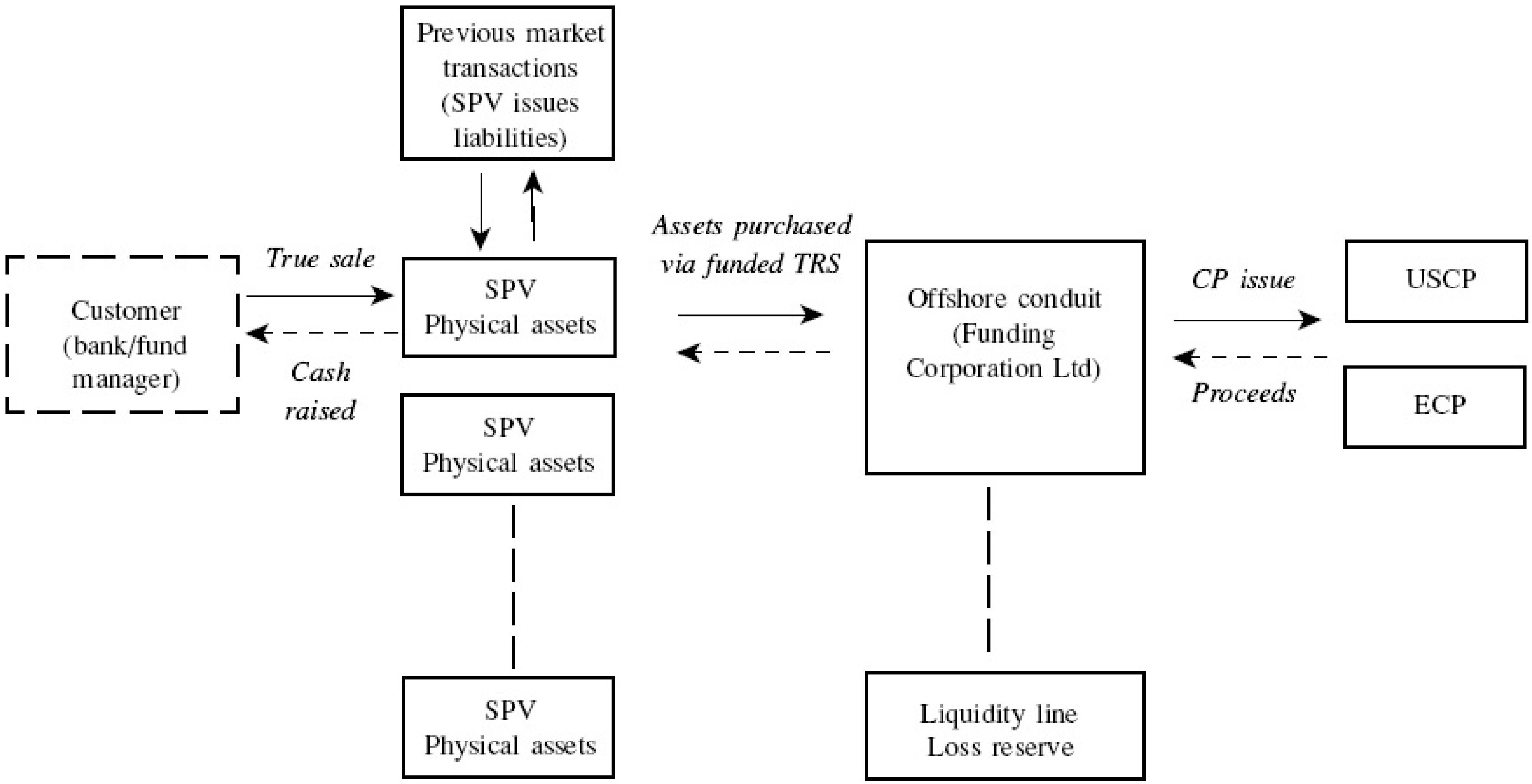
Multi-SPV synthetic conduit funding structure

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 changes in 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 in Figure 19.13 on page 956.

Figure 19.13 Multi-SPV offshore synthetic conduit funding structure


Previous market transactions (SPV issues liabilities)
Customer (bank/fund manager)
True sale
Cash raised
SPV Physical assets
SPV Physical assets
SPV Physical assets
Assets purchased via funded TRS
Offshore conduit (Funding Corporation Ltd)
Liquidity line Loss reserve
CP issue
Proceeds
USCP
ECP

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 there is no more necessity to mark-to-market the assets;
- the investment bank originator, and CP investors (in that order), offers to wear any losses on the reference portfolio due to credit events or default, and earns 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 illustration of the flexibility of credit derivatives, and structured credit products created from credit derivatives, in the debt capital markets today.

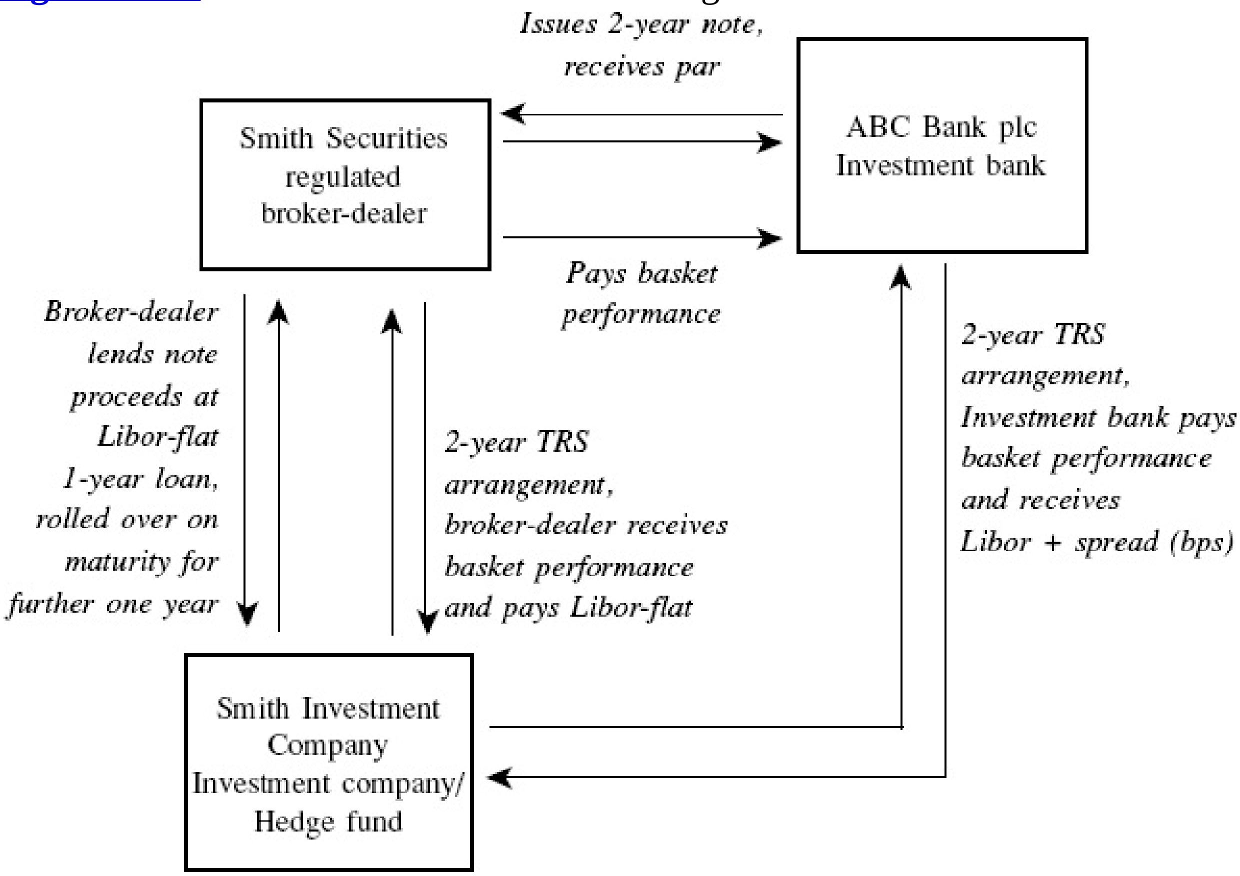
Combined referenced note and TRS funding structure

For a number of reasons, entities such as hedge funds or other investment companies, whether they are independent entities or part of a banking or bancassurance conglomerate, are not able to obtain funding from mainstream banks directly. Hedge funds, for example, are commonly funded via a prime brokerage facility set up with banks. Put simply, under a prime brokerage the provider of the facility holds the assets of the hedge fund in custody, and these assets act as security collateral against which funds are advanced. These funds are used by the hedge fund to pay for the assets it has purchased, and are lent by the prime broker at a spread over Libor, typically 50–70 basis points. The prime broker also lends assets to cover short positions. In both cases margin is required by the prime broker.

Many investment companies hold positions in illiquid assets, such as hedge fund of funds shares, or other difficult-to-trade assets. It is more difficult to raise funds in the wholesale markets using such assets as collateral, because of the problem associated with transferring them to the custody of the cash lender. The advent of credit derivatives and financial engineering has enabled companies to get around this problem by setting up tailor-made structures for funding purposes. Here we describe an example of a funding or liquidity structure that raises cash in the wholesale market via a note and TRS structure that references a basket of illiquid assets.

Assume two entities that are part of a bancassurance group: a regulated broker-dealer ("Smith Securities") and a hedge fund derivative investment house ("Smith Investments Company"). The investment house raises funds primarily from its parent banking group; however, for diversity purposes it also wishes to raise funds from other sources. One such source is the wholesale markets, via a note and TRS structure, illustrated in Figure 19.14.

Figure 19.14 Combined note and TRS funding structure



The lender is an investment bank ("ABC Bank plc"). It is willing to advance funds to the investment company, secured by its assets, at a rate of Libor plus 20 basis points. This is a considerable saving on the investment company's cost of funds with a prime broker, and comparable with its parent group funding rate. However, its assets cannot be transferred as they are untradeable assets, and so cannot act as collateral in the normal way one observes in, say, repo trades.

Instead we structure the following in order to enable the funding to be raised:

- ABC Bank plc does not lend funds directly, instead it purchases a two-year note at a price of par. The return on this note is linked to the performance of a basket of assets held by Smith Investment Company. As Smith Investment Company is an unregulated entity, it cannot issue a note into the wholesale markets. Therefore the note is issued by its sister company, Smith Securities;

- the funds raised by the sale of the note are transferred, in the form of a loan, from Smith Securities to Smith Investment Company at Libor-flat;
- simultaneously the two companies enter into a TRS arrangement, with start and maturity dates matching that of the note. Under this TRS, Smith Securities receives the performance of the basket of assets and pays Libor-flat;
- also simultaneously, Smith Investment Company and ABC Bank plc enter into a TRS arrangement whereby the bank pays the performance of the basket of assets, and receives Libor plus 20 basis points.

The net cash flow of this structure is that Smith Investment Company pays ABC Bank plc Libor plus 20 basis points, and raises funds via the proceeds of the note issue by Smith Securities. The economic effect is that of a two-year loan from ABC Bank to Smith Investment Company, but because of legal, regulatory, operational and administrative restrictions we need to have the structure described above to effect this.

Note that under some jurisdictions, it is not possible for group companies to make inter-company loans, particularly if the two companies are incorporated in different countries, without attracting withholding tax on the loan. For example, it may be that inter-company loans must be of under one-year maturity. To get around this, in Figure 19.14 we have shown the loan from Smith Securities to be a one-year loan, which is then rolled over for another year on maturity.

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Choudhry, M. 2004b, *Structured Credit Products: Credit Derivatives and Synthetic Securitisation*, John Wiley & Sons, Singapore.

Choudhry, M. 2004c, *The Money Markets: A Practitioner's Guide*, John Wiley & Sons, Singapore.

[1] See Chapter 3 for background on CP conduits.

[2] The top S&P and Fitch short-term credit ratings are A−1+ and F−1+.

[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 features of attraction added on, and sold on to new investors.

[4] The author has no qualms in admitting that he is a keen fan of the works of Georges Remi, specifically the adventures of *Tintin.*

[5] For more information on ABCP, see Choudhry (2004c)

[6] We refer to new US accounting rules on consolidating SPVs that are not deemed truly arms-length, part of FASB 142. This was partly a response to the Enron affair, 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.

CHAPTER 22

Collateralised Debt Obligations[1]

Collateralised debt obligations (CDOs) are structured finance products that are related to asset-backed securities. They are important tools in bank ALM, first employed for asset management purposes as vehicles to reduce balance sheet risk. Subsequently, they became an asset class in their own right and later developed into mini-investment funds. In this chapter we look at different types of CDO structures and how they are used as ALM tools.

Collateralised bond obligations (CBOs) and collateralised loan obligations (CLOs), which together make up collateralised debt obligations (CDOs), are natural developments in securitisation. The origins of the market are generally held to be the repackaging of high-yield debt or loans into higher-rated bonds, which began in the late 1980s. Today, there is great diversity in CDO transactions, and the market has expanded into Europe and Asia from its origin in the United States. Both CBOs and CDOs are notes or securities issued against an underlying collateral of assets, almost invariably a diverse pool of corporate bonds or loans, or a combination of both. A transaction with a corporate-or sovereign-bond asset pool is a CBO, while a CLO is backed by a portfolio of secured and/or unsecured corporate and commercial bank loans. Cash flow CBOs/CDOs fall into two types; these are arbitrage and balance sheet CDOs.

A typical CDO structure involves the transfer of credit risk from an underlying asset pool to an SPV and this credit risk is then transferred to investors via the issue of credit-linked notes by the SPV. The objectives behind CDO transactions undertaken by banks include:

- optimisation of returns on regulatory capital by reducing the need for capital to support assets on the balance sheet;
- improvement of return on economic capital by managing risk effectively;
- management of risk (for example, purchasing or transferring credit risk) and balance sheet capital;
- issue of securities as a means of raising funding;
- provision of funding for the acquisition of assets;

- increasing funds under management.

Figure 22.1 shows CDO issue volumes in the years to 2004, while Figure 22.2 shows the country of origin of underlying assets during 2004. The "family tree" of CDOs is shown in Figure 22.3. A typical conventional CDO structure is shown in Figure 22.4 and Figure 22.5 on page 1025.

Figure 22.1 CDO market volume

Source: Moody's.

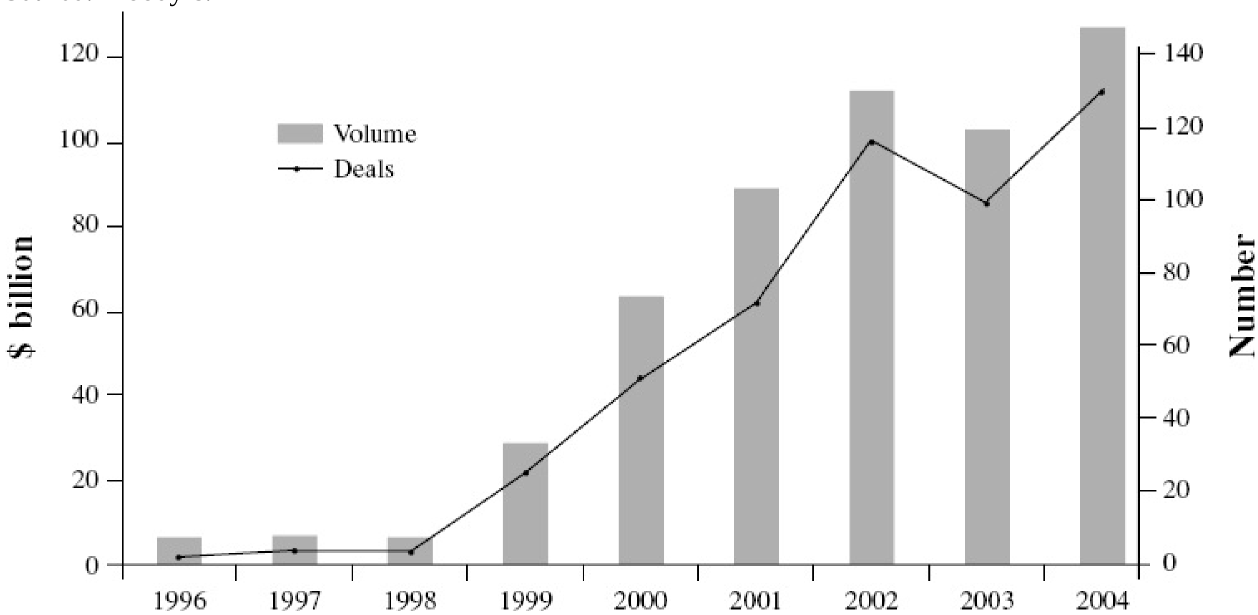


Figure 22.2 Origin of assets, 2004

Source: Moody's

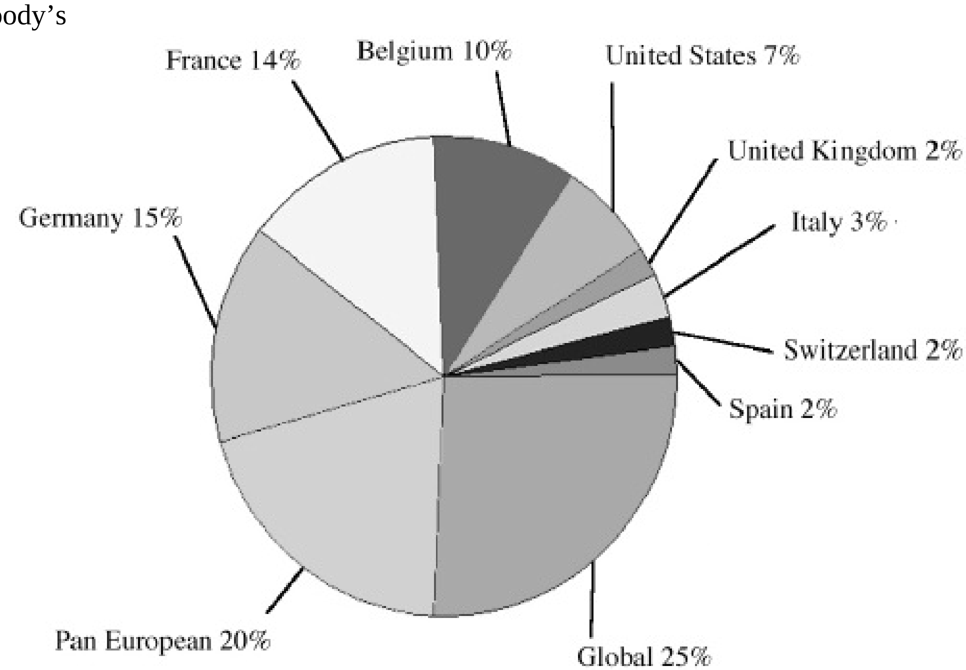


Figure 22.3 The CDO family

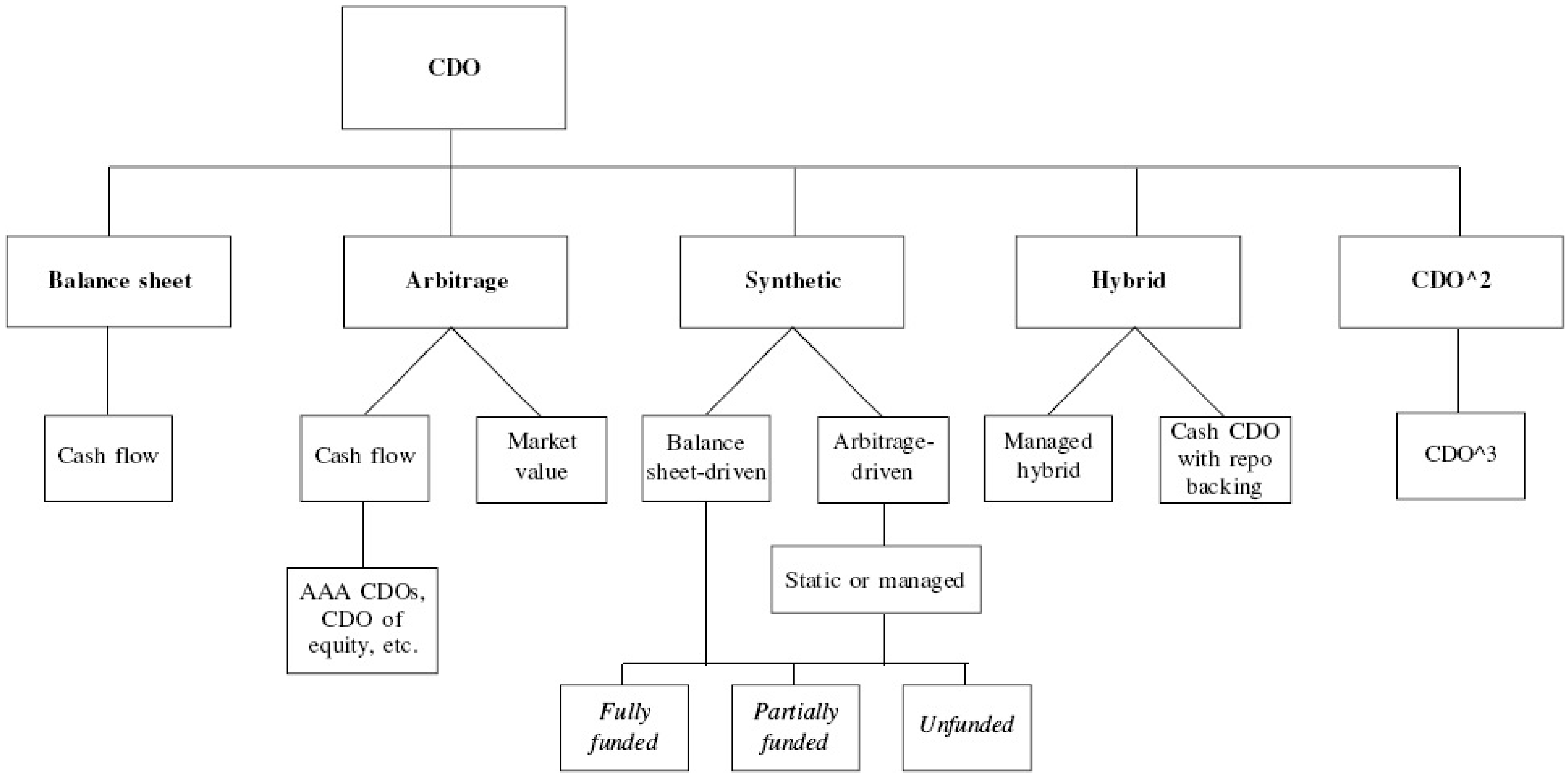

CDO
Balance sheet
Arbitrage
Synthetic
Hybrid
CDO^2
Cash flow
Cash flow
Market value
Balance sheet-driven
Arbitrage-driven
Managed hybrid
Cash CDO with repo backing
CDO^3
AAA CDOs, CDO of equity, etc.
Static or managed
Fully funded
Partially funded
Unfunded

Figure 22.4 Generic cash flow CDO

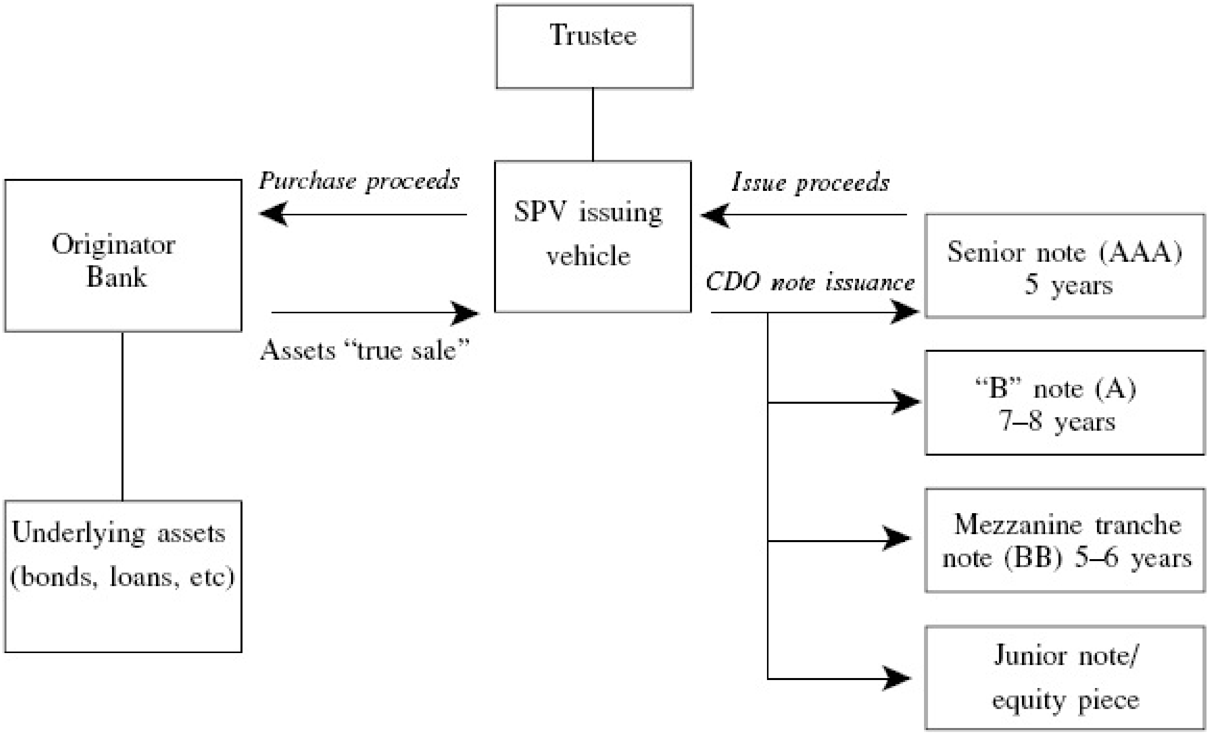
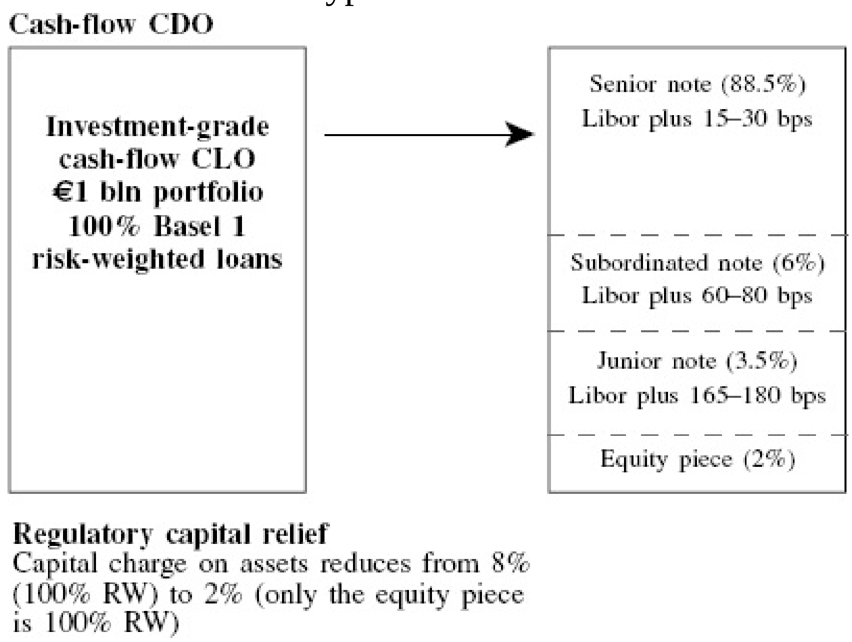


Figure 22.5 Conventional CDO hypothetical mechanics



The main distinction between a CLO and CBO is the dominant investment class in the underlying asset pool. With a CLO, the underlying asset pool is a portfolio of bank loans, while a CBO series is issued against an underlying asset pool of a portfolio of bonds. So although they are grouped into a single generic form, there are differences between CBOs and CLOs. In the first instance, assets such as bank loans have different features to bonds; the analysis of the two will therefore differ. Note also the following:

- loans are less uniform instruments, and their terms vary widely. This includes terms such as interest dates, amortisation schedules, reference rate indices, reset dates, terms to maturity and so on, which affect the analysis of cash flows;
- the legal documentation for loans is less standardised, in part reflecting the observation above, and this calls for more in-depth legal review;
- it is often possible to restructure a loan portfolio to reflect the changed or changing status of borrowers (for example, their ability to service the debt), a flexibility not usually afforded to participants in a CBO;
- the secondary market in bank loans is far less liquid than that in bonds.

These issues, among others, mean the analysis of CBOs often presents differences from that used for CLOs.

This chapter briefly introduces CDOs, describes the motivation for an originator such as a commercial bank, and some of the issues relating to the CDO structures.

Example 22.1 Bonds and loans

Until the mid-1990s there was a distinct separation between bonds and loans in the capital market. The key difference was that the latter did not trade in a liquid secondary market. This factor was a key driver in the origination of CLOs, as banks sought to extract value from and reduce the capital burden of their loan books. The rise and acceptance of CLOs has partly been behind the subsequent development of a secondary market in syndicated loans.

Many loans are now priced, evaluated and traded in a secondary market. Certain syndicated loans can be sold to investors who desire a safer haven than the corporate bond market, or who wish to enter into relative value positions by taking advantage of the spread differential between loans and bonds issued by the same borrower. Syndicated loans are classified as senior debt, so they have a higher priority over corporate bonds in the event of a winding-up of the issuer.

It can be problematic to value a syndicated loan, as it may have a repayment schedule, as well as a floating interest rate that may step up or down, depending on changes in (say) the credit rating of the issuer. This is a key issued addressed whenever loans are evaluated for a CLO portfolio.

Bloomberg’s YA page, which we encountered in Chapter 4, can also be used for syndicated loan analysis. Any loan must be found on the system first by typing

LOAN <Go>

which brings up the syndicated bank loan menu function. This includes a loan finder function. Once the loan is found, it can be evaluated using screen YA.

Figure 22.6 shows the page being used to assess a USD loan issued by Singapore Aircraft Leasing, which is part of the Singapore Airlines group. At the time it was evaluated the loan had approximately six years left to maturity, having been issued originally in 1998 at a spread of 70 basis points over Libor.

Figure 22.6 Loan information data on Bloomberg for a loan issued by Singapore Aircraft Leasing

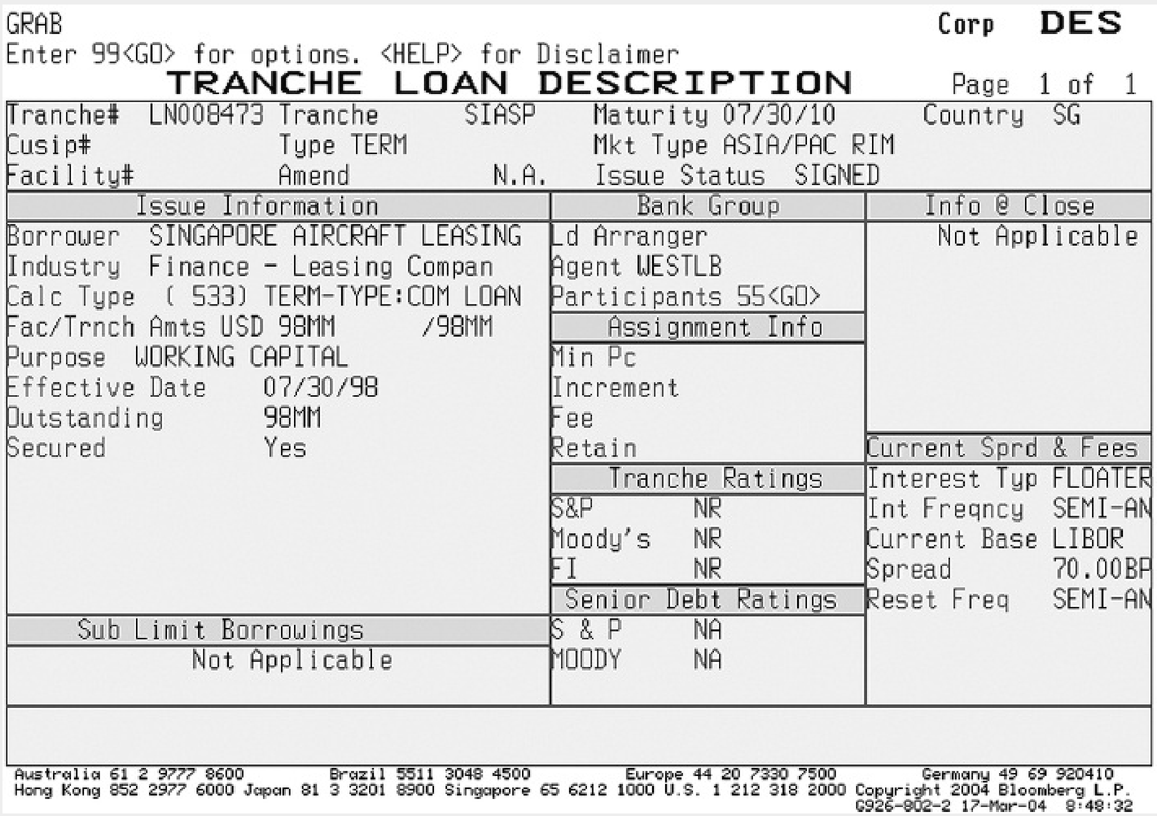
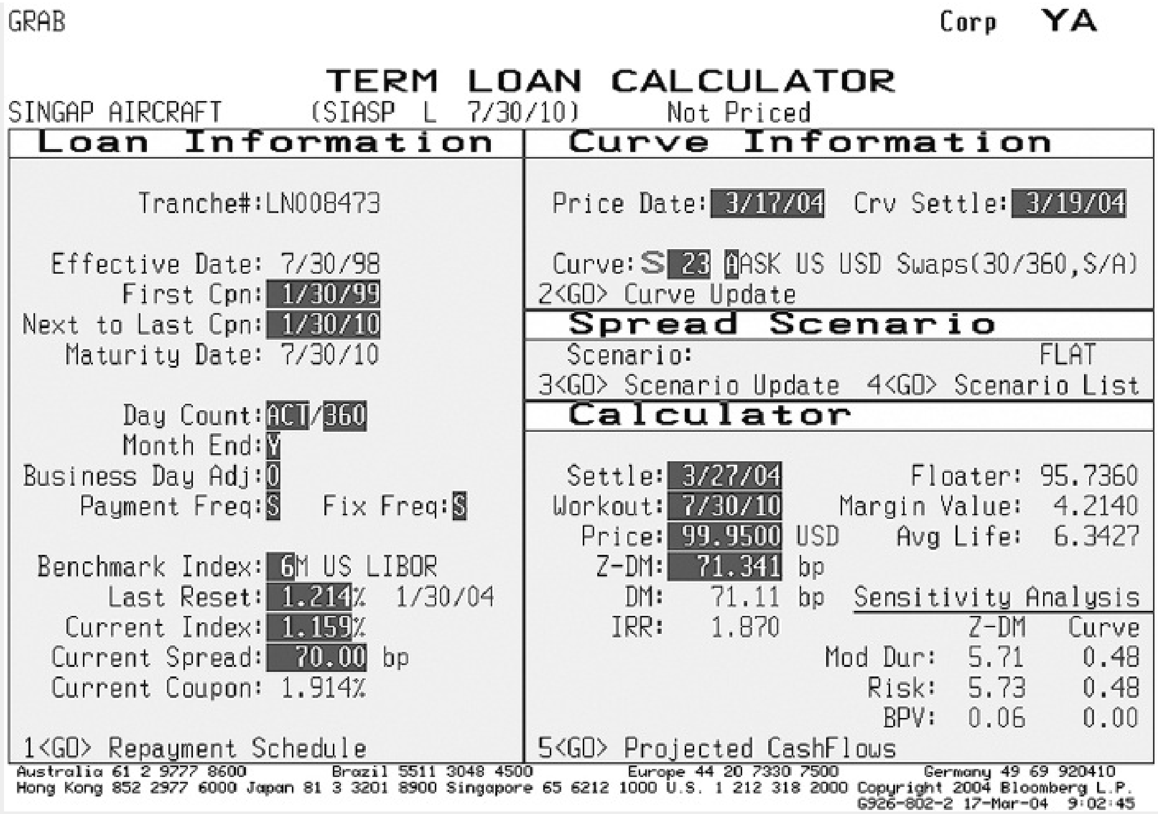


Figure 22.7 shows the yield analysis function for the same loan, as at 17 March 2004. The screen is split into four parts that include:

Figure 22.7 Bloomberg page YA used to evaluate the Singapore Aircraft Leasing syndicated loan, as at 17 March 2004


GRAB Corp YA

TERM LOAN CALCULATOR

SINGAP AIRCRAFT (SIASP L 7/30/10) Not Priced

Loan Information	Curve Information
Tranche#:LN008473	Price Date: 3/17/04 Crv Settle: 3/19/04
Effective Date: 7/30/98	Curve: S 23 AASK US USD Swaps(30/360,S/A)
First Cpn: 1/30/99	2<GO> Curve Update
Next to Last Cpn: 1/30/10	**Spread Scenario**
Maturity Date: 7/30/10	Scenario: FLAT
	3<GO> Scenario Update 4<GO> Scenario List
Day Count: ACT/360	**Calculator**
Month End: Y	
Business Day Adj: 0	Settle: 3/27/04 Floater: 95.7360
Payment Freq: S Fix Freq: S	Workout: 7/30/10 Margin Value: 4.2140
	Price: 99.9500 USD Avg Life: 6.3427
Benchmark Index: 6M US LIBOR	Z-DM: 71.341 bp
Last Reset: 1.214% 1/30/04	DM: 71.11 bp Sensitivity Analysis
Current Index: 1.159%	IRR: 1.870 Z-DM Curve
Current Spread: 70.00 bp	Mod Dur: 5.71 0.48
Current Coupon: 1.914%	Risk: 5.73 0.48
	BPV: 0.06 0.00
1<GO> Repayment Schedule	5<GO> Projected CashFlows

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 17-Mar-04 9:02:45

- loan information data;
- curve information about the yield curve selected to analyse this loan;
- the calculator that shows the IRR and the current spread over the Libor forward curve (zero-discount margin or Z-DM field).

The Z-DM field is the main measure of return on the loan. It shows the current spread on the loan over the Libor forward curve, in this case 71.341 basis points. The evaluation is carried out against the USD swap curve, on a 30/360 and semi-annual basis (the same terms as the loan). The IRR of the loan is shown to be 1.87%.

The discount margin assumes that this day's Libor is unchanged for the life of the loan (a necessary, but unrealistic, assumption). This spread can be used to compare the return on the loan compared to that on a bond. If there is a similar maturity floating-rate bond available from the same issuer, then the comparison is easily made. Otherwise we can compare the asset swap spread for a fixed-coupon bond. To do that we can call up a similar maturity bond for the same issuer on page ASW on Bloomberg. The ASW page calculates the swap market's value of a fixed-rate bond as a spread over Libor. This spread can be compared to the spread for the loan to assess relative value. At any time that the loan pays a higher spread, it might be deemed an attractive investment compared to the bond, especially since it has a repayment priority on default over the bond.

An overview of CDOs

CDO is the generic term for two distinct products, so-called balance sheet transactions and arbitrage transactions. The common thread between these structures is that they are both backed by some form of commercial or corporate debt or loan receivable. The primary differences between the two types are the type of collateral backing the newly created securities in the CDO structure, and the motivations behind the transaction. The growth of the market has been in response to two key requirements: the desire of investors for higher yield investments in higher risk markets, managed by portfolio managers skilled at extracting value out of poorly performing or distressed debt, and the need for banks to extract greater value out of assets on their balance sheet, almost invariably because they are generating a below-market rate of return. By securitising bond or loan portfolios, banks can lower their capital charge by removing them off their balance sheet and funding them at a lower rate. Figure 22.8 is a summary of the key differences between balance sheet and arbitrage CDOs.

Figure 22.8 Collateralised debt obligations

Collateralised debt obligations (CDOs)

Balance sheet CDOs	Arbitrage CDOs
Collateral: high-grade, bank-oriented commercial and corporate loans	**Collateral**: high-yield corporate bonds or corporate loans
Key motivations: reducing balance sheet to improve capital ratios; obtain off-balance sheet treatments; obtain lower funding rates	**Key motivations**: arbitrage opportunity; increasing assets under management; assets purchased in secondary market
Typical issuers: domestic and international banks	**Typical issuers**: insurance companies; mutual funds; private equity funds
Market liquidity: generally lower than investor-driven trades	

Balance sheet CDOs are structured securities developed because banks wished to securitise part of their loan portfolios, in order to improve their capital adequacy position. Securitising a bank's loans reduces the size of its balance sheet, thereby improving its capital ratio and lowering its capital charge. The first domestic balance sheet CLO in the US market was the NationsBank Commercial Loan Master Trust, series 1997–91 and 1997–92, issued in September 1997, which employed what is known as a Master Trust structure to target investors who had previously purchased asset-backed securities.[2]

As balance sheet CLOs are originated mainly by commercial banks, the underlying collateral is usually part of their own commercial loan portfolios, and can be fixed-term, revolving, secured and unsecured, syndicated and other loans. Although most CLOs have been issued by banks that are domiciled in the main developed economies, the geographical nature of the underlying collateral often has little connection with the home country of the originating bank. Most bank CLOs are floating-rate loans with average lives of five years or less. They are targeted mainly at bank sector Libor-based investors, and are structured with an amortising payoff schedule.

Arbitrage CDOs are backed with high-yield corporate bonds or loans. As the collateral can take either form, arbitrage CDOs can be either CLOs or CBOs. Market practitioners often refer to all arbitrage deals as CDOs for simplicity, irrespective of the collateral backing them. The key motivation behind arbitrage CDOs is the opportunity for arbitrage, or the difference between investment-grade funding rates and high-yield investment rates. In an arbitrage CDO, the income generated by the high-yield assets should exceed the cost of funding, as long as no credit event or market event takes place.

Although CDOs are not a recent innovation, the market only experienced high growth rates from 1995 onwards, and certain investors are still prone to regard it as an “emerging” asset class. However, in terms of volume in the US market, CDOs are comparable to credit card and automobile loan asset-backed securities.

CDO structures are classified into conventional CDO structures and synthetic CDO structures. The difference between these structures lies in the method of risk transfer from the originator to the SPV. In conventional CDO structures, the transfer of assets, known as a true sale, is how credit risk is transferred to the SPV. In synthetic CDO structures, credit-derivative instruments are used to transfer credit risk.

In practice, the two structures are categorised by the motivation behind their issue. There are two main motivations: issuer-or balance sheet-driven transactions and investor-driven or market-value arbitrage transactions. To date, balance sheet-driven transactions have been the main reason for structuring the majority of CDOs in Europe. However, investor-driven arbitrage CDO transactions have experienced strong growth as investment managers increase funds under management and release value through management expertise of the underlying asset portfolio.

Synthetic structures are described in the next chapter.

CDOs issue notes from an SPV to investors. SPVs are created to enable the effective transfer of risk from the originator. Most SPVs are set up so that they are bankruptcy-remote and isolated from the originator's credit risk. The creation of an SPV usually involves a nominal amount of equity and the main funding comes from the issue of notes. SPVs may be set up and registered in a tax haven. The funds from the issue of the notes are used to "acquire" the pool of underlying assets (the bonds or loans) from the originator. This will result in the "true sale" of the assets to the SPV. In this way, the SPV has an asset-and-liability profile which must be managed during the term of the CDO.

The ownership of the assets is transferred into the SPV. This asset transfer, if performed and structured properly, removes assets from the balance sheet of a bank originator. As a result, the securitised assets would not be included in the calculation of capital ratios. This provides regulatory-capital relief and is the main motivation for some of the CDO structures in the market today.

The typical liability structure would include a senior tranche rated in the Aaa/Aa category, a junior tranche rated in the Ba category and an unrated equity tranche. The equity tranche is the most risky, as first losses in the underlying portfolio are absorbed by the equity tranche. For this reason, the equity tranche is often referred to as the "first-loss" tranche. The losses on the notes are said to "indemnify" the SPV.

In the case of bank CLOs, the bank will continue to service the loans in the portfolio and usually also retains the first-loss interest.

Structuring a conventional CDO may give rise to significant other issues. The transfer of assets into the SPV in practice may have adverse tax, legal and regulatory implications. The impact will depend on the jurisdiction in which the transfer of assets takes place and the detailed legislation of that jurisdiction. Another practical issue is that the conventional CDO is a funded transaction as the originator receives cash. However, if the originator's main intention is to transfer credit risk or to acquire protection for credit risk, then the conventional CDO structure introduces reinvestment risk, as the cash received would need to be reinvested in other assets.

The SPV which issues the notes is generally an offshore bankruptcy-remote entity to isolate the underlying assets from the default risk of the originator. In most structures, the transfer of credit risk to the investors is via the notes issued by the SPV. The return to investors in the issued notes will be dependent on the performance of the underlying asset pool.

Credit enhancement is provided via subordination (prioritisation of cashflow payments to investors) of the tranches issued by the SPV. However, in addition to a multi-tranche structure, the bank may also use other mechanisms to credit-enhance the senior notes. An example might include credit insurance on the underlying portfolio, known as a credit wrap, and the use of reserve accounts that assume a loss before the equity tranche.

Comparisons with other asset-backed securities

The CDO asset class has similarities in its fundamental structure with other securities in the ABS market. Like other asset-backed securities, a CDO is a debt obligation issued by an SPV, secured by a form of receivable. In this case though, the collateral concerned is high-yield loans or bonds, rather than, say, mortgage or credit card receivables. Again, similar to other ABS, CDO securities typically consist of different credit tranches within a single structure, and the credit ratings range from AAA to B or unrated. The rating of each CDO class is determined by the amount of credit enhancement in the structure, the ongoing performance of the collateral, and the priority of interest in the cash flows generated by the pool of assets. The credit enhancement in a structure is among items scrutinised by investors, who will determine the cashflow waterfalls for the interest and principal, the prepayment conditions, and the methods of allocation for default and recovery. Note that the term “waterfall” is used in the context of asset-backed securitisations that are structured with more than one tranche, to refer to the allocation of principal and interest to each tranche in a series. If there is excess cash and this can be shared with other series, the cash flows are allocated back through the waterfall, running over the successive tranches in the order of priority determined at issue.

A significant difference between CDOs and other ABS is the relationship to the servicer. In a traditional ABS the servicing function is usually performed by the same entity that sources and underwrites the original loans. These roles are different in a CDO transaction; for instance, there is no servicer that can collect on non-performing loans. Instead, the portfolio manager for the issuer must actively manage the portfolio. This might include sourcing higher quality credits, selling positions before they deteriorate and purchasing investments that are expected to appreciate. In essence, portfolio managers assume the responsibility of a servicer. Therefore investors in CDOs must focus their analysis on the portfolio manager as well as on the credit quality of the collateral pool. CDO structures also differ from other ABS in that they frequently hold non-investment-grade collateral in the pool, which is not a common occurrence in traditional ABS structures.

CDO asset types

The arbitrage CDO market can be broken down into two main asset types: *cash flow* and *market value* CDOs. Balance sheet CDOs are all cashflow CDOs.

Cashflow CDOs share more similarities to traditional ABS than market value transactions. Collateral is usually a self-amortising pool of high-yield bonds and loans, expected to make principal and interest payments on a regular basis. Most cashflow CDO structures allow for a reinvestment period, and while this is common in other types of ABS, the period length tends to be longer in cashflow CDOs, typically with a minimum of four years. The cashflow structure relies upon the collateral's ability to generate sufficient cash to pay principal and interest on the rated classes of securities. This is similar to an automobile ABS, in which the auto loan-backed securities rely upon the cash flows from the fixed pool of automobile loans to make principal and interest payments on the liabilities. Trading of the CDO collateral is usually limited – for instance, in the event of a change in credit situation – and so the value of the portfolio is based on the par amount of the collateral securities.

A portfolio of bonds could be traded more often than a portfolio of loans, although with the growing secondary market in loans this distinction is being blurred. A simplified diagram of the liability structure for a portfolio of cash bonds is given in Figure 22.9 on page 1036. The diagram for a market value CBO is shown in Figure 22.10 also on page 1036.

Market value CDOs, which were first introduced in 1995, resemble hedge funds more than traditional ABS. The main difference between a cashflow CDO and a market value CDO is that the portfolio manager has the ability to freely trade the collateral. This means investors focus on expected appreciation in the portfolio, and the portfolio itself may be quite different in, say, 12 months' time compared to its composition today. This leads to the analogy with the hedge fund. Investors in market value CDOs are as concerned with the management and credit skills of the portfolio manager as they are with the credit quality of the collateral pool. Market value CDOs rely upon the portfolio manager's ability to generate total returns and to liquidate the collateral in a timely fashion, if necessary, in order to meet the cashflow obligations (principal and interest) of the CDO structure.

Different portfolio objectives result in distinct investment characteristics. Cashflow CDO assets consist mainly of rated, high-yield debt or loans that are *current* in their principal and interest payments; that is, they are not in default. In a market value CDO the asset composition is more diversified. The collateral pool might consist of, say, a 75 : 25 percentage split between assets to support liability payments and investments to produce increased equity returns. In this case, the first 75% of assets of a market value CDO asset will resemble those of a conventional cashflow CDO, with, say, 25% invested in high-yield bonds and 50% in high-yield loans. These assets should be sufficient to support payments on 100% of the liabilities. The remaining 25% of the portfolio might be invested in “special situations” such as distressed debt, foreign bank loans, hybrid capital instruments and other investments. The higher yielding investments are required to produce the higher yields that are marketed to equity investors in market value CDOs.

We have described in general terms the asset side of a CDO. The liability side of a CDO structure is similar to other ABS structures, and encompasses several investment-grade and non-investment-grade classes with an accompanying equity tranche that serves as the first loss position. In, say, a mortgage-backed transaction the equity class is not usually offered but instead held by the issuer. Typically, in the US market-rated CDO, liabilities have a 10–12-year legal final maturity. The three main rating agencies all actively rate cash flow CDOs, although commonly transactions carry ratings from only one or two of the agencies.

Liabilities for market value CDOs differ in some ways from cashflow CDOs. In most cases senior bank facilities provide more than half of the capital structure, with a 6–7-year final maturity. When a market value transaction is issued, cash generated by the issuance is usually not fully invested at the start. There is a *ramp-up* period to allow the portfolio manager time to make investment decisions and effect collateral purchases. Ramp-up periods result in a risk that cash flows on the portfolio’s assets will not be sufficient to cover liability obligations at the start. Rating agencies consider this ramp-up risk when evaluating the transaction’s credit enhancement. Ramp-up periods are in fact common to both cashflow and market value CDOs, but the period is longer with the latter transactions, resulting in more significant risk.

Although CDOs were created only shortly after the first ABS issues, with the first structure appearing in 1988, it was only in the latter half of the 1990s that the product evolved sufficiently and in enough volume to be regarded as a distinct investment instrument and hence, bank ALM tool. The US market has witnessed the most innovative structures, but interesting developments have also taken place in the United Kingdom and Germany. Table 22.1 summarises the evolution in the CDO product in the US market from its first appearance to present arrangements. In particular, collateral types backing the securities have grown considerably, with increasing sophistication in structure and cashflow mechanics. By 2000, CDOs covered a wide spectrum of credit risk and investment returns, from a diverse pool of high-yielding assets. Investors analyse CDOs as investment instruments in their own right and also with regard to the relative value offered by them vis-à-vis other ABS products.

Table 22.1 CDO product evolution

Early CDO balance sheet	
Assets	*Liabilities*
US domestic high-yield bonds	Fixed-rate private securities Equity
Present-day CDO balance sheet	
Assets	*Liabilities*
US domestic high-yield bonds	AAA to BBB fixed-rate securities
US domestic high-yield loans	AAA to BBB floating-rate securities
Emerging market debt	BB mezzanine securities
Special situation/distressed debt	Contingent interest securities
Foreign bank loan	Credit-linked notes Equity

Figure 22.9 Hypothetical cashflow CBO structure

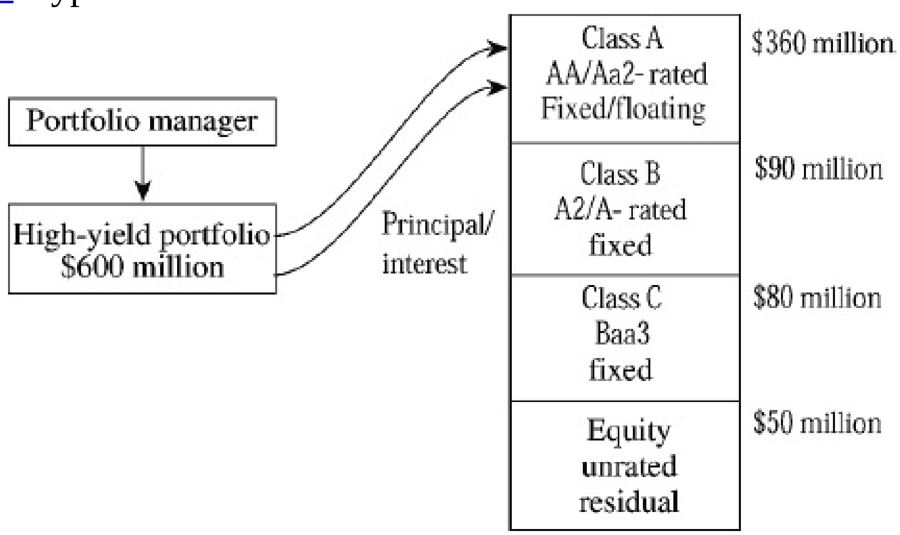
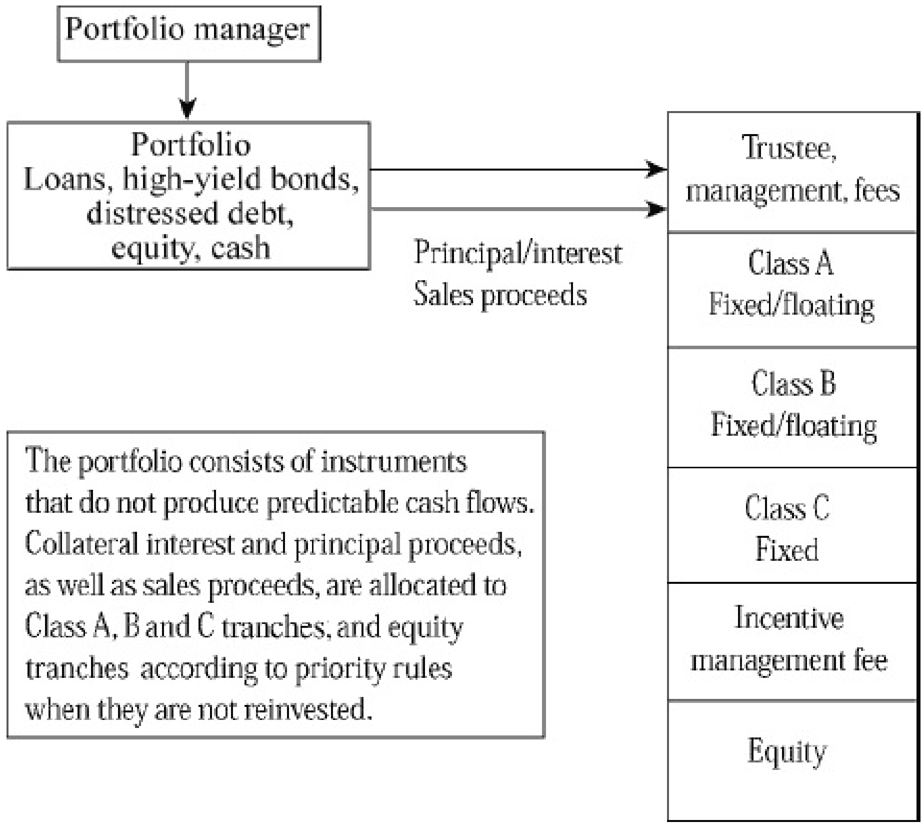


Figure 22.10 Hypothetical market value CBO structure



Motivation behind CDO issue

Bank balance sheet-driven transactions

In a balance sheet CDO, the motivation for the originator is to obtain capital relief through the transfer of credit risk on the pool of underlying assets. The transaction is intended to obtain off-balance sheet treatment for existing on-balance sheet assets to which bank capital has been allocated. The regulatory off-balance sheet treatment enables an originator bank to manage capital constraints and to improve the return on capital for the bank.

The originators of bank balance sheet CLOs are mainly commercial banks. The underlying asset pool may include commercial loans, both secured and unsecured, guarantees and revolving credits. The originator of the underlying assets usually acts as an investment advisor so as to maintain the quality of the underlying asset pool. Although there is usually no trading intention for the underlying asset pool, over the life of the structure there may be changes, such as substitutions or replenishments to the underlying asset pool. A form of protection to the noteholders from these changes is usually that the quality of the underlying pool of assets does not significantly deteriorate. This may be via the maintenance of an average credit quality of the asset pool. Such a restriction is often required by the rating agencies.

The equity tranche in a CDO structure is commonly held by the originator for the following reasons:

- the bank has detailed information on the loans, which will allow it to effectively manage the risk it retains;
- the bank retains economic interest in the performance of the loan portfolio and remains motivated to service the asset pool;
- the return required by a potential purchaser of the equity tranche may be too high, and this tranche may therefore be difficult to place if the overall risk/reward profile is not attractive to investors.

In some cases, the lowest-rated debt tranche is also held by the originator.

Investor-driven arbitrage transactions

In an arbitrage CDO, the underlying asset pool is more actively managed. The investment advisor is usually the manager of the CDO. The type of structure is driven by the opportunity to actively manage the portfolio with the intention of generating arbitrage profits from the spread differential between the investment- and sub-investment-grade markets. The underlying asset pool includes investments which not only provide investment income, but may provide the opportunity to generate value from active trading strategies. The opportunity to generate arbitrage profits is often dependent on the quality and expertise of the manager of the CDO.

The underlying assets may be existing positions that are being managed or may be acquired for the CDO. In practice, when structuring the transaction the profitability of the transaction will depend on factors such as:

- the required return to the noteholders of the issued tranches;
- the portfolio return of the underlying asset pool;
- the expenses (for example, management fee) of managing the SPV.

If the underlying portfolio performs well and the loss-in-the-event-of-default profile is lower than expected, due to lower-than-expected default levels and higher levels of recovery, the required return to investors in the tranches of the CDO will be achieved and the return to the equity holder will be higher than expected. However, if the underlying portfolio performs poorly and the loss in the event of default is higher than expected (due to higher-than-expected default levels and lower levels of recovery rate, perhaps due to adverse economic conditions), then the return on the tranches issued will be lower than expected. Poor investment-management performance will also have an adverse impact on the return to investors.

Fund managers use arbitrage CDOs in higher yielding markets since the CDO structure may allow the manager to achieve a large size of funds under management for a comparatively small level of equity. This has been used effectively in the United States in the past few years. The objective is to set up the CDO so that the returns produced by the underlying pool of high-yielding assets will be enough to pay off investors and provide the originator/fund manager with a profit from the management fee and the return on the equity tranche.

Market convergence: money and debt capital markets

The CDO is a product that was introduced, initially, as a capital-market instrument aimed at medium-and longer-dated investors. But that feature is being blurred. In Chapter 19 we described Treasury and the ALM desk application of synthetic structured products that are used for funding purposes. These are instruments that are utilised at the short-end of the market; that is, they are originated for use by money market desks and the liabilities are bought by short-dated money market investors. In recent years money market investors have also become buyers of shorter-dated CDO paper, thus leading to the concept of the money market CDO.

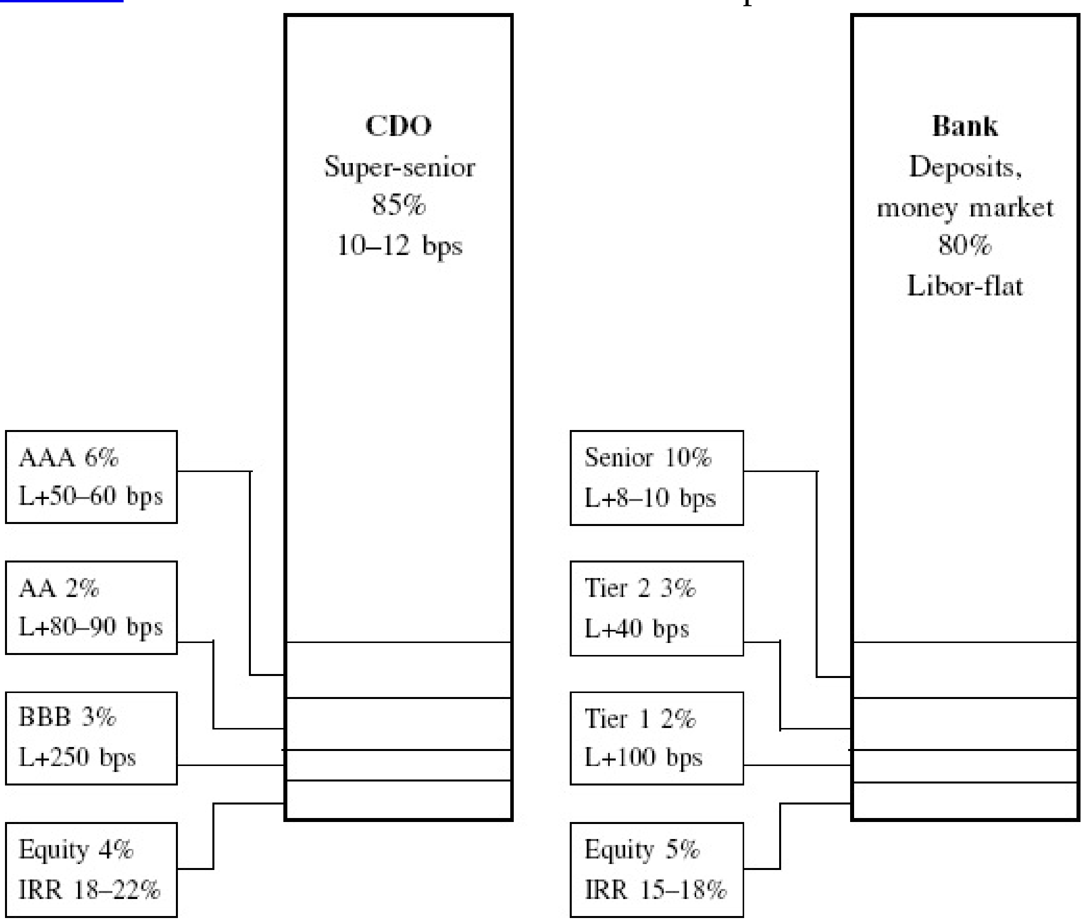
From an ALM point of view, a securitisation originated for funding and balance sheet management purposes, such as a balance sheet CLO of bank loans, will have a similar structure to a money market CDO. The only difference is that the liability structure will consist of short-dated notes; perhaps only the most junior note will have a maturity of five years or more.

Money market CDO

Reviewing the CDO from first principles, we can point out similarities between a CDO balance sheet and a commercial bank balance sheet. A conventional cash CDO will parcel up its balance sheet into different pieces of risk, with each piece exhibiting different risk-reward profiles. CDOs rely on subordination and diversification, in the same way that a bank does.

Figure 22.11 on page 1040 illustrates this concept. It shows the capital structure of a CDO (or synthetic CDO, the point is the same[3]) alongside the asset structure of a bank. Note the sample liability charges depending on the risk associated with each piece; these rates would be reasonable expectation during the first half of 2006. The lowest risk piece carries the lowest return, around 10–12 basis points. The equity piece is unrated and expected to return 18–22%. With the CDO, its "balance sheet" is in effect made up as follows:

Figure 22.11 Bank and CDO "balance sheets" and capital costs



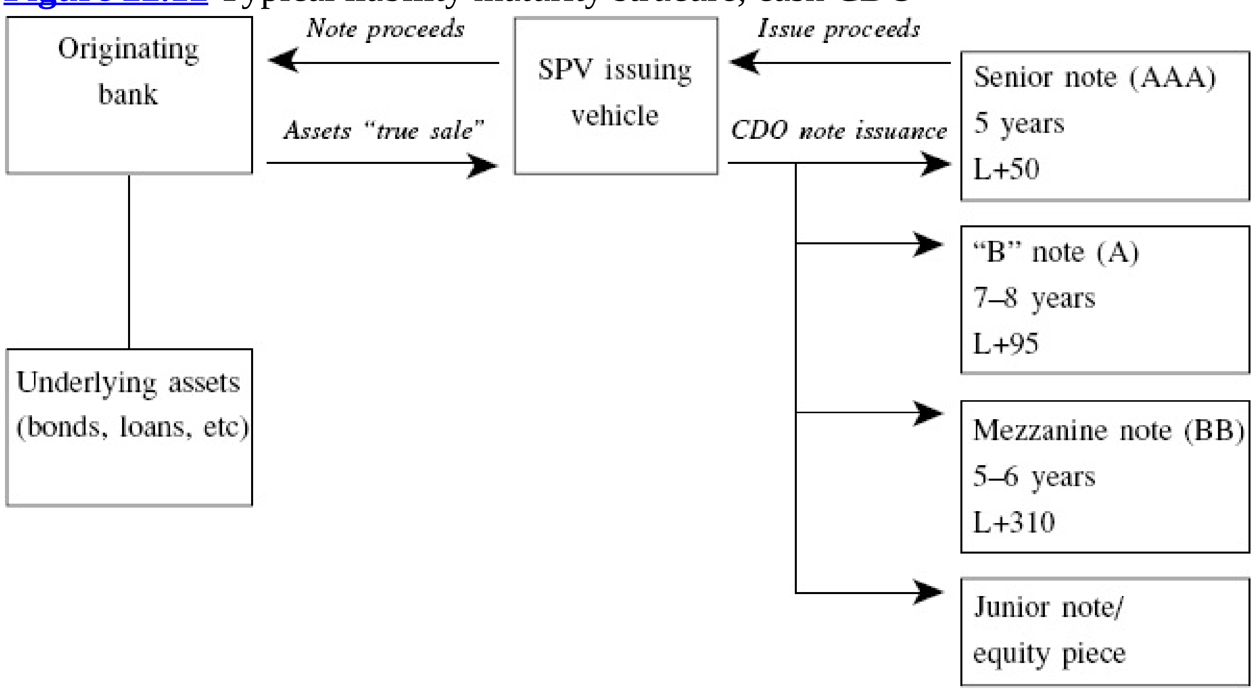
- the vehicle borrows money of varying cost and maturity (the liabilities);

- it invests in collateral, which is given or one that the CDO manager selects. This is a pool of credits or assets.

The bank's balance sheet, on the asset side, is similarly composed of loans made by it to corporates and consumers. The Equity tranche in the CDO receives the residual cash flows from the asset pool; the bank retains its surplus earnings, after discharging liabilities, for its equity holders.[4] So in these respects the capital structure of a commercial bank is similar to that of a CDO.

With a conventional CDO, the average life of notes, both senior and junior, is invariably five years or longer. A prime reason why this maturity is necessary is because it is important to lock-in term funding if, at the time the deal is being closed, market levels are such that the liability cost is sufficiently low that the structure creates value from the assets. If market levels are not attractive when the debt is priced, the deal will probably be delayed or shelved. Given this average maturity, money market investors and bank ALM desks would not be natural holders of CDO paper. A typical structure is shown in Figure 22.12; as money market funds seldom look beyond a three-year investment horizon, and more usually a two-year horizon, such a structure will present no attraction to them.

Figure 22.12 Typical liability maturity strucure, cash CDO

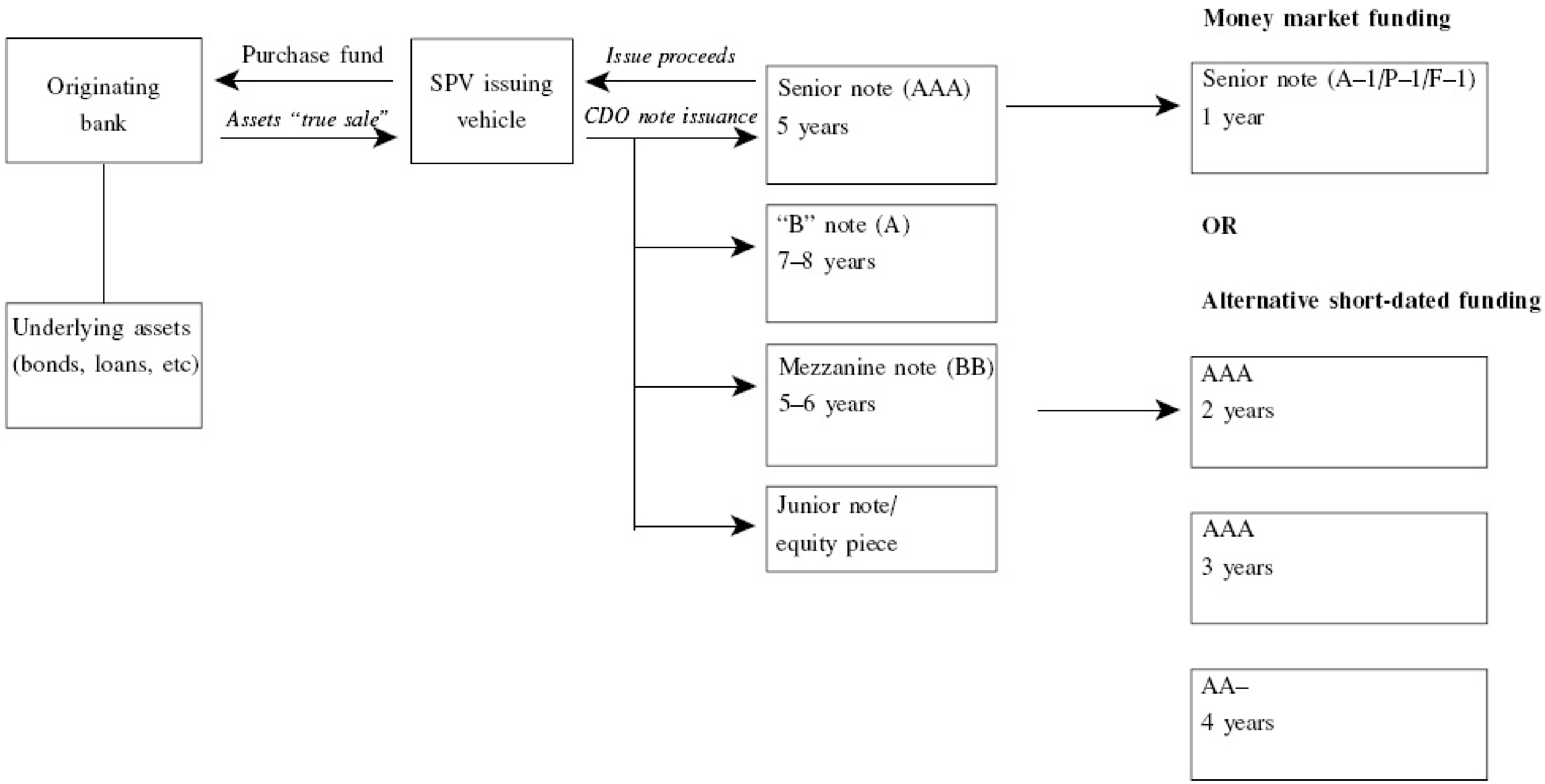


Money market CDO return and structure

At the start of 2005, yield spreads across the credit curve had tightened considerably, such that even relatively risk-averse investors such as bank ALM desks were receiving around Libor plus 9–11 basis points for repoing in assets down to a BBB credit rating. Sub-investment grade assets were being funded at Fed Funds plus 15–20 basis points.[5] Given this situation, money market investors have become buyers of CDO paper, which simultaneously, as this interest was appearing, have been structured to meet this new demand. There is also an attraction for the CDO originator: by structuring the liabilities with a money market piece, the vehicle is able to secure lower cost funding at the short end of the yield curve (the money market curve), which in a positive yield curve environment will be below the capital market curve.

To structure a transaction such that its liabilities will be considered by short-term investors, CDOs have been introduced that incorporate an element of money market funding. This is in the form of a short-dated tranche or a series of short-and medium-term tranches. This appeals to money market investors and also enables the issuer to benefit from lower-cost funding at the short-end of the credit curve. This is illustrated in Figure 22.13, a short-term CDO. This “short-dated CDO” is structurally identical to the regular CDO, except that the senior note tranche is now much shorter-dated. The issuer can roll the senior note each maturity, presenting an element of gap risk, or can structure a series of rolling note tranches at one-year maturities. Alternatively, the issuer can have a multi-tranche senior note arrangement. The short-dated notes are just like a regular capital market note or CDO note, the only difference being that they have an average life below five years.

Figure 22.13 Short-dated CDO structure

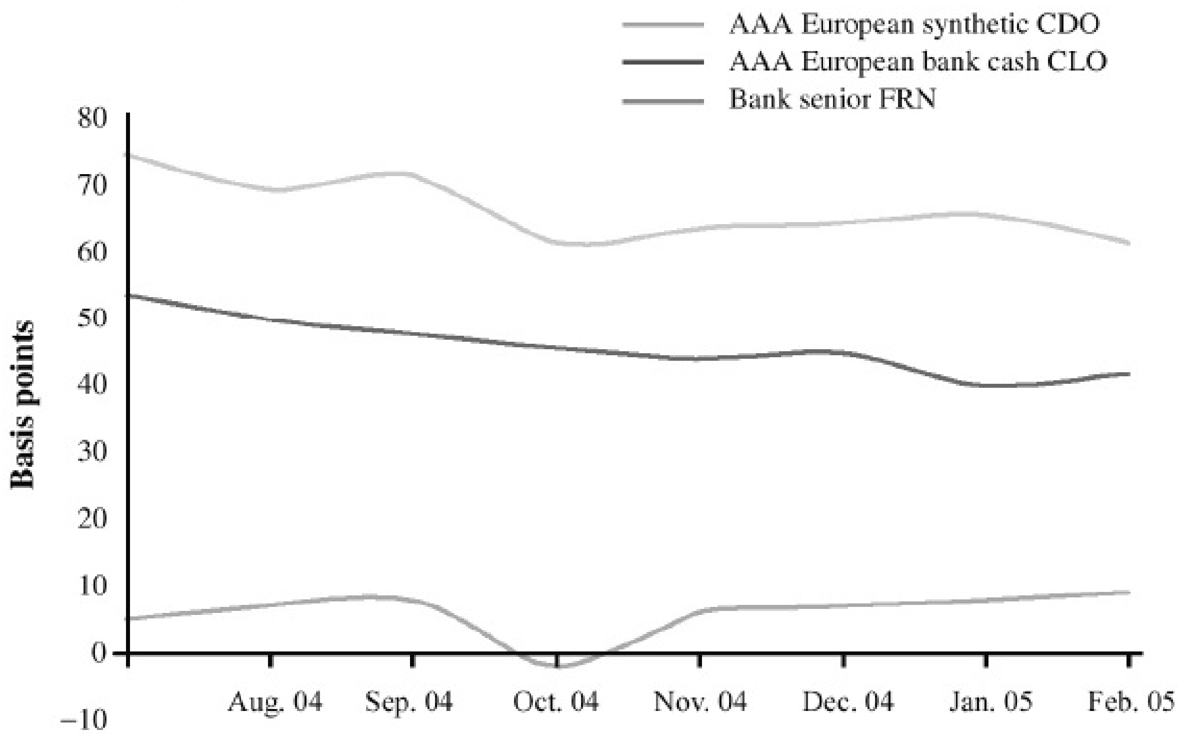


Originating bank
Underlying assets (bonds, loans, etc)
Purchase fund
Assets "true sale"
SPV issuing vehicle
Issue proceeds
CDO note issuance
Senior note (AAA)
5 years
"B" note (A)
7–8 years
Mezzanine note (BB)
5–6 years
Junior note/
equity piece
Money market funding
Senior note (A–1/P–1/F–1)
1 year
OR
Alternative short-dated funding
AAA
2 years
AAA
3 years
AA–
4 years

Money market investors can therefore gain from a yield pick-up compared to bank FRNs or other senior bank paper, but at the same or better credit rating. The short maturity of the CDO note means that its price carries relatively low DV01 risk. Compared to alternative short-dated asset classes, given their higher credit-risk nature, money market CDOs present a yield pick-up compared to bank FRNs. This is illustrated in Figure 22.14, which shows the spread between Residential MBS paper and three different assets, bank senior subordinated FRNs, bank CLOs and synthetic CDOs during 2004–2005. The rates are taken from a sample of European transactions and are averaged, with the notes being in the 1–3 year range maturity.

Figure 22.14 RMBS spread minus three different asset classes including CLO/synthetic CDO

Source: Bloomberg L.P.

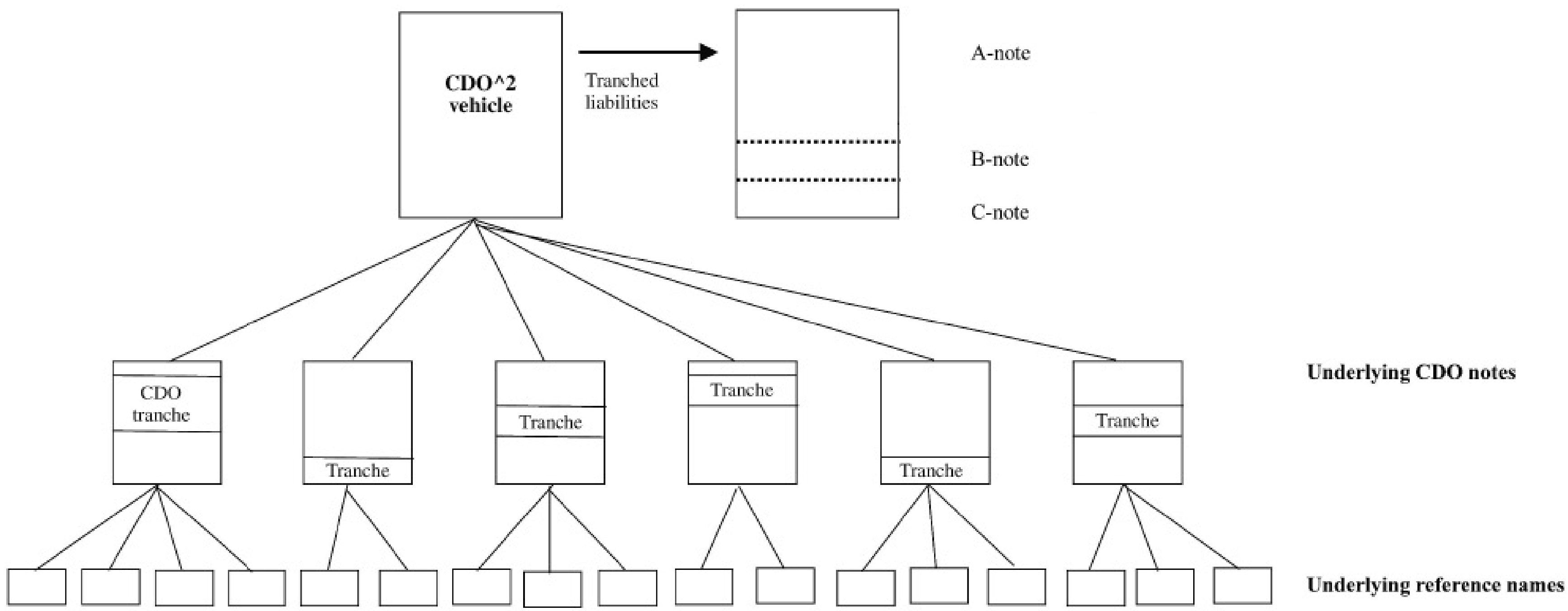


CDO-squared

The CDO-squared (CDO^2) is a more recent product in CDO development, and the market has witnessed also the CDO-cubed or CDO^3. A CDO^2 provides investors with greater leverage compared to a standard CDO, with more exposure to credit risk and less so to event risk. It also increases the choice of risk/reward profiles for investors. CDO^2 was developed as an alternative investment product and its use is not associated with bank ALM.

In a CDO^2, the liability notes are linked to an underlying portfolio of CDO notes and sometimes ABS notes. As a result the structure may reference as many as 1,000 names or more, with some names repeated in underlying note tranches. Figure 22.15 shows a representation of the structure, with six CDO tranches, although in practice this number has ranged from five to 20.

Figure 22.15 CDO^2


CDO^2 vehicle
Tranched liabilities
A-note
B-note
C-note
CDO tranche
Tranche
Tranche
Tranche
Tranche
Tranche
Underlying CDO notes
Underlying reference names

The rationale behind CDO^2 is appealing for certain investors. If the underlying notes include ABS as well as CDO notes, investors can potentially benefit from exposure to a diversified portfolio that might not be readily accessible otherwise. Because CDO^2 notes have lower exposure to event risk than in a standard synthetic CDO, they are able to withstand a higher number of reference entity defaults before suffering loss. However, the proportionally greater leverage means that as defaults start to mount, the level of losses is faster. This risk means that investors receive a higher spread, for the same ratings risk, compared to CDO noteholders.

As with standard CDOs, the CDO^2 liability side can be unfunded, partially funded or fully funded. The key factor for investors to be aware of is the double subordination in a CDO^2 note. In a standard CDO, losses in the underlying portfolio feed through immediately to overlying notes, in order of subordination. This would only affect CDO^2 notes when the losses in an underlying CDO reached the specific level to affect the tranche being held in the portfolio. Thus CDO^2 investors benefit from an extra level of protection from credit events. This double subordination enables the CDO^2 to withstand a higher frequency of default of the ultimate reference entities.

The other key factor behind CDO^2 is higher leverage. Given that a CDO is itself a leveraged product, CDO^2 leverages this leverage. The impact of this is that, although the notes themselves begin to be impacted after a higher number of defaults, the effect is magnified once notes do start to suffer loss.

Analysis and evaluation

Here, we introduce a number of important factors that are relevant when analysing, evaluating or rating a CDO. The list is not an exhaustive one; rather, we address some of the basic concepts.

Portfolio characteristics

Credit quality

The credit quality of the underlying asset pool is critical as this is a source of credit risk in the structure. It is common to allocate an average rating to the initial reference asset pool. A constraint in the structuring of the transaction may be that any future changes to the asset pool that the structure allows should not reduce the average rating below the initial rating. The analysis of the portfolio's credit and the possible variability of the credit quality is used to determine the default frequency and the loss rates that may be experienced by the underlying asset pool. In some cases, the originator's internal credit-scoring system is a key part of the rating process. In particular, for unrated assets the rating process should involve a mapping process between the internal rating system and the agency's rating system to determine accuracy.

Diversity

The level of diversity within the reference portfolio directly influences the level of credit risk in the portfolio. Broadly, we would expect that the greater the level of diversification, the lower the level of credit risk. Diversity may be determined by considering concentrations by industry group, obligor and sovereign country. The level of diversity in the portfolio may be quantified by attributing a single diversity score to reflect the level of diversification of the underlying asset pool.

The diversity score is a weighted-average credit score for a portfolio of credit exposures. The marginal score allocated to each marginal credit exposure in the underlying asset pool depends on the existing credit portfolio. For example, if the portfolio has a concentration in a category-for example, in an industry group – the marginal score attributed to the marginal credit is reduced to reflect this concentration (or lack of diversity). This has the effect that a higher diversity score is attributed to an asset pool where the range of credit exposure is wide. The higher the score, the better the level of diversification.

A constraint may be placed on the level of change in the diversity as a result of a change to the underlying asset pool. For example, a minimum required diversity score for a transaction may need to be maintained.

Cashflow analysis

The cashflow profile of a CDO structure depends on the following issues:

- the spread between the interest earned on the loans/collateral and the coupon paid on the securities issued by the CDO;
- the impact of default events – for example, default frequency and severity (level of recovery rates) in the underlying asset pool – and the impact of losses on the principal of investors;
- the principal repayment profile/expected amortisation;
- the contingent payments in the event of default under any credit-default swap which may be used to transfer credit risk from the originator to another party (such as the SPV or an OECD bank);
- contingent cash flows on any credit wrap or credit insurance on the underlying asset pool;
- cash flows receivable/payable with the hedge counterparty; for example, under swap agreements or derivative contracts;
- fees and expenses.

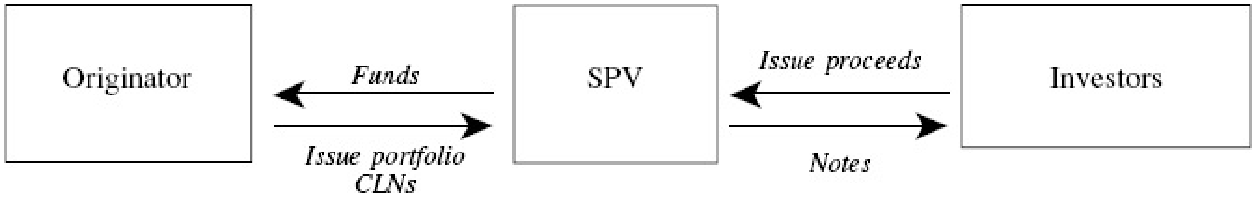
The sensitivity of these cash flows is tested to obtain an understanding of the impact on the cashflow profile under stressed and normal scenarios. The relevant stress scenarios that are tested are dependent on the underlying asset pool.

Originator's credit quality

The impact of the credit quality of the originator on the rating of the notes issued is dependent upon the structure. For example, where the underlying assets are transferred to the SPV (which is bankruptcy-remote) from the originator, the credit quality of the CDO notes is only dependent on the portfolio performance and the credit enhancement. The credit performance of the CDO notes can be said to be "de-linked" from the credit quality of the originator.

However, in some structures the underlying asset pool remains on the balance sheet of the originator; for instance, as with credit-linked CDOs, as shown in Figure 22.16 on page 1048. In this case, the notes issued by the SPV remain "linked" to the credit of the originator.

Figure 22.16 Credit-linked CDO



Here, an investor in the CDO has exposure to both the credit quality of the bank and the portfolio performance. The rating of the credit-linked CDO is capped by the rating of the originator, because payment of interest and principal depends on the originator's ability to pay.

However, for the senior tranches of a synthetic de-linked CDO, the portfolio may remain on the originator's balance sheet, but the senior tranches may be collateralised and de-linked from the bank's rating by using AAA-rated collateral and default swaps. The final rating is influenced by the credit rating of the default-swap provider, the extent to which the cash flows to investors are exposed to the risk of default by the originator.

Operational aspects

In market value transactions, the abilities of the manager are a key aspect to consider, since the performance of the underlying portfolio is critical to the success of the structure. The review of the credit-approval and monitoring process of the originator is another factor that may provide further comfort on the integrity and quality of the underlying asset portfolio. Better credit assessment and monitoring processes will lead to higher levels of comfort.

Review of credit-enhancement mechanisms

Credit enhancement may include the use of reserve accounts, subordinated tranches, credit wraps and liquidity facilities. These are briefly defined below. The impact of any credit-enhancement methods should be considered and understood. This will usually be observed via stress scenarios, which are developed to determine the impact on the cash flows.

Subordination

The rights and priority of each tranche to interest and principal is set out in the offering circular for the issue. This is a detailed description of the notes, together with the legal structure. The cash flows are allocated according to priority of the notes. Typically, fees and expenses are paid first. The most senior tranches are then serviced, followed by the junior tranches and, finally, the equity tranche. The method by which excess cash flows can be allocated to remaining subordinated tranches is referred to as a cashflow *waterfall*. This was illustrated in Figure 18.6.

Credit wrap

This is a credit protection of a debt instrument by an insurer or bank to improve the credit quality of the portfolio, guaranteeing the note nominal value. The wrap is provided in return for a fee.

Reserve accounts

Reserve accounts are cash reserves set up at the outset from note proceeds, which provide first-loss protection to investors. Such surplus funds are usually invested by the servicing agent or specialised cash-management provider.

Liquidity facility

A liquidity facility may exist to ensure that short-term funding is available to pay any interest or principal obligations on the notes if there is a temporary cash shortfall.

Legal structure of the transaction

A typical CDO structure is described in a number of legal agreements. For example, the offering circular is the legal document that presents the transaction in detail to investors.

The various legal agreements formalise the roles played in the CDO structure by the various counterparties to the deal. The documentation includes:

- trustee agreements: the provision of administrative duties and maintenance of books and records;
- manager/servicer agreement: describes management of the underlying portfolio and provides market expertise;
- sale agreement or CDS agreements used to transfer credit risk;
- hedging agreements: for example, interest-rate or cross-currency swaps and other derivative contracts;
- guarantees or insurance: for example, credit wraps on the underlying asset pool.

Prior to the closure of the deal, the SPV incorporation documents are also reviewed to ensure that it is bankruptcy-remote and that it is established in a tax-neutral jurisdiction.

Expected loss

The rating process for each transaction involves a detailed analysis of the CDO structure, including the points noted above. However, the actual process of assigning a rating to the notes issued in the CDO will include a quantitative assessment. Often this is based on the expected loss (EL) to noteholders, which is an important statistic when deciding on the quality of a tranche.

The EL may be defined as:

(22.1) $$EL = \sum_{x} P_x * L_x$$

where

L_x is the loss on the notes under scenario '*x*'

P_x is the probability of the scenario '*x*' occurring.

The calculated EL statistic will be mapped to a table of ratings and their corresponding expected losses. In this way, the rating can be allocated to each tranche.

The loss to noteholders is determined by considering the impact of credit losses on the cash flows to noteholders, which would occur under the various possible scenarios. This would involve the allocation of any credit loss to the various tranches in issue.

The cash flows to the noteholders depend on whether or not a default has occurred, and the size of the loss in the event of default. The severity of the loss will depend on the par value of the note less the recovery rate. The calculated probability of default may be inferred from the rating of the underlying credit exposures. In practice, the calculation of the expected loss may be based on Monte Carlo simulation techniques in which thousands of scenarios and cash flows are simulated. This requires sophisticated computational models.

The expected losses on the tranches should be in line with the level of subordination. The expected losses on the tranche will be a key factor in the process of assigning a credit rating to the tranche. The credit rating of the tranche is a key determinant in the ultimate pricing and marketability of the tranche.

Investor analysis

Investors have a number of motivations when considering the CDO market both in their domestic market and abroad. These include:

- the opportunity to gain exposure to a high-yield market on a diversified basis, without committing significant resources;
- the ability to choose from a number of portfolio managers that manage the CDO;
- CDOs acting as an initial entry point into the high-yield market;
- with respect to lower-rated (BBB and below) tranches, achieving leveraged returns while gaining benefit from a diversified portfolio;
- the appeal of a wide investor base, with ratings ranging from AAA to B,

and maturities from four years to as long as 20 years;
- a wide variety of collateral.

CDOs offer investors a variety of risk/return profiles, as well as market volatilities, and their appeal has widened as broader macroeconomic developments in the global capital markets have resulted in lower yields on more traditional investments.

Investors analysing CDO instruments will focus on particular aspects of the market. For instance, those with a low appetite for risk will concentrate in the higher-rated classes of cashflow transactions. Investors that are satisfied with greater volatility of earnings, but who still wish to hold AA-or AAA-rated instruments, may consider market value deals. The “arbitrage” that exists in the transaction may be a result of:

- industry diversification;
- differences between investment grade and high-yield spreads;
- the difference between implied default rates in the high-yield market and expected default rates;
- the liquidity premium embedded in high-yield investments;
- the Libor rate versus the Treasury spread.

The CDO asset class cannot be compared in a straightforward fashion to other ABS classes, which makes relative value analysis difficult. Although a CDO is a structured finance product, it does not have sufficient common characteristics with other such products. The structure and cash flow of a CDO are perhaps most similar to a commercial MBS; the collateral backing of the two types share comparable characteristics. Commercial mortgage pools and high-yield bonds and loans both have fewer obligors and larger balances than other ABS collateral, and each credit is rated. On the other hand, CDOs often pay floating-rate interest and are private securities,[6] whereas commercial MBS (in the US market) pay a fixed rate and are often public securities.

Example 22.2 Guaranteed investment contracts

A part of the cash raised from the liability side of a CDO is often invested in AAA bonds or other such high-quality assets, to act as a reserve for investors. The collateral reserve in a CDO can be invested in a number of ways. One option is a guaranteed investment contract or GIC. GICs are offered by certain insurance companies, and (less frequently) by banks.

A GIC can be interpreted in a number of ways. In trust banks, it is often no more than a bank account that pays a fixed spread below Libor for the term of the account. The payment frequency is tied in to match that of the coupon on the CDO note liabilities. Strictly speaking, this is not a GIC. Formally defined, a GIC is an obligation from the GIC provider to pay a guaranteed principal and interest rate on an invested premium. The investor places a lumpsum amount (the premium) in a GIC, and the GIC provider guarantees a specified cash amount that will be paid to the investor on the maturity date.

As an example, an investor places $10 million in a five-year GIC that pays an annual rate of 5.00%. The GIC maturity value is therefore:

$$10{,}000{,}000 \times (1.05)^5 = \$12{,}762{,}815.62.$$

There are variations on GICs, but the standard version pays a fixed rate of interest so the investors know their final return with certainty. In some cases, a floating rate may apply, with a fixed spread to the floating-rate index. This is what is usually offered by banks that do not offer the fixed-rate version. GIC maturities can range from one to 20 years. There can be a one-off lumpsum premium or regular premium payments by the investor. Also, some GICs pay interest on a periodic basis to the investor.

GICs therefore make suitable cash reserves for a CDO, but of course this is not risk-free like an investment in US Treasuries would be; rather, its risk is the credit quality of the GIC provider. However, one advantage it has over of a bond is that its value is always postive, unlike that of a bond that suffers marked-to-market fluctuations, and compared to a standard bank account it offers a known return.

Case Study 22.1 H2 Finance Ltd[7]

To conclude this discussion of CDOs we describe a structure that incorporates elements of previous transactions. H2 Finance Limited is an arbitrage CDO of ABS; that is, a cash CDO with underlying assets of asset-backed securities. The underlying securities are purchased through the issuance of both long-dated notes and short-term liabilities. As such it combines elements of a cash CDO, as well as investment entities known as SIVs.[8] H2 Finance is the name of the SPV, a private company with limited liability incorporated in the Cayman Islands. As with other CDO SPVs, it was incorporated on behalf of the sponsor, Wharton Asset Management, for the sole purpose of acquiring the portfolio and issuing notes and short-term liabilities.

An innovative aspect of this transaction is the repo feature. The majority of the portfolio is financed via a short-term repo arrangement with a number of counterparties, with the portfolio itself acting as collateral for the repo. As such, H2 issues two types of liabilities:

- medium-term tranched notes;
- repo agreements using eligible collateral.

The terms of the structure are shown below.

Name:	H2 Finance Ltd €105 million senior secured floating-rate notes
Sponsor and manager:	Wharton Asset Management Bermuda Ltd
Arranger and underwriter:	Nomura International
Trustee:	Deutsche Trustee Co. Ltd
Pay agent, account bank, and administrator:	Deutsche Bank AG, London
Custodian:	HSBC Bank plc
Repo counterparties:	Multiple counterparties rated at A-l or above by S&P
Closing date:	March 2004

The structure is shown in Figure 22.17 on page 1056, while Table 22.2 on page 1057 shows the note tranching.

Figure 22.17 H2 Finance Ltd structure diagram

Source: Standard & Poor's. Reproduced with permission.

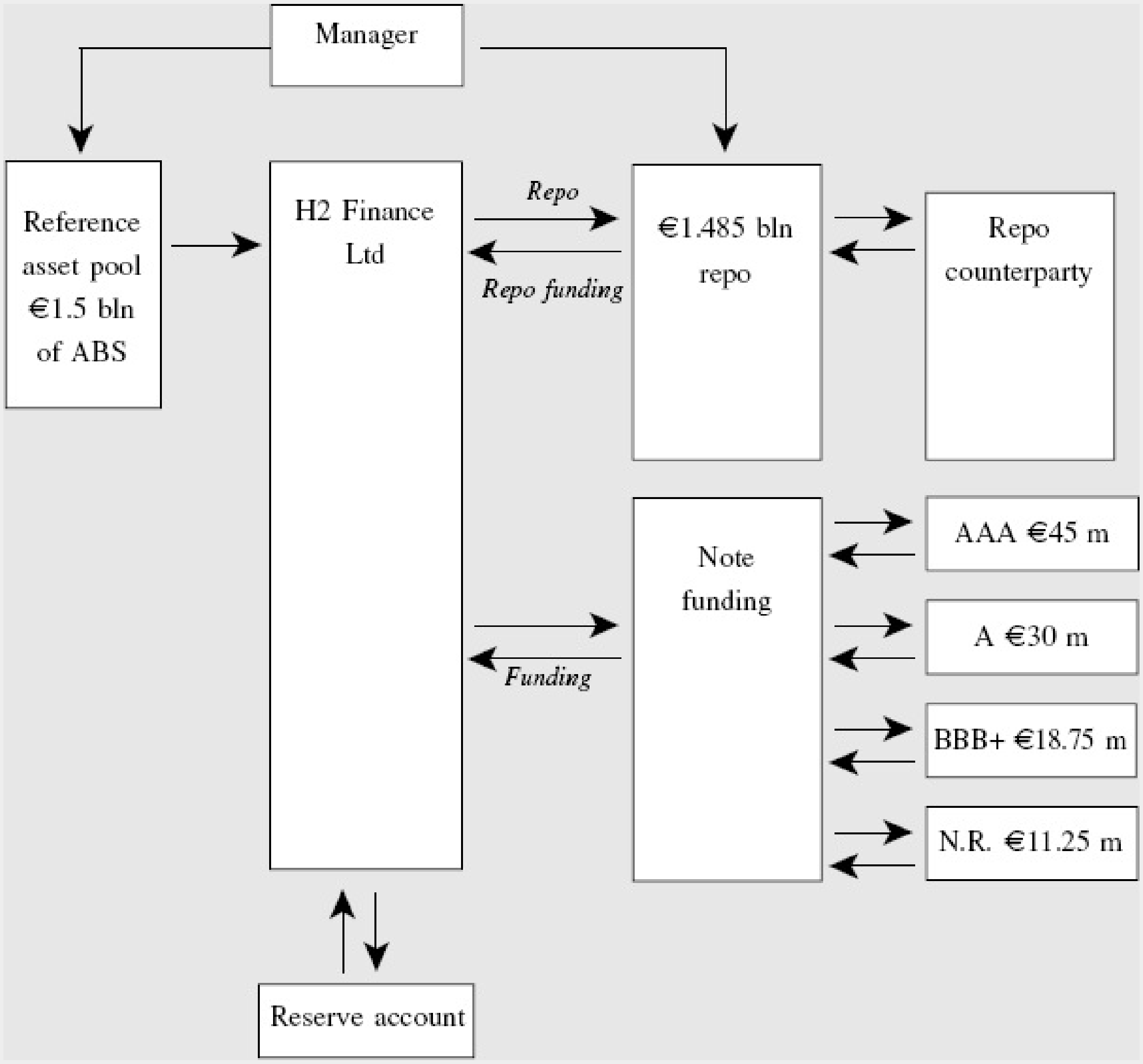


Table 22.2 H2 Finance Ltd note tranching

Source: Standard & Poor's. Reproduced with permission.

Class	Rating	Nominal amount (m)	Weighted-average life (years)	Libor spread (bps)	Legal final maturity
Senior repo programme	A–1+	1,485.00	n/a	0	2052
A	AAA	45.00	5.4	22	2052
B	AA	30.00	6.7	40	2052
C	BBB+	18.75	7.1	120	2052
D	NR	22.25	n/a	Excess	2052

H2 Finance is a CDO of high-rated ABS securities. It is fully funded; that is, the complete value of the portfolio is purchased through the issue of notes and via the repo facility. The underlying portfolio has an average maturity of 3.5 years and weighted-average rating of AAA from S&P, so it is a high-quality portfolio.

Repo arrangement

The repo facility in H2 Finance is one of more unusual features of the transaction. The majority of securities purchased by H2 Finance is repo'ed out to repo counterparties. Counterparties pay the market value of the securities to H2 Finance minus the haircut, which is around 1% of the purchase price.[9] Repo trades are put on for a one-year maturity, at a rate of Libor flat.

During the term of the trade, variation margin will be called if the value of the securities plus the margin level drops outside the 1% threshold. Margin payments are paid out of the cash reserve account that is held by the CDO account bank on behalf of the vehicle. On repo maturity date, the securities are rolled over in a new repo, at the prevailing market price for the securities.

Repo securities are ABS bonds, made up of credit card, consumer loans, auto loans, trade receivables, whole business, sovereign and public-sector ABS, RMBS and CMBS bonds. A minimum of 95% of the securities must be rated at AAA. The portfolio must also meet other specified requirements, laid out by S&P as part of its criteria for rating the vehicle liabilities. Among these are:

- a maximum portfolio amount of €1.5 billion;
- only a maximum of 10% of securities that have coupon frequencies of greater than quarterly.

In addition, no CDO notes or aviation securities (aircraft leasing ABS and so on) are allowed in the portfolio.

Portfolio management

The portfolio is actively managed by the manager, Wharton Asset Management Bermuda Ltd. The manager is permitted to sell and repurchase portfolio securities, in accordance with specified criteria, during the reinvestment period for the deal. It is also permitted to sell and substitute portfolio securities under the following conditions:

- if the security is in default;
- if the security is deemed a credit risk;
- if the security is rated below AA-and the amount of securities below AAA exceeds the 5% level;
- if the security is rated A or below.

Under these circumstances the manager may bring in replacement assets of acceptable quality.

The ability of the asset manager to manage the CDO is what will attract investors to the notes. The D noteholder, in particular, is expecting the vehicle to generate excess spread on its portfolio, after allowing for vehicle liabilities, that will be an attractive return for its investment. The rated note investors are attracted to the risk/ return profile of the notes, which, given the high quality of the underlying assets, presents a high return for comparatively low risk.

[1] This chapter was co-authored with Richard Pereira.

[2] The Master Trust structure is a generic set-up that allows originators to issue subsequent asset-backed deals under the same legal arrangement, thus enabling such issues to be made quicker than they otherwise might be. Investors also welcome such a structure, as they indicate a commitment to liquidity by implying further issues into the market.

[3] Synthetic CDOs are discussed in the next chapter.

[4] To make another analogy, consider the equity piece in a CDO to be like the “excess” in a car or home insurance policy. By retaining the “first loss” piece in an insurance policy, the customer is charged a lower premium by the insurance company. If there is no excess, the cost of insurance (or, by analogy, bank funding costs) would be much higher.

[5] *Sources:* Market counterparties.

[6] In the US market, they are also filed under Rule 144A, as opposed to public securities which must be registered with the Securities and Exchange Commission. Rule 144A securities may only be sold to investors classified as professional investors under specified criteria. Rule 144A provides an exemption from the registration requirements of the Securities Act (1933) for resale of privately placed securities to qualified institutional buyers. Such buyers are deemed to be established and experienced institutions, and so the

SEC does not regulate or approve disclosure requirements.

[7] The author thanks Serj Walia at KBC Financial Products in London for assistance with providing information for this section.

[8] SIVs are covered in Chapter 25. They are essentially CDOs that issue both AB-CP and MTNs.

[9] This is a very low level of haircut and reflects the quality of the collateral. Usual haircut levels for repo of ABS assets range from 3% to 15%, depending on collateral quality; see the author's book *The Global Repo Markets*, John Wiley & Sons, Singapore, 2004.

CHAPTER 26

Bank Regulatory Capital and the Basel Rules

The capital allocation requirements of a bank are behind its overall strategy. Asset allocation decisions are influenced to a great extent by the capital considerations that such allocation implies. Lower capital requirements for derivatives explain to a great extent why derivatives are used by banks and corporates instead of cash products. This is as true of the retail markets as it is of the debt capital and wholesale banking markets. For that reason, a book on bank ALM must cover capital itself, otherwise it will be incomplete. So an understanding of banking is not possible without an understanding of one of its key aspects: regulatory capital.

For instance, a large part of the money markets involves securitised products; for example, ABCP. One of the key motivations behind securitisation is the requirement to obtain capital relief. This leads to mortgages, trade receivables and other assets being securitised. We can see that it is vital to understand the implications of capital costs. Additionally, the issue of the cost of capital that we introduced in Part I must also take into account the regulatory capital implications of any asset allocation taken by a trading desk. Money and capital market participants must know about regulatory capital issues – whether they trade CDs, bills, repo, FRNs, ABCP or structured products – or they will not fully understand the cost of their own capital and hence their return on capital.

Background

Banking activity and the return it generates reflects the asset allocation policies of a bank and the capital costs incurred. The cost of capital itself is a function of the amount of capital that a bank must set aside to cover its lending activity, whether this lending is via short-term loans, repurchase agreements, CDs, Banker’s bills or more long-term instruments. The rules defining what constitutes *capital* and how much of it to allocate are laid out in the Bank for International Settlements (BIS) guidelines, known as the *Basel rules*. The BIS is not a regulatory body in itself, and its pronouncements carry no legislative weight; however, national authorities are keen to demonstrate that they follow the Basel rules at a minimum, to maintain investor and public confidence.

In this chapter we review the main elements of the Basel rules, which were replaced by a new set of guidelines termed Basel II. Money market participants are keenly aware of the basic tenets of the rules, so as to optimise their asset allocation and hedging policy. Derivatives, for instance, require a significantly lower level of capital allocation than cash products, which (along with their liquidity) is a primary reason for their use as hedge instruments instead of cash, despite the existence of basis risk. In addition, the credit quality of a bank's counterparty also affects significantly the level of capital charge, and regulatory rules influence a bank's lending policy and counterparty limit settings. All bank's have internal rules dictating the extent of lending, across all money market products, to their counterparties. Capital allocation, targeted rates of return (which are a function of capital costs) and the extent of counterparty risk aversion all dictate the extent to which funds may be lent to counterparties of various credit ratings. For this reason the bank ALM desk needs to be keenly aware of the approximate extent of capital allocation that results from its operations.

This chapter considers the main aspects of the capital rules and also introduces the Basel II proposals, and how credit risk exposure determines the extent of capital allocation. It also indicates the interplay between the money market desk and longer term traders, whose capital allocation requirements are greater. This will enable the money market participant to place his or her operations in the context of banking specifically and capital markets business generally.

Banking regulatory capital requirements

Banks and financial institutions are subject to a range of regulations and controls; the primary one is concerned with the level of capital that a bank holds, and that this level is sufficient to provide a cushion underpinning the activities that the bank enters into. Typically, an institution is subject to regulatory requirements of its domestic regulator, but may also be subject to cross-border requirements such as the European Union's Capital Adequacy Directive.[1] A capital requirements scheme proposed by a committee of central banks acting under the auspices of the BIS in 1988 has been adopted universally by banks around the world. These are known as the BIS regulatory requirements or the

Basel capital ratios, from the town in Switzerland where the BIS is based.[2] Under the Basel requirements all cash and off-balance sheet instruments in a bank's portfolio are assigned a risk weighting, based on their perceived credit risk, that determines the minimum level of capital that must be set against them.

A bank's *capital* is, put simply, the difference between assets and liabilities on its balance sheet, and is the property of the bank's owners. It may be used to meet any operating losses incurred by the bank, and if such losses exceeded the amount of available capital then the bank would have difficulty in repaying liabilities, which may lead to bankruptcy. However, for regulatory purposes capital is defined differently; again in its simplest form regulatory capital is comprised of those elements in a bank's balance sheet that are eligible for inclusion in the calculation of capital ratios. The ratio required by a regulator will be that level deemed sufficient to protect the bank's depositors. Regulatory capital includes equity, preference shares and subordinated debt, as well as the general reserves. The common element of these items is that they are all *loss-absorbing*, whether this is on an ongoing basis or in the event of liquidation. This is crucial to regulators, who are concerned that depositors and senior creditors are repaid in full in the event of bankruptcy.

The Basel rules on regulatory capital originated in the 1980s, when there were widespread concerns that a number of large banks with cross-border business were operating with insufficient capital. The regulatory authorities of the G-10 group of countries established the Basel Committee on Banking Supervision. The Basel Committee on Banking Supervision's 1988 paper, *International Convergence of Capital Measurement and Capital Standards*, set proposals that were adopted by regulators around the world as the "Basel rules". The Basel Accord was a methodology for calculating risk, weighting assets according to the type of borrower and its domicile. The Basel ratio[3] set a minimum capital requirement of 8% of risk-weighted assets.

The Basel rules came into effect in 1992.

Regulatory capital requirements

The origin of the current capital adequacy rules was a desire by banking regulators to strengthen the stability of the global banking system as well as harmonise international regulations. The 1988 Basel accord was a significant advancement in banking regulation, setting a formal standard for capitalisation worldwide. It was subsequently adopted by the national regulators in over 100 countries. The Basel rules have no regulatory force as such; rather, individual country regulatory regimes adopt them as a minimum required standard. This means that there are slight variations on the basic Basel requirements around the world, of which the European Union's Capital Adequacy Directives are the best example.

The Basel I rules

The BIS rules set a minimum ratio of capital to assets of 8% of the value of the assets. Assets are defined in terms of their risk, and it is the *weighted risk assets* that are multiplied by the 8% figure. Each asset is assigned a risk-weighting, which is 0% for risk-free assets such as certain country government bonds, to 20% for interbank lending, and up to 100% for the highest risk assets such as certain corporate loans. So while a loan in the interbank market would be assigned a 20% weighting, a loan of exactly the same size to a corporate would receive the highest weighting of 100%. The risk weights are given at Table 26.1 on page 1170.

Formally, the BIS requirements are set in terms of the type of capital that is being set aside against assets. International regulation (and UK practice) defines the following types of capital for a bank:

- *Tier 1*: perpetual capital, capable of absorbing loss through the nonpayment of a dividend. This is shareholders' equity and also non-cumulative preference shares;
- *Upper Tier 2:* this is also perpetual capital, subordinated in repayment to other creditors; this may include, for example, undated bonds such as building society PIBS, and other irredeemable subordinated debt;
- *Lower Tier 2:* this is capital that is subordinated in repayment to other creditors, such as long-dated subordinated bonds.

Further detail on the composition of capital for UK-regulated institutions is given in Appendix 26.1.

The level of capital requirement is given by (26.1):

$$\frac{\text{Tier 1 capital}}{\text{Risk-adjusted exposure}} > 4\%$$

$$\frac{\text{Tier 1 + Tier 2 capital}}{\text{Risk-adjusted exposure}} > 8\%. \qquad \textbf{(26.1)}$$

The ratios in (26.1) therefore set minimum levels. A bank's *risk-adjusted exposure* is the cash risk-adjusted exposure, together with the total risk-adjusted off-balance sheet exposure. For cash products on the banking book the capital charge calculations (risk-adjusted exposure) is given by:

$$\text{Principal value} \times \text{Risk weighting} \times \text{Capital charge [8\%]}$$

calculated for each instrument.

The sum of the exposures is taken. Firms may use netting or portfolio modelling to reduce the total principal value.

The capital requirements for off-balance sheet instruments are lower because for these instruments the *principal* is rarely at risk. Interest-rate derivatives such as FRAs of less than one year's maturity have no capital requirement at all, while a long-term currency swap requires capital of between 0.08% and 0.2% of the nominal principal.

The BIS makes a distinction between *banking book* transactions as carried out by retail and commercial banks (primarily deposits and lending) and *trading book* transactions as carried out by investment banks and securities houses. Capital treatment sometimes differs between banking and trading books. A repo transaction, for example, attracts a charge on the *trading book.* The formula for calculating the capital allocation is:

(26.2) $$CA = max.\ (((C_{mv} - S_{mv}) \times 8\% \times RW), 0)$$

where

C_{mv} is the value of cash proceeds

S_{mv} is the market value of securities

RW is the counterparty risk-weighting (as a percentage).

Example 26.1 Basel I capital charge illustration

Calculate the CAD charge for a repo transaction with the following terms:

Clean price of collateral:	100
Accrued interest:	0
Cash proceeds on £50 m nominal:	£50,000,000
Counterparty:	OECD bank
Counterparty risk-weighting:	20%

Clean price of collateral:	100
Accrued interest:	0
Cash proceeds on £50 m nominal:	£50,000,000
Counterparty:	OECD bank
Counterparty risk-weighting:	20%

$$\begin{aligned} CA &= (((50{,}000{,}000 - 50{,}000{,}000) \times 8\% \times 20\%), 0) \\ &= 0. \end{aligned}$$

The CAD charge for a loan/deposit transaction of the same size is as follows:

Unsecured loan:	£50,000,000
Counterparty:	OECD bank
Counterparty risk weighting:	20%

Unsecured loan:	£50,000,000
Counterparty:	OECD bank
Counterparty risk weighting:	20%

$$\begin{aligned} CA &= \max((50{,}000{,}000 \times 8\% \times 20\%), 0) \\ &= £800{,}000. \end{aligned}$$

The detailed risk weights for market instruments are given in Table 26.1.

Table 26.1 Risk weightings of typical banking book assets, Basel I

Weighting	**Asset type**	**Remarks**
0%	• Cash • Claims on own sovereign and Zone A sovereigns and central banks • Claims on Zone B sovereign issuers denominated in	Zone A countries are members of the OECD and countries that have concluded special lending arrangements with the IMF. Zone B consists of all other countries. Under certain regulatory regimes, holdings of other Zone A government bonds are given 10% or 20% weightings, and Zone B government bonds must be funded in that country’s currency to qualify for 0% weighting, otherwise 100% weighting applies.

	that country's domestic currency	
20%	• Claims on multilateral development banks • Claims on regional governments or local authorities in own or Zone A countries • Senior claims on own country or guaranteed by Zone A banking institutions • Senior claims on Zone B banking institutions with an original maturity of under one year	Under certain regulatory regimes, claims on Zone B banking institutions with residual maturity of less than one year also qualify for 20% weighting.
50%	• Claims secured on residential property • Mortgage-backed securities	
100%	• All other claims	

Under the original Basel rules, assets are defined as belonging to a bank's banking book or its trading book. The banking book essentially comprises the traditional activities of deposit taking and lending, with assets booked at cost and not revalued. Trading book assets, which include derivatives, are marked-to-market on a daily basis, with a daily unrealised profit or loss recorded. Such assets are risk-weighted on a different basis to that shown in Table 26.1, on a scale made up of market risk and credit risk. Market risk is estimated using techniques such as VaR, while credit risk is a function of the type of asset. The calculation of capital requirements for trading book assets is more complex than that for banking book assets.

The process of determining the capital requirement of a banking institution involves calculating the quantitative risk exposure of its existing operations and comparing this amount to the level of regulatory capital of the bank. The different asset classes are assigned into the risk buckets of 0%, 20%, 50% and 100%. Not surprisingly, this somewhat rigid classification has led to distortions in the pricing of assets, as any movement between the risk buckets has a significant impact on the capital required and the return on capital calculation. Over time the impact of the Basel rules has led to the modified rules now proposed as Basel II, which are coming into force during 2007–2009, depending on jurisdiction.

Table 26.2 summarises the elements that comprise the different types of capital that make up regulatory capital as set out in the EU's Capital Adequacy Directive. Tier 1 capital supplementary capital is usually issued in the form of non-cumulative preference shares, known in the US as preferred stock. Banks generally build Tier 1 reserves as a means of boosting capital ratios, as well as to support a reduced pure equity ratio. Tier 1 capital now includes certain securities that have similar characteristics to debt, as they are structured to allow interest payments to be made on a pre-tax basis rather than after tax; this means they behave like preference shares or equity, and improve the financial efficiency of the bank's regulatory capital. Such securities, along with those classified as Upper Tier 2 capital, contain interest deferral clauses so that they may be classified similar to preference shares or equity.

Table 26.2 European Union regulatory capital rules

	Limits	Capital type	Deductions
Tier 1	▮ No limit to Tier 1 ▮ "Esoteric" instruments such as trust-preferred securities are restricted to 15% of total Tier 1	▮ Equity share capital, including share premium account ▮ Retained profits ▮ Non-cumulative preference shares and other hybrid capital securities	▮ Bank holdings of its own Tier 1 instruments ▮ Goodwill and other intangible assets ▮ Current-year unpublished losses
Tier 2	▮ Total Tier 2 may not exceed 100% of Tier 1		
Upper Tier 2		▮ Perpetual subordinated, loss-absorbing debt ▮ Cumulative preference shares ▮ General reserves ▮ Revaluation reserves	▮ Holdings of other banks' own fund instruments in excess of 10% of the value of own capital ▮ Holding of more than 10% of another credit institution's own funds ▮ Specified investments in non-consolidated subsidiaries

			■ Qualified investments, defined as a holding of more than 10% of a company
Lower Tier 2	■ Cannot exceed 50% of Tier 1 ■ Amount qualifying as capital amortises on a straight-line basis in the last five years	■ Fixed maturity subordinated debt ■ Perpetual subordinated non-loss absorbing debt	
Tier 3	■ Minimum 28.5% of capital covering market risk must be Tier 1 ■ Tier 3 capital can only cover market risk on trading books. All credit risk must be covered by Tier 1 and Tier 2 capital	■ Trading book profits ■ Short-term subordinated debt with a minimum maturity of two years, plus a feature enabling regulator to block payment of interest or principal in the event of financial weakness	■ Trading book losses
Other	■ Capital to only include fully paid-up amounts ■ Issues of capital cannot include cross-default or negative pledge clauses ■ Default of Lower Tier 2 capital is defined as non-payment of interest or a winding-up of the bank ■ No rights of set-off to be included in capital issues documentation ■ Early repayment of debt must be approved by the bank's regulator ■ Interim profits must be audited accounts, and net of expected losses, tax and dividends		

The UK capital regulations are summarised in Appendix 26.1.

Example 26.2 illustrates a simple capital adequacy calculation for a hypothetical bank. To illustrate, consider a bank with a loan book made up of the following assets:

- £100 million gilts;
- £315 million corporate loans;
- £600 million residential mortgages.

The risk-adjusted exposure of the bank's portfolio is (0.0 × 100) + (1.0 × 315) + (0.5 × 600) or £615 million. Therefore the bank would require a minimum Tier 1 capital level of £24.6 million (that is, 4% × 615 million). If the capital available to support the loan book comprised both Tier 1 and Tier 2 capital, the minimum amount required would be higher, at £49.2 million.

There is of course a cost associated with maintaining capital levels, which is one of the main reasons for the growth in the use of derivative (off-balance sheet) instruments, as well as the rise in securitisation. Derivative instruments attract a lower capital charge than cash instruments, because the principal in a derivative instrument does not change hands and so is not at risk, while the process of securitisation removes assets from a bank's balance sheet, thereby reducing its capital requirements.

The capital rules for off-balance sheet instruments are slightly more involved. Certain instruments, such as FRAs and swaps with a maturity of less than one year, have no capital requirement at all, while longer-dated interest-rate swaps and currency swaps are assigned a risk-weighting of between 0.08% ands 0.20% of the nominal value. This is a significantly lower level than for cash instruments. For example, a £50 million 10-year interest-rate swap conducted between two banking counterparties would attract a capital charge of only £40,000, compared to the £800,000 capital an interbank loan of this value would require; a corporate loan of this value would require a higher capital level still, of £4 million.

The capital calculation for derivatives have detail differences between them, depending on the instrument that is being traded. For example, for interest-rate swaps the exposure includes an "add-on factor" to what is termed the instrument's "current exposure". This add-on factor is a percentage of the nominal value, and is shown in Table 26.3.

Table 26.3 Add-on risk adjustment for interest-rate swaps, percentage of nominal value

Maturity	Plain vanilla	Floating/Floating swaps	Currency swaps
Up to 1 year	0.0	0.0	1.0
Over 1 year	0.5	0.0	5.0

Example 26.2 Simple illustration of calculation of capital adequacy, Basel I rules

Table 26.4 Example of capital adequacy calculation

The assets of ABC Bank plc are £2.536 billion, which are balanced by shareholders' funds and long-term borrowings, as well as the deposit base of the bank. The Basel risk-weighting assigns the various types of assets a certain risk-weighting, and using the rules we calculate a capital at risk value of £1.298 billion. The capital required is 8% of this sum, or just over £103 million. The Basel rule states that at least 50% of this amount must be sourced from Tier 1 capital. We see from Table 26.4 that the level of Tier 1 capital is well above the sum required. The combination of Tier 1 and Tier 2 capital is also well above the minimum required.

ABC Bank plc Balance Sheet

Assets	Weighting (%)	Value (£m)	Capital risk-weighting (£m)
T-Bills	0	250	0
Cash	0	30	0
Interbank loans	20	790	158
Mortgage book	50	652	326
Commercial loan book	100	814	814
TOTAL		**2536**	**1298**
Capital charge (8%)			103.84
Liabilities			
Shareholders' funds	100		
Reserves	356	456	
Long-term debt	500		
Deposits	1580	2080	
		2536	

Action in the event of failure

The existence of a regulatory capital system is designed to protect the financial system, and therefore by definition the free market economy, by attempting to ensure that credit institutions carry adequate reserves to allow for counterparty risk. However, domestic regulators are also faced with a dilemma should a banking institution find itself in an insolvency situation; namely, to what extent should the bank be "rescued" by the authorities. If the bank is sufficiently large, its failure could have a significant negative impact on the national and global economy, as other banks, businesses and ultimately individuals also suffered losses. The large "high street" banks[4] are obvious examples of the type of firm that is considered too important to be allowed to fail. It is not desirable though for regulators or national governments to present explicit guarantees against failure, however, as this introduces the risk of moral hazard as risk of loss is reduced.[5] There would also be an element of subsidy as a bank that was perceived as benefiting from an explicit or implicit guarantee would be able to raise finance at below-market cost. This introduces an anti-competitive element in one of the most important sectors of the economy.

Observation would appear to indicate that domestic regulators do not treat all banks as equal, however, notwithstanding the reluctance of regulators to provide even implicit guarantees. The desire to avoid knock-on effects and safeguard the financial system means that large banks may be rescued while smaller banks are allowed to fail. This has the effect of maintaining an orderly market but also emphasising the need for discipline and effective risk management. For example, in the United Kingdom both BCCI and Barings were allowed to fail, as their operations were deemed to affect relatively few depositors and their failure did not threaten the banking system. In the United States Continental Illinois was saved, as was Den Norske Bank in Norway, while two smaller banks in that country were allowed to fail, these being Norian Bank and Oslobanken. In Japan many small banks have been allowed to fail, as was Yamaichi Securities, while Long Term Credit Bank and Nippon Credit Bank both were rescued.

The original Basel II proposals

The perceived shortcomings of the 1988 Basel capital accord attracted much comment from academics and practitioners alike, almost as soon as they were adopted. The main criticisms were that the requirements made no allowance for the credit risk ratings of different corporate borrowers, and that they were too rigid in their application of the risk-weightings. That these were valid issues was recognised when, on 3 June 1999, the BIS published proposals to update the capital requirements rules. The new guidelines are designed "to promote safety and soundness in the financial system, to provide a more comprehensive approach for addressing risks, and to enhance competitive equality". The proposals are also intended to apply to all banks worldwide, and not simply those that are active across international borders. The 1988 accord was based on very broad counterparty credit requirements, and despite an amendment introduced in 1996 to cover trading book requirements, it remained open to the criticism of inflexibility. The new Basel II rules have three pillars, and are designed to be more closely related to the risk levels of particular credit exposures. These are:

- **Pillar 1:** a new capital requirement for credit risk, as well as a charge for the new category of *operational risk;*
- **Pillar 2:** the requirement for supervisors to take action if a bank's risk profile is high compared to the level of capital held;
- **Pillar 3:** the requirement for greater disclosure from banks than before, to enhance market discipline.

The markets have developed to a much greater level of sophistication since the original rules were drafted, and the Committee has considered a wide range of issues related to the determinants of credit risk. In this section we consider the main points of the Basel II rules published in June 2004 and also assess market reaction to them during the discussion phase.

Elements of the new Basel II rules

The new Basel accord is split into three approaches or pillars, which we consider in this section.

Pillar 1 – the minimum capital requirements

(1) Credit risk

The capital requirements are stated under two approaches:

- the standardised approach;
- the internal ratings-based (IRB) approach. Within IRB there is a foundation approach and an advanced approach, the latter of which gives banks more scope to set elements of the capital charges themselves.

Standardised approach

In the standardised approach banks will risk-weight assets in accordance with a set matrix, which splits assets according to their formal credit ratings. The matrix is detailed in Table 26.5, which shows the new risk weights as percentages of the standard 8% ratio.

Table 26.5 Basel II capital requirement risk weights, percentage weightings

Source: BIS.

	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.

The greatest change is to the four risk weight buckets of the current regime. The revised ruling redistributes the capital required for different types of lending and also adds an additional category for very low-rated assets. For sovereign lending there is a smooth scale from 0% to 150%, while the scale is more staggered for corporates. An unusual feature is that low-rated companies attract a higher charge than non-rated borrowers. For lending to other banks there are two options; in the first, the sovereign risk of the home country of the bank is used, and the bank is placed in the next lower category. In the second option, the credit rating of a bank itself is used. Whatever option is selected, the main effect will be that the capital charge for interbank lending will increase significantly, to virtually double the current level.

National regulators will select which of the two approaches to use for interbank exposures. Under option 1, loans will be categorised in accordance with the rating of their sovereign domicile, while under option 2 loans would be slotted according to the bank's own rating. If using the latter approach, assets of below three months will receive preferential treatment.

Loans made to unrated borrowers will be placed in a separate band that carries the full risk weighting of 100%, although the BIS has stated that regulators should review the historical default experience of the relevant market and assess whether this weighting is sufficient. Short-term credit facilities with corporates that remain undrawn, which under Basel I attract a zero weighting, would be weighted at 20% under Basel II.

Compared to Basel I, under Basel II there is a greater allowance for credit risk reduction, principally in the form of recognition of securities as collateral. The following assets would be recognised as collateral:

- cash and government securities (as currently recognised under Basel I);
- securities rated BB-and above issued by a sovereign or public-sector entity;
- securities rated BBB-and above;
- equities that are constituents of a main index, or listed on a recognised investment exchange;
- gold.

Securities placed as collateral will be given a "haircut" to their market value to reflect their price volatility.

Internal ratings-based (IRB) approach

In the IRB approach, banks' assets are categorised in accordance with their own internal risk assessment. To undertake this approach a bank must have its internal systems recognised by its relevant supervisory body, and systems and procedures must have been in place for at least three years previously. This includes a system that enables the bank to assess the default probability of borrowers. If using an IRB approach a bank will use its own internal ratings to categorise loans in *probability-to-default* or PD bands. The number of PD bands set up is at the discretion of the bank. The BIS has compiled a formula that enables the bank to calculate the capital allocation requirement in accordance with its PD bands. Table 26.6 sets out the capital requirements under Basel I and both the standard and IRB approaches under Basel II.

Table 26.6 Capital requirements under specified PD bands

	%			
	PD band	**Basel I**	**Standard approach**	**IRB foundation approach**
AAA	0.03	8.0	1.6	1.13
AA	0.03	8.0	1.6	1.13
A	0.03	8.0	4.0	1.13
BBB	0.20	8.0	8.0	3.61
BB	1.40	8.0	8.0	12.35
B	6.60	8.0	12.0	30.96
CCC	15.00	8.0	12.0	47.04

If using the advanced approach, banks may recognise any form of collateral and set their own parameters when using the BIS formula for calculating capital, following approval from their banking supervisory body. For the first two years after such approval, the credit risk element of capital allocation cannot be lower than 90% of the allocation calculated under the foundation approach; after two years the BIS propose to review the advanced approach and comment.

(2) Operational risk

One of the most controverisal elements of the Basel II is the new capital charge to cover banks' operational risk. The Committee proposed three different approaches for calculating the operational risk capital charge. These were:

- the basic indicator approach, under which 20% of total capital would be allocated;
- a standardised approach, under which different risk indicators will be allocated to different lines of business within a bank; this would be the level of average assets for a retail bank and assets under management for a fund manager. The Committee would set the capital charge level for each business line, in accordance with its perceived level of risk in each national jurisdiction, and the total operational risk would be the sum of the exposures of all business lines;
- an internal estimation by a bank of the expected losses due to operational risk for each business line. Operational risk here would be risk of loss as a result of fraud, IT failures, legal risk and so on.

(3) Total minimum capital

The sum of the capital calculation for credit risk exposure, operational risk and the bank's trading book will be the total minimum capital requirement. This capital requirement will be expressed as a 8% risk-asset ratio, identical to the rules under Basel I.

Pillar 2 – Supervisory approach

A new element of the Basel II accord is the requirement for a supervision approach to capital allocation. This is based on three principles. First, banks must have a procedure for calculating their capital requirements in accordance with their individual risk profile. This means they are required to look beyond the minimum capital requirement as provided for under Pillar 1, and assess specific risk areas that reflect their own business activities. This would consider, for instance, interest-rate risk exposure within the banking book, or prepayment risk as part of mortgage business. This process will be reviewed constantly by banking supervisory authorities. Second, the risk-weighted capital requirement calculated under Pillar 1 is viewed as a minimum only, and banks are expected to set aside capital above this minimum level to provide an element of reserve. Supervisors will be empowered to require a bank to raise its capital level above the stipulated minimum. Finally, supervisors are instructed to constantly review the capital levels of banks under their authority, and act accordingly in good time so that such levels do not fall below a level deemed sufficient to support an individual bank's business activity.

Pillar 3 – Disclosure

The Basel II accord sets out rules on core disclosure that banks are required to meet, and which supervisors must enforce. In addition there are supplementary disclosure rules; these differ from core rules in that banks have more flexibility on reporting them if they are deemed not relevant to their specific operating activities, or of they are deemed non-material. The disclosures include:

- *capital:* the elements that make up the bank's capital, such as the types of instruments that make up the Tier 1 and Tier 2 capital;
- *capital adequacy:* this covers the amount of capital required against credit, market and operational risk, as well as capital requirements as a percentage of the total capital of the bank;
- *risk exposure:* the overall risk exposure of a bank, as measured by credit risk, market risk, operational risk and so on. Hence this would include a

profile of the ALM book, including maturity profile of the loan book, interest-rate risk, other market risk, essentially the sum of the exposures measured and monitored by a bank's risk management department.

As part of Pillar 3, banks using an IRB approach when calculating their capital requirement are required to disclose their internal policies and procedures used as part of the approach.

In compiling the new Accord, the Basel committee wished to expand capital requirements to cover other areas of risk, such as market risk and operational risk. It recognised that a bank's capital should reflect the level of risk of its own portfolio, but also that this may best be estimated by a bank's own internal model rather than any standard ruling provided by a body such as the BIS. In any event the proposed rule changes attracted considerable comment, although the final form of the rules that were eventually adopted are very similar to the proposals listed above. There is a growing consensus among practitioners that perhaps the markets themselves should carry more of the supervisory burden rather than regulators; for example narrowing the scope of deposit insurance,[6] or by requiring banks to issue specific kinds of uninsured debt, similar to the PIBS issued by UK building societies. Holders of such subordinated debt are more concerned with the financial health of a bank, because their investment is not guaranteed, and at the same time they are not interested in high-risk strategies because their return is the same every year irrespective of the profit performance of the bank; that is, the fixed coupon of their subordinated bond. Therefore the yield on this subordinated debt is in effect the market's assessment of the risk exposure of the bank. An academic at Columbia University[7] has suggested that regulators should place a cap on this yield, which would force the bank to cap the level of its risk exposure, but this level would have been evaluated by the market, and not the regulatory authority.

One improvement of Basel II over Basel I is that it acknowledges that "one size" does not fit all banks, and that greater flexibility is required in the capital allocation process. The IRB approach should result in a lower capital charge than the standardised approach, and as such should encourage the development of risk management systems in banks which are incentivised to adopt this approach. Depending on the nature of their activities, some banks will have higher risk profiles compared to others, and as such need more risk management than would be provided simply by a minimum capital level. This is the reasoning behind the three-Pillar approach, and principally Pillar 2, which empowers supervisors to intervene if they feel steps taken by an individual bank are not adequate. This is meant to extend beyond a requirement to increase capital levels. Pillar 3 is also crucial to this overall process, as it is designed to ensure that there is adequate disclosure, not just of risk exposure, but also of the procedures used to calculate capital under the IRB approach.

Reaction and critique

The weight of market reaction and comment to the Basel proposals initially led to a second draft of the proposals being introduced, in January 2000, following the first draft in June 1999. The consultative period was also extended by three more years, so that final implementation of the Accord was not possible until 2007 in the European Union.

The general market opinion has been that Basel II does at least attempt to focus on the economic substance and risk characteristics of new market instruments, as opposed to their structural form. With one or two notable exceptions, banks should find that their overall level of capital allocation remains broadly similar to that under the previous regime. The IRB approach, by being split into a foundation and advanced options,[8] enables a larger range of banks to opt to adopt it, rather than just the larger ones that might be expected to have the requisite internal systems.

The most contentious element of the proposals was the charge for operational risk. The Accord allows three approaches for determining this charge. The first, the “basic indicator”, uses a simple one-level indicator, while the second is a standardised approach that specifies different levels of charge for different business lines. The third option is an internal measurement mechanism that enables banks to use their own internal loss data to estimate the charge. The overwhelming market response to these proposals was that they resulted in too high a charge for an element of risk that is still vaguely defined. However, the three different options will produce different results, and this flexibility was introduced in the second draft after the market’s negative reaction to the blanket 20% operational risk charge stated in the first draft. For instance, a senior vice-president of a middle-tier investment bank has stated that using the third approach produces a capital charge that is $500 million lower than that produced by the flat 20% charge.[9] Therefore banks will probably wish to ensure that their internal systems and procedures are developed such that they can employ the internal method.

Under the proposals, capital relief can be obtained by the use of collateral, bank guarantees and credit derivatives. This is expected to see a rise in the use of synthetic securitisations such as synthetic CDO transactions, to reduce capital exposure of bank balance sheets. The Accord stipulates a haircut to be applied to collateral, in accordance with its credit quality, as a protection against market risk. This is not controversial. Collateral, non-bank and non-soveriegn guarantees and credit derivatives also will be subject to a charge of 0.15 of the original charge on the exposure, known as *w*. This charge is designed to reflect risks associated with these instruments, such as legal and documentation risks. However, the credit derivatives market has reacted negatively to this proposal, suggesting that *w* is not required and will have an impact on the liquidity of the default swap market.

The Accord has greatest impact in emerging markets, and has been welcomed, for instance, by non-sovereign issuers in these markets. This is because under the new Accord banks may rate other banks and corporate borrowers at a higher level than the sovereign rating of the home country. Under Basel I no institution could be rated higher than its domicile country rating. As a result, banks may target stronger corporate borrowers in lower-rated emerging market economies. In the standardised approach, extra risk buckets of 50% and 150% for corporate exposures have been added to the existing 20% and 100% buckets. This makes the new Accord more risk-sensitive. The impact on bank risk-weightings of the new proposals for certain sovereign credits is given in Table 26.7. Higher-rated banks will probably wish to adopt the IRB approach, while smaller banks are likely to adopt the standardised approach until they have developed their internal risk management systems.

Table 26.7 Bank risk weightings under Basel II: selected Asian economies

Ratings source: Moody's/S&P

	Sovereign rating	Current risk weight (%)	Basel II risk weight
Australia	Aa2 / AA+	20	20
China	A3 / BBB	100	100
India	Ba2 / BB	100	100
South Korea	Baa2 / BBB	20	100
Malaysia	Baa2 / BBB	100	100
Pakistan	Caa1 / B-	100	150
Philippines	Ba1 / BB+	100	100
Singapore	Aa1 / AAA	100	20
Taiwan	Aa3 / AA+	100	20
Thailand	Baa3 / BBB-	100	100

Basel II framework

Following over six years of debate and consultation on its proposals, the BIS published the final version of the Basel II regulatory capital framework in June 2004.[10] This represented a significant milestone in risk management development. By enabling the use of advanced risk measurement techniques and internal bank credit ratings, the Basel II IRB framework should result in the adoption of stronger risk management policies, procedures and controls for banks worldwide. Although its adoption will not be required by all banks, the credit-rating agencies will generally view as a positive factor its adoption by any particular bank. Compared to the Basel I regime, general market opinion holds that the Basel I rules are a much improved benchmark for assessing capital adequacy relative to true economic risk.

The broad objectives of Basel II remain as they were at the start of the formulation process, and are:

- to maintain generally the same level of capital in the banking system as currently;
- to improve on the safety and rigour of financial systems worldwide;
- to allow for a more flexible approach to the measurement of risk, and to align more closely the regulatory capital framework with what is calculated by bank's own internal risk measurement systems;
- to set up an environment that would result in improvement to bank internal risk management methodologies.

The three-pillar structure described earlier in the chapter has remained in place in the final draft. The published final rules have made revisions to the earlier proposals, for all pillars. The most significant changes are to the methodology to calculate the IRB and the treatment of expected and unexpected losses.

With regard to implementation, for European Union countries this took place in January 2007 (with parallel running for up to two years after that). In the US, the regulatory authorities have determined that only the top 20 or so large banks with significant overseas operations need to adopt Basel II, from January 2008 onwards.

The final IRB approach

The basic IRB framework that was in the first proposals has remained in place. However, a significant change was the decision to base the capital charges for all asset classes on *unexpected loss* (UL) only, and not on both UL and *expected loss* (EL). In other words, banks must hold sufficient reserves to cover EL, or otherwise face a capital penalty. This move to an UL-only risk-weight arrangement should result in the alignment of regulatory capital more closely with banks' actual economic capital requirement levels.[11] A UL-only framework should result in banks regarding their capital base in a different light, but should leave overall capital levels the same. 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.

Note that the BIS's desire to leave the general level of capital in the system at current levels means that a "scaling factor" can be applied to adjust the level of capital. This scaling factor has not been determined, but will be assessed based on data collected by the BIS during the parallel running period. It will then be applied to risk-weighted assets' value for credit risk.

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 defaut or other 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 one-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 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.

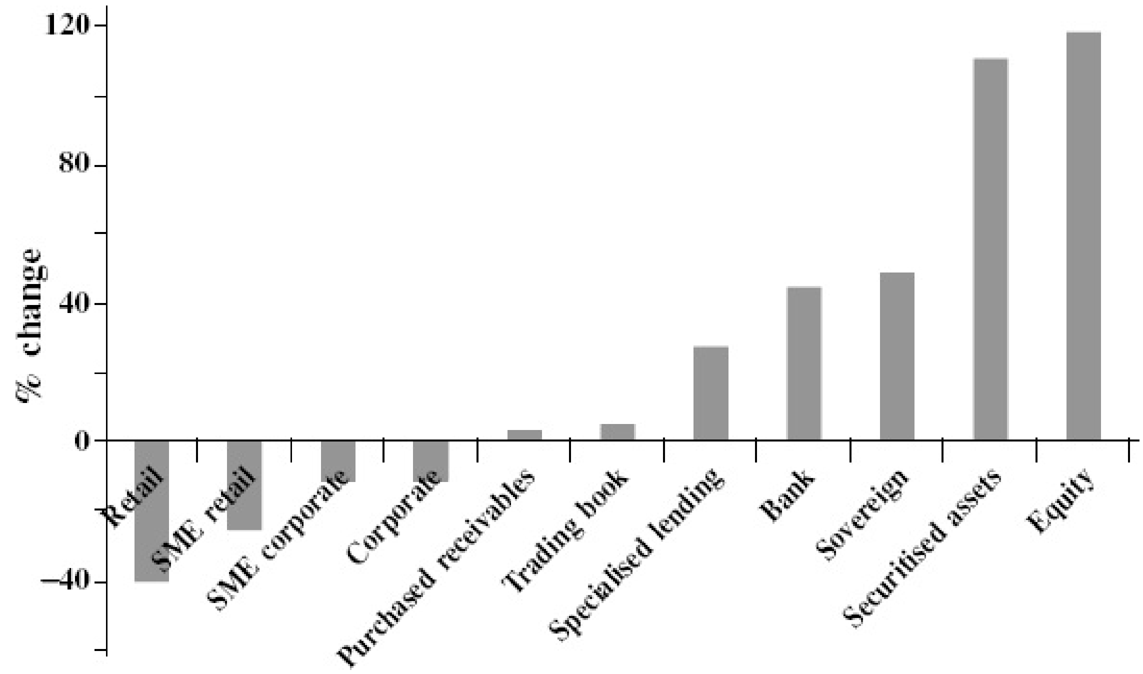
Basel II recognises that different types of assets behave differently, and is much more flexible than Basel I in this respect. The level of economic loss of an asset will differ by asset type, notwithstanding that credit ratings might be identical. For example, for each of the following assets:

- loan to large corporate;
- loan to individual;
- loan secured by collateral;
- cash flows expected by the obligor to service and repay the loan;
- term of loan;
- loan value sensitivity to market movements;

we would expect quite different types of behaviour. Basel II provides specific capital calculation formulas for the following four asset types in a banking book: corporates, commercial real estate and retail. Different asset classes will see different capital requirements under Basel II: Figure 26.1 shows the BIS's own estimate of the change in requirements for Basel II compared to Basel I.

Figure 26.1 Basel II capital requirements for different asset classes: expected % change versus Basel I

Source: BIS.



% change
120
80
40
0
−40
Retail
SME retail
SME corporate
Corporate
Purchased receivables
Trading book
Specialised lending
Bank
Sovereign
Securitised assets
Equity

Asset correlation and diversity

To allow for asset pool diversity, the Basel II capital calculation formulas assume values for the correlation between different types of assets. In this regard banks do not have a free hand: they must use the BIS correlation values and may not use ones they have calculated. Under the framework, a single risk factor is used to account for asset correlation. The BIS makes a number of assumptions about asset behaviour to allow this single factor to be used.

A downside of this is that the Basel II framework does not account for, or cover, concentration risk. For instance, if a bank had a particularly high proportion of its asset book held in a single type of asset, across a single industry or in a single geographic location, it is reasonable to assume that its asset behaviour correlation would be higher than what is stated in the Basel II framework. This opens up the risk that the bank may be putting up insufficient capital to cover its credit risk.

Securitisation

When first aired, the Basel II proposals were expected to have a significant impact on the securitisation market, but this is not so evident on final publication. There is now a common hierarchical approach to the calculation methodology that is applied under the IRB approach to determine risk-weighting for a securitisation transaction. This applies irrespective of whether a bank is the originator or an investor in the transaction. For ABCP conduits, an internal assessment approach (IAA) has been set up, to be used to calculate internal ratings. To use the IAA, a bank will need to meet certain requirements laid down in the rules.

Essentially, however, there is a uniform treatment of securitisation transactions. For use with the ratings-based approach, there is a set of appropriate risk-weights to use to calculate the weightings in a securitisation deal.

The next chapter covers the essential elements of Basel II in greater detail.

Appendix

Appendix 26.1 UK capital regulations

Source: Financial Services Authority.

	Tier 1	Upper Tier 2	Lower Tier 2	Tier 3
Description	* Ordinary shares	* Revaluation reserves	* Dated cumulative preference shares	* Term subordinated debt
	* Preference shares (perpetual non-cumulative)	* General provisions (to maximum of 1.25% of the sum of risk-weighted assets for the regulated bank)	* Subordinated term debt	* Minority interests arising from consolidation of Tier 3 capital instruments
	* Reserves created by appropriations of retained earnings, share premium and other surpluses	* Minority interests arising from consolidation of interests in Tier 2 capital items	* Dated convertible bonds	
	* Audited retained profit from previous year	* Hybrid capital instruments (if perpetual and cumulative)		
	* Minority interests	* Capitalisation of property reserves		
Deductions	* Bank's holdings of own Tier 1 paper	* See Lower Tier 2	* Selected investments in subsidiaries and associates	
	* Goodwill and other intangible assets		* Connected lending of a capital nature and qualifying holdings	
	* Current year's unpublished losses		* All holdings of capital instruments issued by other credit institutions and financial entities	

	* Capitalisation of property revaluation reserves		* Holdings of own capital	
Innovative Tier 1 capital	* Permitted			
Maturity	* Undated	* Undated; no repayment without regulator's permission	* Minimum five years and one day from draw-down date	* Minimum initial maturity of two years
Call characteristics	* Only after five years	* Generally after five years and one day	* No early repayment without consent of the Financial Services Authority (FSA)	* No early repayment without regulator's consent
	* Call option at discretion of issuer (five-year intervals between calls)		* Not before five years and one day	
	* Must have no other provisions which require future redemption			
Step-up	* Only after ten years	* Yes, a maximum of 50 bps in the first 10 years of issue and a maximum of 100 bps over the whole life of the issue	* See Upper Tier 2	* Yes, see Upper Tier 2, but not before five years
	* Maximum of 100 bps, less swap spread between the initial and stepped-up indices, or 50% of the initial credit spread less the swap spread between the initial and	* Subordinated debt issues with set-ups in the first five years are inelgible for inclusion in the capital base		

	stepped-up indices			
Interest accrual	* Non-cumulative (but may be paid in scrip)	* Cumulative, deferred interest may bear interest, but not at penal rates	* Non-payment constitutes default	* Cumulative blocking clause: neither interest nor principal may be paid if, as a result, own funds will fall below minimum requirement. Must notify FSA if capital ratio falls below 10%
Interest deferral	* Yes	* Yes, at option of issuer	* N/A	* Yes, see Upper Tier 2, but not before five years
Loss absorption	* Yes	* Yes, conversion into common equity either initial or deemed	* N/A	* No
Subordination	* Junior to Tier 2 capital except for dated preference shares with which it ranks *pari passu*	* Generally subordinated to Lower Tier 2	* Subordinated to all senior creditors	* Generally senior to Lower Tier 2 in a winding-up
			* Generally subordinated to Tier 3 in a winding-up	
Amortisation			* Amortised over the last five years at a rate of 20% per annum	* No

Source: Financial Services Authority.

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[1] In the United Kingdom, banking regulation is now the responsibility of the Financial Services Authority, which took over responsibility for this area from the Bank of England in 1998. In the United States, banking supervision is conducted by the Federal Reserve; it is common for the central bank to be a country's domestic banking regulator.

[2] Bank for International Settlements, Basle Committee on Banking Regulations and Supervisory Practice, *International Convergence of Capital Measurement and Capital Standards*, July 1988.

[3] Also known as the "Cooke ratio" after the Chairman of the Basel Committee at the time, Peter Cooke.

[4] Known as "money centre" banks in the United States.

[5] This is the risk that, given that a guarantee against loss is available, a firm

ceases to act prudently and enters into high-risk transactions, in the expectation that it can always call on the authorities should its risk strategy land it in financial trouble.

[6] Many countries operate a deposit insurance scheme that guarantees the level of a private customer's deposits in a bank should that bank fail. In the United Kingdom for example, the arrangement is that if a bank or building society is declared bankrupt, individuals are entitled to compensation of 90% of their savings with that institution, up to a maximum of £18,000 per individual.

[7] Charles Calomiris, as described in "Better than Basle", *The Economist*, 19 June 1999.

[8] This was introduced at the time of the second draft proposals.

[9] *RISK*, February 2001, p. 27.

[10] *International Convergence of Capital Measurement and Capital Standards, a Revised Framework*, Bank for International Settlements, June 2004.

[11] For instance, as suggested in "An Overview and Impact Assessment of the Revised Basel II Framework", *Basel Alert* (Incisive Media) 2004, and *Demystifying Basel II* (Fitch special report), 25 August 2004.

CHAPTER 28

Funding and Treasury Procedures for Banking Corporations[1]

The purpose of this chapter is to address the issues specifically faced by a bank Middle Office in their support of the ALM function. While the Treasury front office has primary responsibility for managing transactions facing the external market, Middle Office (MO) plays an important role in *controlling* the ALM function, and the corresponding internal allocations of those transactions across the various internal business units.

This chapter describes what is meant by the term “funding cost” and the various methods of their internal allocation, as well as the logistical issues faced by many banking corporations in effecting this allocation.

Funding

In today’s increasingly complex financial markets where focus is often placed on the development of new and innovative structures designed to unlock financial value, practitioners will do well to remember the age-old banking maxim that “Cash is King”. Regardless of the simplicity or complexity of a transaction, invariably there is either a payment or receipt of cash at some stage throughout its life. In fact, that is ultimately all that banking corporations are – payers and receivers of cash today made in consideration for commitments to paying or receiving cash in the future.

The term “funding cost” in banking refers to the financial cost in the form of interest that is incurred when cash is borrowed to finance other trading assets. Traditionally, investment banks are net borrowers of cash, but the same principles apply to net lenders of cash.

Accordingly, regardless of its size and nature, there are some fundamental questions that an organisation which manages its cash well must address, including:

- Where is cash being borrowed from?
- What is the financial cost (interest) of borrowing this cash?
- Where is the cash being used within the organisation?
- How is the financial cost of borrowing this cash being internally allocated to the areas of the organisation that are using it?

These costs can be real costs or they can be opportunity costs, and the larger and more complex the organisation, so too are the issues around attributing those costs to individual business areas.

Internal funding cost allocation

Banking corporations are often structured with a dedicated Treasury department that is responsible for managing the cash flow of the business, and for arranging the cash borrowings required to finance trading assets. In that respect, the external funding trades are often booked in Treasury's book, which initially bears the funding cost of those borrowings. Those funding costs are then allocated internally to the areas of the business that have generated the funding requirement by internally lending the cash to whoever needs it. Treasury is therefore acting as a conduit between the external sources of funding and the internal businesses requiring it.

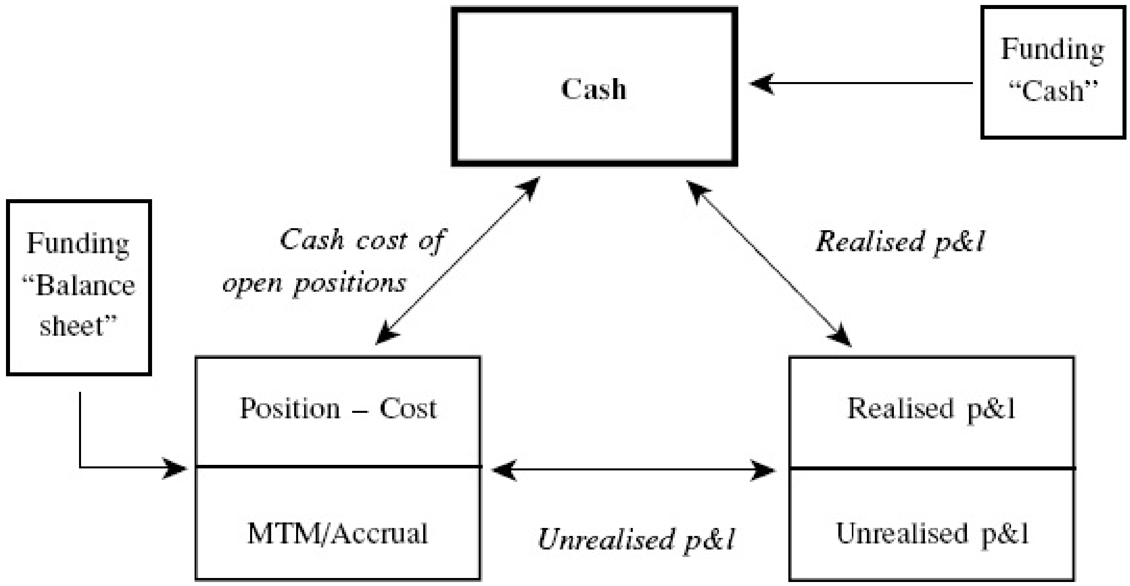
There are two broadly different approaches to determining the amount of cash Treasury is required to internally lend to each business:

(1) Funding "Cash";

(2) Funding "Balance sheet".

These are linked by the principles of double-entry accounting (see Figure 28.1), and differ in their treatment of funding profit and loss generated by each business.

Figure 28.1 Double-entry accounting and funding cash allocation



Funding "Cash"

This approach is both the simplest in theory and the simplest to apply, in that each individual business is deemed to own a portion of the overall entity's cash balance.

This portion represents that business' overall contribution since inception to the entity's cash balance, not only includes the amount required to fund that business' current open positions, but incorporates previously generated realised p&l as well. The amount that each business is therefore required to borrow from Treasury is simply the amount that would flatten that business' own cash balance.

Funding "Balance sheet"

This approach treats Treasury as the owner of all cash, which then lends to businesses to fund the *value* of their current trading portfolio. Figure 28.1 illustrates the difference between the cash balance of the first approach and the balance sheet value of this second approach as being the *realised* and *unrealised p&l.*

It can be less common in some organisations for there to be a clear and effective policy surrounding the funding benefit/detriment of profits earned / losses incurred.

However, particularly in trading environments, it is good practice to dictate that the funding cost/benefit of profits and losses are the property of Treasury (or some other central element of the organisation structure), as opposed to being the property of the business that has generated them. The rationale for this policy, which applies equally to:

- current year and prior year p&l, and
- realised and unrealised p&l

is based on establishing a "level playing field" between businesses for the purpose of performance evaluation.

In trading environments where p&l is generated throughout the trading day, the assessment of the performance of that trading activity should be insulated from the ongoing funding effect of trading undertaken on previous days.

Where historical profits have been *realised*, under "Cash funding" these act to increase the business' cash balance, and therefore decrease its ongoing funding requirement and associated interest cost. This funding benefit attaches itself to the businesses in perpetuity, and may have the effect of distorting the performance assessment of future trading.

Under "Balance sheet funding", however, the ongoing funding benefit of these realised profits remains with Treasury, since it continues to fund the business according to its current open trading portfolio value, but the aggregate external funding requirement of the whole entity on which Treasury pays the interest has been reduced.

Additionally, there is an opportunity cost/benefit to the entity of *unrealised p&l*, since by merely realising that p&l, there would be an immediate impact on the entity's cash borrowing cost. By funding each business based on its current open trading portfolio value, then the business is effectively paying Treasury for this opportunity cost.

By applying "Balance sheet funding", the Treasury p&l should therefore reflect the funding benefit of the entity's p&l as if it was all realised, with the businesses reflecting the opportunity cost of unrealised p&l. Businesses are therefore incentivised not to carry unrealised p&l unnecessarily. As a result, the recognition by a business of a non-cash asset/liability on the entity's balance sheet should incentivise the business concerned to use that asset/liability in a manner that generates a benefit to the entity over and above that which could be generated by Treasury just lending/borrowing the cash equivalent of that asset/liability in the overnight money market.

In practice, for logistical reasons, some organisations set up their cash management operations to adopt the cash funding basis where the amount of internal funding booked to each business flattens their cash balance, which is supplemented by an additional balance sheet charge that transfers funding p&l back to Treasury to capture the funding benefit of historic profits/losses. This method has the added benefit of capturing errors by cash management operations in assigning cash funding to each business, as illustrated in Appendix 28.1.

Transfer pricing

A sometimes contentious issue in banking corporations is often the determination of the rate at which internal businesses borrow their funding requirement from Treasury. This is often impacted by the mandate of the Treasury department, in terms of whether it is set-up as:

(1) a cost centre whose purpose is to act as a service provider to the organisation that provides a central coordination point for funding;

(2) a profit centre whose purpose is not only to arrange funding, but is also to make p&l from trading the interest-rate risk often produced as a by-product of funding activities at the shorter end of the yield curve.

The transfer pricing rate is usually representative of the rate that Treasury pays on the external borrowings. In some organisations a spread is applied to this rate to compensate Treasury for the operational costs involved in acting as the centralised funding provider.

However, further complications arise when the term structure of funding is taken into consideration, since different rates are payable on borrowings of different maturity, as determined by the ALM profile.

Again there are at least two approaches to addressing this issue.

Weighted average rate (WAR)

In order for the businesses to incur a funding cost that incorporates the term structure of funding, Treasury may calculate a daily weighted average rate (WAR) that is then applied to each daily internal borrowing. The advantage to this is that Treasury is compensated by the businesses for the additional funding cost incurred in the borrowing term as required by the ALM profile.

The disadvantage of this transfer pricing approach is that businesses often have different maturity profiles of their assets, and therefore contribute in different amounts to the term funding cost incurred by Treasury, but ultimately all pay the same WAR. Some businesses can therefore end up effectively subsidising other businesses.

“Marginal rate” with term premium allocation

ALM generates the requirement to borrow cash for committed periods longer than overnight.

Incorporated into the cost of borrowing term cash is a market “*term premium*”. This is the spread between borrowing term cash, and the equivalent OIS for swapping that term cash down to overnight floating.

Where the size and tenor of an individual business’ portfolio warrants it, term funding may be allocated directly to that individual business’ book, or passed on to that book “back-to-back” through the Treasury book. Note: The by-product of this is the generation of interest-rate risk in the business’ book.

However, if the term funding is booked into the Treasury book, this term premium will become part of the Treasury p&l, requiring reallocation.

The “marginal rate” transfer pricing approach is to initially charge each business using the incremental overnight funding rate, and to then allocate the term premium back to those businesses with the longer term assets that are being liquidity risk managed.

Allocation methodology

The Treasury book can be split between term funding portfolios and an overnight funding “pool”. The term funding book would then internally lend the cash raised from term borrowings to the overnight pool at the overnight rate, with the resultant term premium p&l being captured within the term funding portfolio, along with any other gap p&l generated by Treasury electing not to swap down the term funding to OIS.

The reallocation method of the term premium p&l is to use:

(1) the asset liquidation profile from the ALM process as the basis for the amounts to be charged (the rationale being that it is this profile which the term funding is being benchmarked against to ensure satisfactory management of liquidity gaps),

in combination with:

(2) a published term premium matrix maintained by Treasury that reflects the current premium of term cash rates by maturity bucket over and above the equivalent OIS rate.

The ALM asset value per bucket is to be multiplied by the term premium for that bucket, for whatever period of time the allocation is being made (possibly in conjunction with ALM reporting), with buckets per business summed together to provide a business total.

This total allocation will not match the actual term premium p&l (since actual term funding will not perfectly match the asset liquidation profile, and the term premium matrix is only indicative), so the actual term premium p&l can then be allocated in the same proportion per business as the theoretical results calculated above.

Depending on the currency mix of the term funding, this methodology may need to be applied at a currency level.

For example, consider Table 28.1 on page 1250–1. Note how “Business F” has 25% of the total asset value, but incurs 50% of the total term premium. This reflects the disproportionate impact that Business F has on the term funding requirement under prudent ALM management.

Table 28.1 Asset liquidation profile and term premium allocation

Asset liquidation profile ($M)

Business	o/n	o/n–1m	1m–6m	6m–12m	12m–2yr
Business A	42	268	150	78	43
Business B	14	113	199		
Business C	32	88	266	512	478
Business D	16	503	168		
Business E	9	20	20		
Business F	7	19	23	150	220
Business G	44	448	213		
Totals	**164**	**1,459**	**1,038**	**740**	**741**

Term premium matrix (bps)

Premium		o/n	o/n–1m	1m–6m	6m–12m
Term premium (bp)	0	0	3	5	7

Annual term premium p&l allocation ($)

Business	o/n	o/n–1m	1m–6m	6m–12m	12m–2yr	2yr–5yr
Business A		80,318	75,000	54,600	43,000	
Business B		34,045	99,500			
Business C		26,398	133,000	358,400	478,000	
Business D		150,750	83,750			
Business E		5,959	9,932			
Business F		5,700	11,500	105,000	220,000	240,000
Business G		134,400	106,500			
Totals		**437,569**	**519,182**	**518,000**	**741,000**	**240,000**

2yr–5yr	5yr–10yr	10yr–15yr	15yr+	TOTAL	%
				581	12%
				326	7%
				1,376	28%
				686	14%
				49	1%
200	185	300	170	1,274	25%
				705	14%
200	**185**	**300**	**170**	**4,997**	

12m–2yr	2yr–5yr	5yr–10yr	10yr–15yr	15yr+
10	12	15	20	25

5yr–10yr	10yr–15yr	15yr+	Theoretical allocation	Actual allocation	%
			252,918	235,538	7%
			133,545	124,368	4%
			995,798	927,371	26%
			234,500	218,386	6%
			15,891	14,799	0%
277,500	600,000	425,000	1,884,700	1,755,191	50%
			240,900	224,346	6%
277,500	**600,000**	**425,000**	**3,758,251**	**3,500,000**	
		Actual term premium p&l:	**3,500,000**		

Capital structure

The funding cost of an entity is also impacted by its capital structure. The relative contributions of debt and share capital, including various different forms and hybrids of each, all have a bearing on the amount of interest-bearing funding required, and the rates of interest payable on that funding.

To demonstrate how the impact of the capital structure on an entity's funding cost is treated, we will address share capital and subordinated debt as examples.

Share capital

The share capital of a legal entity represents a source of funding like any other, except it has one main defining characteristic: it bears no real interest cost. Again, there are different approaches as to where the share capital is booked and where the benefit of this free source of funding is assigned.

Since the share capital is a specific type of external funding source, it is often booked in the Treasury books of the entity in which the capital resides, with the cash forming part of the general cash funding pool of the entity that is then managed by Treasury.

The net interest benefit of the utilisation of this “free” cash is subject to the same transfer pricing issues as those discussed in the Transfer Pricing section above. It can either be:

- factored into the WAR calculation, such that the net interest benefit is distributed across the businesses. The rationale behind this approach is that the benefit is a product of conducting business from a legal entity, and therefore each business operating from that legal entity is entitled to benefit from it;
- it can be retained within Treasury, such that it forms part of the overall Treasury p&l. The rationale behind this approach is that each business should be assessed on its incremental contribution to the profitability of the entity, and should not reflect entity-level share capital that has already been injected.

Either way, the treatment should be consistent with the treatment of retained earnings discussed in the Internal Funding Cost Allocation section above. Since retained earnings and share capital are both similar sources of funding in that neither have a real interest cost, it makes sense that under cash funding, where the business benefits from retained earnings, that share capital is factored into the WAR. Alternatively, under balance sheet funding, where the benefit of retained earnings is retained within Treasury, it makes sense for Treasury also to retain the benefit of share capital.

Subordinated debt

As a mechanism of capital structure management, subordinated debt can sometimes be issued by an entity. This type of debt has characteristics of both share capital and term funding.

It has characteristics of share capital: in ranks below senior debt-holders in the pecking order of net asset distribution in the event of the entity being liquidated. In order to compensate the subordinated debt-holder for this perceived increase in credit risk relative to senior debt-holders, the entity must pay an interest premium on the subordinated debt.

Additionally, subordinated debt has characteristics of term funding in that it is generally of a longer maturity term.

Therefore, the rate paid on the subordinated issue will have three elements:

- the base short-term Libor rate for short-term *senior* debt;
- the *term premium:* this will initially be captured within the Treasury p&l, and possibly reallocated as per the Transfer Pricing section above.
- the *subordinated premium:* this will also initially be captured within the Treasury p&l, and should be treated consistently with the return on initial share capital per the Share Capital section above.

Bid-offer spread

When funding larger organisations with potentially multiple legal entities, there is generally a requirement to consider the bid-offer spread. We consider the approaches in this section.

Entity netting

Where the banking corporation is a *price-taker* in the money markets, and the funding position of multiple entities are "swept" together to generate one central funding requirement, then there is often a netting benefit across the entities within the Group in determining which side of the bid-offer spread it will pay/receive.

If the Group is a *net borrower* of cash, then all entities pay/receive the higher *"offer"* rate on their funding position.

- Individual entities that are net *borrowers* pay the *same side* of the spread as what they would pay if funded separately in an external market.
- Individual entities that are net *lenders* receive the *more beneficial side* of the spread than what they would receive if funded separately in an external market.

If the Group is a *net lender* of cash, then all entities pay/receive the lower *"bid"* rate on their funding position.

- Individual entities that are net *borrowers* pay the *more beneficial side* of the spread than what they would pay if funded separately in an external market.

- Individual entities that are net *lenders* receive the *same side* of the spread as what they would receive if funded separately in an external market.

Individual entities may therefore receive a “subsidy” from other entities in the Group by having an opposite cash position to the combined Group.

Business netting

The same relationship as the above applies to businesses operating within an entity; that is, there is a *funding rate benefit* available to businesses whose cash position is *opposite* to that of the combined entity.

Under these circumstances, there are two policy options available:

(1) Apply the same side of the bid-offer spread to all internal funding tickets, thereby feeding any funding rate netting benefit down to the entities and businesses that are creating the netting benefit.

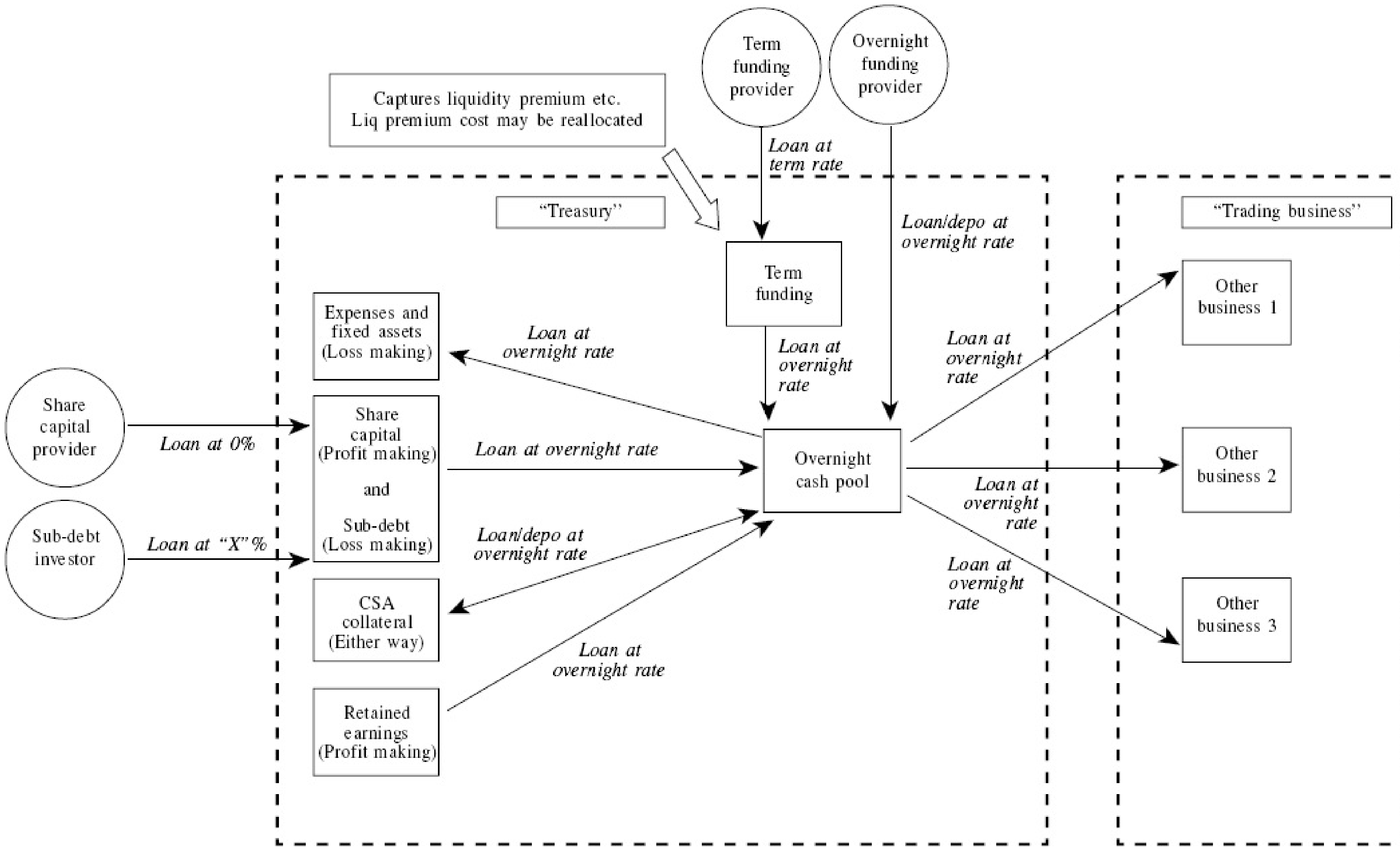
Factors to consider include the implications on the tax status of an entity obtaining a benefit from other group entities, as well as the “benefit at risk” to each entity/business of the existing funding relationships with existing funding sources.

(2) Treat each entity and each business within an entity as a discrete price-taking funding unit that borrows at “offer” and lends at “bid”. The funding rate netting benefit would then accumulate centrally in the Treasury book, both at an entity level and at a group level, and may then be available for some form of reallocation, although the possible allocation bases for this are numerous.

Example ticket booking structure

Figure 28.2 is an example ticket booking structure which incorporates many of the above concepts. It shows the individual books within Treasury, each capturing a particular facet of the entity’s funding, providing highly desired transparency of the funding p&l.

Figure 28.2 Ticket booking structure



Captures liquidity premium etc.
Liq premium cost may be reallocated
Term funding provider
Overnight funding provider
Loan at term rate
Loan/depo at overnight rate
"Treasury"
"Trading business"
Term funding
Loan at overnight rate
Expenses and fixed assets (Loss making)
Loan at overnight rate
Share capital provider
Loan at 0%
Share capital (Profit making)
and
Sub-debt (Loss making)
Loan at overnight rate
Overnight cash pool
Sub-debt investor
Loan at "X"%
Loan/depo at overnight rate
CSA collateral (Either way)
Loan at overnight rate
Retained earnings (Profit making)
Loan at overnight rate
Loan at overnight rate
Loan at overnight rate
Other business 1
Other business 2
Other business 3

As an alternative to actually booking this multitude of internal transactions, which do provide transparency but also require a degree of operational effort to capture and control (especially in larger and more complex organisations), there are systems in the market whose objective is to achieve the same funding p&l allocation as the above without actually capturing the internal funding as ticketed transactions per se.

When implemented correctly, these can achieve the same granularity of management information without the same degree of operational effort, although these function by applying a cost of carry to open trading positions and therefore are inextricably linked to the balance sheet funding method discussed above.

Organisation of reporting line

To support effective asset and liability management (ALM), it is essential that the appropriate corporate structure is in place with associated internal reporting lines, to ensure that the goals of the organisation are best served. All matters regarding ALM are dealt with by a specific committee which has responsibility for ALM decision-making. This committee is labelled the asset and liability committee, otherwise known as “ALCO”.

The chairman of ALCO reports to the Board, and the committee members of the ALCO always include the heads of the key departments, these being the Finance Director, Head of Risk, Head of Front Office, and Head of Operations. Other supporting departmental heads may also have direct representation on the ALCO, although this is not essential and depends on the size and nature of the organisation. For example, the Finance Director may also be flanked by the Head of Finance, the Head of Middle Office and the Head of Regulatory Reporting. The Head of Middle Office may report to the firm Chief Operating Officer (COO) or direct to an ALCO member.

The ALCO determines the remit of the head of ALM, who is therefore also a member of ALCO. The head of ALM is responsible for the day-today implementation of the policies and procedures determined by ALCO. The head of ALM is therefore a key direct report of the head of Treasury.

Appendix

Appendix 28.1

Appendix 28.1

Example A: Balance sheet funding capturing daily profit remittance

Business A has:

- current-year profits of $500 (realised $350, unrealised $150);
- prior year losses of $200 (realised $170, unrealised $30);
- balance sheet trading assets purchased with cash for $2,000 consideration, now worth $2,120 (thus the net unrealised profit of $150 – $30 = $120 above);
- no physical remittance of cash to Treasury;
- The net cash position of the above has been accurately funded with Treasury via inter-book lending *(ticketed funding);* that is, + $350 -$170 – $2,000 = -$1,820.

Business A's Balance sheet therefore looks like:

{+ve = Debit, -ve = Credit}

Trading assets	$2,120
Ticketed funding liability	($1,820)
Net non-cash assets	**$300**
Cash	$0
p&l/Retained earnings	($300)
Cash and p&l	($300)
	$0

In this example, a charge on the net positional assets of $300 at the overnight rate is payable to Treasury, which represents:

- a transfer from the business to Treasury of the real benefit to the entity of reinvesting the $180 *realised* p&l;
- a transfer from the business to Treasury of the notional opportunity cost of being unable to reinvest the $120 *unrealised* p&l.

Applying this charge creates the effect of daily profit remittance to Treasury without the need to actually book the remittance in systems. Note that from Treasury's perspective, the p&l on its external borrowing of $1,820 is offset with that of the ticketed internal lending of $1,820 to Business A, so the Treasury p&l is just left with the unticketed net asset charge from Business A.

Example B: Balance sheet charge capturing daily profit remittance and incorrectly ticketed funding

Business B has:

- current-year profits of $1,000 (realised $600, unrealised $400);
- no prior year p&l;
- balance sheet trading assets purchased with cash for $3,000 consideration, now worth $3,400 (thus the net unrealised profit of $400 above);
- no physical remittance of cash to Treasury;
- the net cash position of the above has been *accurately* funded externally by Treasury, but has been *inaccurately* allocated to Business B due to errors in the cash management funding allocation processes. The funding ticket in Business B has been booked for $2,100 (as opposed to +$600 – $3,000 = -$2,400).

Business B's Balance sheet therefore looks like:

{+ve = Debit, -ve = Credit}

Trading assets	$3,400
Funding liability	($2,100)
Net non-cash assets	**$1,300**
Cash	($300)
p&l/Retained earnings	($1,000)
Cash and p&l	($1,300)
	$0

In this example, a charge on the net positional assets of $1,300 at the overnight rate is payable to Treasury, which represents:

- a transfer from the business to Treasury of the real benefit to the entity of reinvesting the $600 *realised* p&l;
- a transfer from the business to Treasury of the notional opportunity cost of being unable to reinvest the $400 *unrealised* p&l;
- a transfer from the business to Treasury of the mis-allocated cash funding of $300. Note: The business with the opposite side to the funding mis-allocation will have the opposite impact on the Treasury p&l, and will therefore net to zero across the entity.

Andrew Oliver is a Director of Treasury Middle Office at KBC Financial Products, London. He was previously the vice-president of Money Market

Trading and Treasury Middle Office at Deutsche Bank. Andrew is a member of the Institute of Chartered Accountants of Australia, and the Securities Institute of Australia. He obtained his Economics degree at Sydney University where he is a member of the Golden Key Society.

This is a process that just about all of us go through: a realisation, a reluctant acceptance of the fact that life is difficult and that our wildest dream will always be both wild and dreamy. No shame attaches to this adjustment: it is a common experience.

- *Simon Barnes, The Meaning of Sport, Short Books 2006, p. 138*

Falling in love is also something that gives you a very high chance of disappointment. Having children brings you a certainty of anxiety. A lifelong marriage gives you 50–50 chance of bereavement. It seems to me that the human condition is based around things that give you a very high chance of pain, misery, distress, anxiety. We do not seek to avoid them at all: on the contrary. We seek them out, avidly, voraciously, incontinently.

- *Simon Barnes, Ibid., p. 171*

Humans are contradictory creatures. This matter is familiar to us all: we want at the same time to be married, to be free; to be wildly promiscuous, to be forever faithful; to travel, to stay at home; to seek adventures, to remain in safety; to be idle, to be rewardingly busy; to revel in company, to be contentedly alone.

- *Simon Barnes, Ibid., p. 237*

[1] This chapter was written by Andrew Oliver, KBC Financial Products, London. The views, thoughts and opinions contained herein remain those of the author in his individual private capacity.

PART VII

Applications software enclosed with the book

Part VII consists of one chapter, which describes the software and applications available on the CD-R accompanying this book. The software and spreadsheets can be used to undertake a number of the calculations and analyses that have been described in the book.

Appendix

Financial Markets Arithmetic

In this Appendix we describe the basic building blocks of corporate finance. These include the principles of compounded interest, the time value of money, and future and present values. These concepts are important in all aspects of finance and are a vital ingredient of capital market mathematics. It is essential to have a firm understanding of the main principles before moving on to other areas.

Simple and compound interest

The principles of financial arithmetic have long been used to illustrate that £1 received today is not the same as £1 received at a point in the future. Faced with a choice between receiving £1 today or £1 in one year’s time we would not be indifferent, given a rate of interest of, say, 10% and provided that this rate is equal to our required nominal rate. Our choice would be between £1 today or £1 plus lOp – the interest on £1 for one year at 10% per annum. The notion that money has a time value is a basic concept in the analysis of financial instruments. Money has time value because of the opportunity to invest it at a rate of interest.

Simple interest

A loan that has one interest payment on maturity is accruing *simple interest.* On short-term instruments there is usually only the one interest payment on maturity; hence, simple interest is received when the instrument expires. The terminal value of an investment with simple interest is given by (A1.1):

(A1.1) $FV = PV(1 + r)$

where

FV is the terminal value or *future value*

PV is the initial investment or *present value*

r is the interest rate.

So, for example, if PV is £100, r is 5% and the investment is one year then:

$$\begin{aligned} FV &= £100\ (1 + r) \\ &= £105. \end{aligned}$$

The market convention is to quote interest rates as *annualised* interest rates, which is the interest that is earned if the investment term is one year. Consider a three-month deposit of £100 in a bank, placed at a rate of interest of 6%. In such an example the bank deposit will earn 6% interest for a period of 90 days. As the annual interest gain would be £6, the investor will expect to receive a proportion of this, which is calculated below:

$$£6.00 \times \frac{90}{365}.$$

So the investor will receive £1.479 interest at the end of the term. The total proceeds after the three months is therefore £100 plus £1.479. If we wish to calculate the terminal value of a short-term investment that is accruing simple interest we use the following expression:

(A1.2) $$FV = PV\left(1 + r \times \frac{\text{Days}}{\text{Year}}\right).$$

The fraction $^{\text{Days}}/_{\text{Year}}$ refers to the numerator, which is the number of days the investment runs, divided by the denominator that is the number of days in the year. In the sterling markets the number of days in the year is taken to be 365; however, certain other markets (including the euro currency markets) have a 360-day year convention. For this reason we simply quote the expression as “days” divided by “year” to allow for either convention.

Compound interest

Let us now consider an investment of £100 made for three years, again at a rate of 6%, but this time fixed for three years. At the end of the first year the investor will be credited with interest of £6. Therefore for the second year the interest rate of 6% will be accruing on a principal sum of £106, which means that at the end of year 2 the interest credited will be £6.36. This illustrates how *compounding* works, which is the principle of earning interest on interest. What will the terminal value of our £100 three-year investment be?

In compounding we are seeking to find a *future value* given a *present value,* a *time period* and an *interest rate.* If £100 is invested today (at time t_0) at 6%, then one year later (t_1) the investor will have £100 × (1 + 0.06) = £106. In our example the capital is left in for another two years, so at the end of year 2 (t_2) we will have:

$$
\begin{aligned}
&\pounds 110 \times (1 + 0.06) \times (1 + 0.06) \\
&= \pounds 100 \times (1 + 0.06)^2 \\
&= \pounds 100 \times (1.06)^2 \\
&= \pounds 112.36.
\end{aligned}
$$

The outcome of the process of compounding is the *future value* of the initial amount. We don't have to calculate the terminal value longhand as we can use the expression in (A1.3).

(A1.3) $FV = PV\,(1 + r)^n$

where

r is the periodic rate of interest (expressed as a decimal)

n is the number of periods for which the sum is invested.

In our example the initial £100 investment becomes £110 × $(1 + 0.06)^3$, which is equal to £119.10.

When we compound interest we have to assume that the reinvestment of interest payments during the investment term is at the same rate as the first year's interest. That is why we stated that the 6% rate in our example was *fixed* for three years. We can see, however, that compounding increases our returns compared to investments that accrue only on a simple interest basis. If we had invested £100 for three years fixed at a rate of 6%, but paying on a simple interest basis, our terminal value would be £118, which is £1.10 less than our terminal value using a compound interest basis.

Compounding more than once a year

Now let us consider a deposit of £100 for one year, again at our rate of 6%, but with quarterly interest payments. Such a deposit would accrue interest of £6 in the normal way, but £1.50 would be credited to the account every quarter, and this would then benefit from compounding. Again assuming that we can reinvest at the same rate of 6%, the total return at the end of the year will be:

$$100 \times [(1 + 0.015) \times (1 + 0.015) \times (1 + 0.015) \times (1 + 0.015)] = 100 \times (1 + 0.015)^4$$

which gives us 100 × 1.06136, a terminal value of £106.136. This is some 13 pence more than the terminal value using annual compounded interest. In general, if compounding takes place m times per year, then at the end of n years mn interest payments will have been made and the future value of the principal is given by (A1.4) below:

$$FV = PV\left(1 + \frac{r}{m}\right)^{mn}. \quad \text{(A1.4)}$$

As we showed in our example the effect of more frequent compounding is to increase the value of the total return when compared to annual compounding. The effect of more frequent compounding is shown below, where we consider the annualised interest-rate factors, for an annualised rate of 5%.

Compounding frequency	Interest-rate factor	
Annual	$(1 + r)$	$= 1.050000$
Semi-annual	$\left(1 + \frac{r}{2}\right)^2$	$= 1.050625$
Quarterly	$\left(1 + \frac{r}{4}\right)^4$	$= 1.050945$
Monthly	$\left(1 + \frac{r}{12}\right)^{12}$	$= 1.051162$
Daily	$\left(1 + \frac{r}{365}\right)^{365}$	$= 1.051267$

This shows us that the more frequent the compounding the higher the interest-rate factor. The last case also illustrates how a limit occurs when interest is compounded continuously. Equation (A1.4) can be rewritten as follows:

$$FV = PV\left[\left(1 + \frac{r}{m}\right)^{m/r}\right]^{rn}$$

$$= PV\left[\left(1 + \frac{1}{m/r}\right)^{m/r}\right]^{rn}$$

(A1.5) $$= PV\left[\left(1 + \frac{1}{n}\right)^{n}\right]^{rn}$$

where $n = m/r$. As compounding becomes continuous and m and hence n approach infinity, the expression in large brackets in (A1.5) above approaches a value known as e, which is shown below.

$$e = \lim_{n\to\infty}\left(1 + \frac{1}{n}\right)^n = 2.718281 \ldots$$

If we substitute this into (A1.5) this gives us:

(A1.6) $FV = PVe^{rn}$

where we have continuous compounding. In (A1.6) e^{rn} is known as the *exponential function* of rn and it tells us the continuously compounded interest-rate factor. If r = 5% and n = 1 year then:

$$e^r = (2.718281)^{0.05} = 1.051271.$$

This is the limit reached with continuous compounding. From our initial example, to illustrate continuous compounding the future value of £100 at the end of three years when the interest rate is 6% is given by:

$$FV = 100e^{(0.06)\times 3}$$
$$= £119.72.$$

Effective interest rates

The interest rate quoted on a deposit or loan is usually the *flat* rate. However, we are often required to compare two interest rates that apply for a similar investment period, but have different interest payment frequencies; for example, a two-year interest rate with interest paid quarterly compared to a two-year rate with semiannual interest payments. This is normally done by comparing equivalent *annualised* rates. The annualised rate is the interest rate with annual compounding that results in the same return at the end of the period as the rate we are comparing.

The concept of the effective interest rate allows us to state that:

(A1.7) $$PV \times \left(1 + \frac{r}{n}\right)^n = PV \times (1 + aer)$$

where *aer* is the equivalent annual rate. Therefore if r is the interest rate quoted which pays *n* interest payments per year, the *aer* is given by (A1.8):

(A1.8) $$aer = \left[\left(1 + \frac{r}{n}\right)^n - 1\right].$$

The equivalent annual interest rate *aer* is known as the *effective* interest rate. We have already referred to the quoted interest rate as the "nominal" interest rate. We can rearrange equation (A1.8) above to give us (A1.9), which allows us to calculate nominal rates.

(A1.9) $$r = [(1 + aer)^{1/n} - 1] \times n$$

We can see then that the effective rate will be greater than the flat rate if compounding takes place more than once a year. The effective rate is sometimes referred to as the *annualised percentage rate* or APR.

Example A1.1 Effective interest rate

Farhana has deposited funds in a building society 1-year fixed rate account with interest quoted at 5%, payable in semiannual instalments. What is the effective rate that she earns at the end of the period?

$$\left[\left(1 + \frac{0.05}{2}\right)^2 - 1\right] = 5.0625\%$$

Abubakar is quoted a nominal interest rate of 6.40% for a one-year time deposit where the interest is credited at maturity. What is the equivalent rate for the same building society's one-year account that pays interest on a monthly basis?

$$\left[\left(1 + 0.064\right)^{1/12} - 1\right) \times 12 = 6.2196\%$$

Interest-rate conventions

The convention in both wholesale or personal (retail) markets is to quote an annual interest rate. A lender who wishes to earn the interest at the rate quoted has to place his funds on deposit for one year. Annual rates are quoted irrespective of the maturity of a deposit, from overnight to ten years or longer. For example, if one opens a bank account that pays interest at a rate of 3.5%, but then closes it after six months, the actual interest earned will be equal to 1.75% of the sum deposited. The actual return on a three-year building society bond (fixed deposit) that pays 6.75% fixed for three years is 21.65% after three years. The quoted rate is the annual one-year equivalent. An overnight deposit in the wholesale or *interbank* market is still quoted as an annual rate, even though interest is earned for only one day.

The convention of quoting annualised rates is to allow deposits and loans of different maturities and different instruments to be compared on the basis of the interest rate applicable. We must also be careful when comparing interest rates for products that have different payment frequencies. As we have seen from the foregoing paragraphs the actual interest earned will be greater for a deposit earning 6% on a semiannual basis compared to 6% on an annual basis. The convention in the money markets is to quote the equivalent interest rate applicable when taking into account an instrument's payment frequency.

Value date

In both the money markets and the bond markets, the *value date* of a transaction is the date on which the deal is effected, the date when money changes hands between buyer and seller. It is sometimes referred to as the “settlement date” but the two are not strictly synonymous. The date on which the buyer makes good payment, which is the same date that the seller delivers securities, should always be referred to as the value date.

The standard money market value date is known as *spot* and refers to two business days after trade date, also referred to as “T+2”. Same-day settlement is also common in certificate of deposit (CD) and commercial paper (CP) markets, and is known as *cash* settlement or T+0. However, it is possible to deal T+0, T+l, T+2 and T+3 in many markets and instruments as long as both counterparties are agreeable.

For forward dealing and for setting maturity dates, the market convention is to move to the next relevant calendar date under a practice known as *modified following business day*. So a two-month transaction, or a two-month forward transaction, traded on 31 August 2004, would mature (or settle) on 31 October 2004. However, this is a non-business day; ordinarily the maturity or settlement date would move to the next business day, but this changes the month (to November), so it would instead move back to 29 October 2004 as moving forward would change the month. But if both parties are agreeable, a maturity (or settlement) date of 1 November 2004 can be set.

The time value of money

Present values with single payments

The interest rate or discount rate used as part of the present value (price) calculation is key, as it reflects where the instrument is trading in the market and how it is perceived by the market. Earlier we saw how a *future value* could be calculated given a known *present value* and rate of interest. For example, £100 invested today for one year at an interest rate of 6% will generate 100 x (1 + 0.06) = £106 at the end of the year. The future value of £100 in this case is £106. We can also say that £100 is the *present value* of £106 in our example.

In equation (A1.3) we established the following future value relationship:

$$FV = PV\,(1 + r)^n \,.$$

By reversing this expression we arrive at the present value (PV) formula (A1.10):

(A1.10) $$PV = \frac{FV}{(1 + r)^n}$$

where terms are as before. Equation (A1.10) applies in the case of annual interest payments and enables us to calculate the PV of a known future sum.

Example A1.2 Present value

Naseem is saving for a trip around the world after university and needs to have £1,000 in three years' time. He can invest in a building society bond at 7% guaranteed fixed for three years. How much does he need to invest now? To solve this we require the PV of £1,000 received in three years' time.

$$PV = \frac{1000}{(1 + 0.07)^3} = \frac{1000}{1.225043} = 816.29787.$$

Naseem therefore needs to invest £816.30 today.

To calculate the PV for a short-term investment of less than one year we will need to adjust what would have been the interest earned for a whole year by the proportion of days of the investment period. Rearranging the basic equation, we can say that the present value of a known future value is:

(A1.11) $$PV = \frac{FV}{(1 + r \times {}^{\text{Days}}/_{\text{Year}})}.$$

Given a present value and a future value at the end of an investment period, what then is the interest rate earned? We can rearrange the basic equation again to solve for the *yield*.

(A1.12) $$Yield = \left(\frac{FV}{PV} - 1\right) \times \frac{\text{Year}}{\text{Days}}$$

Using equation (A1.12) will give us the interest rate for the actual period. We can then convert this to an effective interest rate using (A1.13).

(A1.13) $$r = \left(1 + Yield \times \frac{\text{Days}}{\text{Year}}\right)^{365/\text{days}} - 1.$$

When interest is compounded more than once a year, the formula for calculating PV is modified, as shown by (A1.14):

(A1.14) $$PV = \frac{FV}{\left(1 + \frac{r}{m}\right)^{mn}}$$

where as before *FV* is the cash flow at the end of year *n*, *m* is the number of times a year interest is compounded, and r is the rate of interest or discount rate. Illustrating this therefore, the PV of £100 that is received at the end of five years at a rate of interest rate of 5%, with quarterly compounding is:

$$PV = \frac{100}{\left(1 + \frac{0.05}{4}\right)^{(4)(5)}}$$

$$= £78.00.$$

Present values with multiple discounting

Present values for short-term investments of under one-year maturity often involve a single interest payment. If there is more than one interest payment, then any discounting needs to take this into account. If discounting takes place *m* times per year then we can use equation (A1.4) to derive the PV formula as follows:

(A1.15) $PV = FV\left(1 + \frac{r}{m}\right)^{-mn}.$

For example, what is the present value of the sum of £1,000 that is to be received in five years where the discount rate is 5% and there is semiannual discounting?

Using (A1.15) above we see that:

$$PV = 1000\left(1 + \frac{0.05}{2}\right)^{-2 \times 5}$$

$$= £781.20.$$

The effect of more frequent discounting is to lower the PV. As with continuous compounding, the limiting factor is reached with continuous discounting and we can use equation (A1.6) to derive the present value formula for continuous discounting:

(A1.16) $PV = FVe^{-rn}.$

Using this expression, if we consider the same example as before but now with continuous discounting, we calculate the PV of £1,000 to be received in five years' time as:

$$PV = 1000e^{-(0.05) \times 5}$$

$$= £778.80.$$

Example A1.3 Calculation summaries

Angela invests £250 in a bank account for five years at a rate of 6.75%. What is the future value of this sum assuming annual compounding?

After 180 days Angela decides to close the account and withdraw the cash. What is the terminal value?

$$250 \times (1.0675)^5 = £346.56$$
$$250 \times (1.0675 \times 180/365) = £258.32.$$

To pay off a personal loan Olivia requires £500 in 30 days' time. What must she invest now if she can obtain 12% interest from a bank?

$$500/(1 + 0.12 \times 30/365) = £495.12.$$

If Olivia deposits £1,000 today and receives a total of £1,021 after 90 days, what yield has she earned on the investment?

$$[(1{,}021/1{,}000) - 1] \times 365/90 = 8.52\%.$$

What is the 180-day discount factor earned during this period if the interest rate is 6.15%? What is the 10-year discount factor?

$$1/(1 + 0.0615 \times 180/365) = 0.97056$$

$$1/(1 + 0.0615)^{10} = 0.55055.$$

What is the PV of £100 in 10 years' time at this discount rate?

$$100 \times 0.55055 = £55.06.$$

Multiple cash flows

Future values

Up to now we have considered future values of a single cash flow. Of course the same principles of the time value of money can be applied to a bundle of cash flows. A series of cash flows can be at regular or irregular intervals. If we wish to calculate the total future value of a set of irregular payments made in the future we need to calculate each payment separately and then sum all the cash flows. The formula is represented with the equation given at (A1.17):

(A1.17) $$FV = \sum_{n=1}^{N} C_n \, (1 + r)^{N-n}$$

where C_n is the payment in year n and the symbol $\sum$ means "the sum of". We assume that payment is made and interest credited at the end of each year.

It is much more common to come across a regular stream of future payments. Such a cash flow is known as an *annuity*. In an annuity the payments are identical and so C_n as given in (A1.17) simply becomes C. We can then rearrange (A1.17) as shown below:

(A1.18) $$FV = C \sum_{n=1}^{N} (1 + r)^{N-n}.$$

This equation can be simplified to give us the expression at (A1.19):[1]

(A1.19) $$FV = C \left[\frac{(1 + r)^N - 1}{r}\right].$$

This formula can be used to calculate the future value of an annuity. For example, if we consider an annuity that pays £500 each year for ten years at a rate of 6%, its future value is given by:

$$FV = 500 \left[\frac{(1.06)^{10} - 1}{0.06}\right] = £6{,}590.40.$$

Example A1.4 Calculating pension contributions

We can use the future value equation (A1.19) to calculate the size of contributions required to establish a pension fund on retirement. If we rearrange (A1.19) to obtain the size of the annuity *C* we obtain:

$$C = FV \left[\frac{r}{(1 + r)^N - 1}\right].$$

Lita wishes to have a savings pool of £250,000 to fund her pension when she retires in 30 years' time. What annual pension contribution is required if the rate of interest is assumed to be a constant 7.9%?

$$C = 250{,}000\left[\frac{0.079}{(1.079)^{30} - 1}\right] = £2247.65.$$

The common definition of an annuity is a continuous stream of cash flows. In practice the pension represented by an annuity is usually paid in monthly instalments, similar to an employed person's annual salary. Certain regular payments compound interest on a more frequent basis than annually, so our formula in (A1.19) needs to be adjusted slightly. If compounding occurs *m* times each year, then (A1.19) needs to be altered to (A1.20) to allow for this.

(A1.20) $$FV = C\sum_{n=1}^{N}\left(1 + \frac{r}{m}\right)^{m(N-n)}$$

To make calculations simpler we can multiply both sides of (A1.20) by [1 + *(r/m)]* and subtract the result from (A1.20).[2] Simplifying this will then result in (A1.21) below:

(A1.21) $$FV = C\left[\frac{[1 + (r/m)]^{mn} - 1}{[1 + (r/m)]^{m} - 1}\right].$$

For example, a 10-year annuity that has annual payments of £5,000 each year, but compounded on a quarterly basis at a rate of 5%, will have a future value of £63,073 as shown below:

$$FV = 5{,}000\left[\frac{[1.025]^{20} - 1}{[1.025]^{2} - 1}\right] = £63{,}073.$$

Where there is continuous compounding, as before, the limiting factor will result in (A1.21) becoming (A1.22):

(A1.22) $$FV = C\left[\frac{e^{rN} - 1}{e^{r} - 1}\right].$$

Equations (A1.21) and (A1.22) can be adjusted yet again to allow for frequent payments together with frequent compounding, but such a stream of cash flows is rarely encountered in practice. For reference, in the case of continuous compounding of continuous payments, the limiting factor expression is as shown in (A1.23):

(A1.23) $$FV = C\left[\frac{e^{rN} - 1}{r}\right].$$

Present values

Using similar principles as we have employed for calculating future values, we can calculate present values for a stream of multiple of cash flows. The method employed is slightly different according to whether the cash flows are regular or irregular.

For irregular payments we calculate PV by applying the conventional PV formula to each separate cash flow and then summing the present values. This is represented by (A1.24):

(A1.24) $$PV = \sum_{n=1}^{N} C_n \left(1 + r\right)^{-n}$$

where C_n is the cash flow made in year *n*.

Consider a series of annual cash payments made up of £100 in the first year and then increasing by £100 each year until the fifth year. The PV of this cash flow stream is:

$$\begin{aligned} PV &= 100(1.05)^{-1} + 200(1.05)^{-2} + 300(1.05)^{-3} + 400(1.05)^{-4} + 500(1.05)^{-5} \\ &= 95.24 + 181.41 + 259.15 + 329.08 + 391.76 \\ &= £1256.64. \end{aligned}$$

The more frequently encountered type of cash flow stream is an *annuity*, regular annual payments with annual discounting. To calculate the present value of an annuity we can use a variation of (A1.19) as shown in (A1.25):

$$\begin{aligned} PV &= \frac{FV}{(1 + r)^N} \\ &= C \left[\frac{(1 + r)^N - 1}{r}\right] \left[\frac{1}{(1 + r)^N}\right] \\ &= C \left[\frac{1 - (1 + r)^{-N}}{r}\right]. \end{aligned}$$

(A1.25)

Consider now an annuity paying £5,000 each year for 20 years at an interest rate of 4.5%. The PV of this annuity is:

$$PV = 5{,}000 \left[\frac{1 - (1.045)^{-20}}{0.045}\right]$$

$$= 65{,}039.68.$$

We illustrated this principle using a 20-year annuity that employed annual discounting. If a cashflow stream employs more frequent discounting we need to adjust the formula again. If an annuity discounts its cash flows *m* times each year then the PV of its cashflow stream is found using the PV-adjusted equation from

(A1.21). This becomes (A1.26).

(A1.26) $$PV = \frac{\text{FV}}{\left(1+\frac{r}{m}\right)^{mN}} = c\left[\frac{1-[1+(r/m)]^{mN}}{[1+(r/m)]^{m}-1}\right]$$

If continuous discounting is employed then this results again in the limiting factor for continuous discounting, so we adjust (A1.26) and the new expression is given in (A1.27):

(A1.27) $$PV = C\left[\frac{1-e^{-rN}}{e^{r}-1}\right].$$

The last case to consider is that of the payments stream that has more frequent cash flows in addition to more frequent discounting. Such a payments stream will have *m* cash flows each year that are also discounted *m* times per year. To calculate the PV of the cash flows we use (A1.28):

(A1.28) $$PV = \frac{FV}{\left(1+\frac{r}{m}\right)^{mN}} = C\frac{1-[1+(r/m)]^{mN}}{r}.$$

The limiting factor for continuous discounting of continuous payments is given by (A1.29):

(A1.29) $$PV = C\left[\frac{1-e^{-rN}}{r}\right].$$

Payment streams that have cashflow frequencies greater than annually or semiannually occur quite often in the markets. To illustrate how we might use (A1.28), consider a mortgage-type loan taken out at the beginning of a period. If the borrower is able to fix the interest rate being charged to the whole life of the mortgage, he or she can calculate the size of the monthly payments that are required to pay off the loan at the end of the period.

For example, consider a repayment mortgage of £76,000 taken out for 25 years at a fixed rate of interest of 6.99%. The monthly repayments that would be charged can be calculated using (A1.28) as shown in (A1.30):

(A1.30) $$C_i = \frac{C}{12} = \frac{PV}{12}\left[\frac{r}{1-[1+(r/m)]^{-12\times N}}\right]$$

where C_i is the size of the monthly payment. Substituting the terms of the mortgage payments in to the equation we obtain:

$$C_i = \frac{76{,}000}{12}\left[\frac{0.0699}{1-[1+(0.0699/12)]^{-12\times 25}}\right] = £536.67.$$

The monthly repayment is therefore £536.67 and includes the interest chargeable in addition to a repayment of some of the principal (hence, the term *repayment* mortgage, as opposed to *endowment* mortgages that only pay off the monthly interest charge). A repayment mortgage is also known as an *amortised* mortgage. An amortised loan is one for which a proportion of the original loan capital is paid off each year. Loans that require the borrower to service the interest charge only each year are known as *straight* or *bullet* loans. It is for this reason that plain vanilla bonds are sometimes known as bullet bonds, since the capital element of a loan raised through a vanilla bond issue is repaid only on maturity.

Perpetual cash flows

The type of annuity that we as individuals are most familiar with is the *annuity pension,* purchased from a life assurance company using the proceeds of a pension fund at the time of retirement. Such an annuity pays a fixed annual cash amount for an undetermined period, usually up until the death of the beneficiary. An annuity with no set finish date is known as a *perpetuity.* As the end date of a perpetuity is unknown we are not able to calculate its PV with exact certainty; however, a characteristic of the term $(1 + r)^{-N}$ is that it approaches zero as N tends to infinity. This fact reduces our PV expression to:

(A1.31) $PV = \dfrac{C}{r}$

and we can use this formula to approximate the present value of a perpetuity. The UK gilt market includes four gilts that have no redemption date, so-called *undated* bonds. The largest issue among the undated gilts is the *3½%* War Loan, a stock originally issued at the time of the 1914–18 war. This bond pays a coupon of *£3½* per £100 nominal of stock. Since the cashflow structure of this bond matches a perpetual, its PV using (A1.33) when long-dated market interest rates are at, say, 5% would be:

$$PV = \frac{3.5}{0.05} = £70.$$

The PV of the cashflow stream represented by the War Loan when market rates are 5% would therefore be £70 per £100 nominal of stock. In fact, because this bond pays coupon on a semiannual basis we should adjust the calculation to account for the more frequent payment of coupons and discounting, so the PV (price) of the bond is more accurately described as:

$$PV = \frac{C/2}{r/2} = \frac{1.75}{0.025}$$

although as we would expect this still gives us a price of £70 per cent!

Discount factors

The calculation of present values from future values is also known as *discounting.* The principles of present and future values demonstrate the concept of the *time value* of money – that in an environment of positive interest rates a sum of money has greater value today than it does at some point in the future because we are able to invest the sum today and earn interest. We will only consider a sum in the future compared to a sum today if we are compensated by being paid interest at a sufficient rate. Discounting future values allows us to compare the value of a future sum with a present sum.

Another way to write the expression in example (A1.14) is to say that we multiply £1,000 by $1/(1.05)^5$, which is the *reciprocal* of $(1.05)^5$ and is denoted in this case as $(1 + 0.05)^{-5}$. The rate of interest r that we use in Example A1.2 is known as the *discount rate* and is the rate we use to *discount* a known future value in order to calculate a present value. We can rearrange equation (A1.14) to give:

$$PV = FV(1 + r)^{-n}$$

and the term $(1 + r)^{-n}$ is known as the *n*-year discount factor. So we have

(A1.32) $df_n = (1 + r)^{-n}$

where df_n is the *n*-year discount factor.

The three-year discount factor when the discount rate is 9% is:

$$df_n = (1 + 0.09)^{-3} = 0.77218.$$

We can calculate the discount factor for all possible interest rates and time periods to give us a *discount function.* Fortunately we don't need to calculate discount factors ourselves as this has been done for us and a discount table for a range of rates is provided in Table A1.3 on page 1314.

Formula Summary

Discount factor with simple interest: $df = \frac{1}{(1 + r \times \text{Days}/\text{Year})}$

Discount factor with compound interest: $df_n = \left(\frac{1}{1 + r}\right)^n$

$$r = \sqrt[n]{\frac{1}{df}} - 1$$

Earlier we established the continuously compounded interest rate factor as e^{rn}. Using a continuously compounded interest rate therefore we can establish the discount factor to be:

$$df = \frac{1}{1 + (e^{r \times \text{Days}/\text{Year}} - 1)}$$

$$= e^{-r \times \text{Days}/\text{Year}}$$

(A1.33) $\therefore df_n = e^{-rn}.$

The continuously compounded discount factor is part of the formula used in option pricing models. It is possible to calculate discount factors from the prices of government bonds. The traditional approach described in most textbooks requires that we first use the price of a bond that has only one remaining coupon, its last one, and calculate a discount factor from this bond's price. We then use this discount factor to calculate the discount factors of bonds with ever-increasing maturities, until we obtain the complete discount function. This method, which is illustrated in the box below, suffers from certain drawbacks and in practice more sophisticated techniques are used, see for example the author's book *Fixed Income Markets* for a discussion of the techniques.

Example A1.5 Discount factors

The following hypothetical government bonds pay coupon on a semiannual basis. Consider the bond prices indicated, and assume that the first bond has precisely six months to maturity, so that it has only one more cash flow to pay, the redemption value and final coupon. Assume further that the remaining bonds mature at precise six-month intervals.

Bond	Price
8% June 2000	101.09
7% December 2000	101.03
7% June 2001	101.44
6.5% December 2001	101.21

The first bond has a redemption payment of 104.00, comprised of the redemption payment and the final coupon payment (remember that this is a semiannual coupon bond). The present value of this bond is 101.09. This allows us to determine the discount factor of the bond as follows:

$$101.09 = 104.00 \times df_{6\text{-}month}$$
$$0.97202 = df_{6\text{-}month}.$$

This shows that the six-month discount factor is 0.97202. We use the second bond in the table, which has cash flows of 3.50 and 103.50, to calculate the next period discount factor, using the following expression:

$$101.30 = 3.50 \times df_{6\text{-}month} + 103.50 \times df_{1\text{-}year}.$$

We have already calculated the six-month discount factor, and use this to calculate the one-year discount factor from the above expression, which solves to give 0.94327.

We then carry on this procedure for the next bond, leaving us the following discount factors:

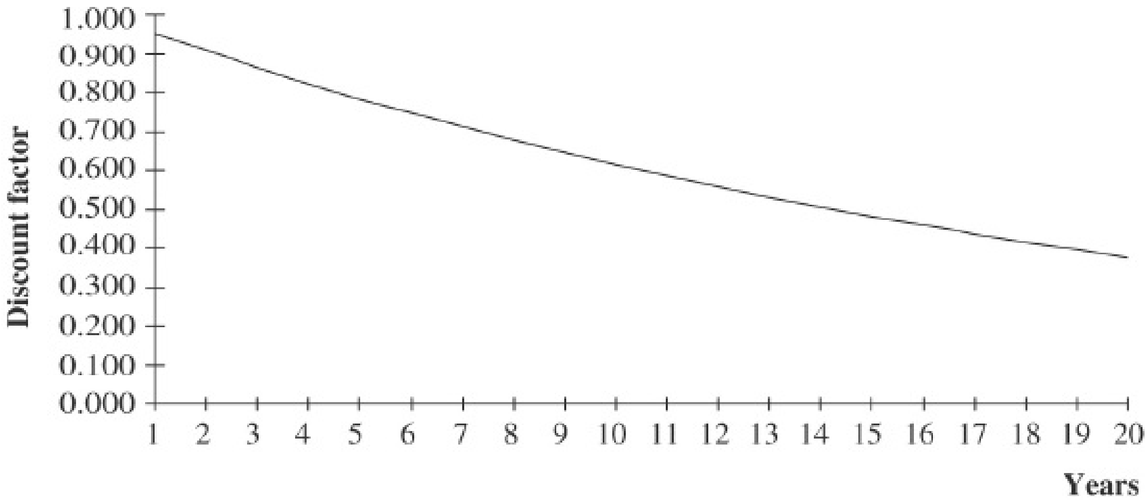
Bond	Price	Discount factor
8% June 2000	101.09	0.97202
7% December 2000	101.03	0.94327
7% June 2001	101.44	0.91533
6.5% December 2001	101.21	0.89114

Note how the discount factors progressively reduce in value over an increasing maturity period. Using one of a number of techniques we can graph the set of discount factors above to obtain the two-year discount function. In the same way, if we have government bond prices for all maturities from six months to 30 years, we can obtain the complete discount function for that currency.

The discount function

Discount factors can be calculated for any discount rate that apply to any term to maturity, using the standard formulas. The complete range of discount factors for any particular rate is known as the *discount function*. Figure A1.1 illustrates the discount function when the discount rate selected is 5%. This is obtained by plotting continuous rather than discrete discount factors for a given rate. A discount factor table for selected rates and investment terms is given in Table A1.3.

Figure A1.1 Discount function with the rate at 5%



Using Discount factors

An n-period discount factor is the present value of one unit of currency (£1 or \$1) that is payable at the end of period n. Essentially it is the present value relationship expressed in terms of \$1. If $d(n)$ is the n-year discount factor, then the five-year discount factor at a discount rate of 6% is given by:

$$d(5) = \frac{1}{(1+0.06)^5} = 0.747258.$$

The set of discount factors for every time period from one day to 30 years or longer is termed the *discount function.* Discount factors may be used to price any financial instrument that is made up of a future cash flow. For example, what would be the value of \$103.50 receivable at the end of six months if the six-month discount factor is 0.98756? The answer is given by:

$$0.98756 \times 103.50 = 102.212.$$

In addition, discount factors may be used to calculate the future value of any present investment. From the example above, \$0.98756 would be worth \$1 in six months' time, so by the same principle a present sum of \$1 would be worth

$$1/d(0.5) = 1/0.98756 = 1.0126$$

at the end of six months.

It is possible to obtain discount factors from current bond prices. Assume a hypothetical set of bonds and bond prices as given in Table A1.1 below, and assume further that the first bond in the table matures in precisely six months' time (these are semiannual coupon bonds).

Table A1.1 Hypothetical set of bonds and bond prices

Coupon	Maturity date	Price
7%	7-Jun-01	101.65
8%	7-Dec-01	101.89
6%	7-Jun-02	100.75
6.50%	7-Dec-02	100.37

Taking the first bond, this matures in precisely six months' time, and its final cash flow will be 103.50, comprising the \$3.50 final coupon payment and the \$100 redemption payment. The price or present value of this bond is 101.65, which allows us to calculate the six-month discount factor as:

$$d(0.5) \times 103.50 = 101.65$$

which gives $d(0.5)$ equal to 0.98213.

From this first step we can calculate the discount factors for the following six-month periods. The second bond in Table A1.2, the 8% 2001, has the following cash flows:

- \$4 in six months' time
- \$104 in one year's time.

The price of this bond is 101.89, which again is the bond's present value, and this comprises the sum of the present values of the bond's total cash flows. So we are able to set the following:

$$101.89 = 4 \times d(0.5) + 104 \times d(1).$$

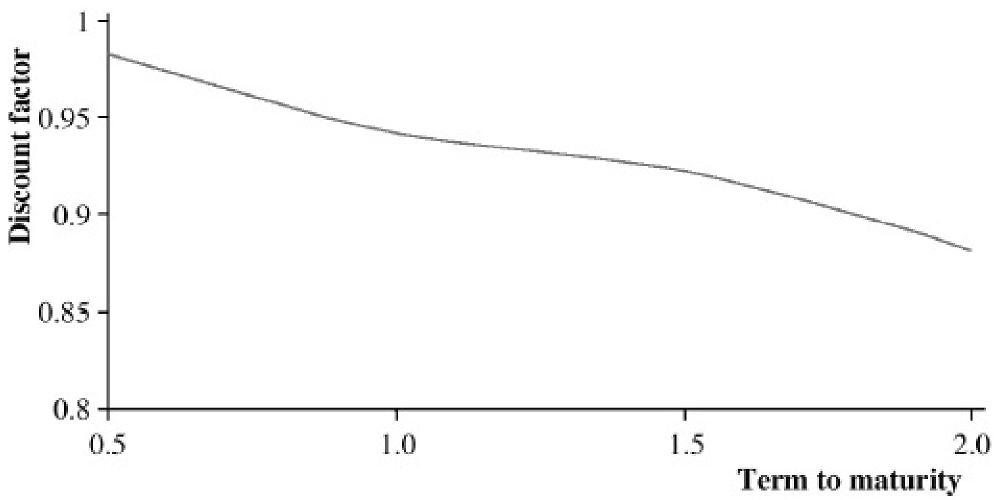
However, we already know *d(0.5)* to be 0.98213, which leaves only one unknown in the above expression. Therefore we may solve for *d(l)* and this is shown to be 0.94194.

If we carry on with this procedure for the remaining two bonds, using successive discount factors, we obtain the complete set of discount factors as shown in Table A1.2. The continuous function for the two-year period from today is known as the discount function, shown in Figure A1.2.

Table A1.2 Discount factors calculated using bootstrapping technique

Coupon	Maturity date	Term (years)	Price	$d(n)$
7%	7-Jun-01	0.5	101.65	0.98213
8%	7-Dec-01	1.0	101.89	0.94194
6%	7-Jun-02	1.5	100.75	0.92211
6.50%	7-Dec-02	2.0	100.37	0.88252

Figure A1.2 Hypothetical discount function



This technique, which is known as *bootstrapping*, is conceptually neat but presents problems when we do not have a set of bonds that mature at precise six-month intervals. In addition, liquidity issues connected with specific individual bonds can also cause complications. However, it is still worth being familiar with this approach.

Note from Figure A1.2 how discount factors decrease with increasing maturity: this is intuitively obvious, since the present value of something to be received in the future diminishes the further into the future we go.

Corporate finance project appraisal

Two common techniques used by corporates and governments to evaluate whether a project is worth undertaking are the *net present value* (NPV) and *internal rate of return* (IRR). Both techniques evaluate the anticipated cash flows associated with a project, using the discounting and present value methods described so far in this Appendix. Generally speaking, it is a company's *cost of capital* that is used as the discount rate in project appraisal, and most companies attempt to ascertain the true cost of their capital as accurately as possible. As most corporate financing is usually a complex mixture of debt and equity this is sometimes problematic. A discussion of cost of capital is outside the scope of this book and we recommend Higson (1995) for readers wishing to know more about this subject.[3]

Net present value (NPV)

In the case of an investment of funds made as part of a project, we would have a series of cash flows of which some would be positive and others negative. Typically, in the early stages of a project we would forecast negative cash flows as a result of investment outflows, followed by positive cash flows as the project began to show a return. Each cash flow can be present valued in the usual way. In project appraisal we would seek to find the PV of the entire stream of cash flows, and the sum of all positive and negative present values added together is the NPV. As the appraisal process takes place before the project is undertaken, the future cash flows that we are concerned with will be estimated forecasts and may not actually be received once the project is underway.

The PV equation is used to show that:

(A1.34) $$NPV = \sum_{n=1}^{N} \frac{C_n}{(1+r)^n}$$

where C_n is the cash flow in the project in period *N*. The rate r used to discount the cash flows can be the company's cost of capital or the rate of return required by the company to make the project viable.

Companies will apply NPV analysis to expected projected returns because funds invested in any undertaking have a time-related cost, the opportunity cost that is the corporate cost of capital. In effect, NPV measures the PV of the gain achieved from investing in the project (provided that it is successful!). The general rule of thumb applied is that any project with a positive NPV is worthwhile, whereas those with a negative NPV, discounted at the required rate of return or the cost of capital, should be avoided.

Example A1.6 Calculating NPV

What is the NPV of the following set of expected cash flows, discounted at a rate of 15%?

Year 0:	−£23,000
Year 1:	+£8,000
Year 2:	+£8,000
Year 3:	+£8,000
Year 4:	+11,000

$$\text{NPV} = 23{,}000 - \frac{8{,}000}{(1.15)} + \frac{8{,}000}{(1.15)^2} + \frac{8{,}000}{(1.15)^3} + \frac{11{,}000}{(1.15)^4} = £1{,}554.$$

The internal rate of return (IRR)

The IRR for an investment is the discount rate that equates the PV of the expected cash flows (the NPV) to zero. Using the PV expression we can represent it by the rate r such that:

(A1.35) $$\sum_{n=0}^{N} \frac{C_n}{(1+r)^n} = 0$$

where C_n is the cash flow for the period N, n is the last period in which a cash flow is expected, and ∑ denotes the sum of discounted cash flows at the end of periods 0 through n. If the initial cash flow occurs at time 0, equation (A1.35) can be expressed as follows:

(A1.36) $$C_0 = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \dots + \frac{C_N}{(1+r)^N}.$$

In corporate finance project appraisal, C_0 is a cash outflow and C_1 to C_N are cash inflows. Thus r is the rate that discounts the stream of future cash flows (C_1 through C_N) to equal the initial outlay at time 0 – C_0. We must therefore assume that the cash flows received subsequently are reinvested to realise the same rate of return as r. Solving for the IRR, r cannot be found analytically and has to be found through numerical iteration, or using a computer or programmable calculator.

To illustrate IRR consider the earlier project cash flows given in Example A1.6. If we wish to find the IRR longhand then we would have to obtain the NPV using different discount rates until we found the rate that gave the NPV equal to zero. The quickest way to do this manually is to select two discount rates, one of which gives a negative NPV and the other a positive NPV, and then *interpolate* between these two rates. This method of solving for IRR is known as an *iterative* process, and involves converging on a solution through trial and error. This is in fact the only way to calculate the IRR for a set of cash flows and it is exactly an iterative process that a computer uses (the computer is just a touch quicker!). If we have two discount rates, say *x* and *y* that give positive and negative NPVs respectively for a set of cash flows, the IRR can be estimated using the equation in (A1.37):

$$\text{IRR estimate} = x\% + (y\% - x\%) \times (+ve\ \text{NPV value}/[+ve\ \text{NPV value} - (-\text{NPV value})]). \quad \textbf{(A1.37)}$$

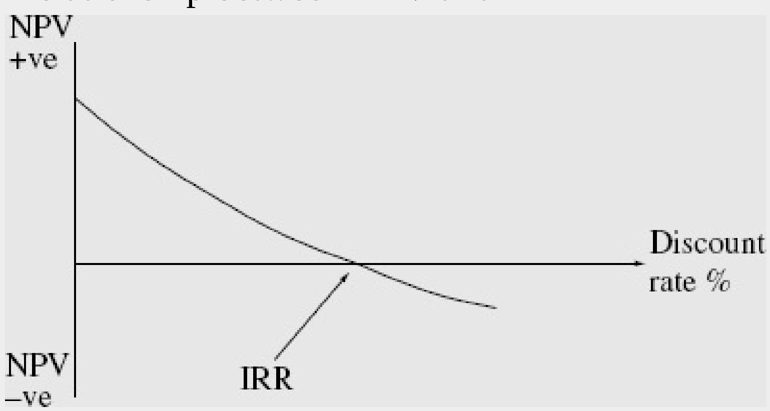
Example A1.7 IRR calculation

In Example A1.6, using a discount rate of 15% produced a positive NPV. Discounting the cash flows at 19% produces an NPV of −£395. Therefore the estimate for IRR is:

$$15\% + 4\% \times 1554/[1554 - (-395)] = 18.19\%.$$

The IRR is approximately 18.19%. This can be checked using a programmable calculator or spreadsheet programme, or may be checked manually by calculating the NPV of the original cash flows using a discount rate of 18.19%; it should come to £23,000. Using an HP calculator we obtain an IRR of 18.14%.

Figure A1.3 Relationship between NPV and IRR



The relationship between the IRR and the NPV of an investment is that while the NPV is the value of the projected returns from the investment using an appropriate discount rate (usually the company's cost of capital); the IRR is the discount rate which results in the NPV being zero. For this reason it is common to hear the IRR referred to as a project's *breakeven* rate. A conventional investment is considered attractive if the IRR exceeds a company's cost of capital, as well as if the NPV is positive. In the context of the bond markets, if we assume that the discount rate applicable does indeed remain constant for the reinvestment of all cash flows arising from a financial instrument, the IRR can then be assumed to be the *yield to maturity* (YTM) for that instrument.

Interpolation and extrapolation

Interest rates in the money markets are always quoted for standard maturities; for example, overnight, "tom next" (the overnight interest rate starting tomorrow, or "tomorrow to the next"), spot next (the overnight rate starting two days forward), one week, one month, two months and so on up to one year. Figure A1.4 shows a typical broker's screen as seen on news services such as Reuters and Telerate.

Figure A1.4 Broker's rates screen

Dow Jones Markets : martin_g Telerate 4734 Wed Dec 08 09:00:44 1999

08/12 8:54 GMT [GARBAN INTERCAPITAL-EUROPE] 12/08 02:12 4734

	FRA		GBP CDS DEPO	GBP INTERBANK DEP	GBP REPO(GC)	
1X4	6.020-990	O/N	-	5 1/16-4 15/16	-	O/N
2X5	6.110-080	T/N	-	5 3/8 -5 1/4	-	T/N
3X6	6.230-200	1WK	-	5 1/4 -5 1/8	-	1WK
4X7	6.330-300	1MO	5 25/32-5 23/32	5 7/8 -5 13/16	-	2WK
5X8	6.420-390	2MO	5 15/16-5 7/8	5 31/32-5 29/32	-	3WK
6X9	6.510-480	3MO	6-5 15/16	6-5 15/16	-	1MO
9X12	6.760-730	4MO	6 1/32-5 31/32	6 1/32-5 31/32	-	2MO
		5MO	6 1/16- 6	6 1/16- 6	-	3MO
1X7	6.240-210	6MO	6 1/8 -6 1/16	6 5/32-6 3/32	-	4MO
2X8	6.330-300	7MO	6 5/32-6 3/32	6 7/32-6 5/32	-	5MO
3X9	6.420-390	8MO	6 7/32-6 5/32	6 9/32-6 7/32	-	6MO
4X10	6.520-490	9MO	6 9/32-6 7/32	6 5/16-6 1/4	-	9MO
5X11	6.610-580	10M	6 11/32-6 9/32	6 3/8 -6 5/16	-	1YR
6X12	6.700-670	11M	6 13/32-6 11/32	6 7/16-6 3/8		
		12M	6 15/32-6 13/32	6 1/2 -6 7/16		

[FRA 695-2040, EUROSTG 695-2030, GBP REPOS 695-2255]

If a bank or corporate customer wishes to deal for non-standard periods, an interbank desk will calculate the rate chargeable for such an "odd date" by *interpolating* between two standard period interest rates. If we assume that the rate for all dates in between two periods increases at the same steady state, we can calculate the required rate using the formula for *straight-line* interpolation, shown in (A1.38):

$$r = r_1 + (r_2 - r_1) \times \frac{n - n_1}{n_1 - n_2} \quad \textbf{(A1.38)}$$

where

r is the required odd-date rate for n days

r_1 is the quoted rate for n_1 days

r_2 is the quoted rate for n_2 days.

Let us imagine that the 1-month (30-day) offered interest rate is 5.25% and that the 2-month (60-day) offered rate is 5.75%. If a customer wishes to borrow money for a 40-day period, what rate should the bank charge? We can calculate the required 40-day rate using the straight-line interpolation process. The increase in interest rates from 30 to 40 days is assumed to be 10/30 of the total increase in rates from 30 to 60 days. The 40-day offered rate would therefore be:

$$5.25 + (5.75 - 5.25) \times 10/30 = 5.4167\%.$$

Example A1.8 Interpolation

On an interbank desk Hussein is quoting the 7-day offered rate (the rate at which a bank will *offer* or lend money) at $5^{11}/_{16}$%, while the 14-day rate is $5^{13}/_{16}$%. What rate should he quote for the 10-day offered rate?

$$5.6875 + (5.8125 - 5.6875) \times 3/7 = 5.7411\%$$

What about the case of an interest rate for a period that lies just before or just after two known rates and not roughly in between them? When this happens we *extrapolate* between the two known rates, again assuming a straight-line relationship between the two rates and for a period after (or before) the two rates.

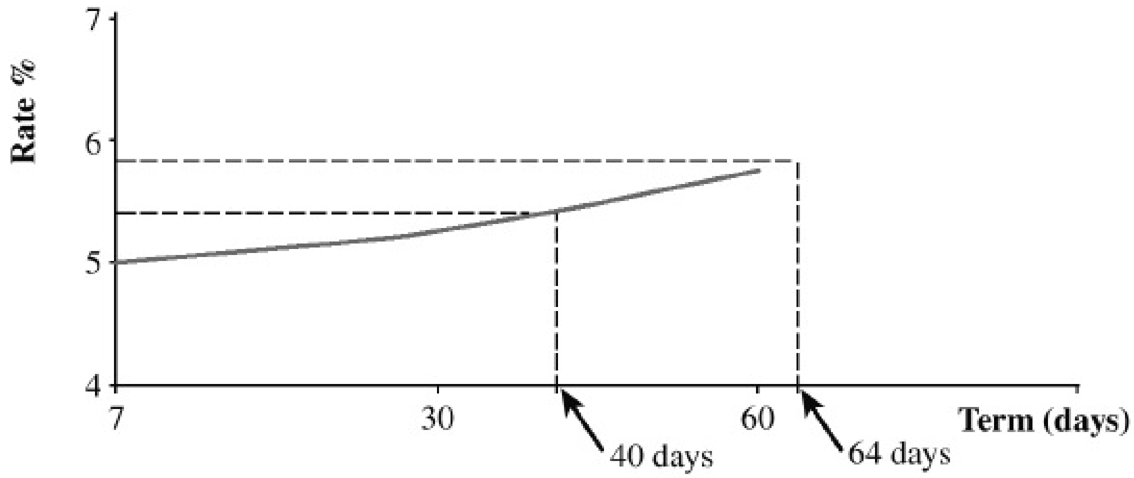
Example A1.9 Extrapolation

The 1-month offered rate is 5.25% while the 2-month rate is 5.75% as before. What is the 64-day rate?

$$5.25 + (5.75 - 5.25) \times 34/30 = 5.8176\%$$

Interpolation and extrapolation are illustrated graphically in Figure A1.5.

Figure A1.5 Interpolation and extrapolation


Rate %
7
6
5
4
7
30
60
Term (days)
40 days
64 days

Measuring the rate of return

Rates of return are calculated in the market and by investors in order to measure the gain that has been achieved, as well as to compare the gains made by different investments. This is the market convention, presenting the profit made by an investment in percentage return figures rather than actual cash increments. In addition to comparing the performance of different investments, there are three other uses for rates of return.

- *Measuring historical performance:* a frequently used measure of investment performance is the historical rate of return, or the *realised rate of return* on an investment. This is the return that has already been realised, as opposed to return anticipated in the future. In the US market this is also known as the *ex-post* rate of return.
- *Determining future investment:* investors often use historical rates of return to estimate future returns, and to gauge the level of risk associated with a particular security. Over a period of time, because of the higher associated risk, investors will expect a higher return from a higher risk stock compared to a less volatile one.
- *Estimating the cost of capital:* rates of return are also used to estimate a firm's cost of capital. Corporate decision-makers use their firm's cost of capital when making capital allocation and budget decisions, and one method for estimating the appropriate discount rate to apply in NPV calculations uses the company's historical rate of return on equity.

The rate of return on an investment can be calculated in several ways and we will look at some of the methods in the rest of this section.

Simple rate of return

The simple rate of return measures the increase or decrease in the value of a given investment over a specified period of time. It is given by:

(A1.39) $$R = \frac{P_2 - P_1 + I}{P_1}$$

where

P_1 is the initial value of the investment

P_2 is the investment value at the end of the period

I is the income earned during the investment.

For example, a bond is purchased at a price of £100 and held for a year, during which a coupon of £8 is paid. At the end of the period the bond price is £108. The rate of return is:

$$\frac{108 - 100 + 8}{100} = 0.16 \text{ or } 16\%.$$

The simple rate of return is effective when measuring investment performance that has only one dividend payment at the end of the period. If dividends are paid more frequently or during the period, the measurement loses accuracy.

The time-weighted rate of return

The simple rate of return can be adjusted to account for the timing of dividend or coupon payments and this is known as the *time weighted rate of return* or the *geometric mean rate of return*. If we take P as the initial value of an investment, FV as the final value, C_n as the payment received by the investment in year n and MV_n as the value of the investment when a dividend is received, the time-weighted rate of return is given by (A1.40):

(A1.40) $$(1 + r)^N = \left(\frac{MV_1}{P}\right)\left(\frac{MV_2}{MV_1 + C_1}\right)\left(\frac{MV_3}{MV_2 + C_2}\right) \cdots \left(\frac{FV}{MV_{N-1} + C_{N-1}}\right).$$

Given that $MV_1/P = (1 + r_1)$ or one plus the return on the investment in the first period, and that $MV_2 / (MV_1 + C_1) = (1 + r_2)$ and so on, the expression can be rewritten as shown in (A1.41):

(A1.41) $$(1 + r)^N = (1 + r_1)(1 + r_2)(1 + r_3) \ldots (1 + r_N).$$

We can rearrange (A1.41) to solve for r and this gives us (A1.42) as shown:

(A1.42) $$r = [(1 + r_1)(1 + r_2)(1 + r_3) \ldots (1 + r_N)]^{1/T} - 1.$$

Expression (A1.42) illustrates how the time-weighted return is in fact the *geometric* return of each individual period return.

Example A1.10 Time-weighted rate of return calculation

An initial investment of $1,000 is made that subsequently earns $64 at the end of the first year, when the investment was valued at $1,118. At the end of the second year another $64 is earned, when the investment value is $1,250. At the end of the third year the investment value is $1,339. What is the time-weighted rate of return earned by the investment?

$$r = \left[\left(\frac{1,118}{1,000}\right)\left(\frac{1,250}{1,118 + 64}\right)\left(\frac{1,339}{1,250 + 64}\right)\right]^{1/3} - 1$$

$$= [(1.118)(1.0575)(1.019)]^{1/3} - 1 = (1.2047)^{1/3} - 1$$

$$= 0.064 \text{ or } 6.4\%.$$

Inflation-adjusted rate of return

Up to now we have been discussing rates of return calculated as the gain in the nominal cash value of an investment. In certain cases it is desirable to adjust the rate of return calculated on an investment to allow for the effects of inflation. In an inflationary environment the purchasing power of the domestic currency is eroded, so measurement of return can be modified to reflect this. In the United Kingdom, inflation is measured using the *retail prices index* or RPI. The RPI measures the change in price of a specified basket of consumer goods. While RPI is the inflation index itself, there are three key percentage indicators that are used; the *headline* rate of inflation or RPI; the rate of inflation, but excluding mortgage interest payments or RPIX; and inflation excluding any rises in value-added tax rates or RPIY. In the United States the consumer price index, or CPI, measures essentially the same thing.

The rate of inflation in any period can be measured by comparing the levels for two index numbers and is given by (A1.43):

(A1.43) $$i = \frac{RPI_1 - RPI_0}{RPI_1}$$

where

i is the rate of inflation

RPI_0 is the inflation index at the start of the period

RPI_1 is the inflation index at the end of the period.

For example, in June 1998 the United Kingdom's RPI was 163.4 and this had risen to 165.6 in June 1999. Therefore the inflation rate for the period June 1998-June 1999 is calculated as:

$$i = \frac{165.6 - 163.4}{163.4} = 0.01346 \text{ or } 1.355\%.$$

The *real rate of return* is the nominal rate of return adjusted for inflation. It can be calculated using (A1.44):

(A1.44) $$R_{real} = 1 + \frac{R_{nom}}{1 + i} - 1$$

where

R_{real} is the real rate of return and R_{nom} is the nominal rate of return.

Equation (A1.44) can be approximated by $R_{real} = R_{nom} - i$ and is derived from the Fisher relationship (see Fisher 1930).[4]

Note that if there is zero or very low inflation, the real rate of return will be equal to the nominal rate of return. If investments are made in an inflationary environment and the nominal rate of return is equal to the rate of inflation such that $R_{nom} - i$, then in real terms the rate of return is zero. This often leads to negative returns where rates are very low; for example, with some types of bank accounts. In the United Kingdom current accounts and some deposit and instant access accounts are offered with interest rates below 1%. As the inflation rate has been consistently higher than 1% in the United Kingdom for some time now, account values will be declining in real terms.

Average rates of return

Where an investment is made up of a portfolio of assets the gain on the portfolio is calculated as an average return. An average is also used when measuring the return on a single asset over a period of years. The two main methods used are *arithmetic average* and *geometric average.*

The expression for calculating the average rate of return is given in (A1.45):

(A1.45) $$R_A = \frac{\sum_{t=1}^{m} R_t}{m}$$

where

R_A is the average arithmetic rate of return

t is the length of the period

m is the number of observations.

The geometric method is an averaging method that compounds rates of return. That is, if £1 is invested in the first period, its future value will be $(1 + R_1)$ at the end of the period. We then assume that £$(1 + R_1)$ is invested in the second period, and at the end of period 2 the investment value will have risen to the value at the beginning of period 2 multiplied by the value of £1 invested in period 2. We illustrate this by saying that the investment value at the end of the second period is $(1 + R_1)(l + R_2)$. More formally we can express the geometric return as:

(A1.46) $$R_G = \left[\prod_{t=1}^{m}(1 + R_t)\right]^{1/m} - 1$$

where R_G is the geometric rate of return and the symbol $\prod$ means “take the product of”.[5]

The geometric average can be considered to be the actual growth rate of the assets. The arithmetic average should be used, on the other hand, when estimating the average performance across different securities for one period of time. The arithmetic average is also an unbiased estimate of future expected rates of return, and will exceed the geometric average whenever the rates of return are not constant.

Indices

An index is used to measure the rate of return for a basket of securities. In the United Kingdom the most familiar index is the FTSE-100, whose level is faithfully reported daily in the media. The FTSE-100 is made up of the largest 100 stocks, measured by market capitalisation, traded on the London Stock Exchange. The change in its index value can be taken to reflect broadly the overall performance of the stock market, although this is a very large approximation since there are over 5,000 stocks listed on the London market. That said, an index level is often a useful indicator, and it is rare to find an index level rising if the general health of the economy is declining, or vice versa. There is a wide range of indices used across markets internationally, and they are all used to measure historical returns for a group of securities, in the same way that the RPI measures the rise in retail prices. Indices are also used as a benchmark against which to measure a fund manager's performance. They are differentiated in the following three ways:

- by the type of securities included in them, such as equities or bonds, and the sector they are part of (for example, utilities stocks, or emerging markets stocks), as well as the number of securities included in each index;
- by the way the index is adjusted for any changes to its constituent stocks (such as a merger or takeover);
- by the method used to calculate the index level.

There are three main types of index: price-weighted, value-weighted and equally weighted indices. Let us look at the way each of these index levels is calculated.

The price-weighted index

In a price-weighted index the value is found by adding all the security prices and dividing by a *divisor*. The value of a price-weighted index at time t is given by (A1.47):

(A1.47) $$I = \frac{1}{\text{divisor}} \sum_{i=1}^{n} P_{i_t}$$

where

I is the index level

P_{i_t} is the price of asset i in period t

n is the number of stocks in the index.

The *divisor* is a number that is adjusted periodically for stock dividends and any other corporate actions.

The price-weighted index return is a relatively simple concept. A fund manager who wished to track such an index would simply purchase the same number of shares of each stock in the index. The Dow Jones Industrial Average index in the United States is an example of a price-weighted index. However, this method tends to result in higher priced stocks having greater influence in the level of the index, so it is not very common. The value-weighted index has been designed to remove this bias.

The value-weighted index

A value-weighted index is based on the total market capitalisation of the company whose security is represented in the index. The index level therefore takes into account share value rather than the absolute price level of individual stocks.

The level of a value-weighted index is given by (A1.48):

(A1.48) $$I = \left[\frac{100}{\sum_{n=1}^{N} N_{i_1} P_{i_1}}\right] \sum_{n=1}^{N} N_{i_t} P_{i_t}$$

where

N_i is the number of shares of company i at time t

P_i is the price of company i shares at time t.

The numerator 100 is taken to be the starting value of the index. Therefore if calculating the level of the FTSE-100 one would use 1,000 in the numerator, as this index was re-based to 1,000 in 1984.

The level of a value-weighted index is not affected by a corporate action such as a dividend payment or a rights issue, and this is considered to be an advantage of the method over the price-weighted index valuation.

The equal weight index

This index is calculated by assigning the same weight to each constituent security regardless of the security's price or the company's market capitalisation. If a fund manager wished to replicate the performance of an equally weighted index, she would purchase an equal cash amount of each security. There are two ways to calculate the value of an equally weighted index: the arithmetic method and the geometric method. In both cases the rate of return measured for each security over a specific period (usually one day) is measured. The arithmetic method value is given by (A1.49):

(A1.49) $$I = I_{t-1}\left(1 + \frac{1}{n}\sum_{n=1}^{N} R_{i_t}\right)$$

where $\frac{1}{n}\sum R$ is the arithmetic average of the rates of return of all the index securities.

The geometric method, as its name suggests, takes the geometric average of the return for each security in the index over a specified time period. The value is give by:

(A1.50) $$I = I_{t-1}\left[\prod_{n=1}^{N}(1 + R_{i_t})\right]^{1/n}.$$

In general the arithmetic method produces higher values over time compared to the geometric method.

Bond indices

In the same way as the more familiar equity market indices, bond indices measure the return generated by a basket of fixed income stocks. Unlike an equity index such as the Dow or the FTSE-100, however, a bond index presents some complications that may make index valuation problematic. First, since bonds are always approaching in maturity, and because some are redeemed early, the set of bonds in a basket changes more frequently than the shares in an equity index. If we consider an hypothetical international "ten-year benchmark index", as a bond falls to less than, say, eight years maturity, it may be replaced by the current ten-year benchmark bond. This will have different risk characteristics to the bond it replaced and will trade differently in the market as a result. As the constituents of a bond index have to change more frequently, we may not always be comparing like-for-like when we consider historical index values. There is also the issue of bond coupon payments, which make up a significant proportion of a bond's overall return, and which must therefore be incorporated in the index valuation. Nevertheless bond indices are important for the same reason that equity indices are, and form the benchmark against which fund managers' performance is measured. There are also "synthetic" indices whose constituents are structured finance securities, and to which credit derivatives contracts are sometimes linked.

Table A1.3 Discount factor table

	Discount rate (%)												
Years	1	2	3	4	5	6	7	8	9	10	12	15	20
1	0.990099	0.980392	0.970874	0.961538	0.952381	0.943396	0.934579	0.925926	0.917431	0.909091	0.892857	0.869565	0.833333
2	0.980296	0.961169	0.942596	0.924556	0.907029	0.889996	0.873439	0.857339	0.841680	0.826446	0.797194	0.756144	0.694444
3	0.970590	0.942322	0.915142	0.888996	0.863838	0.839619	0.816298	0.793832	0.772183	0.751315	0.711780	0.657516	0.578704
4	0.960980	0.923845	0.888487	0.854804	0.822702	0.792094	0.762895	0.735030	0.708425	0.683013	0.635518	0.571753	0.482253
5	0.951466	0.905731	0.862609	0.821927	0.783526	0.747258	0.712986	0.680583	0.649931	0.620921	0.567427	0.497177	0.401878
6	0.942045	0.887971	0.837484	0.790315	0.746215	0.704961	0.666342	0.630170	0.596267	0.564474	0.506631	0.432328	0.334898
7	0.932718	0.870560	0.813092	0.759918	0.710681	0.665057	0.622750	0.583490	0.547034	0.513158	0.452349	0.375937	0.279082
8	0.923483	0.853490	0.789409	0.730690	0.676839	0.627412	0.582009	0.540269	0.501866	0.466507	0.403883	0.326902	0.232568
9	0.914340	0.836755	0.766417	0.702587	0.644609	0.591898	0.543934	0.500249	0.460428	0.424098	0.360610	0.284262	0.193807
10	0.905287	0.820348	0.744094	0.675564	0.613913	0.558395	0.508349	0.463193	0.422411	0.385543	0.321973	0.247185	0.161506
11	0.896324	0.804263	0.722421	0.649581	0.584679	0.526788	0.475093	0.428883	0.387533	0.350494	0.287476	0.214943	0.134588
12	0.887449	0.788493	0.701380	0.624597	0.556837	0.496969	0.444012	0.397114	0.355535	0.318631	0.256675	0.186907	0.112157
13	0.878663	0.773033	0.680951	0.600574	0.530321	0.468839	0.414964	0.367698	0.326179	0.289664	0.229174	0.162528	0.093464
14	0.869963	0.757875	0.661118	0.577475	0.505068	0.442301	0.387817	0.340461	0.299246	0.263331	0.204620	0.141329	0.077887
15	0.861349	0.743015	0.641862	0.555265	0.481017	0.417265	0.362446	0.315242	0.274538	0.239392	0.182696	0.122894	0.064905
16	0.852821	0.728446	0.623167	0.533908	0.458112	0.393646	0.338735	0.291890	0.251870	0.217629	0.163122	0.106865	0.054088
17	0.844377	0.714163	0.605016	0.513373	0.436297	0.371364	0.316574	0.270269	0.231073	0.197845	0.145644	0.092926	0.045073
18	0.836017	0.700159	0.587395	0.493628	0.415521	0.350344	0.295864	0.250249	0.211994	0.179859	0.130040	0.080805	0.037561
19	0.827740	0.686431	0.570286	0.474642	0.395734	0.330513	0.276508	0.231712	0.194490	0.163508	0.116107	0.070265	0.031301
20	0.819544	0.672971	0.553676	0.456387	0.376889	0.311805	0.258419	0.214548	0.178431	0.148644	0.103667	0.061100	0.026084
21	0.811430	0.659776	0.537549	0.438834	0.358942	0.294155	0.241513	0.198656	0.163698	0.135131	0.092560	0.053131	0.021737
22	0.803396	0.646839	0.521893	0.421955	0.341850	0.277505	0.225713	0.183941	0.150182	0.122846	0.082643	0.046201	0.018114
23	0.795442	0.634156	0.506692	0.405726	0.325571	0.261797	0.210947	0.170315	0.137781	0.111678	0.073788	0.040174	0.015095
24	0.787566	0.621721	0.491934	0.390121	0.310068	0.246979	0.197147	0.157699	0.126405	0.101526	0.065882	0.034934	0.012579
25	0.779768	0.609531	0.477606	0.375117	0.295303	0.232999	0.184249	0.146018	0.115968	0.092296	0.058823	0.030378	0.010483
26	0.772048	0.597579	0.463695	0.360689	0.281241	0.219810	0.172195	0.135202	0.106393	0.083905	0.052521	0.026415	0.008735
27	0.764404	0.585862	0.450189	0.346817	0.267848	0.207368	0.160930	0.125187	0.097608	0.076278	0.046894	0.022970	0.007280
28	0.756836	0.574375	0.437077	0.333477	0.255094	0.195630	0.150402	0.115914	0.089548	0.069343	0.041869	0.019974	0.006066
29	0.749342	0.563112	0.424346	0.320651	0.242946	0.184557	0.140563	0.107328	0.082155	0.063039	0.037383	0.017369	0.005055
30	0.741923	0.552071	0.411987	0.308319	0.231377	0.174110	0.131367	0.099377	0.075371	0.057309	0.033378	0.015103	0.004213

[1] If we multiply both sides of (A1.18) by 1 + *r* and then subtract the result from (A1.18) we obtain:

$$FV - (1 + r)\ FV = C\left[\sum_{n=1}^{N}(1 + r)^{N - n} - \sum_{n=1}^{N}(1 + r)^{N - n + 1}\right]$$
$$= -C\left[(1 + r)^{N} - 1\right].$$

[2] The process is:

$$FV - [1 + (r/m)]^{m}\ FV = C\left[\sum_{n=1}^{N}[1 + (r/m)]^{M(N-n)} - \sum_{n=1}^{N}[1 + (r/m)]^{M(N-n)+m}\right]$$
$$= -C\left[(1 + (r/m))^{mN} - 1\right].$$

[3] Higson, C. (1995), *Business Finance*, Oxford, Butterworth.

[4] Fisher, I. 1930, *The Theory of Interest*, Macmillan, New York.

[5] For example, $y = \prod_{i=1}^{5} x_i$ means y = $(x_1)(x_2)(x_3)(x_4)(x_5)$.

Glossary

A

A note: A tranche of a structured finance vehicle such as a CDO that is senior to other note tranches.

ABCP: Asset-backed commercial paper.

ABS: Asset-backed security.

Accreting: An accreting principal is one that increases during the life of the deal. See **amortising, bullet**.

Accreting swap: Swap whose notional amount increases during the life of the swap (opposite of **amortising** swap).

Accrued interest: The proportion of interest or coupon earned on an investment from the previous coupon payment date until the value date.

Accumulated value: The same as future value.

ACT/360: A day/year count convention taking the number of calendar days in a period and a "year" of 360 days.

ACT/365: A day/year convention taking the number of calendar days in a period and a "year" of 365 days. Under the ISDA definitions used for interest-rate swap documentation, ACT/365 means the same as **ACT/ACT**.

ACT/ACT: A day/year count convention taking the number of calendar days in a period and a year equal to the number of days in the current coupon period multiplied by the coupon frequency. For an interest rate swap, that part of the interest period falling in a leap year is divided by 366 and the remainder is divided by 365.

Add-on factor: Simplified estimate of the potential future increase in the replacement cost, or market value, of a derivative transaction.

Advanced IRB (AIRB): The advanced internal ratings-based approach of the Basel II regulations. The AIRB is one of two internal credit-ratings based approaches allowed under Basel II to calculate regulatory capital requirement for credit risk, with the other being the *foundation* IRB approach. Under AIRB, banks and financial institutions are allowed to provide their own internal data to calculate probability of default, exposure-at-default and loss-given-default. The actual calculations of credit risk based on this data must be undertaken using the Basel II model.

Advanced measurement approach (AMA): The BIS methodology for calculating operational risk capital requirements based on a bank's internal data.

Agent: A participant in the financial markets, such as a broker or a custodian, who undertakes transactions on behalf of (principal) clients.

Aggregated exposure: The gross amount of all types of debt exposure on a banking book or portfolio.

All-in price: See **"dirty price".**

All or nothing: Digital option. This option's **put** (call) pays out a predetermined amount ("the all") if the index is below (above) the strike price at the option's expiration. The amount by which the underlying **index** is below (above) the **strike** is irrelevant; the payout will be all or nothing.

Alpha: Under Basel II rules for operational risk, *a* or alpha is the multiplier that is used to calculate the operational risk regulatory capital charge. The level is set at 15%. In the fund management industry, a term used to refer to the above-market return generated by a fund, and attributed to the skills of the fund manager.

American: An American-style option is one that may be exercised at any time between trade inception and option expiry.

American option: An option that may be exercised at any time during its life.

Amortising: A financial instrument whose nominal principal amount decreases in size during its life. An amortising principal is one that decreases during the life of a deal, or is repaid in stages during a loan. Amortising an amount over a period of time also means accruing for it pro rata over the period. See **accreting, bullet.**

Annuity: An investment providing a series of (generally equal) future cash flows.

Appreciation: An increase in the market value of a currency in terms of other currencies. See **depreciation, revaluation.**

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 three-month US dollar CDs in the United States at 5.5% and a purchase of three-month Eurodollar CDs at 5.6%. In the futures market arbitrage might involve buying three-month contracts and selling forward six-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.

Arbitrageur: Someone who undertakes arbitrage trading.

ARCH: (autoregressive conditional heteroscedasticity) A discrete-time model for a random variable. It assumes that variance is stochastic and is a function of the variance of previous time steps and the level of the underlying.

Arithmetic mean: The average.

Asian: An Asian option takes the average value of the underlying over the option's life.

Asian option: *See above.*

Ask: The offered price, in repo transactions the rate at which the market "sells" stock; in other words, the rate at which it pays money on borrowed funds. See **offer.**

Asset: Probable future economic benefit obtained or controlled as a result of past events or transactions. Generally classified as either current or long-term.

Asset allocation: Distribution of investment funds within an asset class or across a range of asset classes for the purpose of diversifying risk or adding value to a portfolio.

Asset and 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. A simple example is a bank using an interest-rate swap to convert a fixed-rate loan (asset) to match the interest basis of its floating-rate deposits (liability).

Asset and liability management committee (ALCO): A committee comprised of (among others) the Head of Treasury, CEO and CFO, which determines overall bank policy and strategy on asset-liability management.

Asset securitisation: The process whereby loans, receivables and other illiquid assets in the balance sheet are packaged into interest-bearing securities that offer attractive investment opportunities.

Asset swap: An interest-rate swap or currency swap used in conjunction with an underlying asset such as a bond investment. See **liability swap.**

Asset swap spread (ASW): The spread over Libor that is received by the person selling the asset swap. This spread reflects the credit quality of the asset.

Asset-backed loan notes (ABN): Another expression for asset-backed securities. See **ABS.**

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. Also defined as security which is collaterised by specific assets -such as mortgages – rather than by the intangible creditworthiness of the issuer.

Asset-risk benchmark: Benchmark against which the riskiness of a corporation's assets may be measured. In sophisticated corporate risk management strategies the dollar risk of the liability portfolio may be managed against an asset-risk benchmark.

Asset-sensitivity estimates: Estimates of the effect of risk factors on the value of assets.

Assured payment: A payment generated by an irrevocable instruction simultaneously with the movement of securities between counterparty accounts, which occurs for example in CREST/CGO.

At-the-money (ATM): An option is at-the-money if the current value of the underlying is the same as the strike price. See **in-the-money, out-of-the-money.**

Auction: A method of issue where institutions submit bids to the issuer on a price or yield basis. Auction rules vary considerably across markets.

Average cap: Also known as an average rate cap, a cap on an average interest rate over a given period rather than on the rate prevailing at the end of the period. See also **average price (rate) option.**

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.

Average price (rate) option: Option on a currency's average exchange rate or commodity's average spot price in which four variables have to be agreed to between buyer and seller: the premium, the **strike** price, the source of the exchange rate or commodity price data and the sampling interval (each day, for example). At the end of the life of the option the **average spot exchange rate** is calculated and compared with the strike price. A cash payment is then made to the buyer of the option that is equal to the face amount of the option times the difference between the two rates (assuming the option is **in-the-money;** otherwise it expires worthless).

Average worst case exposure: The expression of an exposure in terms of the average of the worst case exposure over a given period.

B

Back-testing: The validation of a model by feeding it historical data and comparing the results with historical reality.

Backwardation: The case when the cash or spot price of a commodity is greater than its forward price. A backwardation occurs when there exists insufficient supply to satisfy nearby demand in a commodity market. The size of the backwardation is determined by differences between supply and demand factors in the nearby positions compared with the same factors on the forward position. It is also known as a *back.* See **contango.**

Balance sheet: Statement of the financial position of an enterprise at a specific point in time, giving assets, liabilities and shareholders' equity.

Balance sheet CDO: A CDO backed by a static pool of assets that were previously on the balance sheet of the originator.

Band: The Exchange Rate Mechanism (ERM II) of the European Union links the currencies of EU members that are not members of the euro, such as Estonia and Malta, in a system that limits the degree of fluctuation of each currency against the euro within a band either side of an agreed par value.

Bank exposure: Under Basel II rules for credit risk exposure capital, this is the exposure arising from exposure to banks and financial institutions under regulatory supervision. It also includes exposure to public-sector bodies that are treated as banks under the Basel II standardised approach, and certain multi-lateral development banks that do not meet the 0% risk-weight of the standardised approach.

Bank for International Settlements (BIS): The international body set up in

1930 to encourage cooperation among central banks and promote stable monetary policy, based in Basel, Switzerland. Its original purpose was to manage the transfer of reparation payments from Germany to various countries under the Treaty of Versailles signed in 1919. Under its later objectives of monetary policy cooperation and coordination it established the Basel I and Basel II rules of regulatory capital requirements.

Banker's acceptance: See **Bill of Exchange.**

Banking book: As described under Bank rules and the EU capital adequacy directives (CAD), a bank's outstanding transactions that relate to customer lending or long-term investments. Includes assets that create exposure to sovereigns, corporates, individuals and other bodies, and that are held primarily to maturity.

Barrier option: A barrier option is one that ceases to exist, or starts to exist, if the underlying reaches a certain barrier level. See **knock in/out.**

Base currency: Exchange rates are quoted in terms of the number of units of one currency (the variable or counter currency) that corresponds to one unit of the other currency (the base currency).

Basel Committee: The Basel committee on banking supervision, a group of central banks and financial institutions from the G10 countries, set up to produce common standards in international banking and hence to reduce systemic risk in the financial system.

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 because they are being replaced by new rules (Basel II) from the end of 2007.

Basic indicator approach (BIA): With regard to the Operational Risk capital calculation for Basel II, a method that uses one indicator to represent the entire operational risk for a bank, from which the charge is calculated. The approach uses a single performance measure, such as gross revenue, as the basic indicator.

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: In interest-rate quotations, 0.01%.

Basis risk: A form of market risk that arises whenever one kind of risk exposure is hedged with an instrument that behaves in a similar, but not necessarily identical way. For instance, a bank trading desk may use three-month interest rate futures to hedge it commercial paper or a euronote program. Although eurocurrency rates, to which futures prices respond, are well correlated with commercial paper rates they do not always move in lock step. If therefore commercial paper rates move by 10 basis points, but futures prices dropped by only seven basis points, the three-points gap would be the basis risk.

Basis swap: An interest-rate swap where both legs are based on floating-rate payments.

Basis trade: Buying the basis means selling a futures contract and buying the commodity or instrument underlying the futures contract. Selling the basis is the opposite.

Basis trading: Simultaneous trading in a derivative contract (normally a futures contract) and the underlying asset. The purpose of basis trading is to exploit an arbitrage-type profit potential, or to cover a short derivative position. Arbitrage basis trading is designed to take advantage of mispricing of cash and/or futures, or is based on speculation that the basis risk will change.

Basket option: Option based on an underlying basket of bonds, currencies, equities or commodities.

BBA: British Bankers Association.

Bear spread: A spread position taken with the expectation of a fall in value in the underlying.

Bearer bond: A bond for which physical possession of the certificate is proof of ownership. The issuer does not know the identity of the bondholder. Traditionally, the bond carries detachable coupons, one for each interest payment date, which are posted to the issuer when payment is due. At maturity the bond is redeemed by sending in the certificate for repayment. These days bearer bonds are usually settled electronically, and while no register of ownership is kept by the issuer, coupon payments may be made electronically.

Benchmark: A bond whose terms set a standard for the market. The benchmark usually has the greatest liquidity, the highest turnover and is usually the most frequently quoted. It also usually trades expensive to the yield curve, due to higher demand for it among institutional investors.

Beta: In the context of Basel II, Beta or *b* is a fixed percentage defined in the Basel II rules for calculating the regulatory capital charge under the standardised approach for operational risk. The beta relates the level of required capital to the level of the gross income for each of the following eight business lines:

retail banking 12%
asset management 12%
retail brokerage 12%
commercial banking 15%
agency services 15%
corporate finance 18%
trading and sales 18%
payment and sales 18%.

In the equity market, beta is the sensitivity of a stock relative to swings in the overall market. The market has a beta of one, so a stock or portfolio with a beta greater than one will rise or fall more than the overall market, whereas a beta of less than one means that the stock is less volatile.

Bid: The price at which a market-maker will buy bonds. A tight bid-offer spread is indicative of a liquid and competitive market. The bid rate in a repo is the interest rate at which the dealer will borrow the collateral and lend the cash. See **offer.** In the repo market, the repo rate that the cash investor demands from the seller; to "bid" for stock – that is, lend the cash. This is the same terminology and price quote as for CDs. The repo buyer is the cash lender, and has actually traded a *reverse repo.*

Bid-offer: The two-way price at which a market will buy and sell stock.

Big figure: In a foreign exchange quotation, the exchange rate omitting the last two decimal places. For example, when EUR/USD is 1.1910/20, the big figure is 1.19. See **points.**

Bilateral netting: The ability to offset amounts owed to a counterparty under one contract against amounts owed to the same counterparty under another contract; for example, where both transactions are governed by one master agreement. Also known as **"cherry-picking".** Formally defined as an agreement between two counterparties whereby the value of all transactions on which funds are owed is offset against the value of transactions where funds are due, resulting in a single net exposure amount owed by one counterparty to the other. Bilateral netting can cover the entire range of products, including repo, swaps, and options, to produce one net exposure.

Bill: A bill of exchange is a payment order written by one person (the drawer) to another, directing the latter (drawee) to pay a certain amount of money at a future date to a third party. A bill of exchange is a bank draft when drawn on a bank. By accepting the draft, a bank agrees to pay the face value of the obligation if the drawer fails to pay, hence the term **bankers acceptance. A Treasury bill,** or T-bill, is short-term government paper of up to one year's maturity, sold at a discount to principal value and redeemed at par.

Bill of exchange: A short-term, zero-coupon debt issued by a company to finance commercial trading. If it is guaranteed by a bank, it becomes a banker's acceptance.

Binary default swap: See **digital credit default swap.**

Binomial pricing model: A tool for valuing an option based on building a binomial tree of all the possible paths both up and down that the underlying asset price might take, from start until expiry. It assumes each up or down move is by a given amount.

Binomial tree: A mathematical model to value options, based on the assumption that the value of the underlying can move either up or down a given extent over a given short time. This process is repeated many times to give a large number of possible paths (the "tree") that the value could follow during the option's life.

BIS: Bank for International Settlements.

Black-Scholes: A widely used option-pricing formula devised by Fischer Black and Myron Scholes and published in 1973.

Blended interest-rate swap: Result of adding a forward swap to an existing swap and blending the rates over the total life of the transaction.

Bloomberg: The trading, analytics and news service produced by Bloomberg LP; also used to refer to the terminal itself.

BoE: Bank of England.

Bond basis: An interest rate is quoted on a bond basis if it is on an **ACT/365, ACT/ACT** or 30/360 basis. In the short term (for accrued interest, for example), these three are different. Over a whole (non-leap) year, however, they all equate to 1. In general, the expression "bond basis" does not distinguish between them and is calculated as ACT/365. See **money market basis.**

Bonds borrowed: Stock borrowed in a stock-lending transaction.

Bond futures: Contracts traded on a recognised futures exchange that are standardised agreements to buy or sell a fixed nominal amount of a government bond. The contract is based on a "notional" bond, and a specified basket of actual bonds may be delivered against the contract.

Bond-equivalent yield: The yield that would be quoted on a US treasury bond which is trading at par and which has the same economic return and maturity as a given T-bill.

Bond Market Association: Formerly known as the Public Securities Association (PSA), and now the Securities Industry and Financial Markets Association (SIFMA), this is the trade association of the US domestic bond market. As the PSA it produced the original master repo agreement for use in the US dollar market, subsequently used at the basis for the PSA/ISMA master repo agreement used in international repo markets.

Bootstrapping: Building up successive zero-coupon yields from a combination of coupon-bearing yields.

Borrower: In a classic repo, the counterparty that is taking stock, in other words *lending* cash. In stock-lending, the counterparty borrowing a specified security and supplying cash or stock as collateral.

BPV: Basis-point value. The price movement due to a one basis-point change in yield.

Brass/Fangmeyer: A method for calculating the yield of a bond similar to the **Moosmuller** method, but in the case of bonds that pay coupons more frequently than annually, using a mixture of annual and less than annual *compounding*.

Break forward: A product equivalent to a straightforward option, but structured as a forward deal at an off-market rate that can be reversed at a penalty rate.

Broken date: A maturity date other than the standard ones (such as one week, one, two, three, six and 12 months) normally quoted. Also known as a “cock-date” by FRA traders.

Broker: An intermediary who acts as a broker for repo transactions, either on a matched principal or name-passing basis.

Broker-dealers: Members of stock exchanges who may intermediate between customers and market-makers; may also act as principals, transacting business with customers from their own holdings of stock.

Bull spread: A spread position in options taken with the expectation of a rise in value in the **underlying**.

Bulldog: Sterling domestic bonds issued by non-UK domiciled borrowers. These bonds trade under a similar arrangement to gilts and are settled via the Central Gilts Office (now CREST).

Bullet: A loan/deposit has a bullet maturity if the principal is all repaid at maturity. See **amortising.**

Butterfly: *Either* an option spread that comprises the purchase of a call (or put) combined with the purchase of another call (or put) at a different strike, plus the sale of two calls at a mid-way strike, *or*, a bond spread of one short position and a long position in two other bonds.

Buy/sell-back (Buy/sell-back or sell/buy-back): A sale and spot purchase (for forward settlement) of securities transacted simultaneously. It is not specifically repo but has the same effect and intent, and consists of a simultaneous matching purchase and sale of the same quantity of securities for different value dates. The UK's Gilt Repo Code recommends that buy/sell-backs should only be carried out under a master agreement with the same protections as those in the Gilt Repo Legal Agreement. A buy/sell-back is equivalent to a reverse repo, while a sell/buy-back is equivalent to a repo. Opposite of **sell/buy-back.**

C

Cable: The exchange rate for sterling against the US dollar.

CAD: The European Union's Capital Adequacy Directive.

Calendar spread: The simultaneous purchase/sale of a futures contract for one date and the sale/purchase of a similar futures contract for a different date. See **spread**.

Call option: An option to purchase the commodity or instrument underlying the option. See **put**.

Call price: The price at which the issuer can call in a bond or preferred bond.

Callable bond: A bond that provides the borrower with an option to redeem the issue before the original maturity date. In most cases certain terms are set before the issue, such as the date after which the bond is callable and the price at which the issuer may redeem the bond.

Calling the mark: The process of calling for margin to be reinstated following a mark-to-market revaluation of a repo transaction.

Cancelable swap: Swap in which the payer of the fixed rate has the option, usually exercisable on a specified date, to cancel the deal (see also **swaption**).

Cap: A series of borrower's **IRGs,** designed to protect a borrower against rising interest rates on each of a series of dates.

Capital adequacy: A measure of a bank or financial institution's financial resources to enable it to meet its business and regulatory obligations.

Capital adequacy ratio: A ratio calculated to meet banking regulators' requirements, and made up of the size of a bank's own funds (available capital and reserves) as a proportion of its risky assets (the funds it has lent to credit risky borrowers).

Capital asset pricing model (CAPM): An equity pricing methodology.

Capital market: Long-term market (generally longer than one year) for financial instruments. See **money market.**

Capital ratio: Under Basel I, the minimum ratio of capital to risk-weighted assets. Under Basel II a different approach will apply: the denominator or total risk-weighted assets is determined by multiplying the capital requirements for market risk and operational risk by 12.5 and then adding the result to the sum of risk-weighted assets set for credit risk. Note that 12.5 is the reciprocal of the original Basel I minimum capital ratio of 8%.

Capped option: Option where the holder's ability to profit from a change in value of the underlying is subject to a specified limit.

Caption: Option on a **cap.**

Cash: See **cash market.**

Cash-and-carry: An arbitrage trade in which a trader sells a bond futures contract and simultaneously buys the CTD bond, to lock in perceived mispricing in the implied future price of the bond. A reverse cash-and-carry is a purchase of futures against a sale of cash bonds. The key measure to analyse is the repo rate for the CTD, and whether the CTD is expected to be unchanged on futures expiry. For the strategy to be successful the futures contract must be theoretically expensive compared to the cash. The value of the futures contract is determined by reference to the *implied repo rate*; if the implied repo rate is higher than the actual market repo rate, then the futures contract is said to be cheap.

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 market: The market in full cash instruments, as opposed to derivatives, for which the full nominal value is paid for up front on purchase. The cash market is the underlying market for derivatives contracts.

Cash-driven repo: A repo transaction initiated by a party that wishes to invest cash against security collateral.

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 by which the issuer can pay investors in order of seniority.

CBOE: Chicago Board Options Exchange.

CBOT: The Chicago Board of Trade, one of the two futures exchanges in Chicago, United States. It lists the US Treasury bond futures contract, and the 10-year, 5-year and 2-year note contracts, among others.

CD: See **certificate of deposit.**

CDO: Collateralised debt obligation, a structured financial product.

Cedel: Centrale de Livraison de Valeurs Mobilieres; a clearing system for Eurocurrency and international bonds. Cedel is located in Luxembourg and is jointly owned by a number of European banks. Now known as **Clearstream.**

Ceiling: The same as *cap.*

Central bank repo: A central bank repo is when the central bank lends funds (provides liquidity) to the market; as such it is a reverse repo in market terms.

Central Gilts Office: The office of the Bank of England which runs the computer-based settlement system for gilt-edged securities and certain other securities (mostly **Bulldogs)** for which the Bank acts as Registrar. It merged with CRESTCo, the London market equity settlement system, in July 2000, and is now known as CREST/CGO or simply CREST.

Central line theorem: The assertion that as sample size, *n*, increases, the distribution of the mean of a random sample taken from almost any population approaches a normal distribution.

Certificate of deposit (CD): A money market instrument of up to one year's maturity (although CDs of up to five years have been issued) that pays a bullet interest payment on maturity. After issue, CDs can trade freely in the secondary market, the ease of which is a function of the credit quality of the issuer.

CGBR: Central government borrowing requirement.

CGO reference prices: Daily prices of gilt-edged and other securities held in CREST/CGO that are used by CREST/CGO and market-makers in various processes, including revaluing stock loan transactions, calculating total consideration in a repo transaction, and DBV assembly. Now referred to as CREST reference prices or DMO prices (because the prices are published by the UK Debt Management Office).

Cheapest to deliver (CTD): In a bond futures contract, the one underlying bond among all those that are deliverable, which is the most price-efficient for the seller to deliver.

Cherry-picking: See **bilateral netting.**

Classic repo: The term used to refer to a generic sale and repurchase transaction. Originally introduced by ISMA as a term for repo as practised in the US market.

Clean deposit: The same as **time deposit.**

Clean price: The price of a bond excluding accrued coupon. The price quoted in the market for a bond is generally a clean price rather than a **dirty price.**

Clean-up of interest: The practice of transferring repo interest prior to the repo termination date. The most common reason for this is when *close-out and repricing* of a repo transaction takes place.

Clearstream: Formerly CEDEL or its banking arm known as Cedel Bank, the international clearing system owned by a consortium of banks, and which also offers triparty repo facilities. It was formed following the merger of Cedel with Deutsche Bourse. The German domestic clearing system is known as Clearstream AG, while Eurobonds clear through Clearstream International.

Close-out and repricing: A method of removing mark-to-market credit exposure in a repo and restoring margin balance. It involves terminating the current repo and restarting it to the original termination date with the margin balance restored.

Close-out netting: The ability to net a portfolio of contracts with a given counterparty in the event of default. See also **bilateral netting.**

Closing leg: The second (terminating) stage of a repo transaction. A repo involves two trades in the same security, one for a near value date and the other for a value date in the future. The closing leg refers to the second trade. Also known as *second* leg, *far* leg, *end* leg, *reverse* leg or *termination* leg.

CMBS: Commercial mortgage-backed security.

CMO: Central Moneymarkets Office which settles transactions in Treasury bills and other money markets instruments, and provides a depository.

CMTM: Current **mark-to-market** value. See **current exposure** and **replacement cost.**

Collar: The simultaneous sale of a *put* (or *call*) *option* and purchase of a call (or put) at different strikes – typically both *out-of-the-money*.

Collateral: Assets or assets of value given up as security in exchange for cash borrowed under a loan. A general term used in the market to cover any securities exchanged in a repo transaction, both initially and subsequently during the period before the repo matures. Used as security against the transfer of cash. Or, in stock-lending, of securities. Under the PSA/ISMA and Gilt Repo Legal agreements, full title to collateral passes from one party to another, the party obtaining title is obliged to deliver back *equivalent* securities.

Collateralised callable notes (CCN): A form of extendible commercial paper (CP) that has two maturity dates, the formal final legal maturity and an earlier maturity date when it is expected to mature in practice.

Collateralised debt obligation (CDO): A multi-asset and multi-tranche debt structure, with the underlying assets comprised of bonds (collateralised bond obligation), loans (collateralised loan obligation) or a mixture of both.

Collateralised loan obligation (CLO): A form of *CDO.*

Collateralised mortgage obligation (CMO): A form of *MBS.*

Collateralised synthetic obligations (CSO): A term for synthetic *CDO.*

Commercial paper (CP): A short-term security issued by a company or bank, generally with a zero coupon.

Commodity swap: Swap where one of the cash flows is based on a fixed value for the underlying commodity and the other is based on a floating index value. The commodity is often oil or natural gas, although copper, gold, other metals and agricultural commodities are also commonly used. The end-users are consumers, who pay a fixed-rate, and the producer.

Competitive bid: A bid for the stock at a price stated by a bidder in an auction. A *non-competitive bid* is a bid where no price is specified; such bids are allotted at the weighted average price of successful competitive bid prices.

Compound interest: When some interest on an investment is paid before maturity and the investor can reinvest it to earn interest on interest, the interest is said to be compounded. Compounding generally assumes that the reinvestment rate is the same as the original rate. See **simple interest.**

Compound option: Option on an option, the first giving the buyer the right, but not the obligation, to buy the second on a specific date at a predetermined price. There are two kinds. One, on currencies, is useful for companies tendering for overseas contracts in a foreign currency. The interest-rate version comprises **captions** and **floortions.**

Consideration: The total price paid in a transaction, including taxes, commissions and (for bonds) accrued interest.

Constant prepayment rate (CPR): An assumed rate used to determine how fast a mortgage or other debt obligation is repaid ahead of its legal maturity.

Contango: The situation when a forward or futures price for something is higher than the spot price (the same as forward premium in foreign exchange). See **backwardation.**

Contingent option: Option where the premium is higher than usual, but is only payable if the value of the underlying reaches a specified level. Also known as a contingent premium option.

Continuous compounding: A mathematical, rather than practical, concept of compound interest where the period of compounding is infinitesimally small.

Contract date: The date on which a transaction is negotiated. See *value date.*

Contract for differences: A deal such as an **FRA** and some futures contracts, where the instrument or commodity effectively bought or sold cannot be delivered; instead, a cash gain or loss is taken by comparing the price dealt with the market price, or an index, at maturity.

Conventional gilts (included double-dated): Gilts on which interest payments and principal repayments are fixed.

Conversion factor: A value assigned by the futures exchange to all bonds deliverable into a futures contract. It is the price at which the bond would have a yield-to-maturity equal to the notional coupon of the futures contract specification. Also known as the *price factor*. The price paid for a bond on delivery is the futures settlement price times the conversion factor.

Convertible bond: A bond that endows on its holder the right to purchase a defined quantity of shares at a defined price. This is achieved by returning the bond to the issuer on maturity (or in some cases earlier), and receiving in return the specified amount of equity. In the absence of a company's bankruptcy or default there will be a floor value to the convertible bond; for example, its redemption value at maturity. In the event that the price of the company's shares rises, the value of the bond will also rise but not necessarily in a perfectly correlated way. The bond has features of both fixed income and equity instruments and these features combined create a return profile akin to that of a call option.

Convertible currency: A currency that may be freely exchanged for other currencies.

Convexity: A measure of the curvature of a bond's price/yield curve (mathematically, [*d2P/dr2*] / dirty price).

Cooke ratio: The original minimum capital ratio of 8% set under Basel I is sometimes called the Cooke ratio because the Basel Committee chairman at the time was Peter Cooke, a director of the Bank of England.

Correlation matrices: Statistical constructs used in the value-at-risk methodology to measure the degree of relatedness of various market forces.

Corridor: The same as **collar**.

Cost of carry: The net running cost of holding a position (which may be negative); for example, the cost of borrowing cash to buy a bond less the coupon earned on the bond while holding it.

Cost volatility: Volatility relating to operational errors or the fines and losses a business unit may incur. Reflected in excess costs and penalty charges posted to the profit and losses. See also **revenue volatility**.

Counterparty: Generally, from the point of view of a bank or financial market entity, the other side to a financial contract it has entered into. Under Basel II, the entity to which a bank or financial institution has an on-or off-balance sheet exposure.

Counterparty credit risk: The risk of financial loss arising as a result of holding or a contract to which the counterparty fails to fulfil its obligations. Under Basel II this credit risk is made up of three elements:

- the value of the position exposed to default; that is, the credit risk exposure;
- the proportion of this value that is expected to be recovered after the event of default;
- the probability of default itself.

Counterparty risk: The risk that the other side to a transaction will default on payments owed by it during the transaction and/or on maturity.

Counterparty risk-weighting: See **risk-weighting**.

Country risk: The risks, when business is conducted in a particular country, of adverse economic or political conditions arising in that country. More specifically, the credit risk of a financial transaction or instrument arising from such conditions.

Coupon: The interest payment(s) made by the issuer of security to the holders, based on the coupon rate and the face value.

Coupon swap: An interest-rate swap in which one leg is fixed-rate and the other floating-rate.

Cover: To cover an exposure is to deal in such a way as to remove the risk – either reversing the position, or hedging it by dealing in an instrument with a similar but opposite risk profile. Also the amount by how much a bond auction is subscribed.

Covered call/put: The sale of a covered call option is when the option writer also owns the underlying. If the underlying rises in value so that the option is exercised, the writer is protected by his or her position in the underlying. Covered puts are defined analogously. See **naked.**

Covered-interest arbitrage: Creating a loan/deposit in one currency by combining a loan/deposit in another with a forward foreign-exchange swap.

CP: See **commercial paper.**

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 swap (CDS): A bilateral financial contract in which one counterparty, known as the protection buyer, pays a premium in the form of a periodic fee, to the other counterparty known as the protection seller. The fee is expressed in basis points of the nominal value of the contract. The contract is written on a reference asset, and in the event of a predefined credit event the protection buyer will deliver the asset to the protection seller, in return for a payment of the nominal value of the contract from the protection seller.

Credit derivative: A *bilateral* contract that isolates credit risk from an underlying specified reference asset and transfers this risk from one party of the contract (the buyer) to the other party (the seller). The seller receives a one-off or periodic premium payment in return for taking on the credit risk. It involves 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. The most common credit derivatives are **credit default** swaps and **total return**

swaps.

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-equivalent amount: As part of the calculation of the risk-weighted amount of capital the Bank for International Settlements (BIS) advises each bank to set aside against derivative credit risk, banks must compute a credit-equivalent amount for each derivative transaction. The amount is calculated by summing the *current replacement cost,* or market value, of the instrument and an **add-on factor.**

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-linked note (CLN): A funded credit derivative. Can be regarded as a bond whose final return is linked to the credit performance of a reference entity. See **credit derivative.**

Credit risk: The risk of loss that will be incurred if a counterparty to a transaction does not fulfil its financial obligations under the transaction contract. It also refers to financial loss suffered by a bondholder as a result of default of the issuer of the bond held. Also known as *default risk.*

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.

Credit swap: See **credit default swap.**

Credit value-at-risk (CVaR): See **Value-at-Risk (VaR).**

CREST: The London equity market electronic book-entry clearing and settlement system, with which the CGO merged in July 2000. The system is operated by CRESTCo and was introduced in 1996.

Cross: See cross-rate.

Cross-currency repo: A repo transaction in which the collateral transferred is denominated in a different currency to that of the cash lent.

Cross-rate: Generally an exchange rate between two currencies, neither of which is the US dollar. In the US market, spot cross is the exchange rate for US dollars against Canadian dollars in its direct form.

CTD: See **cheapest to deliver**.

Cum-dividend: Literally "with dividend", stock that is traded with interest or dividend accrued included in the price.

Cumulative default rate: See **probability-of-default**.

Currency option: The option to buy or sell a specified amount of a given currency at a specified rate at or during a specified time in the future.

Currency swap: An agreement to exchange a series of cash flows determined in one currency, possibly with reference to a particular fixed or floating interest payment schedule, for a series of cash flows based in a different currency. See **interest-rate swap**.

Current assets: Assets that are expected to be used or converted to cash within one year or one operating cycle.

Current exposure: A risk management term referring to current outstanding aggregate interest rate risk.

Current liabilities: Obligations that the firm is expected to settle within one year or one operating cycle.

Current yield: Bond coupon as a proportion of clean price per 100; does not take principal gain/loss or time value of money into account. See **yield to maturity, simple yield to maturity**.

Curve fitting: Plotting or estimating the yield curve from market-observed yield data.

Customer repo: A term used in the US Treasury market, where the Federal Reserve Bank of New York places cash in the market on behalf of its customers.

Cylinder: The same as **collar.**

D

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DAC-RAP: Delivery against collateral – receipt against payment. Same as DVP.

Daily range: The difference between the high and low points of a single trading day.

Day-count: The convention used to calculate accrued interest on bonds and interest on cash. For UK gilts the accrued interest convention changed to actual/actual from actual/365 on 1 November 1998. For cash, the interest basis in money markets is actual/365 for sterling and actual/360 for US dollar and euro.

DBV (delivery by value): A mechanism whereby a CGO member may borrow from or lend money to another CGO member against overnight gilt collateral. The CGO system automatically selects and delivers securities to a specified aggregate value on the basis of the previous night's CGO reference prices; equivalent securities are returned the following day. The DBV functionality allows the giver and taker of collateral to specify the classes of security to be included within the DBV. The options are: all classes of security held within CGO, including strips and bulldogs; coupon bearing gilts and bulldogs; coupon bearing gilts and strips; only coupon bearing gilts.

DBV repo: A repo transaction in which the delivery of securities is by means of the DBV facility in CREST/CGO.

DEaR: Daily earnings at risk.

Debenture: In the US market, an unsecured domestic bond, backed by the general credit quality of the issuer. Debentures are issued under a trust deed or indenture. In the UK market, a bond that is secured against the general assets of the issuer.

Debt Management Office (DMO): An executive arm of the UK Treasury, responsible for cash management of the government's borrowing requirement. This includes responsibility for issuing government bonds (gilts), a function previously carried out by the Bank of England. The DMO began operations in April 1998.

Debt service coverage ratio (DSCR): A measure of the ability of an entity to service debt liability.

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 nonpayment 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. This statistic cannot be observed in practice, so the market uses proxy indicators, such as equity price correlation, where needed.

Default probability: See **probability-of-default.**

Default risk: See **credit risk.**

Default risk exposure: See **credit-risk exposure.**

Default start options: Options purchased before their "lives" actually commence. A corporation might, for example, decide to pay for a deferred-start option to lock into what it perceives as current advantageous pricing for an option that it knows it will need in the future.

Default-risk exposure: See **credit-risk exposure. Deferred strike option:** An option where the strike price is established at a future date on the basis of the spot foreign exchange price prevailing at that future date.

Delegation costs: Incentive costs incurred by banks in delegating monitoring activities.

Deliverable bond: One of the bonds which is eligible to be delivered by the seller of a bond futures contract at the contract's maturity, according to the specifications of that particular contract.

Delivery: Transfer of gilts (in settlements) from seller to buyer.

Deliver-out repo: A term for a conventional classic repo where the buyer takes delivery of the collateral.

Delivery repo: A term used in the US market to refer to a repo in which the lender of cash takes actual delivery of the collateral, as opposed to a *hold-in-custody* repo.

Delivery versus payment (DVP): The simultaneous exchange of securities and cash. The assured payment mechanism of the CGO achieves the same protection.

Delta (δ): The change in an option's value relative to a change in the underlying's value.

Delta neutral: An option portfolio contracted to have zero delta.

Demand repo: Another term for open repo, a repo trade that has no fixed maturity term, and is renewed at one or both counterparties' agreement each morning.

Depreciation: A decrease in the market value of a currency in terms of other currencies. See **appreciation, devaluation**.

Derivative: Strictly, any financial instrument whose value is derived from another, such as a forward foreign exchange rate, a futures contract, an option, an interest-rate swap and so on. Forward deals to be settled in full are not always called derivatives, however.

Devaluation: An official one-off decrease in the value of a currency in terms of other currencies. See **revaluation, depreciation.**

Diffusion effect: The potential for increase over time of the credit exposure generated by a derivative: as time progresses, there is more likelihood of larger changes in the underlying market variables. Depending on the type and structure of the instrument this effect may be moderated by the **amortisation effect.**

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 predetermined amount. Also known as a **binary default swap.**

Digital option: Unlike simple European and US options, a digital option has fixed payouts and, rather like binary digital circuits, which are either on or off, pays out either this amount or nothing. Digital options can be added together to create assets that exactly mirror index price movements anticipated by investors.

Direct: An exchange rate quotation against the US dollar in which the dollar is the *variable currency* and the other currency is the **base currency.**

Dirty price: The price of a bond including accrued interest. Also known as the "all-in" price.

Discount: The amount by which a currency is cheaper, in terms of another currency, for future delivery than for spot, is the forward discount (in general, a reflection of interest rate differentials between two currencies). If an exchange rate is "at a discount" (without specifying to which of the two currencies this refers), this generally means that the variable currency is at a discount. See **premium.**

Discount factor: A factor by which one multiplies a future known cash flow, to obtain its present value.

Discount house: In the UK money market, originally securities houses that dealt directly with the Bank of England in T-bills and bank bills, or discount instruments; hence, the name. Most discount houses were taken over by international banking groups and the term is no longer used, as the Bank of England deals directly with clearing banks and securities houses.

Discount rate: The method of market quotation for certain securities (US and UK treasury bills, for example), expressing the return on the security as a proportion of the face value of the security received at maturity – as opposed to a yield, which expresses the yield as a proportion of the original investment.

Discount swap: Swap in which the fixed-rate payments are less than the internal rate of return on the swap, the difference being made up at maturity by a balloon payment.

Diversified: A portfolio that has been invested across a range of assets such that its credit risk is minimised. This is achieved by having a mixture of assets whose individual credit risks are uncorrelated with each other.

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.

Dividend discount model: Theoretical estimate of market value that computes the economic or the net present value of future cash flows due to an equity investor.

DMO: The UK Debt Management Office.

DMR: The *Debt Management Report,* published annually by HM Treasury.

Dollar repo: A repo transaction in which collateral returned at the maturity of the trade need not be exactly the same as that originally transferred. This is actually incorporated in the PSA/ISMA GMRA, which states that the obligation is only to return "equivalent" securities. In the US mortgage market it is also known as a *dollar roll,* but there are some detail differences to repo.

Dollar roll: A transaction with a number of similarities to repo, used exclusively for mortgage-backed securities, in the US market.

Down-and-in option: Barrier option where the holder's ability to exercise is activated if the value of the underlying drops below a specified level. See also **up-and-in option**.

Down-and-out-option: Barrier option where the holder's ability to exercise expires if the value of the underlying drops below a specified level.

DRM: Debt and Reserves Management Team in HM Treasury.

Dual currency option: Option allowing the holder to buy either of two currencies.

Dual currency swap: Currency swap where both the interest rates are fixed rates.

Dual strike option: Interest rate option, usually a **cap** or a **floor,** with one floor or ceiling rate for part of the option's life and another for the rest.

Duration: A measure of the weighted average life of a bond or other series of cash flows, using the present values of the cash flows as the weights. See **modified duration** and **Macauley duration**.

Duration gap: Measurement of the interest-rate exposure of an institution.

Duration weighting: The process of using the modified duration value for bonds to calculate the exact nominal holdings in a spread position. This is necessary because £1 million nominal of a two-year bond is not equivalent in interest-rate risk to £1 million of, say, a five-year bond. The modified duration value of the five-year bond will be higher, indicating that its "basis point value" (bpv) will be greater and that, therefore, £1 million worth of this bond represents greater sensitivity to a move in interest rates (risk). As another example, consider a fund manager holding £10 million of five-year bonds. The fund manager wishes to switch into a holding of two-year bonds with the same overall risk position. The basis point values of the bonds are 0.041583 and 0.022898, respectively. The ratio of the basis point values are 0.041583/0.022898 = 1.816. The fund manager, therefore, needs to switch into £10 million x 1.816 = £18.160 million of the two-year bond.

DV01: An acronym for "dollar value of an 01", meaning price value of a basis point. The change in value of a bond or derivative for a 1 basis point change in interest rates. Also known as "Dollar value of a basis point" or DVBP.

DVP: Delivery versus payment, in which the settlement mechanics of a sale or loan of securities against cash is such that the securities and cash are exchanged against each other simultaneously through the same clearing mechanism and neither can be transferred unless the other is.

E

Early exercise: The exercise or assignment of an option prior to expiration.

ECU: The European Currency Unit, a basket composed of European Union currencies, now defunct, following the introduction of the euro currency.

Effective rate: An effective interest rate is the rate that, earned as simple interest over one year, gives the same return as interest paid more frequently than once per year and then compounded. See **nominal rate**.

Efficient frontier method: Technique used by fund managers to allocate assets.

Embedded option: Interest-rate-sensitive option in debt instrument that affects its redemption. Such instruments include **mortgage-backed securities** and **callable bonds.**

End-end: A money market deal commencing on the last working day of a month and lasting for a whole number of months, maturing on the last working day of the correlation.

EONIA: The euro overnight interest-rate reference index, reported daily by the European Banking Federation. It is calculated as the average of the range of overnight interest-rates during the day.

Epsilon (ε): The same as **vega**.

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. For accounting purposes defined as the residual interest in the net assets of an entity that remains after deducting the liabilities.

Equity default swaps (EDS): A swap contract whose payout is linked to the fall in price of a reference equity, similar to a CDS and used to hedge against or speculate on equity price movements.

Equity options: Options on shares of an individual common stock.

Equity warrant: Warranty, usually attached to a bond, entitling the holder purchase share(s).

Equity repo legal agreement: The 1995 PSA/ISMA GMRA when extended to cover equity repo, now stated in Annex IV of the October 2000 agreement.

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.

Equivalent rate: The interest rate that returns the same amount as another quoted interest rate, but at a different compounding basis.

Equivalent securities: A term used in repo to denote that the securities returned must be of identical issue (and *tranche*, where relevant) and nominal value to those repo'ed in.

ERA: See **exchange-rate agreement**.

Eta (η): The same as *vega*.

Euribor: The reference rate for the euro currency, set in Brussels.

Euro: The name for the domestic currency of the European Monetary Union. Not to be confused with **Eurocurrency.**

Euroclear: The international bond and equity clearing system, based in Brussels and owned by a consortium of banks. Euroclear is managed by Morgan Guaranty Trust Company.

Eurocurrency: A Eurocurrency is a currency owned by a non-resident of the country in which the currency is legal tender. Not to be confused with **Euro**.

Euro-issuance: The issue of gilts (or other securities) denominated in Euro.

Euromarket: The international market in which Eurocurrencies are traded.

European: A European *option* is one that may be exercised only at **expiry.** See **American**.

Excess spread: Total cash left over in a securitisation transaction, after paying all costs.

Exchange controls: Regulations restricting the free convertibility of a currency into other currencies.

Exchange-rate agreement: A *contract for differences* based on the movement in a **forward-forward** foreign-exchange swap price. Does not take account of the effect of spot rate changes as an *FXA* does. See **SAFE**.

Exchange-traded: Futures contracts are traded on a futures exchange, as opposed to forward deals, which are **OTC**.

Ex-dividend: The time period before a bond's coupon date when it is traded without its accrued interest payment. This period is usually one or two weeks.

Ex-dividend (xd) date: A bond's record date for the payment of coupons. The coupon payment will be made to the person who is the registered holder of the stock on the xd date. For UK gilts this is seven working days before the coupon date.

Exercise: To exercise an **option (by** the **holder)** is to require the other party (the writer) to fulfil the underlying transaction. Exercise price is the same as **strike** price.

Exotic option: An option that is not plain vanilla; any complex option.

Expected (credit) loss: Estimate of the amount a counterparty is likely to lose as a result of default from a financial contract, with a given level of probability. The expected loss of any 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 loss: A statistical measure of the average potential loss expected across a portfolio of assets over a given time period. Under Basel II capital allocation should cover expected losses.

Expected rate of recovery: See **rate of recovery.**

Expiry: An option's expiry is the time after which it can no longer be exercised.

Exposure: Risk to market movements.

Exposure at default (EAD): A Basel II measure for the expected exposure of a bank or financial institution for an asset such as a loan or bond upon default of the issuer. Under the foundation IRB this value is assigned by the Basel Committee, whereas under the advanced IRB it can be set by the firm itself.

Exposure profile: The path of worst case or expected exposures over time. Different instruments reveal quite differently shaped exposures profiles due to the interaction of the diffusion and amortisation effects.

Extinguishable option: Option in which the holder's right to exercise disappears if the value of the underlying passes a specified level. See also **barrier option.**

Extrapolation: The process of estimating a price or rate for a particular value date, from other known prices, when the value date required lies outside the period covered by the known prices. See **interpolation.**

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.

Failure or failed trade: A trade that does not complete because the seller is unable to deliver the stock on time.

FAS 133: The United States Financial Accounting Standards Board (FASB) rule that states that all firms regulated by the Securities and Exchange Commission must mark-to-market their derivatives positions on their balance sheet.

Fed repo: A repo trade entered into between the US Federal Reserve ("Fed") and US Treasury primary dealers, similar to the Bank of England open market operations. The Fed undertakes this in order to supply liquidity to the market. The typical term of a Fed repo is 15 days and is at the Fed funds rate. The collateral accepted is Treasury or Agency securities.

Fence: The same as **collar.**

First-to-Default (FtD): A CDS contract that references a basket of credit names, and which is triggered when a name in the basket experienced a credit event.

First-to-default 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.

Fixed-coupon repo: Similar to a *dollar repo,* except that the collateral returned must have the same coupon as that originally transferred.

Fixing: See **Libor fixing.**

Flat repo: Repo undertaken with no margin. Also known as *flat basis.*

Flex repo: Classic repo trade in which the lender of cash may draw down the cash supplied in accordance with a schedule agreed at trade inception.

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 refixed 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 CD: CD on which the rate of interest payable is refixed in line with market conditions at regular intervals (usually six months).

Floating rate gilt: Gilt issued with an interest rate adjusted periodically in line with market interbank rates.

Floating rate note (FRN): Capital market instrument on which the rate of interest payable is refixed in line with market conditions at regular intervals (usually three or six months).

Floor: A series of lender's **IRGs,** designed to protect an investor against falling interest rates on each of a series of dates.

Floortion: Option on a **floor**.

Forward: In general, a deal for value later than the normal value date for that particular commodity or instrument. In the foreign exchange market, a forward price is the price quoted for the purchase or sale of one currency against another where the value date is at least one month after the spot date. See **short date**.

Forward band: Zero-cost collar that is one in which the premium payable as a result of buying the cap is offset exactly by that obtained from selling the floor.

Forward break: See **break forward.**

Forward exchange agreement (FXA): A contract for differences designed to create exactly the same economic result as a foreign exchange cash forward-forward deal. See **ERA, SAFE.**

Forward-forward: Short-term exchange of currency deposits. (See also forward-forward deposit.) **Forward-forward deposit:** Deposit of cash where the interest rate is effective from a future date *(*t_1 to a later date, t_2).

Forward-forward yield curve: A yield curve of zero-coupon rates for periods starting at a future point, say, one month or one year from today.

Forward rate agreement (FRA): Short-term interest-rate hedge. Specifically, a contract between buyer and seller for an agreed interest rate on a notional deposit of a specified maturity on a predetermined future date. No principal is exchanged. At maturity the seller pays the buyer the difference if rates have risen above the agreed level, and vice versa.

Forward swap: Swap arranged at the current rate but entered into at some time in the future.

Foundation internal ratings-based approach (FIRB): Under Basel II and its Pillar One framework, the ruling that allows banks and financial institutions to calculate their regulatory capital requirement by using their own internally generated estimate of the probability of default. However, the banks must use

BIS-provided values for exposure-at-default and loss-given-default in this calculation.

FRA: See **forward rate agreement.**

Framework document: Sets out the Direct Management Office's responsibilities, objectives and targets; its relationship with the rest of the Treasury; and its accountability as an Executive Agency.

Fraption: Option on a forward-rate agreement. Also known as an interest-rate guarantee.

FRCD: See **floating rate CD.**

FRN: See **floating-rate note.**

FSA: The Financial Services Authority, the body responsible for the regulation of investment business, and the supervision of banks and money market institutions in the United Kingdom. The FSA took over these duties from nine "self-regulatory organisations" that had previously carried out this function, including the Securities and Futures Authority (SFA), which had been responsible for regulation of professional investment business in the City of London. The FSA commenced its duties in 1998.

FTSE-100: Index comprising 100 major UK shares listed on The International Stock Exchange in London. Futures and options on the index are traded at the London International Financial Futures and Options Exchange **(LIFFE).**

Funding reserve: A specified (say, 10 basis points) multiple of the aggregate value of the funding gap, across the maturity structure.

Fungible: A financial instrument that is equivalent in value to another, and easily exchanged or substituted. The best example is cash money, as a £10 note has the same value and is directly exchangeable with another £10 note. A bearer bond also has this quality.

Future: A futures contract is a contract to buy or sell securities or other goods at a future date at a predetermined price. Futures contracts are usually standardised and traded on an exchange.

Futures contract: A deal to buy or sell some financial instrument or commodity for value on a future date. Unlike a *forward* deal, futures contracts are traded only on an exchange (rather than *OTC)*, have standardised contract sizes and value dates, and are often only **contract for differences** rather than deliverable.

Future exposure: See **potential exposure.**

Future value: The amount of money achieved in the future, including interest, by investing a given amount of money now. See **time value of money, present value.**

G

G7: The "Group of Seven" countries, the United States, Canada, United Kingdom, Germany, France, Italy and Japan.

G10: The Group of Ten, comprising Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, United Kingdom and the United States (actually 11 countries).

Gamma (γ): The change in an option's delta relative to a change in the underlying's value.

Gap: The difference in the maturity profile of assets versus liabilities by time bucket. Gives rise to gap risk.

Gap ratio: Ratio of interest-rate sensitive assets to interest-rate sensitive liabilities; used to determine changes in the risk profile of an institution with changes in interest-rate levels.

Gapping: Feature of commodity markets whereby there are large and very rapid price movements to new levels followed by relatively stable prices.

GDP: Gross domestic product, the value of total output produced within a country's borders.

GEMM: A gilt-edged market-maker, a bank or securities house registered with the Bank of England as a market-maker in gilts. A GEMM is required to meet certain obligations as part of its function as a registered market-maker, including making two-way price quotes at all times in all gilts and taking part in gilt auctions. The Debt Management Office now make a distinction between conventional gilt GEMMs and index-linked GEMMs, known as IG GEMMs.

General collateral (GC): Securities, which are not "special", used as collateral against cash borrowing. A repo buyer will accept GC at any time that a specific stock is not quoted as required in the transaction. In the gilts market GC includes DBVs. There is no standard accepted GC in equity repo, although some participants make markets in blue-chip index stocks a quasi-equity GC.

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.

Gilt: A UK government sterling denominated, listed security issued by HM Treasury with initial maturity of over 365 days when issued. The term "gilt" (or gilt-edged) is a reference to the primary characteristic of gilts as an investment: their security.

Gilt-edged market-maker: See **GEMM.**

GMRA: Global Master Repurchase Agreement, the industry-standard legal agreement describing repo transactions. Issued under the auspices of the Bond Market Association in the US and the International Securities Market Association (ISMA).

GNP: Gross national product, the total monetary value of a country's output, as produced by citizens of that country.

Gold warrant: Naked or attached warrant exercisable into gold at a predetermined price.

Gross basis: The difference between the price of an asset and its implied price given by the price of a futures contract. The gross basis for a government bond futures contract is given by: $Basis = P_{bond} - (P_{fut} \times CF)$

where *CF* is the bond's conversion factor.

Gross redemption yield: The same as **yield to maturity;** "gross" because it does not take tax effects into account.

GRY: See **gross redemption yield**.

Guarantee: A legal obligation in which the guarantor undertakes to repay a third party liability, such as a loan.

Guarantor: A third party to a contract that guarantees the legal obligations under that contract for one party to it, such as repayment of a loan. Such a contract therefore carries a **guarantee.**

H

Haircut: Also known as margin, a reduction measure applied to an asset that is being used as collateral that reduces its accepted market value such that this lower figure is the amount of cash lent against it. The collateral value is therefore given a "haircut", whereas strictly speaking "margin" is the amount over and above the cash loan value that must be added when calculating collateral. In economic terms the effect of both is identical.

Hard stock: Another term for a *special* stock. In the US market the term *hot stock* is also used.

Hedge ratio: The ratio of the size of the position it is necessary to take in a particular instrument as a hedge against another, to the size of the position being hedged.

Hedging: Protecting against the risks arising from potential market movements in exchange rates, interest rates or other variables. See **cover, arbitrage, speculation**.

Herstatt risk: See **settlement risk**.

High coupon swap: Off-market coupon swap where the coupon is higher than the market rate. The floating-rate payer pays a front-end fee as compensation. Opposite of **low coupon swap**.

Historic rate rollover: *A forward rate swap* in FX where the settlement exchange rate for the near date is based on a historic *off-market* rate rather than the current market rate. This is prohibited by many central banks.

Historic volatility: The actual *volatility* recorded in market prices over a particular period.

Historical simulation methodology: Method of calculating *value-at-risk (VaR)* using historical data to assess the likely effect of market moves on a portfolio.

Holder: The holder of an *option* is the party that has purchased it.

Hold in custody (HIC) repo: A repo in which the party that receives cash does not deliver the securities to the counterparty, but segregates them in an internal account for the benefit of the cash provider. In the US market, this is also known as a *trust me* repo.

Hot stock or hard stock: A security in high demand, and therefore "special" in the repo market.

Hybrid: A term used to refer to a structure comprising elements of cash and synthetic securitisation. Also a bond that is not conventional or plain vanilla.

I

Icing: The term used to reserve stock, ahead of possibly borrowing it, in the stock-lending market. Stock that has been iced is *open to challenge.*

IDB: Inter-dealer broker, in this context a broker that provides facilities for dealing in bonds between market-makers.

IG: Index-linked gilt whose coupons and final redemption payment are related to the movements in the Retail Price Index (RPI).

Illiquid: An asset that is difficult to trade in a secondary market, either because no buyer or seller is readily available, no price can be determined and/or it cannot be transferred easily to the ownership of a new buyer.

Immunisation: This is the process by which a bond portfolio is created that has an assured return for a specific time horizon irrespective of changes in interest rates. The mechanism underlying immunisation is a portfolio structure that balances the change in the value of a portfolio at the end of the investment horizon (time period) with the return gained from the reinvestment of cash flows from the portfolio. As such, immunisation requires the portfolio manager to offset interest-rate risk and reinvestment risk.

Implied repo rate: The breakeven interest rate at which it is possible to sell a bond *futures contract,* buy a **deliverable bond,** and **repo** the bond out. See **cash-and-carry.**

It is defined as the rate used to measure which stock is the cheapest to deliver (CTD) into the government bond futures contract. The bond with the highest implied repo rate is the CTD bond. It is given by: $\frac{P_{fut} - P_{bond}}{P_{bond}} \times \frac{365}{N} \times 100$

where P_{fut} is the dirty futures price, P_{bond} is the dirty cash price and N is the number of days to expiry of the futures contract. The dirty futures price is the cash inflow from selling the futures contract and the dirty cash price is the cash outflow from simultaneously buying the CTD bond. The term *implied repo rate* is also used, erroneously, to refer to the repo rate "implied" in a sell/buy-back transaction but incorporated in the forward buy-back price.

Implied volatility: The **volatility** used by a dealer to calculate an **option** price; conversely, the volatility implied by the price actually quoted.

Index: A statistical measure of the value of a basket of assets. The constituent assets may be bonds, equities, interest rates or other financial assets. An index is often used as an economic indicator of the group of assets it represents, or as a benchmark against which overall economic performance is measured.

Index option: An option whose **underlying** security is an index. Index options enable a trader to bet on the direction of the index.

Index swap: Sometimes the same as a basis swap. Otherwise, a swap like an **interest-rate** swap where payments on one or both of the legs are based on the value of an index – such as an equity index, for example. Also, 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.

Indexed notes: Contract whereby the issuer usually assumes the risk of unfavourable price movements in the instrument, commodity or index to which the contract is linked, in exchange for which the issuer can reduce the cost of borrowing (compared with traditional instruments without the risk exposure).

Indexed repo: A repo transaction where the repo rate is linked to an external, specified index such as **Libor.**

Indirect: An exchange rate quotation against the US dollar in which the dollar is the **base currency** and the other currency is the **variable currency.**

Initial margin: The excess either of cash over the value of securities, or of the value of securities over cash in a repo transaction at the time it is executed and subsequently after margin calls.

Interbank: The market in unsecured lending and trading between banks of roughly similar credit quality.

Interest-rate cap: See **cap.**

Interest-rate floor: See **floor.**

Interest-rate guarantee: An option on an **FRA.**

Interest-rate option: Option to pay or receive a specified rate of interest on or from a predetermined future date.

Interest-rate swap: An agreement between two parties in which one party pays interest on the agreed notional amount at a specified fixed rate, and the other party pays at a floating rate linked to Libor. Only net cash flows are actually transferred, based on the difference between the fixed rate and the prevailing floating-rate fix. Interest-rate swaps are used to transform the interest-rate basis of an asset or liability. Swaps in liquid currencies such as dollar, sterling and euro can be transacted out to 30 years' maturity, and the swap rate is calculated from the government bond zero-coupon yield curve. May be combined with a **currency swap.**

Intermarket spread: A spread involving futures contracts in one market spread against futures contracts in another market.

Internal rate of return (IRR): The yield necessary to discount a series of cash flows to an NPV of zero.

Internal ratings-based approach (IRB): Under Basel II, the IRB is a procedure used in determining the regulatory capital requirement of a pool of credit exposures. It comprises a classification of exposures by type, with a bank providing risk data for each type. A risk-weighting function allocates a risk-weight for each type, and a bank must meet the minimum requirements set out in the approach in line with the risk-weighting allocated.

Interpolation: The process of estimating a price or rate for value on a particular date by comparing the prices actually quoted for value dates either side. See **extrapolation.**

Intervention: Purchases or sales of currencies in the market by central banks in an attempt to reduce exchange rate fluctuations or to maintain the value of a currency within a particular band, or at a particular level. Similarly, central bank operations in the money markets to maintain interest rates at a certain level.

In-the-money: A call (put) option is in-the-money if the underlying is currently more (less) valuable than the **strike** price. See **at-the-money, out-of-the-money**.

Intrinsic value: The amount by which an option is in-the-money.

Investment grade: Debt rated at or above BBB-by Standard & Poor’s or Baa3 by Moody’s.

Investor: A party that is long cash and therefore a purchaser of securities, or lender of money. In a repo transaction, the lender of cash and therefore the taker of collateral.

IRG: See **interest-rate guarantee**.

IRR: See **internal rate of return**.

IRS: See **interest-rate swap.**

ISDA: International Swaps and Derivatives Association.

ISMA: The International Securities Market Association. This association compiled with the PSA (now renamed the Bond Market Association) the PSA/ISMA Global Master Repurchase Agreement.

Issuer risk: Risk to an institution when it holds debt securities issued by another institution. (See also **credit risk.) Issuing and paying agent (IPA):** An entity responsible for making payments on bond and money market instruments, such as the initial proceeds, coupon payments and redemption proceeds. Generally, a banking institution.

Iteration: The mathematical process of estimating the answer to a problem by seeing how well an estimate fits the data, adjusting the estimate appropriately and trying again, until the answer is close to the actual. Used, for example, in calculating a bond's **yield** from its price.

J

Junk bonds: The common term for high-yield bonds; higher risk, low-rated debt.

K

Kappa (κ): An alternative term to refer to volatility; see **vega.**

Kick-in note: An index-linked hybrid bond whose enhanced return is triggered if the index reaches a certain level above or below where it is when the note is issued.

Knock in/out: A knock out (in) **option** ceases to exist (starts to exist) if the underlying reaches a certain trigger level. See **barrier option.**

L

Lambda (λ): The same as **vega.**

Large exposure: A risk exposure to a bank caused by having a large part of lending made to just one counterparty. Under EU CAD, an extra risk number must be allocated for this risk.

LCH: London Clearing House.

Lender: The provider of collateral in a repo or sell/buy-back, and therefore a *borrower* of cash, or the lender of stock (and taker of collateral) in a stock loan transaction.

Lender option: Floor on a single-period forward rate agreement.

Leptokurtosis: The non-normal distribution of asset-price returns. Refers to a probability distribution that has a fatter tail and a sharper hump than a normal distribution.

Level payment swap: Evens out those fixed-rate payments that would otherwise vary, for example, because of the amortisation of the principal.

Leverage: The ability to control large amounts of an underlying variable for a small initial investment.

Leveraged buy-out (LBO): A mechanism by which a company is purchased, funded by issue of large-scale debt well in excess of the equity behind the deal.

Liability: Probable future sacrifice of economic benefit due to present obligations to transfer assets or provide services to other entities as a result of past events or transactions. Generally classed as either current or long-term.

Liability swap: An interest-rate swap or currency swap used in conjunction with an underlying liability such as a borrowing. See **asset swap.**

Libid: The London Interbank Bid Rate, the rate at which banks will pay for funds in the interbank market.

Libor: The London Interbank Offered Rate, the lending rate for all major currencies up to one-year set at 11 a.m. each day by the British Bankers Association.

Libor fixing: The Libor rate “fixed” by the British Bankers Association (BBA) at 11 a.m. each day, for maturities up to one year.

LIFFE: The London International Financial Futures and Options Exchange, the largest futures exchange in Europe.

Limean: The arithmetic average of Libor and Libid rates.

Limit up/down: Futures prices are generally not allowed to change by more than a specified total amount in a specified time, in order to control risk in very volatile conditions. The maximum movements permitted are referred to as limit up and limit down.

Liquidation: Any transaction that closes out or offsets a futures or options position.

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 CDs.

Liquidity risk: The risk associated with undertaking transactions in illiquid markets, which are characterised by wide bid-offer spreads, lack of transparency, a small number of market-makers and large movements in price after a deal of large size. In the context of banking asset and liability management, the risk of having insufficient funds available to meet a sudden large-scale demand for funds from depositors.

Loan-equivalent amount: Description of derivative exposure that is used to compare the credit risk of derivatives with that of traditional bonds or bank loans.

Lognormal: A variable's **probability distribution** is lognormal if the logarithm of the variable has a normal distribution.

Lognormal distribution: The assumption that the log of today's interest rate, for example, minus the log of yesterday's rate is normally distributed.

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-dated forward: Forward foreign-exchange contract with a maturity of greater than one year. Some long-dated forwards have maturities as great as 10 years.

Long-term assets: Assets that are expected to provide benefits and services over a period longer than one year.

Long-term Capital Management (LTCM): A US-hedge fund that went bust in 1999.

Long-term liabilities: Obligations to be repaid by the firm more than one year later.

Lookback option: Option that allows the purchaser, at the end of a given period of time, to choose as the rate for exercise any rate that has existed during the option's life.

Loss-given-default (LGD): A calculation of the amount of loss expected to be experienced by an asset default should it default. Under Basel II the credit loss incurred if an obligor of a bank defaults. LGD includes three types of losses: (i) loss of principal (ii) funding cost loss associated with holding non-performing loans and (iii) operational costs such as cost of collection, legal costs and so on.

LGD may be measured in the following ways:

- market LGD, calculated market price of a bond or loan after its issuer has experienced default;
- workout LGD, which is calculated from the cash flows expected from the collection process;
- implied market LGD, which is observed from similar-risk (but not defaulted) bonds or loans.

For Basel II, LGD is reported as a percentage of the exposure-at-default, given as (1 – *RR)* where *RR* is the recovery rate. If any particular loan or exposure is backed by collateral (for example, in a repo), the LGD value is reduced.

Low coupon swap: Tax-driven swap, in which the fixed-rate payments are significantly lower than current market interest rates. The floating-rate payer is compensated by a front-end fee.

LSE: London Stock Exchange.

LTV: Loan-to-value, the ratio of the loan amount over the value of the asset. A lending risk ratio calculated by dividing the total amount of the mortgage or loan by the appraised value of the asset.

M

Macaulay duration: See **duration.**

Manufactured dividend: A payment from the repo buyer to the repo seller during the term of the trade, representing the coupon or dividend received by the temporary owner (repo buyer) of the security being repo'ed. Also applies in a stock loan transaction.

Mapping: The process whereby a Treasury's derivative positions are related to a set of risk "buckets".

Margin: Initial margin is **collateral,** placed by one party with a counterparty at the time of the deal, against the possibility that the market price will move against the first party, thereby leaving the counterparty with a credit risk. Variation margin is a payment or extra collateral transferred subsequently from one party to the other because the market price has moved. Variation margin payment is either in effect a settlement of profit/loss (for example, in the case of a **futures contract)** or the reduction of credit exposure (for example, in the case of a **repo).** In gilt repos, variation margin refers to the fluctuation band or threshold within which the existing collateral's value may vary before further cash or collateral needs to be transferred. In a loan, margin is the extra interest above a **benchmark** (for example, a margin of 0.5% over **Libor)** required by a lender to compensate for the credit risk of that particular borrower.

Margin call: A request following marking-to-market of a repo transaction for the initial margin to be reinstated or, where no initial margin has been taken, to restore the cash/securities ratio to parity.

Margin default rate: See **probability-of-default.**

Margin ratio: A term used in the GMRA and the Equity Legal Agreement, and a term for the initial margin. It is defined as the ratio of the market price of the securities to their purchase price.

Margin transfer: The payment of a **margin call.**

Market comparables: Technique for estimating the fair value of an instrument for which no price is quoted by comparing it with the quoted prices of similar instruments.

Market-maker: 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 tradeable macroeconomic 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.

Matched book: Running a market-making operation in repo. Alternatively, only trading repo to cover your own financing requirements. Also refers to the matching by a repo trader of securities repo'ed in and out. It carries no implications that the trader's position is "matched" in terms of exposure or term to maturity, for example to short-term interest rates, and in fact books are "mismatched" to reflect views on interest rates.

Maturity date: Date on which stock is redeemed.

Mean: Average.

Mezzanine: The intermediate tranche(s) note of a structured credit product such as a CDO or MBS issue, senior to the equity note.

Minmax option: One of the strategies for reducing the cost of options by forgoing some of the potential for gain. The buyer of a currency option, for example, simultaneously sells an option on the same amount of currency but at a different strike price. MLV: Maximum likely potential increase in value.

Modified duration: A measure of the proportional change in the price of a bond or other series of cash flows, relative to a change in yield. (Mathematically – *[dP/di] /* dirty price.) See **duration**.

Modified following: The convention that if a value date in the future falls on a non-business day, the value date will be moved to the next following business day, unless this moves the value date to the next month, in which case the value date is moved back to the last previous business day.

Momentum: The strength behind an upward or downward movement in price.

Monetary Policy Committee (MPC): The committee of the Bank of England, staffed by five BoE employees (including the Governor and the Deputy Governor) and four external appointees who are responsible for setting UK interest rates.

Money market: Short-term market (generally up to one year) for financial instruments. See **capital market.**

Money market basis: An interest rate quoted on an ACT/360 basis is said to be on a money market basis. See **bond basis.**

Monte Carlo simulation: Technique used to determine the likely value of a derivative or other contract by simulating the evolution of the underlying variables many times. The discounted *average* outcome of the simulation gives an approximation of the derivative's value. Monte Carlo simulation can be used to estimate the *Value-at-Risk* (VaR) of a portfolio. Here, it generates a simulation of many correlated market movements for the markets to which the portfolio is exposed, and the positions in the portfolio are revalued repeatedly in accordance with the simulated scenarios. This gives a probability distribution of portfolio gains and losses from which the VaR can be determined.

Monte Titoli: The Italian domestic market clearing system.

Moosmuller: A method for calculating the yield of a bond.

Mortgage-backed security (MBS): Security guaranteed by a pool of mortgages, created by the process of securisation.

Moving average convergence/divergence (MACD): The crossing of two exponentially smoothed moving averages that oscillate above and below an equilibrium line.

MTN: Medium-term note.

Multi-index option: Option that gives the holder the right to buy the asset that performs best out of a number of assets (usually two). The investor would typically buy a call allowing him or her to buy the **equity.**

N

Naked: A naked option position is one not protected by an offsetting position in the underlying. See **covered call/put**.

Naked option: An option position in which the writer does not hold the underlying asset.

NAO: National Audit Office.

Negative divergence: When at least two indicators, indexes or averages show conflicting or contradictory trends.

Negotiable: A security that can be bought and sold in a **secondary market** is negotiable.

Net basis: The gross basis of a futures-deliverable bond, adjusted for net carry.

Net interest income (NII): Interest income on all assets held in a banking asset portfolio, net of costs.

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).

Netting: The practice of counterparties taking the net exposure of all the trades they have outstanding between them and only settling the net difference. When used in conjunction with a centralised clearing counterparty (similar to a derivatives exchange clearing house), a process that eliminates counterparty credit risk and simplifies stock and cash movements.

NLF: National Loans Fund, the account that brings together all UK government lending and borrowing.

Noise: Fluctuations in the market that can confuse or impede interpretation of market direction.

Nominal amount: Same as **face value** of a security.

Nominal rate: The quoted interest rate, rather than the **effective rate** to which it is equivalent.

Non-deliverable forward: A forward FX contract that does not result in exchange of actual cash currency amounts on maturity, but instead has a single net payment representing the change between the traded forward rate and the spot rate on maturity.

Non-interest-bearing deposits (NIBL): Liabilities of a bank that earn no or very low rates of interest; for example, cheque accounts.

Non-performing: A loan or other asset that is no longer being serviced, or has experienced default.

Non-performing loan (NPL): A loan for which the obligor has not made recent interest payments, or has not paid on maturity or repaid only partially, but which is not yet considered to be in default. An NPL is usually designated as such for a time set by the bank, after which, if it is still non-performing, it will be declared to be in default and recovery processes instituted. This time period can be as little as three months or stretch into years. Also defined as loans that are no longer being serviced by interest payments and/or principal repayment. Typically, a loan is deemed to be an NPL if 90 days has passed since a scheduled payment was missed.

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.

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, it is the balance that is used as the basis for calculating interest or credit protection due with respect to an obligation.

Novation: Replacement of a contract or, more usually, a series of contracts with one new contract.

NPV: See **net present value.**

NYSE: New York Stock Exchange.

O

O/N: See **overnight.**

Obligor: A borrower of funds.

Odd date: See **broken date.**

Off-balance sheet: A transaction whose nominal value is not entered on the balance sheet, because the principal amount is not traded. The standard accounting treatment for *contracts for differences.*

Off-balance sheet instruments (OBS): Derivative contracts that are held off the balance sheet, because they are not "cash" assets, and the premium paid to purchase them is a fraction of their notional value.

Off-market: A rate that is not the current market rate.

Off-market coupon swap: Tax-driven swap strategy in which the fixed-rate payments differ significantly from current market rates. There are high and low coupon swaps.

Offer: The price at which a market-maker will sell bonds. Also called "ask". In the repo market, the repo rate that the seller is willing to pay on cash received, to "offer" the stock; that is, take the cash.

Open book: A term for a "mismatched" book. However, the term "mismatched" book is not itself generally used by traders.

Open repo: A repo trade with no fixed maturity date, with the daily possibility of terminating the repo or refixing its terms or substituting collateral.

Open to challenge: A request to ice a stock is open to challenge if the party making the icing request has not confirmed the order, and a second party subsequently approaches the stock-lender with a firm request to borrow. The first party retains first option on the stock it has iced.

Opening leg: The first half of a repo transaction. Also known as *start* leg, *first* leg, *near* leg or *onside* leg. See also **closing leg.**

Operational market notice: Sets out the DMO's (previously the bank's) operations and procedures in the gilt market.

Operational risk: Risk of loss occurring due to inadequate systems and control, human error, or management failure.

Opportunity cost: Value of an action that could have been taken if the current action had not been chosen.

Option: The right (but not the obligation) to buy or sell securities at a fixed price within a specified period.

Option forward: See **time option.**

Ordinary least squares (OLS): An econometric technique used to estimate the strength and direction of the relationship between two or more variables.

Originator: In a securitisation transaction, the bank or other entity that is behind the securitisation. Also known as the sponsor. The originating bank directly or indirectly transfers assets in the securitisation, or acts as a sponsor of an asset-backed commercial paper conduit.

Ornstein-Uhlenbeck equation: A standard equation that describes mean reversion. It can be used to characterise and measure commodity price behaviour.

OTC: 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 FRAs and (non-exchange traded) options are said to be "over-the-counter" instruments. OTC also refers to non-standard instruments or contracts traded privately 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 trade with a bank that makes markets in such products.

Out-of-the-money: A call (put) option is out-of-the-money if the **underlying** is currently less (more) valuable than the strike price. See **at-the-money, in-the-money.**

Outright: An outright (or **forward** outright) is the sale or purchase of one foreign currency against another value on any date other than spot. See **spot, swap, forward, short date.**

Over-the-counter: See **OTC.**

Overborrowed: A position in which a dealer's liabilities (borrowings taken in) are of longer maturity than the assets (loans out).

Over-collateralisation: A capital structure in which assets exceed liabilities.

Over-collateralised: Where the value of collateral exceeds that of the cash lent against it. Used to protect against counterparty and market risk.

Overlent: A position in which a dealer's assets (loans out) are of longer maturity than the liabilities (borrowings taken in).

Overnight: A deal from today until the next working day ("tomorrow").

Overnight index swap (OIS): An interest-rate swap that pays/receives fixed-rate interest on one leg and receives/pays the average of the overnight interest rate on the other leg.

P

p/e ratio: price/earnings ratio.

Pair-off: The netting of consideration and stock in the settlement of two trades (one buy, one sell) in the same security, possible where value dates are identical, to allow settlement of the net differences only.

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.

Parity: The official rate of exchange for one currency in terms of another which a government is obliged to maintain by means of intervention.

Participation forward: A product equivalent to a straightforward **option** plus a forward deal, but structured as a forward deal at an **off-market** rate plus the opportunity to benefit partially if the market rate improves.

Path-dependent: A path-dependent **option** is one which depends on what happens to the **underlying** throughout the option's life (such as the **American** or **barrier option),** rather than only at expiry (a **European option).**

Pay-as-you-go (PAUG): A type of CDS contract used when the reference entity is a structured finance security such as an ABS, and whose notional is adjusted to reflect paydowns and other adjustments to the outstanding balance of the reference security.

Peak exposure: If the worst case or the expected credit risk exposures of an instrument is calculated over time, the resulting graph reveals a credit risk exposure profile. The highest exposure marked out by the profile is the peak exposure generated by the instrument.

Pension: The French domestic market classic repo. Formally documented in law in December 1993, previously known as *pension livrée.*

Periodic resetting swap: Swap where the floating-rate payment is an average of floating rates that have prevailed since the last payment, rather than the interest rate prevailing at the end of the period. For example, the average of six 1-month **Libor** rates rather than one, 6-month Libor rate.

Pillar One: One of the three pillars that comprise the Basel II framework. Pillar One stipulates the methodology for the calculation of the specific capital charges for credit risk and operational risk.

Pillar Two: Pillar Two is part of the Basel II framework and sets out guidelines for supervisory bodies. This includes directions to follow with regard to capital adequacy, internal procedures and risks such as interest-rate risk.

Pillar Three: The market-discipline element of the three-pillar framework behind Basel II, Pillar Three sets out the disclosure requirements for a bank or financial institution to its shareholders and customers.

Pips: See **points.**

Plain vanilla: See **vanilla.**

Points: The last two decimal places in an exchange rate. For example, when EUR/USD is 1.1910/1.1920, the points are 10/20. See **bid figure.**

Pool factor: A value assigned to a tranche of a structured finance security such as an ABS or MBS that is used to determine outstanding market value. As the underlying asset pool experiences paydowns (such as prepayment of a mortgage that is in the underlying pool), the overlying notes are also paid down, usually on a pro-rata basis, to reflect their reduced actual amount. On issue, ABS and MBS notes have a pool factor of 1.0000. As prepayment takes place, the pool factor reduces. To obtain the market value of an ABS or MBS tranche, we multiply the nominal value of the note by the pool factor, and then multiply this value with the dirty price.

Portfolio variance: The square of the **standard deviation** of a portfolio's return from the mean.

Positive cash-flow collar: Collar other than a zero-cost collar.

Potential exposure: Estimate of the future replacement cost, or positive market value, of a derivative transaction. Potential exposure should be calculated using probability analysis based on broad confidence intervals (for example, two standard deviations) over the remaining term of the transaction.

Preference shares: These are a form of corporate financing. They are normally fixed interest shares whose holders have the right to receive dividends ahead of ordinary shareholders. If a company were to go into liquidation, preference shareholders would rank above ordinary shareholders for the repayment of their investment in the company. Preference shares ("prefs") are normally traded within the fixed interest division of a bank or securities house.

Premium: For a bond, the amount by which the price is over par. In the FX market, the amount by which a currency is more expensive, in terms of another currency, for future delivery than for spot, is the forward premium (in general, a reflection of interest-rate differentials between two currencies). If an exchange rate is "at a premium" (without specifying to which of the two currencies this refers), this generally means that the **variable currency** is at a premium. See **discount.**

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.**

Pre-settlement risk: As distinct from credit risk arising from intra-day settlement risk, this term describes the risk of loss that might be suffered during the life of the contract if a counterparty to a trade defaulted and if, at the time of default, the instrument had a positive economic value.

Price differential: A term used in the Equity Repo Agreement to describe the accrued return on the cash involved in a repo.

Price-earnings ratio: A ratio giving the price of a stock relative to the earnings per share.

Price factor: See **conversion factor.**

Pricing rate: Another term for repo rate.

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: A party to a repo transaction who acts on their own behalf. Also, a term used to refer to the nominal value of a bond.

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.

Probability distribution: The mathematical description of how probable it is that the value of something is less than or equal to a particular level.

Probability-of-default (PD): In general, the probability that an asset will suffer from issuer default over the next 12 months, calculated on historical rates of default among the same class of issuer. Under Basel II, the statistical measure that a borrower or portfolio of borrowers will default on its financial obligations. Banks and financial institutions must provide to their regulatory authority a measure of PD for each borrower and each borrower of rating, under both the foundation and advanced IRB approaches. PD itself is defined as a conservative view of the long-term average PD for the grade of borrower being assessed. For sovereign exposure, PD is the one-year PD of the borrower grade; for bank and corporate exposures, PD is the greater of either the one-year PD of the borrower grading or 0.03%. The PD of exposures of obligors in default is defined as 100%.

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.

PSA/ISMA Global Master Repurchase Agreement: Developed jointly by PSA and ISMA, this is the market standard documentation for nondollar repo markets. A revised edition was issued in November 1995. The Gilt Repo Legal Agreement is an amended version of the revised edition (through the inclusion of a Part 2 to its Annex I and modified by a side letter in connection with the upgrade of the CGO service in 1997) designed to meet the needs of the gilt repo market.

PSA: The Public Securities Association. A US-based organisation that developed the market standard documentation for repo in the US domestic market and that developed with the ISMA the Global Master Repurchase Agreement. It changed its name to the Bond Market Association, before merging in July 2006 with the Securities Industry Association to form the Securities Industry and Financial Markets Association (SIFMA).

Put: A put option is an option to sell the commodity or instrument **underlying** the option. See **call option**.

Put-call parity: The theory that demonstrates the relationship between the call price and put price of an option with otherwise identical terms.

PVBP: Present value of a basis point, the change in value of a bond or derivative contract resulting from a 1 basis point change in its yield, or in the level of interest rates. Sometimes used synonymously with **DV01.**

Q

Quanto: An option that has its final payoff linked to two or more underlying assets or reference rates.

Quanto swap: A swap where the payments in one or both legs are based on a measurement (such as the interest rate) in one currency but payable in another currency.

Quasi-coupon date: The regular date for which a **coupon** payment would be scheduled if there were a coupon payable. Used for price/yield calculations for **zero-coupon bonds.**

R

Range forward: A zero-cost collar where the customer is obliged to deal with the same bank at spot if neither limit of the collar is breached at expiry.

Rate of recovery: Estimate of the percentage of the amount exposed to default – that is, the credit-risk exposure – that is likely to be recovered by an institution if a counterparty defaults. The recovery value of a defaulted asset is dependent on its rate of recovery.

Rating: The credit rating of an obligor. This can be a formal rating from an institution such as Moody's, Standard & Poor's or Fitch, or an internal rating assigned by a bank or financial institution based on its own assessment.

Rebate: The fee payable by a borrower of stock in the stock-lending market.

Recall: Where the repo is an open transaction, a request to return repo'ed securities.

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. See **ex-dividend, cum-dividend**.

Recovery rate: See **rate of recovery.**

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).

Re-denomination: A change in the currency unit in which the nominal value of a security is expressed (in context, from sterling to euro).

Reduced-cost option: Generic term for options for which there is a reduced premium, either because the buyer undertakes to forgo a percentage of any gain, or because he or she offsets the cost by writing other options (for example, minmax, range forward). See also **zero-cost option. Refer:** The practice whereby a trader instructs a broker to put "under reference" any prices or rates quoted, meaning that they are no longer "firm" and the broker must refer to the trader before he or she can trade on the price initially quoted.

Register: Record of ownership of securities. For gilts, excluding bearer bonds, entry in an official register confers title.

Registered bond: A bond for which the issuer keeps a record (register) of its owners. Transfer of ownership must be notified and recorded in the register. Interest payments are posted (more usually electronically transferred) to the bondholder.

Registrar's Department: Department of the Bank of England that maintains the register of holdings of gilts.

Regulatory arbitrage: The practice of engaging in financial transactions that provide a benefit that is available due to regulatory requirements of different types and/or ratings of assets.

Regulatory capital: Capital that is obliged to be held by a bank or financial institution to meet regulatory requirements. Defined under Basel I and split into Tier I and Tier II capital, and slightly modified under Basel II with regard to Tier II.

Reinvestment rate: The rate at which interest paid during the life of an investment is reinvested to earn interest on interest, which in practice will generally not be the same as the original yield quoted on the investment.

Relative performance option: Option whose value varies in line with the relative value of two assets.

Replacement cost: The present value of the expected future net cash flows of a derivative instrument. Aside from various conventions dealing with the bid/ask spread, synonymous with the "market value" or "current exposure" of an instrument.

Repo: Usually refers in particular to classic repo. Also used as a term to include classic repos, buy/sell-backs and securities lending.

Repo rate: The return earned on a repo transaction expressed as an interest rate on the cash side of the transaction.

Repo (reverse repo) to maturity: A repo or reverse repo where the security repo'ed matures on the same day as the closing leg.

Repricing: At a variation margin call, when a repo is closed out and restarted to reflect margin delivery. Also used as another term for *marking-to-market.*

Repurchase agreement: See **repo.**

Restructuring: An event of financial modification that is of significance under the terms of a credit derivative contract. Essentially it involves the obligor to a set of loans changing the terms of its obligations, usually due to financial stress, that result in the terms of the obligation becoming less favourable to lenders than previously. Restructuring can take the form of longer term to repay, reduction in principal amount payable, postponement of interest payments, change in priority of payment and so on.

Return on capital employed (ROCE): Measure of the return on capital used in the business.

Return on equity (ROE): The net earning of a company divided by its equity.

Return on net assets (RONA): Measure of the return on the value of the net assets used in the business.

Return on Value-at-Risk (ROVAR): An analysis conducted to determine the relative rates of return on different risks, allowing corporations to compare different risk capital allocations and capital structure decisions effectively.

Revaluation: An official one-off increase in the value of a currency in terms of other currencies. See **devaluation.**

Revenue volatility: Another term for value of income at risk from market fluctuations.

Reverse: See **reverse repo.**

Reverse repo: A repo, but from the point of view of the counterparty taking in collateral. The US AIMR, in its CFA exam syllabus, defines a reverse repo as one undertaken by a corporate customer with a banking counterparty (who engages in repo).

Reversing: Entering into reverse repo, as in "reverse in" securities.

Rho (ρ): The change in an option's value relative to a change in interest rates.

Right of substitution: The right of the party to a repo, which has delivered securities, to substitute equivalent collateral during the life of the repo.

Risk-adjusted return on capital (RAROC): Measure of the return on capital adjusted for the level of risk to which capital has been used, usually by means of incorporating the volatility of the assets whose return is being measured.

Risk reversal: Changing a long (or short) position in a call option to the same position in a put option by selling (or buying) forward, and vice versa.

Risk-free rate: The interest rate payable on an investment that carries zero credit risk. Usually associated with the 90-day T-bill rate.

Risk-weighted asset: Assets that carry an element of credit risk and so must be weighted in accordance with relative risk, for capital adequacy purposes under Basel regulations.

Risk-weighting: The level of risk assigned to a certain type of collateral or counterparts, as used in Basel I capital calculations.

RMBS: Residential mortgage-backed security.

ROA: Return on assets.

Roll: To renew a repo trade at its maturity.

Rollover: See **tom/next** and **roll.** Also refers to a renewal of a loan on its maturity date.

Rump: A gilt issue so designated because it is illiquid, generally because there is a very small nominal amount left in existence.

Running yield: Same as **current yield.**

S

S/N: See **spot/next.**

S/W: See **spot-a-week.**

Safe custody repo: Also known as *safekeeping* repo, where the borrower of cash keeps hold of collateral pledged, placing it in a segregated client account.

Sale and repurchase agreement: The full name for repo.

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.

Securities and Exchange Commission (SEC): The central regulatory authority in the United States, responsible for policing the financial markets including the bond markets.

Securities lending: The market in borrowing and lending stock, for a fee, against collateral. Also know as stock lending.

Securitisation: The sale of assets, which generate cash flows, from the institution that owns them, to another company that has been specifically set up for the purpose, 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 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 corporates to convert assets that are not readily marketable – such as residential mortgages or car loans – into rated securities that are tradeable in the secondary market. The investors that buy these securities gain an exposure to these types of original assets that they would not otherwise have access to. The technique was first introduced by mortgage banks in the United States during the 1970s. The later synthetic securitisation market is more recent, dating from 1997. The key difference between cash and synthetic securitisation is that in the former, 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. We can define securitisation as the process by which illiquid assets of a corporation or a financial institution are transformed into a package of securities backed by these assets; the process of securitisation creates *asset-backed bonds.*

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.

Sell/buy-back: A trade economically identical to a classic repo, but conducted as a spot sale and simultaneous repurchase of stock, with the forward repurchase price adjusted to account for interest payable on borrowed funds. The repurchase price is not connected to the actual market price of the stock on repurchase date.

Seller: The counterparty that "sells" collateral in a repo or sell/buy-back; in other words, the party borrowing funds.

Set off: The practice of netting obligations between two counterparties, in the event of default.

Settlement: The process of transferring stock from seller to buyer and arranging the corresponding movement of funds between the two parties.

Settlement bank: A bank that agrees to receive and make assured payments for gilts bought and sold by a CGO member.

Settlement date: Date on which the transfer of gilts and payments occur, usually the next working date after the trade is conducted.

Settlement risk: The risk that occurs when there is a non-simultaneous exchange of value. Also known as “delivery risk” and “Herstatt risk”.

Sharpe ratio: A measure of the attractiveness of the return on an asset by comparing how much risk premium the investor can expect it to receive in return for the incremental risk (volatility) the investment carries. It is the ratio of the risk premium to the volatility of the asset.

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.

Short date: The term for short maturity deposits, typically overnight, tom/next, and 2–3 day maturity trades. Sometimes the one-week term will be considered among the short dates.

Simple interest: When interest on an investment is paid all at maturity or not reinvested to earn interest on interest, the interest is said to be simple. See **compound interest.**

Simple yield to maturity: Bond coupon plus principal gain/loss amortised over the time to maturity, as a proportion of the clean price per 100. Does not take time-value of money into account. See **yield to maturity, current yield.**

SLN: Secured liquidity notes.

Special: A security which 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 it 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.

Special purpose vehicle (SPV): A legal entity set up to effect securitisation. Also known as a special purpose company (SPC) or special purpose entity (SPE). Under the securitisation process an *issuer* acquires 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 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.

Specific: A repo in which the collateral is specified; that is, it is not GC. A specific security is not necessarily special.

Speculation: A deal undertaken because the dealer expects prices to move in his or her favour, as opposed to **hedging** or **arbitrage.**

Spot: A deal to be settled on the customary value date for that particular market. In the foreign exchange market this is for value in two working days' time.

Spot-a-week: Money market deposit value spot (T + 2) for one week.

Spot/next: A transaction from **spot** until the next working day.

Spot yield curve: The current zero-coupon yield curve.

Spread: The difference between the bid and offer prices in a quotation. Also a strategy involving the purchase of an instrument and the simultaneous sale of a similar related instrument, such as the purchase of a **call option** at one **strike** and the sale of a call option at a different strike.

Square: A position in which sales exactly match purchases, or in which assets exactly match liabilities. See **long, short.** In the money markets, to be "squared off" is to be net zero balance at the clearing bank.

Standard deviation (σ): A measure of how much the values of something fluctuate around its mean value. Defined as the square root of the variance.

Standardised approach (SA): The basic approach to implementing the Basel II capital calculation, based on external credit ratings of balance sheet assets.

Step-down swap: Swap in which the fixed-rate payment decreases over the life of the swap.

Step-up swap: Swap in which the fixed-rate payment increases over the life of the swap.

Stock-driven repo: A repo initiated by a party who is motivated by the need to borrow a specific security or repo out of a specific security for funding purposes. A stock-driven trade usually involves a round nominal amount of stock.

Stock index future: Future on a stock index, allowing a hedge against, or bet on, a broad equity market movement.

Stock index option: Option on a stock index future.

Stock lending: See **securities lending**.

Stock option: Option on an individual stock.

Straddle: A position combining the purchase of both a call and put at the same strike for the same date. See **strangle**.

Strangle: A position combining the purchase of both a call and a put at different strikes for the same date. See **straddle**.

Street: The "street" is a term for the market, originating as "Wall Street". A US term for market convention, so in the US market is the convention for quoting the price or yield for a particular instrument.

Stress testing: An analysis that gives the value of a portfolio under a range of worst case scenarios.

Strike: The strike price or strike rate of an option is the price or rate at which the holder can insist on the underlying transaction being fulfilled.

Strip: A zero-coupon bond that is produced by separating a standard coupon-bearing bond into its constituent principal and interest components. To strip a bond is to separate its principal amount and its coupons and trade each individual cash flow as a separate instrument ("separately traded and registered for interest and principal"). Also, a strip of **futures** is a series of short-term futures contracts with consecutive delivery dates, which together create the effect of a longer term instrument (for example, four consecutive 3-month futures contracts as a **hedge** against a one-year swap). A strip of FRAs is similar.

Structured investment vehicle (SIV): Investment companies set up as stand-alone, purpose-built legal entities that invest in assets and raise funds in the debt capital markets. They also require an equity share in the total funding, which is the vehicle's capital.

Structured note: A bond that is an over-the-counter (OTC) product that combines a number of elements into a single instrument. It may contain an embedded option, or it may link its return to the performance of another specific asset or index. The liquidity of the secondary market in structured notes is variable.

Substitution: The practice of replacing collateral with another of equivalent credit quality during the term of a repo trade. This is initiated by the supplier of collateral, but must be agreed beforehand by the lender of cash.

Supervisory formula (SF): A BIS-described approach to calculating Basel II capital requirements based on the methodology of the national regulator.

Swap: A foreign exchange swap is the purchase of one currency against another for delivery on one date, with a simultaneous sale to reverse the transaction on another value date. See also **interest-rate swap, currency swap.**

Swaption: An option on an interest-rate swap, currency swap.

Switch: Exchanges of one gilt holding for another, sometimes entered into between the DMO and a GEMM as part of the DMO's secondary market operations.

Synthetic: A package of transactions which 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.

Synthetic securitisation: Defined by the Basel Committee as a structure with at least two different stratified risk positions or tranches that reflect different degrees of credit risk, where the credit risk of an underlying pool of assets is transferred by means of credit derivatives. The actual assets may not be transferred in ownership, only their credit risk exposure is transferred.

T

T/N: See **tom/next.**

Tail: The exposure to interest rates over a forward-forward period arising from a mismatched position (such as a two-month borrowing against a three-month loan). A forward foreign exchange dealer's exposure to spot movements. The interest-rate *gap* between a deposit and loan (or reverse repo and repo) of differing maturities, representing interest-rate risk. Tap: The issue of a gilt for exceptional market-management reasons and not on a pre-announced schedule.

TED spread: A term referring to the spread in a trade involving a long/short futures position against a short/long government bond position. Also the futures strip hedge page on Bloomberg. Originally referred to as "Treasury-Eurodollar spread".

Term: The time between the beginning and end of a deal or investment.

Term repo: Repo trades (of a maturity over one day) with a fixed maturity date.

Term structure of interest rates: The plot of zero-coupon interest rates by maturity. Sometimes used synonymously with **yield curve**.

Terminable on demand: A repo trade that may terminated on a daily basis, in other words an *open repo.*

Termination: The maturity date.

Theta (τ): The change in an option's value relative to a change in the time left to expiry.

Tick: The minimum change allowed in a futures price.

Tick value: The change in value of a futures contract for a 1-tick movement in price.

Tier 1 capital: The capital of a bank or financial institution defined as shareholder equity and retained earnings. At least 50% of regulatory capital must be held as Tier 1 capital.

Tier 2 capital: Defined in Basel I but not with a uniform definition in different national jurisdictions. It is generally viewed as the other forms of capital available to a bank or financial institution and so may include long-term subordinated debt, preference shares, undisclosed reserves and hybrid equity capital.

Tier 3 capital: A modification to the original Basel I rules that allowed banks to issue short-term subordinated debt to meet part of their market risk capital requirements. A maximum of 250% of a firm's Tier 1 capital may be issued in this way, subject to the discretion of the national regulator.

Time bucket: The maturity group into which a loan or other exposure is placed. For instance, time buckets of o/n, o/n – one week, one week -three month, three month – six month, six month – 12 month may be calculated, and assets and liabilities placed in buckets according to their maturity.

Time deposit: A **non-negotiable** deposit for a specific term.

Time option: A forward currency deal in which the value date is set to be within a period rather than on a particular day. The customer sets the exact date two working days before settlement.

Time value of 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.**

Today/tomorrow: See **overnight.**

Tom/next: A transaction from the next working day ("tomorrow") until the day after ("next day" – that is, **spot** in the foreign-exchange market).

Total return swap (TRS): A bilateral financial contract in which one party (the total return payer) makes floating-rate payments to the other party (the total return receiver) equal to the total return on a specified asset or index, in return for amounts that generally equal the total return payer's cost of holding the specified asset on its balance sheet. Price appreciation or depreciation may be calculated and exchanged at maturity or on an interim basis. Total return swaps are economically similar to a repo trade, and may be considered as synthetic repos or as a form of credit derivative. However, a total return swap is distinct from a credit default swap in that the floating payments are based on the total economic performance of the specified asset, and are not contingent upon the occurrence of a credit event.

Traded option: Option that is listed on and cleared by an exchange, with standard terms and delivery months.

Trading book: A bank's investment, trading and short-term activity, grouped into the trading book for regulatory capital purposes.

Tranche: In the loan market, one of a series of two or more issues with the same coupon rate and maturity date. The tranches become fungible at a future date, usually just after the first coupon date. In the structured finance market, a term for liability or note in a securitisation transaction.

Transaction risk: Extent to which the value of transactions that have already been agreed is affected by market risk.

Translation risk: An accounting or financial reporting risk where the earnings of a company can be adversely affected due to its method of accounting for foreign earnings.

Transparent: A term used to refer to how clear asset prices are in a market. A transparent market is one in which a majority of market participants are aware of what level a particular bond or instrument is trading.

Treasury bill (T-bill): A short-term security issued by a government, generally with a zero coupon.

Triparty repo: A repo in which an independent agent bank or clearing house oversees a standard two-party repo transaction. The responsibilities of the triparty agent include maintaining acceptable and adequate collateral and overall maintenance of the outstanding repo trades.

Trigger option: See **barrier option.**

True yield: The yield on a bond that is equivalent to the quoted discount or zero-coupon rate.

Trust account repo: Another term for *safe custody repo.*

Trustee: A third-party specialist appointed to act on behalf of investors.

Tunnel: The same as **collar.**

Tunnel options: Set of collars, typically zero-cost, covering a series of maturities from the current date. They might, for example, be for dates six, 12 or 24 months ahead. The special feature of a tunnel is that the strike price on both sets of options, not just on the options bought, is constant.

U

Uncovered option: When the writer of the option does not own the underlying security. Also known as a **naked option.**

Undated gilts: Gilts for which there is no final date by which the gilt must be redeemed.

Underlying: The cash market asset on which a futures or option contract is written. Also, the reference asset in a credit derivative. Thus, underlying for a bond option is the bond; the underlying for a short-term interest-rate futures contract is typically a three-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.

Up-and-away option: See **up-and-out option.**

Up-and-out option: Type of barrier option that is extinguished if the value of the underlying goes above a predetermined level. See also **down-and-out option.**

V

Value: The date that the cash is received for stock sold (and vice versa), the value date. Alternatively, the date from which interest begins to commence.

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 certainity (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.

VaR: See **Value-at-Risk.**

Variable currency: Exchange rates are quoted in terms of the number of units of one currency (the variable or counter currency) which corresponds to one unit of the other currency (the **base currency).**

Variance (σ^2): A measure of how much the values of something fluctuate around its mean value. Defined as the average of (value – mean)^2. See **standard deviation.**

Variance-covariance methodology: Methodology for calculating the VaR of a portfolio as a function of the **volatility** of each asset or liability position in the portfolio and the correlation between the positions.

Variation margin: The band agreed between the parties to a repo transaction at the outset within which the value of the collateral may fluctuate before triggering a right to call for cash or securities to reinstate the initial margin on the repo transaction.

Vega: The change in an option's value relative to a change in the **underlying's volatility.**

Volatility: The standard deviation of the continuously compounded return on the underlying. Volatility is generally annualised. It measures the price fluctuation of an asset or derivative. See **historic volatility, implied volatility.**

W

Warrant: A security giving the holder a right to subscribe to a share or bond at a given price and from a certain date. If this right is not exercised before the maturity date, the warrant will expire worthless.

Warrant-driven swap: Swap with a warrant attached allowing the issuer of the fixed-rate bond to go on paying a floating rate in the event that he or she exercises another warrant allowing him or her to prolong the life of the bond.

Weighted average cost (WAC): A term for WACC.

Weighted average cost of capital (WACC): The average cost of capital used in a business, both debt and equity, and which is weighted by the proportion of each type of capital used in the total.

Weighted average life (WAL): The weighted-average life of a portfolio of securities or other assets, each of which has a different term-to-maturity. The weighting is the proportion of nominal value of assets as part of the total portfolio nominal or market value.

Weighted average rate (WAR): The weighted-average cost of all funds borrowed, from all sources, by a business.

When-issued trading: Trading a bond before the issue date; no interest is accrued during this period. Also known as the “grey market”.

Worst case (credit risk) exposure: Estimate of the highest positive market value a derivative contract or portfolio is likely to attain at a given moment or period in the future, with a given level of confidence.

Worst case (credit-risk) loss: Estimate of the largest amount a derivative counterparty is likely to lose, with a given level of probability, as a result of default from a derivatives contract or portfolio.

Worst-case default rate: The highest rates of default that are likely to occur at a given moment or period in the future, with a given level of confidence.

Write: To sell an option is to write it. The person selling an option is known as the writer.

Writer: The same as “seller” of an option.

Writing: A generic term for selling or underwriting a contract. For example, the writer of an option is selling to the buyer the option to purchase the underlying asset from the writer at a future date.

X

X: Used to denote the strike price of an option; sometimes this is denoted using the term *K*.

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: A graphical representation of interest rates plotted against terms to maturity. Most commonly, government bond yields are plotted against their respective maturities. The plot of zero-coupon rates against maturity is known as the *term structure of interest rates.* Only assets of homogenous quality can be used when plotting yields. A *positive* yield curve exhibits an increasing level of interest rates over longer maturity periods, while a *negative* or *inverted* yield curve exhibits diminishing yields over time.

Yield-curve option: Option that allows purchasers to take a view on a yield curve without having to take a view about a market's direction.

Yield-curve swap: Swap in which the index rates of the two interest streams are at different points on the yield curve. Both payments are refixed with the same frequency whatever the index rate.

Yield to equivalent life: The same as **yield to maturity** for a bond with partial redemptions.

Yield to maturity: The **internal rate of return** of a bond – the yield necessary to discount all the bond's cash flows to an NPV equal to its current price. See **simple yield to maturity, current yield.**

YTM: See **yield to maturity.**

Z

Zero-cost collar: A collar where the premiums paid and received are equal, giving a net zero cost.

Zero-cost option: An option structure combining puts and calls, or buys and sells, that result in a zero net premium for the purchaser.

Zero-coupon: A coupon of 0% or zero. Usually used to refer to a **zero-coupon bond** or **strip.**

Zero-coupon bond: Bond on which no coupon is paid. It is either issued at a discount or redeemed at a premium to face value.

Zero-coupon rate: The interest rate on a zero-coupon bond, sometimes called the spot rate. The two terms are not strictly synonymous however; the spot rate refers to the interest rate payable for a term that is infinitesimal, an instantaneous change in time, so in other words it is a theoretical construct. A zero-coupon rate is observable in the market as the rate payable on a zero-coupon bond.

Zero-coupon swap: Swap converting the payment pattern of a zero-coupon bond, either to that of a normal, coupon-paying *fixed-rate* bond or to a **floating rate.**

Zero-coupon yield: The yield returned on a zero-coupon bond.

Zero-premium option: Generic term for options for which there is no premium, either because the buyer undertakes to forgo a percentage of any gain or because he or she offsets the cost by **writing** other options.

Zone A: The categorisation of certain countries under Basel rules; that is, the identification of which sovereign borrowers attract the lowest risk-weighting.

> ... The New English, for the most part Johnny Rasheed and Shareef C from Surrey, were writing songs about an English day. Beautiful tunes with harmonies and melodies to match, sung with passion and spirit. Shareef C played the guitar liked he'd been born playing it, as for Johnny, well he had so much energy live that if you hooked him up to the national grid you could run London for a week. The New English....speed, style, soul, and that red, red Harrington. The best. Inspiration and spirit all rolled up into one high-energy ball of real feeling.
>
> This is it! London 1987. Enjoy.

– Nik Slater sleeve notes to *London 1987 – the definitive New English collection*
March 2001