STRATEGIC INTEREST RATE RISK MANAGEMENT: A CORPORATE ALM PERSPECTIVE

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ABSTRACT

During the early 1980's there was a sudden and dramatic increase in bank failures in the United States of America. In fact, the situation was so desperate, that it threatened to collapse the entire financial system of that country. Subsequent investigations into the cause of the bank failures showed that the banks had failed because the traditional model of managing the assets and liabilities of a bank separately could not cope with modern demands. The banks that had survived the ordeal all had some form of communication between the managers of assets and the managers of liabilities. This realization led to the birth of the field of Asset and Liability Management, or ALM. Today, ALM is widely used by banks and other entities in the financial services industry as the accepted method of managing financial risk. Strangely, the same cannot be said of the other industries. Traditionally, corporates in the manufacturing, agricultural and retail industries were involved solely in the buying and selling of goods and services, a business model which does not require an ALM process. Over the last few decades, however, the face of the corporate sector has changed dramatically. Many corporates are now involved in activities which are traditionally associated with banks. This is especially true in the agricultural and retail industries. For example, agricultural co-operatives borrow money from banks, which they on-lend to their members. Many retail companies have in-store credit cards, as well as other types of finance, which they offer to their clients. As a matter of fact, there are several retail companies in South Africa who derive the majority of their income from the interest they charge on their debtors' book. Through these activities, corporates are exposed to the same risks as banks, and they should therefore employ risk management methodologies similar to those employed by banks. This dissertation explores the history of ALM and establishes the need for ALM in the corporate sector. It then shows how the ALM methodologies developed for banks, as well as the financial instruments used to hedge interest rate risk, can successfully be applied to strategic interest rate risk management in the corporate sector.

OPSOMMING

Gedurende die vroeë 1980's was daar 'n drastiese toename in bankmislukkings in die Verenigde State van Amerika. Latere ondersoeke na die oorsaak van die mislukkings het getoon dat die banke misluk het omdat die tradisionele model vir die aparte bestuur van die bates en laste van 'n bank, nie voldoende was om tred te hou met moderne verwikkelinge nie. Die banke wat oorleef het, het almal 'n vorm van kommunikasie gehad tussen die bestuurders van bates en die bestuurders van laste. Dié besef het gelei tot die geboorte van die vakgebied Bate- en Lastebestuur, of te wel BLB. Vandag word BLB algemeen deur banke en ander finansiële instelllings gebruik om finansiële risiko's te bestuur. Dieselfde kan egter nie gesê word van organisasies in ander industrieë nie. Korporatiewe instellings in industrieë soos vervaardiging, landbou en kleinhandel, was tradisioneel slegs betrokke by die koop en verkoop van goedere en dienste, en die bestuur van winsmarges. Dit was dus nie nodig om 'n proses van BLB toe te pas nie. Vandag is baie korporatiewe instellings egter betrokke by aktiwiteite wat tradisioneel met banke geassosiëer was, veral in die landbou- en kleinhandelindustrieë. Landbou koöperasies leen byvoorbeeld geld by banke, wat hulle dan weer uitleen aan hulle lede. Kleinhandelaars gee kredietfasiliteite en ander vorme van finansiering aan hulle klante. Daar is verskeie kleinhandelmaatskappye in Suid-Afrika wat die grootste deel van hulle inkomste genereer uit die rente wat hulle vra op hulle debiteureboek. Sodoende stel korporatiewe instellings hulself bloot aan dieselfde risiko's as waaraan banke blootgestel word, en moet hulle dus soortgelyke risikobestuursbeginsels toepas. Hierdie verhandeling skets die agtergrond van BLB en bevestig die noodsaaklikheid en toepasbaarheid daarvan in die korporatiewe sektor. Daarna word gewys hoe die BLB metodes wat ontwikkel is vir banke, asook die finansiële instrumente wat gebruik word om rentekoersrisiko te verskans, suksesvol toegepas kan word vir strategiese rentekoersrisikobestuur in die korporatiewe sektor.

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CHAPTER 1: OVERVIEW

1.1 Introduction

Asset and liability management, commonly referred to as ALM, is a term often used and a concept that has become an integral part of today's business environment. Yet, few people are clear on exactly what the term ALM refers to.

As the title suggests, this dissertation will focus on strategic interest rate risk management from a corporate ALM perspective. In later chapters, interest rate risk and the tools used to measure and manage it will be covered in detail. Throughout the dissertation, however, the reader should view the material from the viewpoint of a corporate ALM practitioner, as opposed to, for example, the risk manager of an interest rate trading desk in a bank. It is therefore imperative that the reader establishes a clear image of what the term ALM means before delving into the various detailed aspects described in the following chapters.

This chapter first of all defines the concept of ALM very clearly in order to give the reader a thorough understanding of what the term entails. This is followed by a brief history of ALM and its development to serve the needs of the banking sector. The problem statement, goals and layout of the dissertation are also described.

1.2 Definition

One of the best descriptions of ALM is found in the 2002-2003 SOA Professional Actuarial Speciality Guide: Asset-Liability Management. It defines ALM as follows (Society of Actuaries, 2003:2):

"ALM is the practice of managing a business so that decisions and actions taken with respect to assets and liabilities are coordinated. ALM can be defined as the ongoing process of formulating, implementing, monitoring and revising strategies related to assets and liabilities to achieve an organisation's financial objectives, given the organisation's risk tolerances and other constraints. ALM is relevant to, and critical for, any organization that invests to meet its future cash flow needs and capital requirements."

The ALM process is the process by which an institution's assets and liabilities, along with their associated risks, are managed simultaneously. Put differently, it is the coordination of the interrelationships between the sources and uses of funds in short-term financial planning and decision-making (Haslem, 1984:116). "In its most pristine sense, asset/liability management involves the coordination of all balance sheet categories in a way that maximizes shareholder value" (Graddy et al, 1985:495). The ALM process is the responsibility of the Asset and Liability Management Committee, or ALCO. The ALCO is the nerve center of any bank and is responsible for the strategic risk management of the bank.

Although ALM has traditionally focused on managing interest rate risk, it has evolved so that today it considers a much broader range of risks. These include equity risk, liquidity risk, currency risk, legal risk and sovereign or country risk. The main focus of this dissertation, however, is interest rate risk.

The following section describes the history of ALM and how it was originally developed for the banking industry. Today, however, it is practiced in diverse settings. Derivative dealers manage their long and short positions. Bankers coordinate the re-pricing and cash flow characteristics of their assets and liabilities. Pension plans adjust their assets to mirror the characteristics of their liabilities with respect to interest rates, equity returns and expected changes in wages. Insurers select investment strategies to ensure they can support competitive pricing and interest crediting strategies (Society of Actuaries, 2003:2).

This dissertation will also show in detail the importance of ALM in the corporate environment and how the ALM model developed for banks can be successfully applied to the corporate sector.

1.3 The history of ALM

In the early part of the 1980's the financial system in the United States of America experienced one of the biggest financial crises in the history of that country. During this time, the bank failure rate in the USA saw a dramatic increase. From 1946 to 1982, only 187 banks failed, about 6 banks per year. In 1982, 42 banks failed, followed by 48 bank failures in 1983. In the first eight months of 1984, 54 banks failed (Graddy et al., 1985:459).

The sudden increase in bank failures was evidence that the traditional bank management models were no longer sufficient. Subsequent investigations by MBA students yielded a very interesting result: The institutions that survived the time of crises had either an active social club or a tee room. Unbelievable as this may sound, further studies have shown that this was indeed the case. Traditionally, bank assets and bank liabilities were managed separately. Typically, employees responsible for raising funds and managing liabilities were situated on one floor or part of the office block. Employees dealing with customers, granting loans, managing assets and credit risk, were situated on a different floor. There were very little or no communication between these two groups of employees. This was known as the separation principle: Decisions pertaining to asset composition can be made independently of decisions about how to raise funds to support those assets (Mason, 1979:225).

In institutions that had a social club or a tea room, the social interaction between the asset managers and the liability managers made them aware of each other's situations. This lead to integrated strategies and was part of the reason why those institutions survived the crises.

Today it is a well-known fact that the risks which financial institutions face are inter-related. Credit risk can lead to defaults on the bank's assets, which in turn increases the risk that the bank will not have enough liquidity to meet its own obligations (liquidity risk). Market risk can also lead to increased liquidity risk if the market moves against a bank's trading positions. If the market moves in favour of the bank's trading positions, the bank's exposure to counterparties is increased (credit risk), which can lead to defaults and liquidity problems (liquidity risk).

The interaction between different classes of risk was precisely what led to the downfall of the financial institutions in the early-eighties. Since assets and liabilities were managed separately, the risks associated with each were also managed separately. The interaction between the different types of risk was therefore not given the attention it deserved, with disastrous consequences. In the case of a bank, both assets and liabilities are paper claims, and the independence assumption does not reflect reality (Mason, 1979:225).

The revelation of the importance of the interaction between the different types of risk, and therefore the important relationship between the assets and liabilities that these risks are associated with, gave birth to the field of Asset and Liability Management, or ALM. The ALM process is the process by which an institution's assets and liabilities, along with their associated risks, are managed simultaneously. Put differently, it is the coordination of the interrelationships between the sources and uses of funds in short-term financial planning and decision-making (Haslem, 1984:116).

In terms of interest rate risk, Styger & van der Westhuizen (2002:1) defines the responsibility of the ALCO as follows: "Banks are managers of risk. One of the fundamental risks that are faced by all banks is the interest rate risk. A bank's asset and liability management committee (ALCO) is responsible for measuring and monitoring interest rate risk. It also recommends pricing, investment, funding and marketing strategies to achieve the desired trade-off between risk and expected return. In managing the interest rate risk the ALCO co-ordinates, or directs, changes in the maturities and types of bank assets and liabilities to sustain profitability in a changing economic environment."

Banks are traditionally in the business of raising funds on one hand, and lending funds on the other. Banks source funds in various ways and the collection of funding instruments used is called the funding portfolio or the liability portfolio. The funding portfolio typically consists of short-term debt like deposits and money market instruments, as well as medium-term and long-term debt like equity and capital market instruments.

Banks use the funds raised in the funding portfolio to invest in various types of assets. These could include mortgage loans, vehicle finance, project finance, overdraft facilities and credit cards. Banks also use the funds as capital to fund their trading activities or to invest in liquid money market instruments for liquidity purposes. The collection of assets of a bank is called the asset portfolio.

All the different types of assets and liabilities that comprise the book of a bank have different maturity profiles, different cash flow profiles and different re-pricing profiles. This gives rise to two of the biggest risks that banks are faced with: liquidity risk and interest rate risk. Liquidity risk is defined as the current and potential risk to earnings and market value of stockholders' equity that a bank cannot meet payment or clearing obligations in a timely and cost-effective manner (Koch, 2000:124). Interest rate risk is defined as the decline in earnings due to movements in interest rates (Bessis, 1998:8). As stated earlier, this study will primarily focus on interest rate risk: Its sources, its quantification and its hedging. The focus on interest rate risk is a reflection of its importance to the bottom line and well being of financial institutions and, as the study will show, also to corporates.

Whereas most banks have diversified and derive fee income from the various services that they provide, banks still earn the largest portion of their income from their net interest margin, or NIM. The NIM of a bank is the difference between the interest they receive on their asset portfolio and the interest they pay on their funding portfolio. Due to its importance to the bottom line of the bank, managing the NIM is one of the primary concerns of the ALCO. The ALCO is responsible for the strategic risk management of the bank, which means it has to structure the bank's balance sheet in such a way that it will be protected against and benefit from likely future events.

Designing and evaluating strategies for structuring the bank's balance sheet in such a way forms part of the ALCO process, which will be discussed in detail in the dissertation. There are various ways in which the ALCO can restructure the balance sheet in order to change an institution's interest rate sensitivity profile and strategic creativity on the part of the ALCO is a requirement. The dissertation will discuss various possible strategies in an attempt to show the possibilities, which are endless. It is up to the ALCO to thoroughly understand the current position of the organisation. Once this is achieved, the ALCO can then use the basic building blocks to compile a strategy that suits the specific needs of the specific institution.

The basic building blocks of an ALM strategy are three-fold (Decillion, 2003:1):

- The bank could invest in different asset products, or the interest rate profiles of existing products could be changed.

- The bank could fund with different products.

- The bank could use derivatives to change the profile of the balance sheet without having to change the underlying assets and liabilities. There is a wide variety of derivatives available in the market and by implementing the field of financial engineering, different types of derivatives can be combined to form a new derivative product. This is what is referred to as structured products. The possibilities are endless. The different types of interest rate derivatives, as well as some of their possible combinations and how they can be used to hedge against interest rate risk will be discussed in great detail.

Today ALM is widely used throughout the financial industry and increasingly so by corporates. Over the decades the process of ALM was refined to the point where there is now a generally accepted model for implementing ALM in any organization. Whereas the specifics and complicity of each step in the process may differ from one organization to the next, the basic framework can be applied universally. This basic framework will be discussed in detail in Chapter 2.

1.4 Problem statement

Since corporates act in similar ways to banks and are faced with, amongst others, the same financial risks, these risks have to be managed properly in order to ensure the survival of the corporates. The question that this dissertation attempts to address is: How can the ALM methodology developed for banks be applied successfully in the corporate sector to manage interest rate risk?

1.5 Goals of the dissertation

The dissertation will meet four goals:

- To show the need for ALM in the corporate environment.
- To define the tools that can be used to measure interest rate risk.
- To define the instruments that can be used to hedge interest rate risk.
- To demonstrate the use of the above measurement tools and hedging instruments through a corporate case study, thereby satisfying the above problem statement.

1.6 Layout of dissertation

The dissertation comprises of seven chapters. In Chapter 1 the concept of ALM is defined and a brief history of the development of ALM is given. The problem statement, goals and layout of the dissertation are also described.

Chapter 2 investigates the need for ALM in the corporate environment. Chapter 3 deals with interest rate risk, which is the main focus of the dissertation. It defines interest rate risk, gives a detailed discussion on the term structure of interest rates, and describes the tools for measuring interest rate risk.

Chapter 4 and Chapter 5 describe the different notional and derivative instruments that can be used to hedge interest rate risk. Chapter 6 brings together Chapter 3, Chapter 4 and Chapter 5, and shows in a practical case study how interest rate risk should be measured and hedged in corporates. Chapter 7 is the conclusion and summarises the dissertation.

Finally, it should be noted that any reference to gender, either as male or female, should be seen as a reference to both genders, since all the concepts and ideas discussed in this dissertation is applicable to both genders.

1.7 Conclusion

This chapter started off by giving a broad definition for the term ALM. This was done in recognition of the fact that the reader needed a clear understanding of the concept of ALM in order to fully comprehend the more detailed discussions that follow in later chapters.

The chapter also described the history of the development of ALM, primarily in the banking sector, and briefly referred to the diverse environments that ALM is practiced in today.

In addition to the above, the problem statement, goals and layout of the dissertation were defined. In the following chapter, a closer look is taken at the need for ALM and the role of strategic management in the corporate environment, thereby achieving the first goal of the dissertation.

CHAPTER 2: ALM IN THE CORPORATE ENVIRONMENT

2.1 Introduction

In the previous chapter the concept of asset and liability management, or ALM, was defined. An overview was also given of the history of ALM and how the need for ALM in banks was identified. In addition, the problem statement, goals and layout of the dissertation were defined.

ALM methodologies were developed for banks. As a natural extension of this, these techniques were later also used by other financial institutions, like insurers and financial instrument trading houses.

This chapter explores how the corporate sector has entered into activities traditionally associated with banks and why this has given rise to an ALM approach in the corporate environment. In proving the corporate need for ALM, this chapter will achieve the first goal of the dissertation.

2.2 The corporate need for ALM

Many corporates and agricultural companies act in similar ways to banks: They borrow money on one hand, externally or internally, and lend it out on the other. Most of the large retail groups have in-store cards through which they give credit for purchases to customers. These are similar to the credit cards held by banking customers and the credit granted under such agreements has to be funded. Agricultural companies are in the business of providing production credit to farmers and give credit lines to farmers for derivative transactions on SAFEX. In this case too, the credit has to be funded.

In this way, corporates and agricultural companies acquire assets and liabilities with the same characteristics as those of banks, giving rise to the same risks that banks are faced with, and therefore the need for ALM. This dissertation will show how the ALM process used for banks can be successfully applied in the corporate sector.

In recognition of the risks that banks face and the potential impact that bank failures can have on the financial system of a country, banks are closely regulated, usually by the central bank of a country (Graddy et al, 1985:57-58). According to Kelly (1989:26), it is a logical function of the country's central bank to administer banking legislation and regulations in terms of the relevant Acts of Parliament. Such supervision also includes the setting of non-statutory guidelines to promote sound banking and building society business and practice, and strives for adequate internal control and auditing systems within all such institutions. One of these guidelines is the implementation of a sound ALM process.

The central bank prescribes certain management practices, reports and statements, disclosure of information regulatory capital that banks have to keep against the risks they are faced with (Graddy et al, 1985:58). Since the central bank acts in terms of Acts of Parliament, the regulator has the power to enforce its prescriptions by law, and banks that do not comply will lose their banking licenses. Banks therefore have no choice but to incur the substantial cost of implementing the necessary systems and processes in order to comply with regulations.

As stated above, many corporates today act like banks and therefore face the same risks as banks. Corporates, however, are not regulated, apart from the stipulations of the Companies Act. The question thus arises: Why should corporates go through the costly exercise of implementing the systems and processes, including ALM, required for sound corporate governance, if they are not required to do so by law?

The first and most obvious answer to this question is that unmanaged risks will invariably lead to unexpected losses of an unknown quantity. By entering into traditional banking activities and then ignoring the substantial associated risk, the company is simply setting a time bomb for itself and putting its profitability at risk.

Styger & van der Westhuizen (2002:3) links the profitability of a bank to ALM as follows: "The critical factor in achieving high bank profitability is the development of an analytical framework of asset and liability management which highlights key relationships and identifies major underlying influences."

According to J.P. Morgan/Arthur Andersen (1997:8), the value of a loss is increased by the costs of financial distress. The appearance of financial difficulty puts a firm in a more difficult position with customers, who will not value long-term quality assurances. Suppliers will also adjust their terms in order to recoup the increased cost of doing business with a firm in distress. Therefore, if the firm can hedge against risk at sufficiently low cost, it should.

The second and less obvious answer is that corporates are dependent on capital injections in the form of bank funding, equity and paper issued in the market. How well a company manages its risks has a definite impact on how the company is perceived by the market. The cost of capital is directly linked to the company's perceived risk of default in the market.

J.P. Morgan/Arthur Andersen (1997:9) states the following: "Many companies have experience with insuring their assets to secure financing, particularly buyers of long-term capital-intensive assets such as the airlines. Small energy companies are often required to hedge some of their earnings to obtain bank-debt. Project financing in many cases involves hedging to reduce the volatility of cash flows... And finally, rating agencies are beginning to examine the benefits of hedging when evaluating debt issuances and tax reduction."

The way the market views a particular firm is determined by how well the firm performs on issues related to sound corporate governance. There is, however, no regulatory environment for corporates by which a firm's compliance to corporate governance can be measured.

In order to address this issue, the King Committee on Corporate Governance issued their first report, known as the King report (IOD, 2005), in 1994, which contained the Code of Corporate Practices and Conduct. The Code is not legally binding, but if a company wishes to be perceived by the market as following best international practices, it has to comply with the Code. In 2002, the King Committee issued a second report, known as the King 2 report (IOD, 2005).

The following highlights of the King 2 report, pertaining to the relationship between corporate governance, boards of directors, investors and risk management, were taken from the Institute of Directors (IOD) in Southern Africa's Executive Summary of the King Report (IOD, 2002:6 – 44):

- Highlights regarding the importance of good corporate governance:
  - The purpose of the King Committee is to promote the highest standards of corporate governance in South Africa.
  - Corporate governance principals were developed, amongst other reasons, to protect investors against the excessive concentration of power in the hands of the managers.
  - In the age of electronic information and activism, no company can escape the adverse consequences of poor governance.

- If South Africa is to remain a destination of choice for emerging market global investors, it must visibly demonstrate impeccable governance standards.

- Markets exist by the grace of investors. Today's more empowered investors will determine which companies will stand the test of time. No market has a divine right to investors' capital.

- The seven characteristics of good corporate governance are discipline, transparency, independence, accountability, responsibility, fairness and social responsibility.

- In order to attract capital, companies need to be perceived in the market as well-governed. Simply by developing good governance practices, managers can add significant shareowner value.

- The information age has made everyone part of the global market place. Capital can flow at the push of a button.

- Amongst other things, the report specifically mentions management credibility, risk management and benchmarking as aspects of company performance that should be monitored.

- Highlights regarding the Code of Corporate Practices and Conduct:

  - The code applies to all companies listed on the JSE, all banks and financial institutions and all public sector enterprises and agencies.

  - All companies, in addition to those above, should give consideration to the Code insofar as the principals are applicable.

- All stakeholders interacting with such companies are encouraged to monitor the application of the Code by these companies.

- Highlights regarding the board of directors:

    - The board is the focal point of the corporate governance system and is ultimately responsible and accountable for the performance and affairs of the company.

    - The board should have full control over the company and ensure that management implements board strategies and plans.

    - The board must identify and regularly monitor key risk areas and performance indicators.

    - The board is responsible for the total process of risk management. Management is accountable to the board for designing, implementing and integrating the process of risk management.

    - Risk management policies should be defined and communicated to all employees.

    - The board must decide the company's appetite for risk in pursuit of its goals and objectives.

    - The board should ensure that an ongoing system for identifying and quantifying risk has been implemented and that risks are managed proactively.

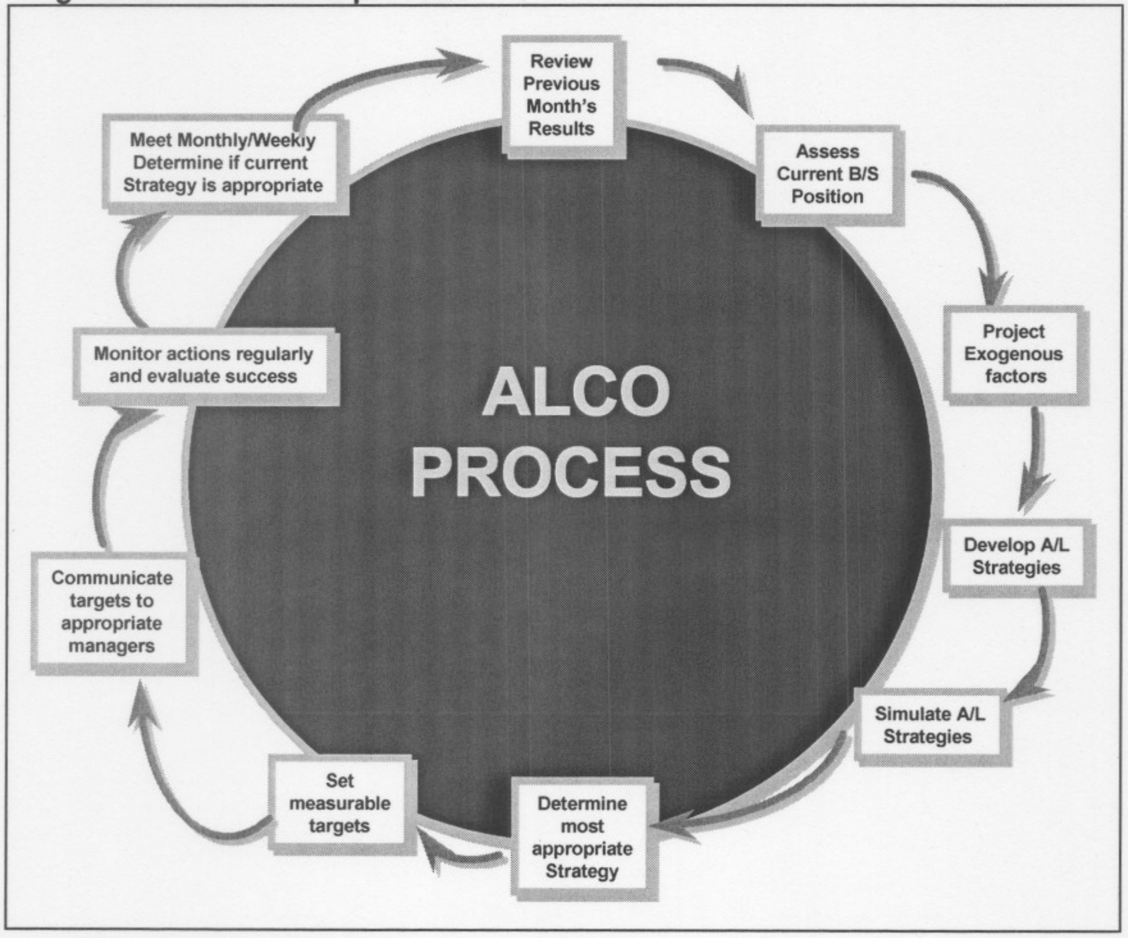
    - The board should make use of generally recognised risk management models and frameworks.

- All boards and individual directors have a duty to ensure that the principles set out in the Code are observed.

It is clear from the above that sound corporate governance is a key aspect by which the business world of today judges companies and that such companies will do well to comply.

It is also clear that one of the main elements of sound corporate governance is an ongoing, integrated process of risk management, controlled directly by the board, and that the board should use generally recognised risk management models. In an asset and liability environment, like that of banks and now increasingly large corporates, one of the most widely used models is the ALM process.

Figure 2.1: The ALCO process



Decillion Limited (2003:1)

Figure 2.1 describes the generally accepted model for ALM. It shows the ten steps of the ALCO process in chronological order, starting with the first step at the top and proceeding to the other steps in a clockwise direction. In more detail, the steps described by Figure 2.1 are as follows (Decillion Limited, 2003:1-2):

- ***Step 1***: Review the previous month's results as stated in the management accounts.
- ***Step 2***: Assess the current balance sheet position, giving attention to aspects such as asset and liability cash flow and re-pricing profiles, as well as the liquidity position.
- ***Step 3***: Project the exogenous factors affecting the business for the period under consideration. These could include various interest rates and exchange rates, as well as other economic variables not under control of the company. Determine the sensitivity of the future performance of the business to these projections or forecasts.
- ***Step 4***: Develop asset and liability strategies, which could include hedging strategies, new products and new funding arrangements.
- ***Step 5:*** Run simulations for the forecast period, testing the different strategies under the different scenarios for the exogenous factors.
- ***Step 6:*** Determine the most appropriate strategy by examining and interpreting the results of the simulations.
- ***Step 7:*** Set measurable targets for implementation of the chosen strategy.
- ***Step 8:*** Communicate the targets to the appropriate managers who will be responsible for the successful implementation.
- ***Step 9:*** Monitor the actions taken regularly and evaluate the success of the implementation of the strategy and whether or not it is achieving the desired results.
- ***Step 10:*** Meet weekly or monthly to determine if the current strategy is still appropriate. If the environment has changed or if the desired results are not achieved, the strategy should be changed or replaced.

The entire process should be repeated at least on a monthly basis. Steps 1 to 5 normally form part of the pre-ALCO process. Steps 6 to 10 involve decision-making and therefore require the attention of the senior members forming the ALCO committee.

The results of the pre-ALCO process should be summarised in an ALCO documentation pack, which should be distributed to the members of the ALCO at least a week before the ALCO meeting. This will allow the members of the ALCO to prepare properly for the meeting and ensure the maximum benefit.

Managing risk is a very important function of ALM. However, there is another and perhaps equally important function of ALM: To help with the strategic decision making process in the company. In the next section, the concept of strategic management and how it relates to ALM is discussed in detail.

2.3 Strategic management

The strategic management of a company is the domain of the board and top management. Strategic management is forward-looking and has the goal of positioning a company in such a way that its ability to reach the strategic goals and objectives in the future is optimized.

Collins & Devanna (1990:292) defines strategy as a pattern of objectives, purposes, or goals and plans for achieving those goals, stated in such a way as to define what business the company is in or should be in. Vosloo (2003:30) says that strategic management strives to create a fit between opportunities, challenges, strengths, weaknesses, personal values and the broad societal expectations through strategy formulation and strategy implementation.

Weihrich & Koontz (1993:169) define strategy as the determination of the purpose and long-term objectives of a company, and the adoption of plans of action and allocation of resources necessary to achieve those goals. Pearce & Robinson (1995:3) says the following: "Strategic management is defined as the set of decisions and actions that result in the formulation and implementation of plans designed to achieve a company's objectives."

Strategic management is therefore the process by which top management tries to create a competitive advantage for the company to better its chances of survival in a competitive environment. In order to do so, the board and top management need to clearly define the strategic goals of the company. The company's strategic goals depend on top management's views on where the company should be focusing its efforts. Therefore, the strategic goals act as pivot points to ensure the organisation's success in achieving the ultimate goal of profitability and sustainable growth.

In light of this ultimate goal, Vosloo (2003:22-23), says the following: "... [companies] are confronted with specific strategic imperatives. Some of these imperatives ... are *inter alia* the creation of a sustainable competitive advantage with the ability to accommodate changes in the dynamic competitive environment where various challenges are imposed by the internal and external environment...corporate governance and shareholder wealth creation and maximisation."

The creation of a sustainable competitive advantage is one of the most important objectives of strategic management. If the top management fails to position a company in such a way that it can remain competitive, the company will surely not remain profitable. However, what is a sustainable competitive advantage?

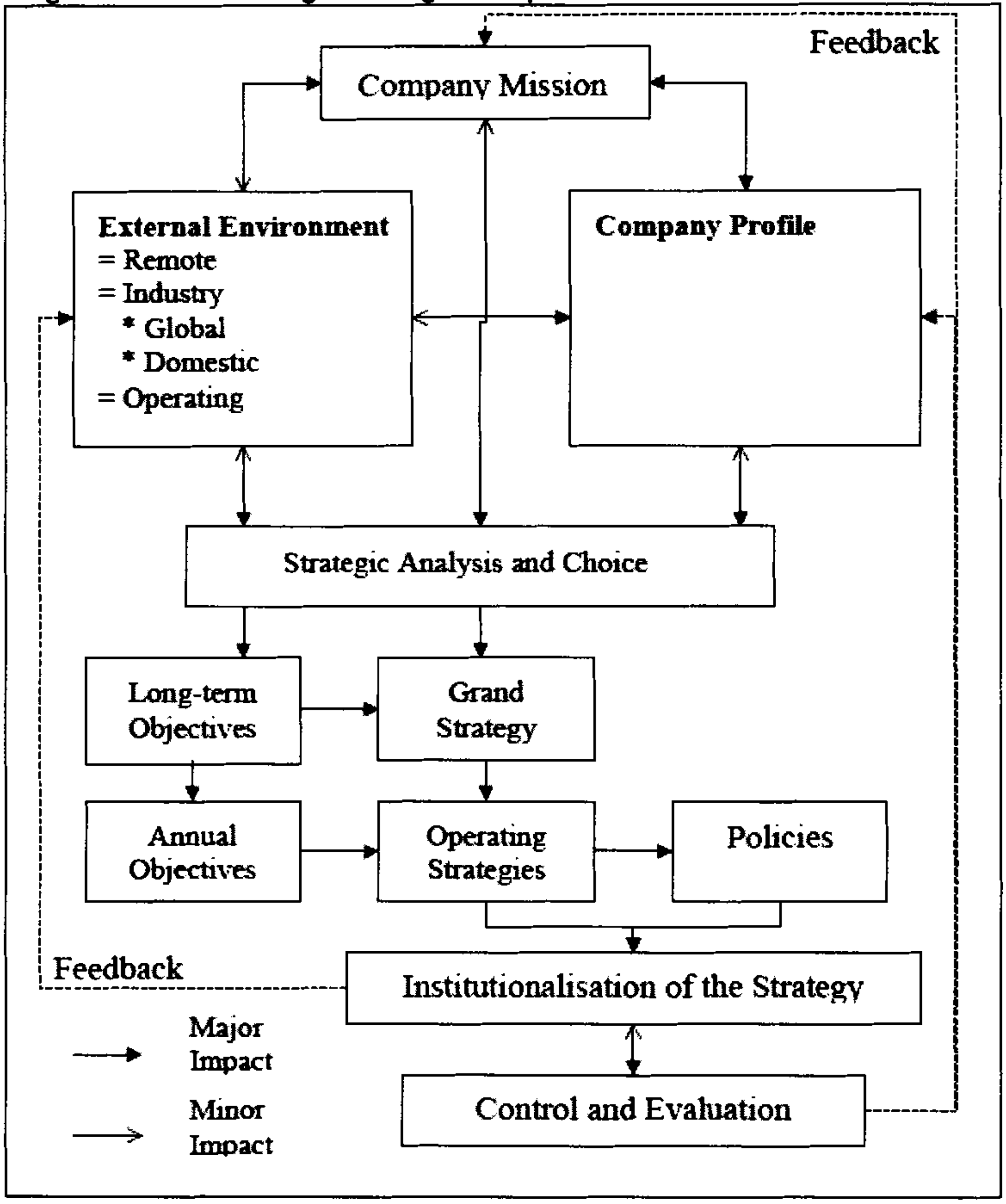
According to Thompson & Strickland (1989:181), there are three main elements to a competitive advantage. Firstly, there should be a differentiation in important attributes. The differentiation must be reflected in some delivery attribute that is a key criterion for the market. Secondly, the advantage should be durable, which depends heavily on managerial quality and their ability to be consistently innovative and to adapt quickly and effectively. Finally, the competitive advantage should be sustainable, which relates to management's ability to maintain the advantage once created.

One of the most important tools that managers use for effective strategic management is scenario analysis. This enables management to be pro-active by considering in advance different scenarios for key variables affecting the business and to plan accordingly. Today's technology provides powerful simulation systems through which different scenarios and strategies can be tested. Vosloo (2003:24) says the following: "Maintaining competitive advantage and ensuring long-term survival depends on an institution's ability to pro-actively and rapidly change but also being able to accommodate change. This can be achieved using scenario-planning theory...as it becomes a key component in an institution's ability to accommodate change."

In Chapter 5 the use of scenario analysis in ALM will be demonstrated in detail. The case study will illustrate clearly how dynamic simulation models are used to do scenario analysis, quantify risk and test hedging strategies. Scenario analysis forms an integral part of ALM. From the above paragraphs, it follows that ALM forms an integral part of strategic management.

Another key objective of strategic management is that of maximizing the wealth of its shareholders (Levy & Sarnat, 1982:9). An organization belongs to its shareholders who expect a return on their investment inclusive of a premium for the risk involved. Management should aim to ensure that the owners of the organization are satisfied in their expectations. In this regard, the process of achieving the company's goals and objectives can be described as the process of shareholder wealth creation and maximization.

Figure 2.2: The strategic management process



Pearce & Robinson (1995: 18)

Figure 2.2 describes strategic management as a dynamic, reiterative process. Starting from the top, it shows that strategic management starts with the company mission, which is influenced by both the external environment and the company profile. In turn, the company profile has a major impact on the company mission. The company's mission and profile, together with the external environment, determines the process of analyzing and choosing strategies.

From this analysis, the long-term objectives and grand strategy are formulated. The long-term objectives are then broken down into annual targets or objectives that, together with the grand strategy, give rise to the operating strategies and the company policies. This is followed by the institutionalization of the strategies and continuous control and evaluation to measure the effectiveness of the strategies and their implementation.

The feedback gained from the last step is again used as inputs at the top of the process, and all the steps are repeated. In this way, management is continually striving to refine the strategy and giving the company the best possible chance at achieving and maintaining a competitive advantage. The ALM process, as described earlier in this chapter, along with the associated scenario analysis, is an essential tool in this process, notably when analyzing and choosing strategies.

According to Hodnett (1998:1), the concept of shareholder wealth creation is measured by focusing on five explicit measurements. These are asset growth, Return on Investment (ROI), Return on Equity (ROE), Return on Assets (ROA) and the level of operating expenditure as reflected in the cost-to-income ratio. From a risk management perspective, Return on Risk Adjusted Capital (RORAC), Risk Adjusted Return on Capital (RAROC) and Value at Risk (VAR) are used to measure the creation of shareholder value.

As will be seen in later chapters, testing future scenarios and strategies through simulation, and assessing their impact on the key variables important to the business, falls directly in the domain of ALM. Therefore, once again, it is argued that ALM is an all-important tool for effective strategic management.

2.4 Conclusion

In Chapter 1 the concept of asset and liability management, or ALM, was defined. An overview of the history of ALM was given and the need for ALM in banks, as well as other financial institutions, was described. In short, Chapter 1 gave a broad overview of the concept of ALM, its origins and its reason for existence, aimed at broadening the reader's understanding of ALM and setting the scene for the chapters to follow.

Chapter 2 endeavoured to achieve the first goal the dissertation: To prove the need for ALM in the corporate environment. This chapter explored how the corporate sector is engaged in activities traditionally associated with banks and why this has given rise to an ALM approach in the corporate environment. It has shown that corporates are faced with the same risks that banks are faced with, including, but not limited to, interest rate risk.

Referring to various issues such as potential losses, profitability, sustainability, the King 2 report, corporate governance, market perception and strategic management, this chapter has proven that an ALM approach in corporate management is no longer a luxury, but indeed a necessity.

As stated earlier, one of the most important aspects of ALM, and the main focus of this dissertation, is that of interest rate risk management. In order to manage any kind of risk, including interest rate risk, the risk has to be quantified. Accordingly, the following chapter, Chapter 3, will achieve the second goal of the dissertation by defining interest rate risk and the tools used to measure it.

CHAPTER 3: MEASURING INTEREST RATE RISK

3.1 Introduction

In Chapter 1 the term ALM was defined and a brief history of its development for the banking sector was given. The problem statement, goals and layout of the dissertation were also described.

Chapter 2 endeavored to satisfy the first goal of the dissertation, which is to show the need for ALM in the corporate environment. It described how many large corporates today engage in activities traditionally associated with banks. Referring to statements in the King 2 report regarding corporate governance and concepts such as market perception and strategic management, the need for ALM for such entities was established.

In this chapter, Chapter 3, the dissertation turns to its main focus, which, as stated before, is interest rate risk. In order for any risk to be managed properly, it must first be understood, measured and quantified. In later chapters, the instruments used to hedge against interest rate risk will be defined and their practical use will be demonstrated. First, however, this chapter will define interest rate risk, followed by a detailed discussion on the term structure of interest rates, commonly known as the yield curve. Understanding the shape of the yield curve and the forces that influence it is fundamental to strategic interest rate risk management.

Lastly, the tools that can be used to measure interest rate risk will be defined. In doing so, it will satisfy the second goal of the dissertation, which is to define the tools that can be used to measure interest rate risk.

3.2 Definition of interest rate risk

It has been stated several times so far that corporates are exposed to many of the same risks that banks and other financial institutions are exposed to. This is due not only to the funding of normal corporate operations, but also to the fact that many corporates are engaged in traditional banking activities, as described in Chapter 2. One of the main risks resulting from these activities is interest rate risk. But what exactly is interest rate risk?

Interest rate risk is the risk that earnings will decline due to movements in interest rates (Bessis, 1998:8). Alternatively, it is the risk that rising interest rates will reduce the value of a financial asset (Graddy et al., 1985:689). Many items on the balance sheet generate income and expenditure, which are linked to interest rates. Since interest rates are unstable, earnings are subject to interest rate risk. Therefore, anyone engaged in lending or borrowing is subject to interest rate risk. If a lender earns a variable rate on his investment and interest rates decline, the lender will suffer a loss of income. A borrower who pays a variable rate will have increasing interest expenditure if interest rates should rise. Clearly, both positions are risky.

Interest rate risk does not only apply to variable rate loans or investments. Interest rate risk also applies to fixed rate loans or investments that have to be renewed on maturity, since the rate at which it will be renewed will depend on market conditions at the time, and is therefore uncertain. Furthermore, according to Lore & Borodovsky (2000:118), the value of any portfolio is the discounted value of its expected cash flows. Therefore, regardless of whether or not the future cash flows are dependent on interest rate levels, the value of the portfolio will be subject to a degree of interest rate risk through the calculation of the discount factors.

A further source of interest rate risk finds its origin in the implicit options embedded in some banking products. For example, many fixed rate loans gives the borrower the option of early repayment, which is a right the borrower will exercise if rates fall substantially (Bessis, 1998:9). In such a case, the lending institution will either lose the business completely to another institution, or be forced to refinance the loan at a lower rate. Both scenarios will decrease the institution's earnings. These types of risks are known as indirect interest rate risks, since they do not arise directly from changing interest rates, but rather from the behaviour of customers in response to such changes.

In summary, interest rate risk can thus be defined broadly as the risk of any loss or decline in earnings caused directly or indirectly by changes in the level of interest rates.

Before getting into the detail of measuring interest rate risk, however, it is imperative that the reader has a good understanding of the term structure of interest rates, commonly called the yield curve. Understanding the yield curve is also essential for the discussion in Chapter 5 on interest rate derivative instruments.

3.3 The term structure of interest rates

The ability to value future cash flows is fundamental to any trading and risk management activity. This also holds true for the measurement of interest rate risk and, amongst others, pricing of interest rate derivatives. The valuation of future cash flows is achieved by implementing the discounted cash flows (DCF) methodology (Lore & Borodovsky, 2000:75). According to this methodology, the value of a future cash flow today is:

$$V_0 = C_{(t)}Z_{(t)} \qquad (3.1)$$

where V_0 = the current value of the cash flow happening at time t

$C_{(t)}$ = the amount of the cash flow happening at time t

$Z_{(t)}$ = the present value (PV) factor or discount factor

Therefore, to value any asset, the necessary information is the cash flows, their payment dates and the corresponding discount factors to PV these cash flows. The cash flows and payment dates are specified by the contract, but obtaining the discount factors requires knowledge of the yield curve (Lore & Borodovsky, 2000:75).

In the case of derivative instruments, not all the future cash flows are known. Therefore, in order to value an instrument, the yield curve is not only used to determine the discount factors, but also to estimate the expected future cash flows. In order to estimate these future cash flows, the yield curve is used to calculate the necessary forward interest rates, or forward-forwards. A forward interest rate is a rate implied by current zero (yield curve) rates for a specified future time period (Hull, 2000:93).

Forward rates for any future period or periods can be calculated from the zero rates specified by the yield curve by employing the following formula (Beaufort Institute, 2003 (b):3):

$$i_{fwd\text{-}fwd} = \left(\frac{1+(r_1 \times d_1)/b}{1+(r_2 \times d_2)/b} - 1\right) \times \frac{b}{d_1 - d_2} \qquad (3.2)$$

where r_1 = interest rate for "long period"

d_1 = days in "long period"

r_2 = interest rate for "short period"

d_2 = days in "short period"

b = day basis

Apart from knowledge of the use of the yield curve to price and value financial market instruments, any market participant making use of financial instruments should also familiarize himself with the theory behind the shape of the yield curve. This will not only give the participant insight into how the current shape of the yield curve describes the reigning economic environment, but also how changes in the economic environment can impact the future shape of the yield curve. These insights are essential for risk managers and ALM practitioners.

Originally, there were, according to Kelly (1989:16), three basic theories that sought to explain the shape, as well as likely changes in the shape, of the yield curve. They were the expectations theory, the market segmentation theory and the liquidity preference theory.

King & Kurmann (2002:49) regards the expectations theory to be the dominant explanation of the relationship between short- and long-term interest rates, and describe the theory as one that suggests that long-term rates are determined entirely by the expectations of future short-term rates. According to the theory, the yields on securities of longer maturity are the average of expected future yields on assets of shorter maturity. For example, if the 1-year yield is 6%, and the market consensus is that in one year's time the 1-year will have risen to 8%, then the current 2-year yield should be more or less the average of the two, about 7%. The market will then be in equilibrium, because the choice between investing or borrowing for two successive 1-year periods at 6% and 8% respectively, or one 2-year period at 7%, will be equivalent.

Kelly (1989:16) states that observations of the actual behaviour of yield curves as interest rates vary cyclically have shown that when the overall level of interest rates is low, the curve tends to slope upwards, and when rates are high, the curve tends to slope downwards. This is in agreement with the expectations theory: when rates are low, the market consensus is that rates will rise in the future and the curve should be upward sloping. Similarly, when rates are high, the market could reasonably expect rates to fall in the future and the curve should be downward sloping.

These effects make logical sense in light of the behaviour of borrowers and investors under the respective circumstances. When interest rates are low, one could expect the supply and demand forces to drive the level of interest rates up. Similarly, when interest rates are high, demand will be poor and supply will be high, thereby driving the level of interest rates down. In this argument it is useful to remember that interest rates are simply the price of money, and like all prices subject to the forces of supply and demand.

The market segmentation theory holds (Kelly, 1989:18-19) that there are some groups of investors who prefer long-term securities, while others prefer short-term securities. For example, life-assurance companies and pension funds have long-term liabilities and low liquidity needs, and would therefore prefer long-term assets. Banks, on the other hand, have greater need for liquidity and would avoid large-scale investment in long-term assets. Segmentation theorists believe that the shape of the yield cure is determined at any given time by the prevailing relationship between funds available for investment by long-term oriented investors, and funds available for investment by short-term oriented investors.

Lastly, the liquidity preference theory (Kelly, 1989:19) is based on the principle that long-dated securities have more market risk and more credit risk than short-dated securities. If interest rates rise, the value of long-dated securities will fall more sharply than the value of short-dated securities. Furthermore, the greater the maturity, the greater the probability of a counterparty default, thus resulting in higher credit risk. In light of such greater risk, rational investors will prefer long-dated assets to short-dated assets only if they offer higher rates of return. In other words, investors have liquidity preference, so that illiquidity premiums must be progressively applied to interest rates as the maturity lengthens.

The three theories described above were market participants' first attempts at modeling the term structure of interest rates. Of the three, the most popular seems to have been the expectations theory. A later theory, which bears some similarity to the expectations theory, is the inflation premium theory. According to this theory, investors require higher premiums for long-dated investments than for short-dated investments, because of the uncertainty of future inflation (Henriques, 2002). The theory stems from the fact that nominal interest rates change because of a change in real interest rates, or a change in expected inflation, or both. Since future inflation is uncertain, the investor has no guarantee that the nominal return on the investment will give him a positive real return over time. The longer the investment horizon, the bigger this risk becomes and the bigger the premium that a borrower will have to pay to attract long-term funds.

As with all other aspects of modeling the yield curve, the inflation premium theory has been researched in great length. In a study conducted by Ang & Bekaert (2003), they found that the real rate yield curve is fairly flat and slightly humped. The variation in nominal rates for different maturities is therefore ascribed to inflation. By using a model that they built to identify the components of the yield curve, they found that the inflation risk premium theory, with inflation premiums that increase over time, fully accounts for the normal upward sloping yield curve (see Figure 3.1).

A separate study conducted by Buraschi & Jiltsov (2005) supports the conclusion of Ang & Bekaert (2003) that inflation risk premiums is responsible for the variation in nominal interest rates over time, although to a lesser degree. According to the model built by Ang & Bekaert (2003) inflation risk premiums explained an average of 80% of the variation in nominal rates, while Buraschi & Jiltsov (2005) found that between 23% and 42% of the variation can be explained by inflation risk premiums, depending on the maturity. Buraschi & Jiltsov (2005) also found that the term structure of the inflation risk premiums is upward sloping and dependent on the business cycle.

Craig & Haubrich (2003) conducted yet another study on the inflation premium theory for the Federal Reserve Bank of Cleveland. In their study, they gained a fresh perspective on how the real and nominal influences, i.e. including inflation, interact to create the observed term structure of interest rates. By using a discrete-time multivariate pricing kernel[1], employing both yield and inflation rates, they were able to create separate estimates of the real and nominal kernels, taking into account the dynamic interaction between the real and nominal economies.

The modeling of the term structure of interest rates is, and has been for decades, one of the hottest topics for research and debate in the field of finance, as evidenced by the huge amount of literature covering the subject. According to Rebonato (2003:1) the modeling of interest rates is to this day still evolving due to several reasons, amongst others the increasing complexity of products available in the market. Perhaps another reason is because it is a considerable academic challenge. To quote Benninga & Wiener (1998:1): "Interest rates and their dynamics provide probably the most computationally difficult part of the modern financial theory."

Over the years, many different and rather complex mathematical models have been developed for estimating the true term structure of interest rates. According to Benninga & Wiener (1998:4) all of these models fall into one or the other of two broad classes: Equilibrium models and non-equilibrium models. Equilibrium models are the older class of models and attempt to estimate the yield curve by making use of consumer maximisation functions and production functions. The most famous of these is the Cox-Ingersoll-Ross model (Cox et al., 1985), which makes use of logarithmic utility functions and linear production functions. In

[1] A pricing kernel, otherwise known as a stochastic discount factor, is the stochastic process that governs the prices of state contingent claims. Furthermore, given a pricing kernel, the price of any financial asset can be computed. Under the assumption that there are no arbitrage opportunities, a pricing kernel always exists (Craig & Haubrich, 2003: 1).

another study Benninga & Protopapadakis (1986) showed that under the assumptions of maximization of concave utility functions and slightly concave production functions, the real term structure of interest rates must be upward sloping.

The second class of models, i.e. non-equilibrium models, is more popular in finance (Benninga & Wiener, 1998:4) and involves the creation of plausible and numerically tractable mathematical descriptions of the yield curve. One of the first models in this class was Vasicek's model (Vasicek, 1977), which used the Ornstein-Uhlenbeck process and derived a partial differential equation to describe the yield curve. Most of the more recent studies either develop or use models from this class. For example, in a study conducted by King & Kurmann (2002) they used linear versions of the expectations theory along with linear forecasting models of future interest rate expectations to show that the levels of both long- and short-term interest rates are driven by a common stochastic trend. In Japan, Maki (2005) employed the unit root test in a non-linear STAR[2] framework to show that the yield curve is stable with non-linear adjustment. Heidari & Wu (2002) used a dynamic term structure model to develop a new model for pricing derivatives.

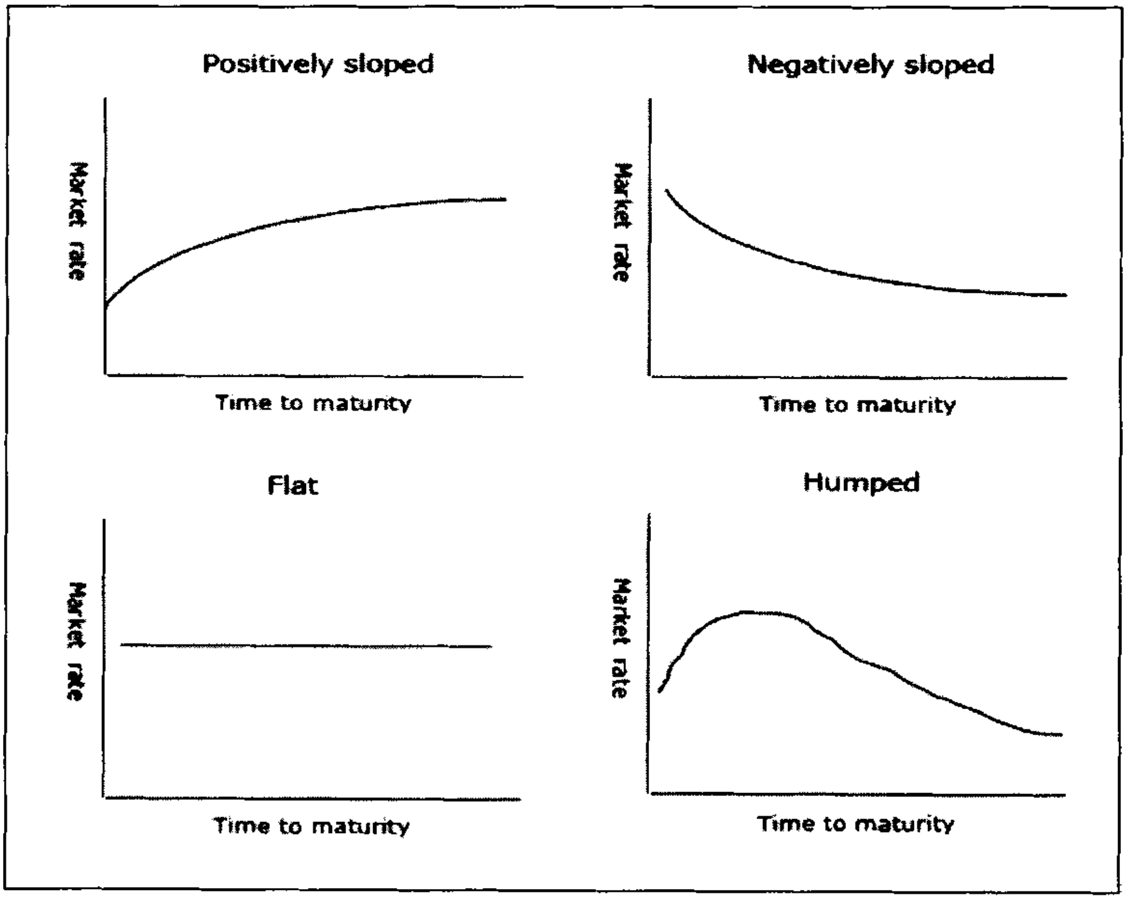
The list of studies goes on and on. It should be noted, however, that the theoretical models developed in the academic world are not always practical for implementation in the actual market place. Practical solutions are often the simpler solutions to a problem. One such example is the method employed by the Bank of Canada to model the yield curve. The model is called the Super-Bell model and was developed by Bell Canada Limited in the 1960s (Bolder et al, 1999:2-4). The model makes use of a regression function to derive a par yield curve, i.e. a curve that shows what the yields of the sample of bonds would have been if they were all trading at par. The par yield curve is then used to derive the

[2] Smooth transition autoregressive framework (Maki, 2005: 1)

theoretical zero-coupon curve, which in turn is used to determine the implied forward rates.

Criticisms against the Super-Bell model include that it can lead to forward curves with strange shapes and that the model focuses exclusively on yields instead of the actual bond cash flows (Bolder & Streliski, 1999:4). However, because of its ease of use and practical efficiency, it remains the model of choice for the Bank of Canada, in spite of all the newer and more sophisticated models available.

Figure 3.1: Basic shapes of the yield curve



SAIFM (2004 (a): 49)

Through empirical observation, several basic shapes of the yield curve have been identified. They are described in Figure 3.1. The upper left-hand corner shows a basic positively sloped (normal) yield curve. The upper right-hand corner shows the basic negatively sloped (inverse) yield curve. The bottom left-hand corner shows a flat yield curve, while the bottom right-hand corner gives an example of a humped yield curve.

Now that the concepts of interest rate risk and the term structure of interest rates have been properly defined, the next section will focus on the measurement of interest rate risk and quantifying the company's exposure thereto.

3.4 Measuring interest rate risk

In the previous section interest rate risk was defined. It was also mentioned in the introduction to this chapter that interest rate risk, like any other risk, could only be managed or hedged if it has been properly measured and quantified.

In this section, the issue of measuring interest rate risk is explored in detail. In the sections that follow several interest rate risk measurement tools will be discussed. These include the interest rate gap, duration, duration gap and dynamic simulation models.

3.4.1 Interest rate GAP

According to Kelly (1988:124) banks typically run a mismatched book, which means that they are funding long-term assets such as loans with short-term funds, or vice versa. Another term often used to describe mismatching is known as "running a gap". Gaps exist when assets and liabilities re-price or mature at different times. The term re-pricing refers to a change in the interest rate applicable to the asset or liability.

Running a mismatched book exposes the net interest margin – the difference between the interest received on assets and the interest paid in liabilities - to interest rate risk. For example, if a bank, or a corporate, runs a short-term funded mismatched book, it is hoping to profit from borrowing short and lending long. The risk is that should short-term interest rates rise rapidly, the interest spread will deteriorate and could even become negative. Conversely, if the bank is running a long-term funded mismatched book, it is hoping to profit from borrowing long and lending short. In this case, the risk is that short-term rates will fall rapidly, thereby putting the net interest spread under pressure (Graddy et al., 1985:497). In order to manage this risk, it has to be assessed properly.

Traditional static GAP analysis is a type of analysis that measures the amount of interest rate risk that an institution is exposed to at a certain point in time (Koch, 2000: 304-305). It does so by comparing the interest rate sensitivity of assets with that of liabilities over different time intervals or "time buckets". GAPs are calculated for each time bucket based on the aggregate balance sheet data at a fixed point in time. In other words, GAP analysis does not take into account future growth strategies for the book. It takes a snapshot of the balance sheet at a specific point in time and calculates an interest rate GAP for each time bucket, based on that snapshot. These GAPs are then used to determine by how much net interest income will change if rates change.

According to Koch (2000:306), there are four basic steps to GAP analysis. They are as follows:

- Develop an interest rate forecast.

- Select the series of sequential time intervals or buckets for determining when assets and liabilities are rate sensitive.

- Group all assets and liabilities, including derivative positions, into these buckets according to the time until first re-pricing. The static GAP for each bucket is then the nominal amount of rate sensitive assets (RSAs) less the nominal amount of rate sensitive liabilities (RSLs).

- Forecast net interest income given the interest rate forecast and the calculated GAPs.

For each time bucket, there is a periodic GAP and a cumulative GAP (Koch, 1989:306). The periodic GAP is the difference between RSAs and RSLs for the specific time bucket. The cumulative GAP for a specific time bucket is the sum of the periodic GAP for that time bucket plus all previous time buckets. For example, if the periodic GAPs for the 0 - 30 days bucket and 31 – 90 days bucket are 1000 and 200 respectively, then the cumulative GAP for 0 – 90 days will be 1200.

Once the GAP report has been calculated showing the GAPs and cumulative GAPs for each period, the ALCO can develop strategies to manage the associated interest rate risk. With the use of the notional and derivative instruments described in Chapter 4 and Chapter 5, it is possible to change the size of the GAP to either hedge the net interest income against interest rate risk, or to try to make gains from changes in interest rates. The latter could be done by deliberately adjusting the GAP profile of the book in such a way that the net interest income will increase if the ALCO's view of future interest rates are realised. This behaviour should clearly be deemed speculative because it is based on a certain view of future interest rates and assumes that the ALCO can forecast interest rates better than the market can.

Table 3.1 gives a simplified example of a GAP report. The company for whom the above GAP report was drawn up has R30m in both RSAs and RSLs. Of the RSAs, R7.5m either matures or re-prices within one month's time, R15m in two month's time and R7.5m in three month's time. Of the RSLs, R15.0m matures in one month's time, R10.5m matures in two month's time and R4.5m matures in three month's time. As a result, the company has a negative gap in the first time bucket equal to –R7.5m, a positive gap of R4.5m in the second time bucket and a positive gap of R3.0m in the last time bucket. The cumulative gap is negative – R7.5m by the end of the first time bucket, negative –R3.0m by the end of the second period and 0 by the end of the last period.

Table 3.1: A simplified GAP report

	BALANCE SHEET	TIME OF MATURITY OR REPRICING		
	Total	*1 Month out*	*2 Months out*	*3 Months out*
Assets	R30m	R7.5m	R15.0m	R7.5m
Liabilities	R30m	R15.0m	R10.5m	R4.5m
Gap		-R7.5m	+R4.5m	+R3.0m
Cumulative gap		-R7.5m	-R3.0m	0

Kelly (1989:127)

The above has to be interpreted in terms of the ALCO's expectation of future interest rates. If the interest rates stay flat, it will have no effect on the net interest income of the company. However, if interest rates increase, the following will happen:

- In the first month, the company will have R7.5m more RSLs re-pricing at the higher rate than RSAs, based on the *current* book. As a result, the net interest income earned for the month will decrease accordingly. If rates increase by 1% on average, one can expect that the net interest income for the month will decrease by approximately (-7.5m x 1%)/12 = -R6,250.

- In the second month, the company's RSAs will start to catch up with R4.5m more RSAs re-pricing at the higher rate than RSLs. The cumulative gap is still negative, however, so the net interest income will still be decreasing after 2 months.

- By the end of the third month, all the RSAs and RSLs will have re-priced, but the damage to the net interest income of the company will have been done.

The calculation of the expected change in the net interest income in the first point above is done according to the following formula, given by Koch (2000: 312):

$$\Delta NII_{exp} = GAP \times \Delta i_{exp} \quad (3.3)$$

where:

ΔNII_{exp}	=	the expected change in net interest
GAP	=	cumulative GAP over the interval
Δi_{exp}	=	the expected permanent change in the interest rate

If rates decrease, the following will happen:

- In the first month, the company will have R7.5m more RSLs re-pricing at the lower rate than RSAs, based on the *current* book. As a result, the net interest income earned for the month will increase accordingly. If rates decrease by 1% on average, one can expect that the net interest income for the month will increase by approximately (-7.5m x -1%)/12 = R6,250.

- In the second month, the company's RSAs will start to catch up with R4.5m more RSAs re-pricing at the lower rate than RSLs. The cumulative gap is still negative, however, so the net interest income will still be increasing after 2 months.

- By the end of the third month, all the RSAs and RSLs will have re-priced, but the increase in the net interest income of the company will have been realized.

From the above, it is clear that the book of the company under consideration is structured for decreasing interest rates. If rate decrease, the net interest income will increase, and vice versa. Therefore, if the ALCO is of the opinion that interest rates are going to decrease, no action is required. However, if they believe that interest rates are going to increase, they should employ derivative transactions or other means to reduce the negative gap to zero, or even make it positive.

Table 3.2: The relationship between GAP and net interest income

GAP Summary					
GAP	**Change in Interest Rates**	**Change in Interest Income**		**Change in Interest Expense**	**Change in Net Interest Income**
Positive	Increase	Increase	>	Increase	Increase
Positive	Decrease	Decrease	>	Decrease	Decrease
Negative	Increase	Increase	<	Increase	Decrease
Negative	Decrease	Decrease	<	Decrease	Increase
Zero	Increase	Increase	=	Increase	None
Zero	Decrease	Decrease	=	Decrease	None

Koch (2000:310)

Table 3.2 describes the direction of changes in net interest income for both an increase and decrease in interest rates based on the different possible GAP positions. If the GAP is positive, an increase in interest rates will lead to a larger increase in interest income than in interest expense, because more assets than liabilities will re-price at the higher interest rate. As a result, net interest income will increase. If interest rates decrease, the net interest income will also decrease. If the GAP is negative, an increase in interest rates will lead to a larger increase in interest expense than in interest income, because more liabilities than assets will re-price at the higher interest rate. As a result, the net interest income will decrease. If interest rates decrease, the net interest income will increase. If the GAP is zero, it means that there is an equal amount of assets and liabilities re-pricing for any given change in interest rates. The net interest income will therefore not be affected by the change in interest rates, i.e. the book is neutral.

That concludes the section on GAP analysis. In the following section, the concept of duration is detailed.

3.4.2 Duration

According to Kelly (1989:131-132), duration is an alternative method to GAP analysis for the management of interest rate risk. It is a measure of the average life of a stream of payments. Unlike GAP analysis, which focuses solely on the net interest margin and income, as measured by conventional accounting methods, duration disregards traditional accounting considerations and focuses on market value.

Kelly (1989:131-132) further states that duration is measured in units of time as a measure of average maturity. Duration is almost always smaller than maturity. The only exception is in the case of discounted products, like for example Treasury Bills, banker's acceptances and zero coupon bonds. In these cases, duration is equal to maturity. As can be seen from the formula for Macaulay duration later in this section, this characteristic of duration is due to the fact that for discounted products there are no interim cash flows between the time of valuation and maturity.

As will be seen later in the calculation of duration, it is a measure of effective maturity that incorporates the timing and size of a security's cash flows. It is a measure that captures the combined effect of interim payments, market rate and maturity on the security's price volatility. Duration is an indication of how price sensitive a security or portfolio is to changes in interest rates. According to Hull (2000:19), the percentage change in a bond's price due to a shift in the yield curve is approximated by the bond's duration multiplied by the size of the shift. It follows that the greater the duration of the security or portfolio is, the greater the price sensitivity, and vice versa.

According to Koch (2000:232), duration is conceptually best understood as a measure of interest elasticity in determining a security's market value. Koch further states that, in general, the price elasticity of demand is given by the following formula:

$$\text{Price elasticity of demand} = -\frac{\%\text{ change in quantity demanded}}{\%\text{ change in price}} \qquad (3.4)$$

This elasticity measure indicates by how much demand will fall due to an increase in the price, and vice versa. For example, if a bank raises its ATM charge from 25 cents to 35 cents per transaction, and monthly ATM transactions drops from 12,000 to 10,000, then the price elasticity of demand is estimated at 0.416, calculated as follows:

$$\text{Price elasticity of demand} = -\frac{-2{,}000/12{,}000}{0.10/0.25} = 0.416 \qquad (3.5)$$

Therefore, assuming that elasticity stays constant at higher prices, the bank can estimate that a further 20% price increase to 42 cents per transaction will lower usage by approximately 8.3% (i.e. 0.20 x 0.416) to 9,166 transactions per month.

Following the discussion above, duration can also be interpreted as an elasticity measure. Instead of the above relationship between quantity demanded and price, duration provides information on the relationship between market value and interest rates. As such, Koch (2000: 233) approximates duration with the following equation:

$$\text{Duration} \cong -\left[\frac{\Delta P / P}{\Delta i / (1+i)}\right] \tag{3.6}$$

where:

P = the price of the security

i = the prevailing market interest rate

In the above equation, the numerator represents the percentage change in price and the denominator the approximate percentage change in interest rates.

Solving for ΔP, the equation can be restated as follows:

$$\Delta P \cong -\text{Duration} \times \left[\frac{\Delta i}{(1+i)}\right] \times P \tag{3.7}$$

This formula can be used to approximate the change in price of a security for a change in the market rate. For example, consider a 3-year zero coupon bond paying R10,000 at maturity. Discounted at 9.4% NACS the current price of the bond is R7,591.37. As stated earlier, the duration of a zero coupon bond is equal to its maturity, in this case 3 years or 6 semi-annual periods. If the market rate rises from 4.7% NACS to 5% NACS, the change in the market price of the bond can be estimated as follows, using semi—annual data (adapted from Koch, 2000:232):

$$\Delta P \cong -6 \times \left[\frac{0.003}{1.047}\right] \times \text{R}7{,}591.37 = -\text{R}130.51 \tag{3.8}$$

The above estimated price change is an approximation, and will deviate slightly from the actual price change. The difference between the duration estimated price change and the actual price change is due to convexity, which falls outside the scope of this text.

Simplistically, duration is applied in interest rate risk management by first calculating the duration of assets and liabilities separately. According to Bessis (1998:207), duration has the additivity property. This means that the duration of a portfolio is equal to the weighted average of the durations of the components of the portfolio, with each component's market value being applied as its weight.

The duration of the assets is then compared to the duration of the liabilities. If the duration of the assets is longer than the duration of the liabilities, then earnings will fall if interest rates rise. This is due to the fact that, because of the longer duration, the market value of the assets will fall more than the market value of the liabilities. However, should interest rates fall, then earnings will rise, because the market value of the assets will increase by more than that of the liabilities (Kelly, 1989:132).

Conversely, if the duration of the assets is shorter than the duration of the liabilities, and interest rates rise, then the market value of liabilities will fall by more than the market value of assets, leading to increased earnings. If interest rates fall, then the market value of the liabilities will rise by more than the market value of the assets and hence, earnings will decline.

From a duration analysis point of view, interest rate sensitivity is eliminated if the duration of assets is equal to the duration of liabilities, as opposed to GAP analysis, where interest rate sensitivity is eliminated if the value of assets and liabilities maturing or re-pricing is equal. In other words, if interest rate risk is managed through a duration approach instead of a GAP approach, then asset and liability maturity matching is replaced by duration matching.

There are two traditional forms of duration that are commonly used. These are Macaulay duration and modified duration. Macaulay duration is a measure of the average life of a bond (Au et al., 1995). It is a measure of time, expressed in years, which measures the weighted average time to receipt of all principal and interest payments. Macaulay duration is calculated as follows (SAIFM, 2004 (a):57):

$$D = \frac{\sum_{t=1}^{n} \frac{tC}{(1+y)^t} + \frac{nP}{(1+y)^n}}{PV} = \frac{\sum (t)(\text{present value of cash flows})}{\text{bond price}} \tag{3.9}$$

where:

D	=	Macaulay duration
PV	=	price of the bond
C	=	periodic coupon payment
y	=	periodic yield to maturity
n	=	number of periods
P	=	principal

Duration is a tool that was developed for bond or fixed income securities, but it is applicable for any interest rate sensitive asset or liability, or portfolio's thereof. The above formula relates specifically to bonds. Koch (2000:234) gives a more general equation that can be used to calculate the Macaulay duration for any string of cash flows. The formula is as follows:

$$D = \frac{\sum_{t=1}^{k} \frac{CF_t (t)}{(1+i)^t}}{\sum_{t=1}^{k} \frac{CF_t}{(1+i)^t}} \tag{3.10}$$

where:

CFt	=	cash flow at time t
t	=	the number of time periods until the cash flow payment
i	=	the periodic yield to maturity generating the cash flow
k	=	the number of cash flows

As an example, consider a 2-year 12% semi-annual coupon bond. The bond is priced to yield 14% NACS, giving it a current market price (PV) of R966.13 on a face value of R1,000.00. Table 3.3 shows the calculation of Macaulay duration for the bond.

Table 3.3: Calculation of Macaulay duration

Period (t)	Cash flow	Present value of cash flow (PVCF)	Present value calculation	(t x PVCF)	(t x PVCF) / price or PV of bond
1	60.00	56.07	60/(1+0.14/2)^1	56.07	0.06
2	60.00	52.41	60/(1+0.14/2)^2	104.81	0.11
3	60.00	48.98	60/(1+0.14/2)^3	146.93	0.15
4	1,060.00	808.67	1060/(1+0.14/2)^4	3,234.68	3.35
Total		**966.13**			**3.67**

SAIFM (2004 (a): 58)

As per the first column of Table 3.3, there are four 6-month periods in the calculation. The second column shows the future cash flows for each period. In the third column, the present value for each cash flow (PVCF) is calculated, as shown in the fourth column, and summed to give the price of the bond. In the fifth column, each PVCF is multiplied by its respective period. The last column calculates the Macaulay duration by first dividing each value in the fifth column by the price of the bond, as calculated in the third column, and then summing for the total. Since each period in the calculation consists of 6 months, the result is semi-annual, i.e. the bond's semi-annual duration is 3.67. This result has to be divided by two in order to annualize. Therefore the bond's annualized duration is 3.67/2, which is equal to 1.83 years.

Modified duration is an adjusted version of Macaulay duration and is very useful in estimating the interest rate sensitivity of an instrument or portfolio. It is calculated in accordance with the following formula (adapted from Hull, 2000:111):

$$D_{mod} = \frac{D}{1+y} \tag{3.11}$$

where:

D_{mod}	=	Modified duration
D	=	Macaulay duration
y	=	periodic yield to maturity

The relationship between modified duration, yield and price, and hence its usefulness as a measure of interest rate sensitivity, is given by the following formulae (SAIFM, 2004 (a):58):

$$-D_{mod} = \frac{\Delta P}{\Delta y} \times \frac{1}{P} \tag{3.12}$$

or

$$\Delta P = -D_{mod} \times \Delta y \times P \tag{3.13}$$

or

$$\frac{\Delta P}{P} = -D_{mod} \times \Delta y \tag{3.14}$$

where:

P	=	bond price
ΔP	=	change in bond price
Δy	=	change in yield

If the analyst would like to calculate the Rand bond price change in response to a change in yield, he would use equation (3.13), the result of which is referred to as Rand duration. Alternatively, a percentage change in the price of the bond in response to a change in the yield could be calculated using equation (3.14). It is important to remember that, due to convexity, both of these calculations are approximations.

As with the term structure of interest rates, a great deal of research has been conducted over the years to improve on the Macaulay duration measures as described above. Despite its popularity and widespread use in the market place, Macaulay duration does have several shortcomings.

One such shortcoming has to do with the fact that Macaulay duration is a discrete time measure, as should be evident from the discussion above. Au & Thurston (1995: 371) pointed out that duration measures are dependent on the particular term structure model being used. As such, Macaulay duration is not applicable when the term structure model being used is a continuous time model, such as the model constructed by Heath et al. (1992) for pricing contingent interest rate claims. In their study, Au & Thurston (1995) solves this problem by developing a new class of duration measures, which can be used for continuous time dynamic term structure models.

Another shortcoming, as pointed out by Wu (2000:911), is that fundamentally, Macaulay duration cannot be an equilibrium model, since it does not satisfy the no-arbitrage condition. Wu attempted to solve this problem by developing a stochastic duration model with zero-coupon yields as a proxy for the yield curve risk, and testing his model empirically. The results showed that, in terms of portfolio immunisation performance, Wu's model outperformed previously developed stochastic models, as well as Macaulay's duration in certain cases. In some cases, however, Macaulay's duration performed better. Hence, one cannot conclude that Wu's model is a better measure of duration than Macaulay's.

In a recent study on portfolio immunisation using duration, Soto (2004) used Spanish government bond data to compare the immunisation performance of the latest single and multiple risk factor duration models. Her study led to some interesting conclusions. She showed, for example, that the number of risk factors used has a bigger impact on the result than the actual choice of a particular duration model. Specifically, the study showed that three-factor immunisation strategies performed the best.

A further factor to consider is credit risk. According to Babbel et al. (1997:35), the effective duration of fixed-income portfolios is shortened by the default- or credit risk inherent in these portfolios. In their study, Babbel et al. employed observable bond data to test various duration measures in an attempt to estimate the extent to which varying degrees of credit risk shortens the portfolio duration.

Other studies have also been conducted on the effect of credit risk on duration. For example, Fooladi et al. (1997) derived a general expression for duration adjusted for credit risk. They then used this expression to test the extent to which ignoring credit risk leads to errors in using duration to measure interest rate risk and to immunise portfolios. They concluded that any practical application of duration on portfolios containing credit risk must make use of duration measures adjusted for such risk, since failing to do so leads to unacceptable errors.

More recently, Jacoby (2003) and Jacoby & Roberts (2003) also studied the effect of credit risk on the duration of corporate bonds. In addition, Jacoby &

Roberts (2003) extended their study to the effect of call provisions (see Chapter 4, section 4.5.3) on duration. Duffee (1998) pointed out that previous studies, such as Fons (1990), which used US corporate bond indices to estimate the effect of credit risk on duration, should be treated with caution. The motivation for this caution is that US corporate bond indices contains bonds with call features, which makes it difficult, if not impossible, to isolate the impact of credit risk.

Jacoby & Roberts (2003:2298) solved this problem by extending the Fons (1990) model to incorporate the impact of both call features and credit risk. They then tested their model on Canadian investment grade corporate bond indices with an unusual characteristic making it possible to distinguish between callable and non-callable bonds. This enabled them to isolate the effects of call features and credit risk. Their conclusion was that the effects of call features on duration outweigh those of credit risk. Managers of bond portfolios containing call features should therefore take extra care.

Buetow et al. (2003) defines effective duration as a measure of duration that fully accounts for the effect of any embedded options in on the value of a security in response to a change in interest rates. They go on to compare two methods for calculating effective duration, i.e. partial durations and key rate durations. Both methods are essentially the same, but they measure two very different sensitivities. Partial durations measure a bond or portfolio's value to changes in the yield curve, while key rate durations measure the same for changes in the spot curve. According to them, the two measures are often confused and used interchangeably, which leads to errors.

The research on duration measures discussed above is but a small sample of the volume of research available. Other recent research papers on the topic of duration include for example Rzadkowski & Zaremba (2000), where they developed new formulas for duration immunisation in the context of continuous interest rates. Ghysels et al. (2004) developed a stochastic volatility duration model for processes involving time related risk. Fernandes & Grammig (2005) used Monte Carlo simulations (see section 3.4.5) to investigate autoregressive conditional duration models. Some of the theories developed are very sophisticated and offer solutions to some very pertinent issues. Unfortunately, they are often difficult to understand and impractical in the market place. Despite its shortcomings, Macaulay's duration is still the most understandable and widely used measure of exposure to interest rate risk (Wu, 2000:911).

This concludes the discussion on the calculation of duration. In the next section, the discussion on the use of duration for interest rate risk management is continued by detailing the concept of duration gap.

3.4.3 Duration GAP

The previous section briefly referred to a simplistic use of duration for risk management. This section serves to give a more formal discussion on the concept of duration gap.

Duration gap analysis compares the duration of assets with the duration of liabilities in an attempt to ascertain how the market value of shareholder's equity will change when the level of interest rates changes (Kelly, 1989:132). Whereas funding GAP analysis approaches interest rate risk by focusing on the frequency of the re-pricing of assets and liabilities, duration gap analysis takes the approach of focusing on the price sensitivity of assets and liabilities.

This approach overcomes the major flaw in GAP analysis, as described by Bessis (1998:208): "With the gap model, all flows within periods are supposed to occur at the same date. This generates errors due to reinvestments or borrowings within the period. The accurate condition of immunization of the interest margin over a given horizon depends upon the duration of the stream of flows of the period."

Denoting the market values of assets and liabilities as VA and VL, and their respective durations as D_A and D_L, Bessis (1998:208) further defines the condition that makes the margin immune as follows:

$$VA(1 - D_A) = VL(1 - D_L) \tag{3.15}$$

The above formula summarises the streams of flows for both assets and liabilities with only two parameters, i.e. their market values and their durations. According to the formula, the streams of interest flows generated by assets and liabilities are matched when the duration of the portfolio of assets is equal to the duration of the portfolio of liabilities.

Perhaps the best explanation of duration gap analysis is given by Koch (2000:344). According to Koch, there are four steps in duration analysis. They are as follows:

- Management develops an interest rate forecast. This is important, because the analysis produces different outcomes in different interest rate environments.

- Management estimates the market value of assets (MVA), market value of liabilities (MVL) and market value of shareholders' equity (MVE).

- Next, the weighted average duration of both the portfolio of assets and liabilities are estimated, taking into account the effects of both on- and off-balance sheet items. These estimates are then used to calculate the duration gap.

- Changes in the market value of shareholders' equity can now be forecast for different interest rate scenarios.

Koch (2000:344) further specifies the formulae to be used in the above steps. The weighted average duration of assets (DA) is calculated as follows:

$$DA = \sum_{i}^{n} w_i Da_i \qquad (3.16)$$

where:

w_i	=	A_i divided by the market value of all assets (MVA)
A_i	=	market value of asset i (i equals 1, 2, ..., n)
Da_i	=	Macaulay's duration of asset i, and
n	=	number of different assets

Similarly, the weighted average duration (DL) of liabilities is calculated as:

$$DL = \sum_{j}^{m} z_j Dl_j \qquad (3.17)$$

where:

z_j	=	L_j devided by the market value of all liabilities (MVL)
L_j	=	market value of liability j (j equals 1, 2, ..., m)
Dl_j	=	Macaulay's duration of liability j, and
m	=	number of different liabilities

Once DA and DL has been calculated, the duration gap (DGAP) can be calculated as follows:

$$DGAP = DA - \left(MVL / MVA \right) \times DL \qquad (3.18)$$

If the general level of interest rates is denoted by y and the change in interest rates by Δy, then the change in the market value of shareholders' equity can be estimated as follows:

$$\Delta MVE = -DGAP \times \left[\frac{\Delta y}{(1+y)}\right] \times MVA \qquad (3.19)$$

This equation provides the ALCO with information on the sensitivity of the MVE to changes in interest rates. According to the equation, the greater the DGAP is, the greater the potential variation is in MVE for a given change in the level of interest rates. The equation can therefore be used to quantify the amount of risk assumed.

Equation 3.19 also indicates the direction of the variation in MVE for changes in interest rates. If DGAP is positive and interest rates decline, the MVE will increase. However, an increase in interest rates will lead to a lower MVE. If DGAP is negative, rising interest rates will increase the MVE, while decreasing interest rates will lower the MVE. The closer DGAP is to zero, the smaller the effect of changing interest rates will be on the MVE.

That concludes the discussion on duration GAP. In the following section, a closer look is taken at the concept of Value at Risk.

3.4.4 Value at Risk (VAR)

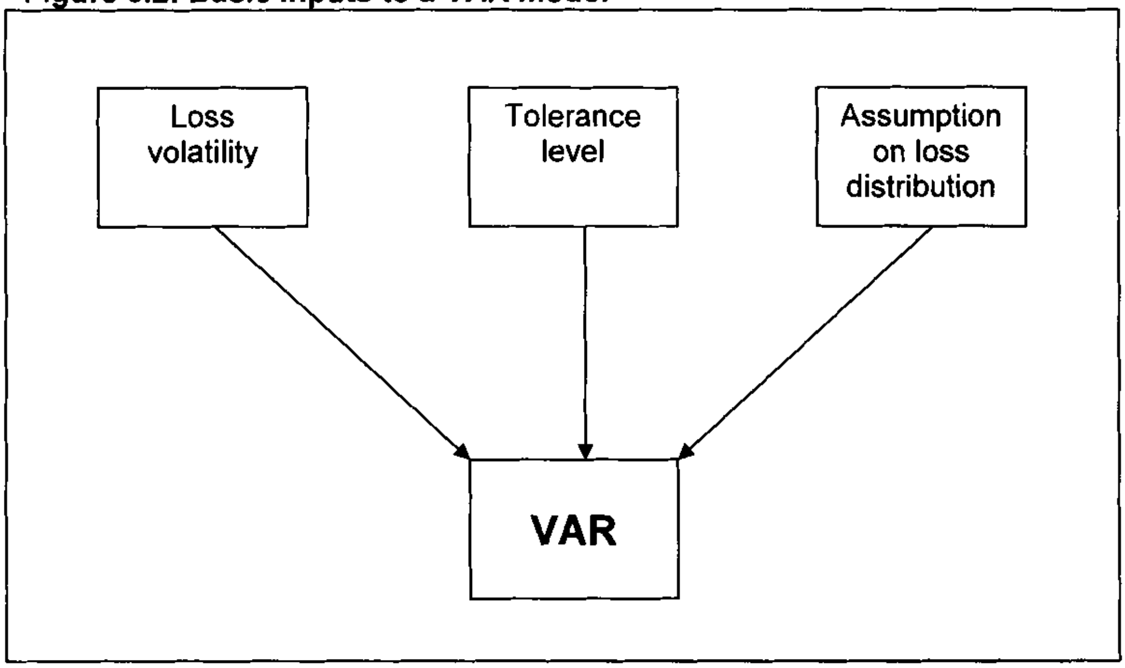
The previous section described the interest rate risk measurement tool known as duration GAP. This section describes another widely used interest rate risk measurement tool, known as Value at Risk, or VAR.

VAR is a statistical approach to measuring risk. J.P. Morgan/Arthur Andersen (1997:52-53) defines VAR as the maximum expected loss, within a specified confidence interval, of a portfolio's value resulting from adverse market movement that could occur in normal markets over a defined unwind period.

Bessis (1998: 34) defines VAR as the value of potential losses that will not be exceeded in more than a given fraction of possible events. This fraction is called the "tolerance level" and is expressed as a percentage. A tolerance level has to be specified in order for VAR to be calculated. The higher the tolerance level is the bigger the VAR will be. For example, if VAR is calculated to be 100 at a tolerance level of 5%, then the statistical probability that future losses will exceed 100 for the period under consideration is 5%.

At first glance, calculating VAR for a portfolio seems simple enough. According to Bessis (1998:72 – 73), there are three basic inputs to a VAR model, namely the loss volatility, tolerance level and assumption on the loss distribution. These basic inputs are illustrated by Figure 3.2.

Figure 3.2: Basic inputs to a VAR model



Bessis (1998: 73)

Once these inputs have been decided on or calculated, and assuming that losses are normally distributed, the VAR of the portfolio is simply a multiple of the loss volatility, where the multiple is determined by the loss distribution and required tolerance level. In other words, for normally distributed losses, VAR can be calculated according to the following formula (Bessis, 1998:72):

Loss volatility x Multiple of volatility = Value at Risk (VAR) (3.20)

For example, if the simplifying assumption is made that losses are normally distributed and the loss volatility is calculated to be 100, the volatility multiple to be used for a 2.5% tolerance level is 1.96. The VAR of the portfolio can then be calculated as 100 x 1.96 = 196, i.e. the losses on the portfolio will not exceed 196 with 97.5% certainty. In terms of quantifying interest rate risk, the loss volatility would have been calculated for changes in the value of the interest rate sensitive portfolio due to changes in interest rates. According to the above calculation, you would then say with 97.5% certainty that the losses on the portfolio due to changes in interest rates will not exceed 196.

If, on the other hand, the ALCO deems a 5% tolerance level sufficient, then under the assumption of a normal distribution the volatility multiple of 1.65 standard deviations should be used. Following on the above example, the VAR can then be calculated as 100 x 1.65 = 165, i.e. it is 95% certain that losses on the portfolio will not exceed 165 (J.P. Morgan/Arthur Anderson, 1997:53).

From the above examples, calculating VAR seems to be a simple exercise. In practice, however, it is a lot more complicated. As indicated in the above diagram, the VAR calculation depends on three basic inputs. They are the loss volatility, the tolerance level, and the loss distribution. It follows that the quality of the calculated VAR figure depends on the quality of the inputs to the VAR model. This raises several practical issues (Bessis, 1998:73-76):

- First of all, the assumption of the normal distribution, though easy to use, is not always accurate. In such cases, it is often better to use the skewed lognormal curve. This complicates the calculation of VAR because the simple relationship between tolerance level and volatility multiple is broken.

- Secondly, the real distributions could have so-called "fat tails". Fat tails point to the possibility of extreme losses that are very infrequent and not observable, which makes the modeling of losses very difficult, if feasible at all. Using a VAR figure calculated under such circumstances is very hazardous.

  This problem could be addressed by making use of so-called Pareto distributions. Pareto distributions attempt to replicate the fat tails phenomenon, although they are often not a very good reflection of the real distribution.

- Lastly, the loss distribution of a portfolio should take into account that the losses on a portfolio are dependent on several underlying parameters, instead of just one, as well as the risk diversification in the portfolio (Bessis, 1998:74). VAR is not additive, i.e. the VAR of a portfolio is not equal to the sum of the VAR values for the individual securities in the portfolio. Summing the individual VAR values would imply that all losses occur at the same time, and would therefore overstate the VAR of the portfolio.

  This problem can be addressed in one of two ways (Bessis, 1998:76). Firstly, the correlations between all the different risk parameters relating to the portfolio can be calculated and brought into the VAR calculation for the portfolio. Secondly, simulation models can be used to simulate the outcome of the portfolio for a very large number of possible combinations of the relevant risk parameters. A loss distribution can then be fitted on the results of the simulations. Once this has been done, the maximum loss for a given confidence level can be calculated by using a non-parametric method, i.e. the maximum loss is obtained by counting how many times a given value of loss is exceeded. For example, the value of losses not exceeded more than two or three times in a hundred simulated cases is the VAR at a 2.5% tolerance level. The simulation methodology has the advantage that it is not dependent on unrealistic assumptions. However, the drawback is that it generates a heavy calculation load and requires large processing capacity and specialized software.

Beder (1995:12) calls VAR a seductive but dangerous risk management technique. She tested eight different VAR methodologies on three hypothetical portfolios, and found that the discrepancies in the results of the different methods were shocking in magnitude. She attributes the discrepancies to the fact that VARs are extremely sensitive to the parameters, data, assumptions and methodology used. She admits the usefulness and popularity of VAR, but points out that using VAR in isolation is not sufficient to control risk. Instead, VAR should be part of a broader risk management program.

The above problems should not be misinterpreted as saying that VAR is in danger of falling from grace as a risk management tool. The reality is that VAR is widely used in the market as a summary measure of market risk and is also popular with regulators (Yiu, 2004:1318). In fact, Yiu (2004) even showed how VAR could be applied as a constraint in the well-known problem of optimal portfolio allocation.

Due to its popularity, a great deal of research has been done to enhance the credibility of VAR calculations, attempting to find solutions to the above-mentioned problems. Some of the solutions found have already been mentioned above. A very popular solution, as mentioned, is to use simulation techniques, since these techniques solve most of the problems associated with VAR due to their independence from unrealistic assumptions (see above). The cost, however, is the requirement for large processing power and specialized software. Even so, the models chosen for the study conducted by Beder (1995) attests to the popularity of simulation VAR techniques. Following a review of dozens of models used in the market, she chose eight models for her study, all of which involved simulation techniques.

There are two broad classes of simulation VAR models, i.e. historical simulation and Monte Carlo simulation (Beder, 1995). Historical simulation techniques select values for the key variables from a database of historical values to calculate the value of the portfolio. As such, it is extremely dependent on the underlying data set. By contrast, Monte Carlo simulations essentially involve generating random values for the key variables, before valuing the portfolio. Since this attribute makes it independent from any underlying data set or assumptions, Monte Carlo techniques offer quite different views of risk than historical simulation techniques.

Geocities.com (2005) defines Monte Carlo techniques as follows: "The Monte Carlo method provides approximate solutions to a variety of mathematical problems by performing statistical sampling experiments on a computer." As this definition implies, Monte Carlo techniques are used in a diverse range of settings. Due to its randomness and independence of assumptions, Monte Carlo simulation techniques are very useful and popular.

According to Hubbert (2004:1) the Monte Carlo methodology consists of three major steps. First of all, a large amount of scenarios must be generated through the random selection of values for the underlying variables applicable to the portfolio. The random selection of values should, however, take into account the correlations between the different underlying variables, in order to produce random, yet plausible, scenarios. Secondly, the portfolio has to be valued for each scenario. If possible, this should be done via a full valuation of the actual portfolio. However, due to the calculation load, it is often necessary to use some or other approximation method. Lastly, the results of the simulations can be summarized in a way that is useful for the problem under investigation. In the case of VAR, it would be a probability distribution function.

It is also possible to set certain constraints to the Monte Carlo process in order to produce scenarios conducive to the topic under research. As an example, consider the study by Glasserman et al. (2002), where they used a Monte Carlo method to address the problem of calculating VAR when the loss distribution displays the so-called "fat tails", or as they call it in their paper, "heavy-tailed". In order to produce the "fat tails", they developed a low-variance Monte Carlo method that specifically guided the random selection key variables so that large losses are produced more often.

There are two very useful groups of models that are commonly used to guide the random variable selection in Monte Carlo simulations, i.e. ARCH and GARCH models. ARCH refers to the autoregressive conditional heteroscedastic models introduced by Engle (1982), while GARCH refers to the generalized ARCH models developed by Bollerslev (1986). Usually, Monte Carlo simulations are conducted under the assumption that the variables under consideration follow the normal distribution. What makes ARCH and GARCH models so useful in the Monte Carlo process is that they display larger variance, as well as kurtosis, than that of the normal distribution (Ferreira, 1999:111). As such, they can be used to model "fat tails". Due to the popularity of GARCH models, several variations have been developed, including asymmetric GARCH, or AGARCH (Ferreira, 1999:124). These models are especially useful in modeling the asymmetric behaviour of interest rates when generating the interest rate scenarios to be used in Monte Carlo simulations.

The research by Glasserman et al. (2002) falls into a category of VAR research called Extreme Value Theory, or EVT (Bekiros & Georgoutsos, 2005:209). It is a field of research that, amongst other subjects, attempts to develop VAR models that can accurately estimate VAR in cases where it is possible, though unlikely, for extreme losses to occur, such as would be suffered by an equity fund if there is a general crash in the market. The study conducted by Bekiros & Georgoutsos (2005) compared the predictive performance of various VAR methodologies. They found that at very high confidence levels the EVT methodologies produced the most accurate forecast values.

This section served to give the reader a basic understanding of VAR. VAR can be applied from an enterprise wide perspective, encapsulating all the risks faced by a company, or at any other level down to a specific risk on a specific portfolio. VAR and all the different methodologies used to calculate it is a very wide subject, and will not be discussed further in this dissertation. In the next section, a closer look is taken at dynamic simulation models.

3.4.5 Dynamic simulation models

The previous section made reference to the use of simulations for determining a value for VAR at a specific tolerance level. Simulations are, however, also used extensively in the wider field of ALM. Dynamic simulation models are built using specialized software, like ALMAN from Riskflow Technologies, which will be used in the case study in Chapter 6 to measure the interest rate risk exposure of a hypothetical company.

These models are used to forecast the financial statements into the future, as well as various risk reports, stepping through time month by month in accordance with the variable input scenarios. The methodology of dynamic simulations will become very clear in Chapter 6, where the entire process is covered in a practical example. This section serves to show the need for and usefulness of simulation models, and to give the reader a basic understanding of the process.

Koch (2000:305) defines simulation as follows: "An analysis of possible outcomes for net interest margin resulting from selecting hypothetical values for key variables that influence the re-pricing of assets, liabilities, and off-balance sheet items and conducting forecasts to determine the effects of changes in these variables on a bank's net interest income."

Bessis (1998:169) says the following about simulations: "In order to project various sets of assumptions and projections, and to optimize hedging, it is necessary to combine various interest rate scenarios with various scenarios of balance sheet projections, and with several funding and hedging solutions. The goal is to evaluate the impact of multiple scenarios and assumptions on the target variables. These include the interest margin over several periods, the net profit, or the mark-to-market value of the balance sheet. Simulations are used to model the behaviour of these target variables. This allows optimization of the funding and hedging policies, given their impact on target variables." Bessis (1998:169) further states that the need for simulations stems from the fact that it is impossible to determine the influence of all combined parameters without modelling of the balance sheet and the margins.

Simulations therefore model the balance sheet, as well as the income- and cash flow statements, in order to quantify the impact of different interest rate scenarios and other uncertainties on the risk-reward trade-off (refer to Figure 2.1: The ALCO process). The simulation process consists of the following steps (adapted from Bessis,1998: 170):

- Determine the interest rate scenarios and the strategic goals to be used in the simulations (Figure 2.1, Step 3 and 4).

- Project the balance sheet, income- and cash flow statements, as well as the gaps, into the future. This should be done according to the chosen interest rate scenarios and strategic goals (Figure 2.1, Step 5).

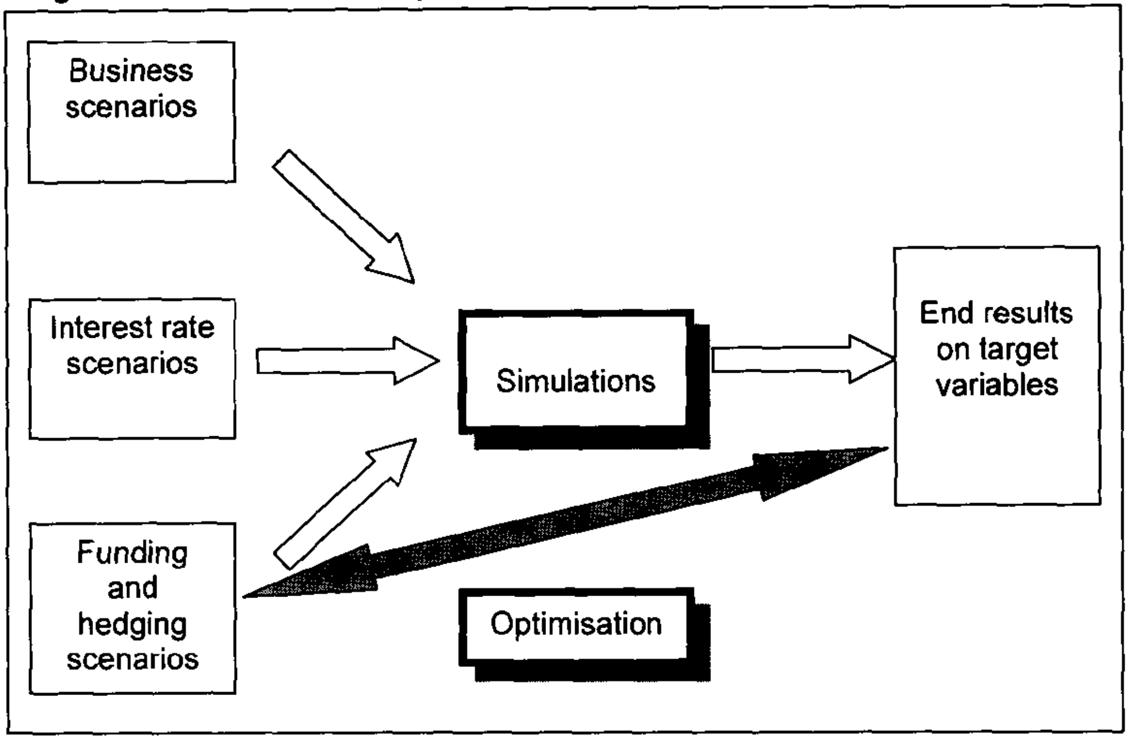
- Calculate the projected interest margins, or any other target variable as required.

- Use the simulation results to specify your strategic risk management goals, amongst others optimising funding and hedging (Figure 2.1, Step 6).

Once a set of inputs has been defined, the simulation model is used to determine the values of the target values for each of the scenarios. Strategies can then be compared with each other in terms of their profitability and the possible variance thereof across the different scenarios, i.e. by doing a risk-reward comparison. Simulating different strategies can thus optimise funding and hedging solutions by choosing the most appropriate strategy based on the results.

Figure 3.3 describes the simulation process. The process starts with defining the three inputs, i.e. the business scenarios (the company's budget is often used for this), the interest rate scenarios and the funding or hedging scenarios. The simulation model is then run for the required forecast period to determine the end results on the target variables. A target variable can be any variable that is of particular importance to the company, such as ROE or net interest margin. Once a set of results have been obtained, the funding and hedging scenarios can be optimized by choosing the scenario that gives the most desired result in the target variables.

Figure 3.3: The simulation process



Bessis (1998:171)

It should be noted at this point that true optimization could only occur if results have been obtained for a large number of simulations. Monte Carlo techniques have been discussed previously in the context of VAR calculation. It is, however, as stated before, a general technique with a wide range of applications. Dynamic simulation is one such application where Monte Carlo techniques are very useful. In fact, many of the simulation software packages have Monte Carlo capabilities, either as a standard feature, or as an add-on.

In the context of dynamic simulation, Monte Carlo methodologies can be used to generate a large number of interest rate scenarios for which the simulations will have to be run. In order to guide the Monte Carlo selection of variables to produce plausible scenarios, an ARCH or GARCH methodology could be followed, as described in the previous section under VAR (see section 3.4.4). The results can then be presented in a way useful towards solving the problem under investigation, e.g. measuring interest rate risk or testing a certain hedging strategy. The methodology is therefore exactly the same as described in the previous section under VAR (see section 3.4.4), with only a slight shift in focus.

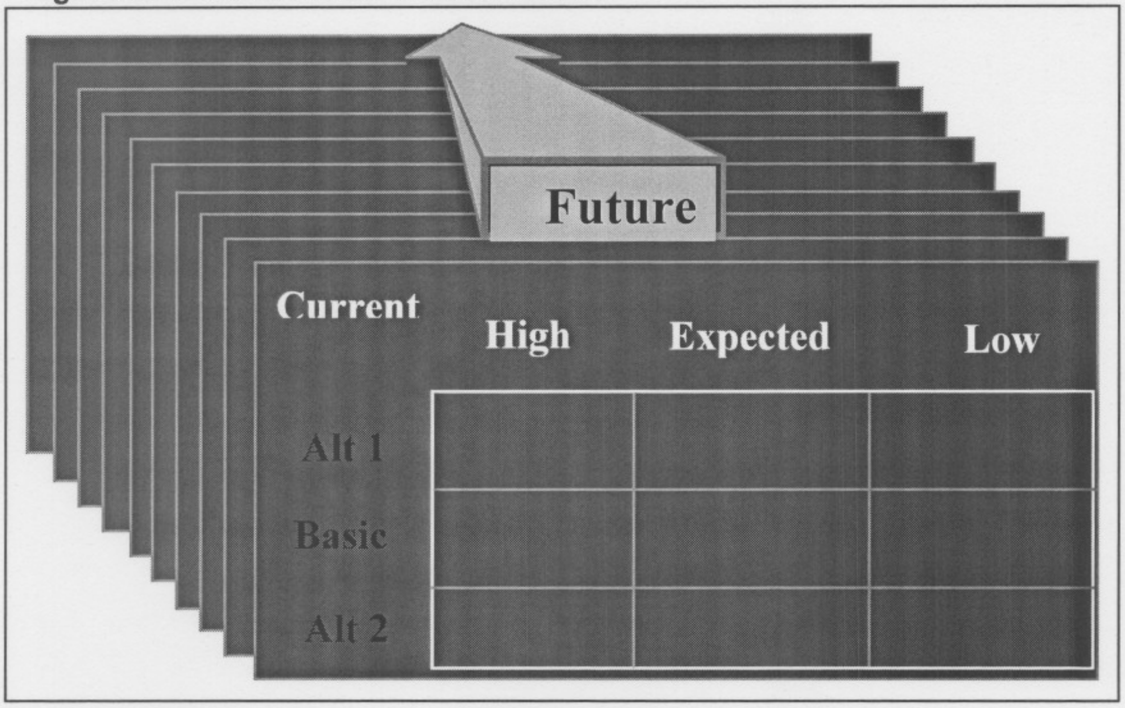
From a management point of view, however, it is often not necessary to go to such lengths as described in the last few paragraphs. Management wants to know what the performance of the business will be given their view of the relevant exogenous factors. To allow for errors in their view, it is also useful to see what the performance of the business will be if their expectations on the exogenous factors are over- or undershot. Running the simulations for three different scenarios, i.e. a high-, expected- and low interest rate scenario, is therefore often sufficient from a management point of view. This will greatly reduce the required investment in computational capacity and systems, while still enabling management to make informed strategic and budgetary decisions. This is the methodology that will be followed in Chapter 6, where the use of a dynamic simulation model is demonstrated using three different interest rate scenarios.

Although Bessis (1998:170) only refers to the modelling and forecasting of the balance sheet, simulation software like ALMAN also provides for the modelling and forecasting of the income statement and the cash flow statement. In fact, it should be a requirement of any good system that all three statements can be modelled. The reason for this is that the system (like ALMAN) can then conform to GAAP (General Acceptable Accounting Principles). During the simulation, as the system steps through time, it actually does all the debit and credit entries on all the balance sheet, income statement and cash flow accounts, keeping the books in balance (Riskflow, 2005). It does so for each possible combination of interest rate scenario and strategy scenario. As such, it is a very powerful tool.

ALMAN provides for at least three different interest rate scenarios, i.e. a low scenario, a high scenario and an expected scenario, as well as three different strategy scenarios (Riskflow, 2005). The end result is a set of financial statements plus risk reports for each of the nine possible combinations of strategy and rate scenario, for each month in the forecast period, as described by Figure 3.4 (adapted from Decillion Limited, 2003).

In Figure 3.4, each pane represents one of the periods in the simulation period, starting from the current position and continuing to each of the future periods. On each pane it can be seen that there are nine different combinations of strategy (basic plus two alternatives) and interest rate scenario (high, expected and low).

Figure 3.4: The set of simulation results



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Dynamic simulation models, as stated before, require specialized software systems. These systems can be very expensive. In addition, the models need continuous maintenance and staff members with specialized skills are needed to maintain the models and run the simulations. The process can therefore become expensive. However, if a company wishes to implement a proper ALM process, the associated expense is necessary. If properly implemented and utilized, the benefits will exceed the expense by a long margin. Other risk measurement tools, such as the GAP analysis and VAR methodologies discussed earlier, rely heavily on assumptions, which are often unrealistic. Dynamic simulation offers an exceptionally accurate risk measurement tool, given the input scenarios. Of course, the input scenarios still require assumptions, but they can often be derived from market expectations, such as reflected through the yield curve.

The bottom line is, where other risk measurement methodologies rely on assumptions that often hide risks, simulation models rely on scenarios that reveal risks. As such, they pose a significant improvement in risk measurement (Bessis, 1998:187).

3.5 Conclusion

In Chapters 1 and 2 the groundwork and background for the dissertation was established. Chapter 1 defined the term ALM and gave a brief history of its development for the banking sector. The problem statement, goals and layout of the dissertation were also described. Chapter 2 addressed the first goal of the dissertation and demonstrated the need for ALM in the corporate environment. It described how many large corporates today engage in activities traditionally associated with banks. Referring to statements in the King 2 report regarding corporate governance and concepts such as market perception and strategic management, the need for ALM for such entities was established.

In this chapter, Chapter 3, the dissertation started to focus on interest rate risk by first of all defining interest rate risk. This was followed by a detailed discussion on the term structure of interest rates, or the yield curve. The chapter then attempted to address the second goal of the dissertation, which was to define the tools that can be used to measure interest rate risk. This chapter discussed several measurement tools in detail. These included the interest rate gap, duration, duration gap and value at risk (VAR). These are all tools that the ALM practitioner can employ in order to properly quantify the company's exposure to interest rate risk.

As stated before, in order for any risk to be managed properly, it must first be understood, measured and quantified. Chapter 3 has shown how this can be achieved for interest rate risk. In the next two chapters, the instruments used to hedge against interest rate risk will be defined and their practical use will be demonstrated.

Chapter 4 is dedicated to the discussion of notional instruments while Chapter 5 takes a detailed look at interest rate derivatives. Chapters 4 and 5 form a unit, which will satisfy the third goal of the dissertation, which is to define the instruments that can be used to hedge interest rate risk.

CHAPTER 4: FINANCIAL NOTIONAL INSTRUMENTS THAT CAN BE USED TO HEDGE INTEREST RATE RISK

4.1 Introduction

Chapters 1 and 2 gave an overview of ALM in general and proved the need for ALM in the corporate environment, thereby achieving the first goal of the dissertation, as stated in Chapter 1.

As stated previously, strategic interest rate risk management in the corporate ALM environment is the main focus of this dissertation. In the previous chapter, Chapter 3, this focus became apparent. Chapter 3 achieved the second goal of the dissertation by defining interest rate risk and describing the tools that can be used to measure and quantify the extent of the exposure to interest rate risk.

Once the exposure to interest rate risk has been properly measured, as described in Chapter 3, the ALCO has to devise and implement strategies for hedging against possible losses resulting from such exposures. ALM is dynamic and ALCO's are required to be innovative. The number of possible hedging strategies is infinite and can comprise of one or a combination of many different hedging instruments. These instruments can be grouped into two broad classes: notional instruments and derivative instruments.

In this chapter, Chapter 4, notional instruments that can be used to hedge against interest rate risk are looked at in detail. Derivative instruments are dealt with in the following chapter, Chapter 5. Chapters 4 and 5 should therefore be seen as a unit, which will satisfy the third goal of the dissertation, i.e. defining the instruments that can be used to hedge against interest rate risk.

4.2 *Definition of notional instruments and description of their use*

The term "notional" can lead to some confusion, since it is used across a wide range of markets. In the case of derivatives, which will be discussed in detail in Chapter 5, the term "notional principal" refers to the value of the underlying notional instrument (Lore et al, 2000:16). According to Bessis (1998:352), a notional debt can be qualified as debt that replicates the characteristics of an asset. It follows logically from this that a notional asset is an asset that replicates the characteristics of a debt.

Notional instruments are debt and investment instruments that do not derive their value from some other or underlying quantity, as is the case with derivatives, but rather from the actual characteristics of the instrument itself, i.e. the amount invested or borrowed, or the face value stated on the contract. These instruments are generally traded in the money market and capital market, for example bonds, BA's, Treasury Bills and NCD's.

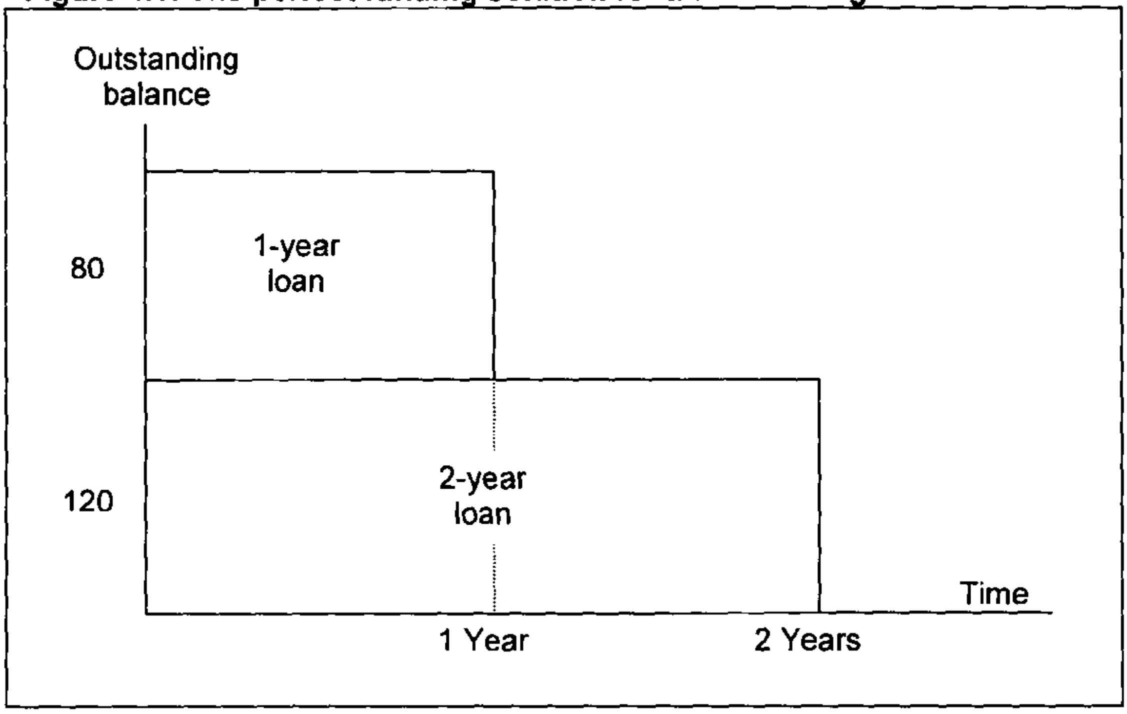
The use of notional instruments as funding or investment products by themselves does lead to exposure to interest rate risk. In fact, interest rate derivatives are often used to hedge against the risk inherent in notional instruments. However, from a portfolio or ALM perspective, notional instruments can also be used as an alternative to derivatives in order to hedge interest rate risk. Bessis (1998:350) says that for any given asset, there is only one funding solution that totally removes the liquidity and interest rate risk of that asset. It is the funding solution that replicates the time profile of cash flows and that replicates the interest rate type.

In some cases the replication is obvious. For example, a bullet loan can be backed with a bullet debt at the market rate corresponding to the maturity of the transaction. In other cases, the funding has to be defined. For an amortising loan, the outstanding balance varies over time until maturity. Therefore, a bullet debt with a market rate associated with that maturity is not appropriate. The funding that actually replicates the time profile of the loan is a combination of debts of various maturities.

This concept is best illustrated with the following example, adapted from Bessis (1998:350 – 351):

> Assume that a bank gives a client a two-year loan to the value of 200, and that the loan is amortised over two years, with capital repayments of 80 in the first year and 120 in the second year. What would be the perfect funding solution? In this case, the perfect funding solution would consist of two separate loans, both out of spot, contracted at the spot market rates, as follows: a one-year loan for 80 and a two-year loan for 120. Figure 4.1 describes the solution graphically.

Figure 4.1: The perfect funding solution for an amortising loan



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In Figure 4.1, the y-axis denotes the outstanding balance of the loan and the x-axis denotes the time to maturity of the loan. Figure 4.1 shows how a 2-year amortising loan, for which the capital balance reduces from 200 to 120 after the first year, can be viewed as two separate spot bullet loans, i.e. a spot to1-year loan for 80 and a spot to 2-year loan for 120. This example shows that it is possible to find a unique notional funding solution for any asset whose amortising schedule is known. However, for those assets that have no maturity, conventions are necessary.

Similar to the example above, an asset that pays interest semi-annually and capital at maturity can be funded with a bond or debenture with the same maturity. A short-term loan can be funded with a NCD with similar characteristics. By choosing funding instruments that fully replicates the structure of assets the ALCO has immunized the net interest margin against changes in interest rates. In other words, the book is fully hedged against interest rate risk.

In practice, the ALCO does not have to use a funding policy that fully replicates the assets, and thereby immunizing the net interest margin. Depending on their views on future economic variables, for example future interest rates, the ALCO may deviate from a policy that replicates asset flows and decide on a strategy that will profit from such future rates.

The above describes the use of notional instruments for hedging in general. Basically, it comes down to using notional funding instruments to match the profiles of assets, or vice versa. The following paragraphs discuss the different types of notional products that can be used by the ALCO in more detail. The discussion is grouped under the general categories of discount products, negotiable certificates of deposit (NCD's), fixed-income securities and other types of notional instruments.

It should be noted that the discussions on discount products, NCD's and fixed income securities go into lengthy detail on the valuation of these instruments. For some readers, especially those from a banking background, the valuation concepts discussed will be general knowledge. However, readers from the corporate environment will not have had the same exposure to the valuation of financial instruments. Since this dissertation is written form the viewpoint of corporate ALM and understanding the price dynamics of these instruments is important in terms of using them for hedging purposes, their pricing techniques are discussed in detail.

4.3 Discount products

Discount products are products where the investor pays less than the full face value of the investment on the value date and receives the full face value at maturity (Beaufort Institute, 2003 (d):21). The difference between the purchase price and the redemption value constitutes the return to the investor.

Assuming a 365-day year, professional traders use the following equation to price discount instruments (Koch et al, 2000: 242):

$$i_{dr} = \frac{Pf - Po}{Pf} \times \frac{(365)}{h} \qquad (4.1)$$

where

i_{dr} = discount rate

Po = initial price of the instrument

Pf = final price of the instrument at maturity or sale, and

h = number of days in holding period

In order to compare the interest rate on a straight discount product to that of another product that is quoted on a yield basis, the discount rate first has to be converted into a yield rate. This can be done using the following formula (Beaufort Institute, 2003 (d):22):

$$\text{Yield} = \frac{\text{Discount rate}}{1 - \left(\text{Discount rate} \times {}^{d}\!/_{B}\right)} \qquad (4.2)$$

where

B	=	Day base
Discount rate	=	Discount rate expressed in decimals
d	=	Days in period

This is a yield using a compounding frequency of 365/d times per year. For example, in the case of a 3-month T-Bill, it is a quarterly compounded, or NACQ yield. To convert a yield compounded *m* times per annum into an effective annual yield, or NACA yield, the following formula can be used (adapted from Hull, 2000: 53):

$$i^* = \left[1 + \frac{i_m}{m}\right]^m - 1 \qquad (4.3)$$

where

i^* = effective annual yield, and

i_m = Yield compounded *m* times per year (expressed in decimal form)

Once the yield of the straight discount product has been calculated, it can be compared directly to yields of other instruments. For example, following the general hedging methodology described in section 4.2, a short-term fixed rate asset, like a 90-day or a 6-month credit facility to a client, could be hedged by funding it with a discount product of similar maturity. The interest rate on both the asset and the liability will then be fixed and the pair will be interest rate neutral. However, in order to assure that an acceptable interest rate margin is locked in, the discount product will first have to be priced, as described above, and then the discount rate has to be converted to a yield rate and compared to the yield on the asset.

4.4 Negotiable Certificates of deposit

Negotiable Certificates of Deposit, or NCD's, were developed to enhance the liquidity in the interbank deposits market. NCD's are bearer instruments, which mean that they can be traded with other banks or lenders in the secondary market (Beaufort Institute, 2003 (d):9). NCD's are usually issued for tenors less than one year, in which case interest is payable on maturity. NCD's can, however, be issued for tenors longer than one year. In this case, interest may be paid either at maturity or half-yearly in arrears, i.e. on a coupon-bearing basis.

The value of a NCD at any given point in time is calculated as the price the investor paid for it plus accrued interest up to that point in time (Kelly, 1988:14-15). If the investor holds the NCD until maturity, the yield to the investor will be equal to the rate at which the NCD was bought. However, should the investor decide to sell the NCD in the secondary market prior to maturity, the price will be determined according to rates prevailing on NCD's in the market at the time. In this case, the price that the NCD fetches in the market determines the yield to the investor.

The following example explains the pricing of a NCD in both the primary and secondary markets (Kelly, 1988:14-15):

Investor A buys a 6-month R1 000 000 NCD at a bank offering of 13.5% per annum. The bank issues a certificate that promises to pay the bearer a sum of R1 067 500 at maturity, six months from now. This amount is calculated as follows: [1 000 000 x 13.5% x 6/12] + 1 000 000 = 1 067 500.

If investor A decides to sell the NCD in the money market two months after he bought it, the price at which he can sell would be determined by the prevailing market rates on NCD's. If the prevailing rate is 13%, then the price would be R1 023 162.90, since this is the sum that would amount to R1 067 500 after four months, invested at 13% per annum.

In terms of hedging interest rate risk, following the general hedging methodology described in section 4.2, NCD's could for example be used to invest the surplus cash from a fixed-rate liability, thereby locking in the interest rate margin. Of course, following Figure 4.1, care should be taken to use one or more NCD's to construct an asset notional profile matching that of the liability.

4.5 Fixed-income securities

A bond, or fixed-income security, represents an obligation of the borrower, or issuer, to make periodic payments of interest and to repay the borrowed amount, or face value, on a specified future date (Beaufort Institute, 2003 (c): 4). The coupon rate, or nominal rate, of a bond is the rate at which the periodic interest payments are made. The issuer pays interest either semi-annually or annually.

The par face value of a bond is the amount that the borrower promises to repay on or before the maturity date of the particular issue. A bond may sell for more or less than its par value, depending on the movement of market interest rates in relation to the bond's coupon rate. If market rates move above (below) the coupon rate, the bond will sell below (above) its par value in the secondary market. If a bond is trading above its par value, it is said to be trading at a premium. If it is trading below its par value, it is said to be trading at a discount (Koch, 2000:228). If the market rate is equal to the coupon rate, the bond will trade at par. A bond is therefore issued in the primary market at par, below par or above par, depending on how the coupon rate compares with the yield to maturity expected by the market. Similarly, the bond will trade in the secondary market at par, below par or above par.

Most bonds pay semi-annual coupons. For such a bond, the market price of the bond can be determined by using the following formula (Graddy et al, 1985:335):

$$\textbf{Market Price} = \sum_{t=1}^{2n} \frac{\frac{1}{2}(\text{Coupon interest payment})}{(1+\frac{1}{2}[\text{Actual yield}])^{t}} + \frac{\text{Principal}}{(1+\frac{1}{2}[\text{Actual yield}])^{2n}} \quad (4.4)$$

where

Coupon interest payment	= Face value x annual coupon rate
Actual yield	= Yield expected by market
Principal	= Face value of the bond
n	= The number of years until maturity

The market price of a bond as calculated above is known as the all-in price, which includes accrued interest due to the seller of the bond when the bond is sold between coupon dates. This is the price that the buyer pays the seller. The clean price, or flat price, is the dirty price less the accrued interest portion. The accrued interest portion can be calculated as follows (Beaufort Institute, 2003 (c):20):

$$\text{Accrued interest} = \text{Coupon} \times \frac{\text{No. of days since last coupon settlement}}{\text{No. of days in coupon period}} \quad (4.5)$$

In terms of hedging interest rate risk, following the general hedging methodology described in section 4.2, bonds could be used as a means to raise medium- to long-term fixed-rate funding for long-term assets. The interest rate margin will then be locked in. Of course, in this case the interest rate margin is the difference between the yield on the asset and the yield of the bond, and not the coupon rate of the bond.

4.6 Other types of notional instruments

The importance of innovation is a key feature of today's financial markets. In an increasingly competitive environment, financial intermediaries are continuously striving to find new ways to meet the demands of a more and more knowledgeable investor and debt issuer base.

As a result, there are many different variations of each type of financial instrument, both in the notional market and in the derivatives market, as will be seen later. These instruments are created by either changing a characteristic of the original "vanilla" instrument, as is the case with variable rate bonds, or by combining different types of instruments, called hybrid instruments, like preference shares and convertible bonds. Hybrid instruments usually employ embedded derivatives.

The following sections discuss some of these instruments. The mathematical models used to price hybrids are often complex and beyond the scope of this dissertation. The purpose is to give the reader some idea of the endless possibilities for innovation. It is important for any ALM practitioner to realise that any hedging requirement can be met by creating an instrument with the required characteristics through the combination of two or more vanilla instruments.

4.5.1 Variable rate bonds

Variable rate bonds are bonds that do not pay a fixed coupon, but instead pay a floating rate of interest that resets periodically according to some pre-defined benchmark. For example the R193 government bond pays interest quarterly and the rate of interest is linked to the 91-day Treasury Bill (SAIFM, 2004 (a): 67). Floating rate bonds can have a number of features, like put options, caps, floors or convertibility into a fixed rate security or the shares of the issuer.

In terms of an interest rate hedging example, variable rate bonds are attractive to investors who wish to purchase an asset with characteristics that match those of a floating rate liability. Similarly, the issuer will use the proceeds to fund a variable rate asset. As another example, variable rate bonds can also be used to substitute short-term securities, thereby saving on the cost of continuously rolling over short-term securities on their maturity dates.

4.5.2 Convertible bonds

Convertible bonds are securities that are hybrids of debt and common stock, or shares. They make fixed coupon payments like straight bonds, but have the additional feature that the holders may convert the bonds into common stock at a pre-determined price (Koch, 2000:289). The yield is higher than the dividend yield of the issuer's common stock and the conversion price exceeds the prevailing market price of the shares. Once a bond is converted into stock, the transaction is irreversible.

It is therefore a bond with an embedded option. The holder of the bond essentially has an option that changes in value along with the market's perception of the underlying corporate's financial condition. Since the conversion feature has value, investors are willing to accept a lower yield than that of straight bonds.

In terms of interest rate hedging, a corporate could use a convertible bond to fund medium- to long-term fixed-rate assets. However, in this case, since the investor has the option to convert the bond into stock, there is still risk and the interest rate margin has not been locked in for the full maturity of the instrument. If the bond is converted, it will dilute the shareholders' interest and alter the corporate's asset and liability mix. This will have a definite impact on the corporate's GAP, as described in section 3.4.1, and hence on the corporate's exposure to interest rate risk.

4.5.3 Callable and puttable bonds

A callable bond is a corporate bond issue with a call provision that gives the issuer the right to buy back all or part of the issue from investors prior to maturity. Typically, if interest rates fall far enough below the Bond's coupon rate, the issuer will redeem the bond and replace it with a new bond with a lower coupon. This is obviously disadvantageous to the bondholder (SAIFM, 2004 (a):9).

A puttable bond is a bond that allows the bondholder to sell the bonds back to the issue or a third party at par or close to par. Typically, the bondholder will exercise this right if interest rates increase far enough above the coupon rate or if the issuer's credit rating declines (SAIFM, 2004 (a):9).

In terms of hedging interest rate risk, using a callable bond to fund medium- to long-term assets will be preferable, because the option can only be exercised at the discretion of the issuer. However, because the option is in favour of the issuer, it is reasonable to expect that the issuer will have to pay a higher yield, thereby reducing its interest rate margin. In the case of a puttable bond, the option is in favour of the investor, and hence one could reasonably expect that the yield will be lower. However, as with the convertible bond, a puttable bond does not fully hedge the interest rate risk, because if interest rates rise and the investor sells the bond back to the issuer, the funding will have to be replaced at a higher interest rate.

4.5.4 Preference shares

Preference shares are hybrid securities containing features of both ordinary shares and debt. Like debt, preference shares pay their holders a fixed amount per year, have no voting rights and in the event of non-payment of dividends have a cumulative feature that requires all dividends to be paid before any payments are made to common shareholders (SAIFM, 2004 (b):56). Like ordinary shares they are perpetual claims and in the event of default they are subordinate to bonds in terms of seniority. Preference shares can also be cumulative, non-cumulative, participating in profits, convertible or redeemable.

In terms of hedging interest rate risk, preference shares could for example be used to fund long-term fixed rate assets, bearing in mind that the funding is perpetual. When the assets being funded mature, they will have to be replaced with assets yielding a currently unknown return, which leads to interest rate risk. Great care should also be taken to understand the impact of any additional features, like those mentioned above, on the overall risk profile of the company.

4.7 Other research and developments

Market practitioners commonly use the pricing methodologies described above, even though they are relatively old. However, it is important to know that a lot of research has been done in order to design better pricing methodologies. The body of research seems to center around some common issues, i.e. different ways to model the yield curve being used, how to include default risk in the price of the instrument, and how to handle special features like call and put provisions.

Section 3.3 described the term structure of interest rates and various alternative ways of modeling the yield curve. Obviously, when pricing financial instruments based on a yield curve, the price will be greatly influenced by the particular yield curve model being used. In practice, market prices of traded instruments, and by implication the market yield curve, are influenced by market forces. In theory, however, there are many different ways to derive the correct price of an instrument, which may or may not differ from the market price.

Black & Karansinski (1991) developed a so-called one-factor model for pricing bonds (and options) based on short-term interest rates. Their model operated under the assumption that short-term rates' movement over any give time horizon displays a lognormal distribution, which according to them, allowed them to match the yield curve. They then used this interest rate process in a conventional binary tree model to price bonds (as well as options).

In a study conducted by Heath et al. (1992), they developed a model for pricing bonds under a stochastic term structure of interest rates. In their model, they took the initial forward interest rate curve, as implied by the yield curve, as the starting point. They then used stochastic processes to model the curve's subsequent movements. Using this interest rate process, they developed a model for pricing bonds subject to the no-arbitrage condition.

Kim et al. (1993) also used a stochastic term structure of interest rates as the starting point for their study and developed a model for pricing corporate bonds. The aim of their study was to develop a bond pricing methodology that could take into account the default risk inherent in corporate paper. However, they also extended their model to have the ability to price bonds with call features.

These were but a few examples of other theoretical models for pricing financial instruments that have been developed over the years. There are many other examples. All the alternative methodologies for modeling the term structure could serve as further examples in this discussion, since the ultimate goal of those studies was to price financial instruments more accurately.

This concludes the discussion of notional instruments. The chapter is summarized in the following section.

4.8 Conclusion

This chapter, Chapter 4, was dedicated to describing some of the different notional instruments that can be used to hedge against interest rate risk. It first of all defined the term "notional instrument" and described a general method for the use of such instruments for hedging purposes by the ALCO.

The chapter then went into more detail on the different types of notional instruments and their characteristics. Specifically, discount products, negotiable certificates of deposit (NCD's), fixed-income securities and other types of notional instruments like variable rate bonds, puttable and callable bonds, convertible bonds and preference shares were looked at.

As stated in the introduction to Chapter 4, it forms a unit with Chapter 5. Together, the two chapters will satisfy the third goal of the dissertation, which is to define the instruments that can be used to hedge against interest rate risk.

In the next chapter, Chapter 5, a closer look is taken at the different derivative instruments that can be used to hedge against interest rate risk.

CHAPTER 5: FINANCIAL DERIVATIVE INSTRUMENTS THAT CAN BE USED TO HEDGE INTEREST RATE RISK

5.1 Introduction

In Chapter 3, the tools for measuring and quantifying interest rate risk management were described in detail. Once the exposure to interest rate risk is known, the ALCO can formulate hedging strategies to protect the company against the possible losses associated with the risk exposure.

Chapter 4 stated that hedging strategies can take on many forms and can have different goals. For example, a hedging strategy may comprise of a single instrument, or of a combination of various instruments from the pool of notionals and derivatives. Furthermore, the strategy can be designed to completely remove the exposure to interest rate risk, thereby immunizing the interest margin of the company, or it can leave room to benefit from expected future events (Bessis, 1998:352).

Chapter 4 was dedicated to describing the different notional instruments that can form part of a hedging strategy. It was noted that Chapter 4 and 5 forms a unit that will satisfy the third goal of the dissertation, which is to define the instruments that can be used to hedge against interest rate risk.

Chapter 5 first of all defines interest rate derivative instruments and describes their use for hedging interest rate risk. This is followed by a closer look at the different types of interest rate derivatives, including forward rate agreements (FRA's), swaps, options and combination structures.

5.2 *Definition of derivative instruments and description of their use*

The classic definition of a derivative states that it is a contract whose value depends on and is derived from the value of some more basic underlying instrument (Hull, 2000:1). The underlying instrument could be an asset, reference rate or index, or literally anything else with a measurable value.

Although accurate, this definition can lead to confusion. For example, a bond derives its value from the "underlying" yield curve, but is not legally classified as a derivative. Likewise, exchange-traded funds like the SATRIX 40, which is listed on the JSE as a conventional security, derives its value from the underlying shares used to calculate the ALSI40 index. According to SAIFM (2003:11), a more accurate definition of a derivative is as follows: "A derivative is an instrument which embodies different terms, rights, or obligations, to those prevailing in the "underlying", "cash" or "physical" market to which the instrument relates."

The previous chapter discussed some of the various notional instruments that can be used to hedge interest rate risk. Notional instruments can, however, be cumbersome and expensive, especially for smaller corporates. For example, if a corporate wishes to obtain a fixed rate liability by issuing a bond, it will have to employ the services of a legal firm to draw up the contracts and the services of an investment bank to underwrite the issue. It will have to draw up a prospectus of the issue and go on a "road show" to market the issue to investors. A bank or trust company must be appointed to serve in a fiduciary capacity as trustee to protect the rights of the bondholders (Graddy et al, 1985:563). The associated expense requires a large issue in order to make it a viable funding option.

By contrast, the same fixed rate result can be achieved by taking a normal floating rate term loan from a bank and fixing the interest rate with a fixed-for-floating interest rate swap (see par 5.2.2). While the cost saving will depend on the corporate spread that the bank charges, the process is certainly a lot less cumbersome. Buying an interest rate swap, or any other derivative for that matter, is as simple as calling a few banks for quotes an accepting the best quote. The whole process is done telephonically and can be concluded in a matter of minutes, providing that credit lines[3], ISDA[4] and FICA[5] documentation are in place.

Furthermore, using derivative instruments is flexible. Unlike the equity and commodity derivative markets, interest rate derivatives are predominantly traded off-exchange in the over-the-counter (OTC) market. The swaps market, for example, is the largest OTC market in the world (SAIFM, 2004 (a):27). As such, they can be structured to meet the exact requirements of the client, such as broken dates, i.e. dates that do not conform with a formal exchange delivery date, as well as other unique or non-standard requirements.

With the use of derivatives, hedgers exposed to adverse movements in the cash-market price can eliminate the exposure completely by taking a derivatives position that is equal and opposite to the cash-market position. In doing this, the risk of loss is eliminated by giving up any potential for gain, with certainty as the end result. As an example, a hedger could eliminate exposure to floating interest rates on a loan with the use of an interest rate swap (see section 5.4.1). Alternatively, the hedger could buy an option for a premium to eliminate the risk of loss while retaining the potential for gain (see section 5.5).

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[3] A credit line is the maximum amount of exposure that a bank is willing to take against a counterparty, based on the bank's credit assessment of that couterparty. The counterparty can use its credit line with a bank for a range of credit services, including amongst others loans, overdrafts and derivatives (Channon, 1993:123-124).

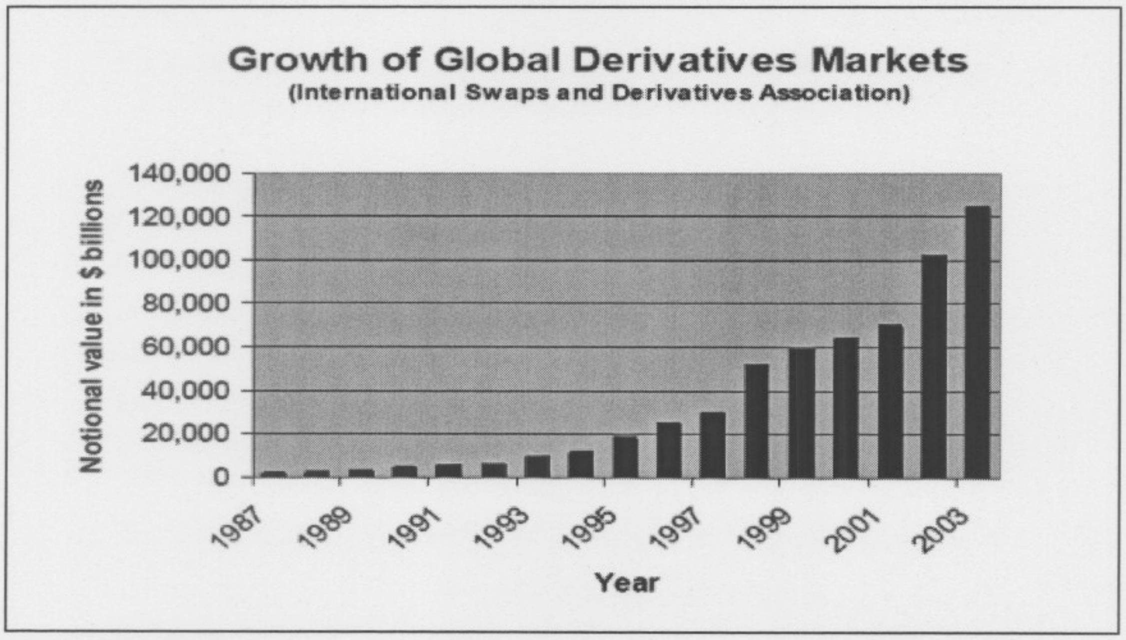
[4] ISDA refers to the standard documentation that governs all swaps and derivative transactions between two counterparties (ISDA, 2005). In general, a bank will only enter into a derivative position with a couterparty if the ISDA documentation is signed and in place.

[5] FICA stands for Financial Intelligence Centre Act 38 of 2001, which forms part of the worldwide drive to curb terrorism. It forces banks and other participants in the financial industry to comply with regulations designed to prevent money laundering. A key feature of FICA is the requirement to have documents that prove the identity of the client (Standard Bank, 2005).

Hull (2000:20) states that if a hedger wishes to close out or unwind a futures position, all he needs to do is to enter into an equal and opposite transaction. The same principal goes for all other derivative positions. The hedger can then net off the two positions. There will of course be a profit or loss on closing out, depending on where the market is at the time, but this should be off-set by an equal and opposite loss or profit on the asset or liability that the hedge referred to. If the closing out transaction is done with the same bank as the original transaction, the hedger will probably not even see the equal and opposite transaction, because the bank will likely just quote the hedger a Rand amount for closing out.

If the hedger made a profit by closing out the derivatives position, he will receive money from the bank as final settlement of the position. Conversely, if the hedger made a loss, he will have to pay the bank for final settlement of the position. Once payment has been made, the position will be officially closed out and neither party will have any further rights or obligations pertaining thereto.

Figure 5.1: The growth in global derivative volumes



SAIFM (2003:1)

The use of derivatives has become hugely popular over that last two decades, as evidenced by Figure 5.1, which shows the annual volume of global derivative sales. Note that the y-axis is denoted in billions of USD. In Figure 5.1, it can be seen that the annual volume grew exponentially from just a few billion dollars in 1987 to over $120 billion in 2003.

There are several reasons for the growing popularity of derivatives, including the following (SAIFM, 2003:19):

- The globalisation and liberalization of world trade, giving rise to new and different risk profiles of economic agents

- The relaxation of capital controls permitting a huge increase in global investment opportunities and risks.

- The technology and communications revolution, especially the advent of the microprocessor.

- The development of risk management as a strategic focus of organizations.

- The generally acknowledged success of the theoretics of derivatives pricing and hedging in the real world over this period.

In the sections that follow, the interest rate derivative instruments commonly used for hedging interest rate risk are discussed. The discussion starts off with a detailed description of forward rate agreements, commonly referred to as FRA's. This will be followed by discussions on interest rate swaps, interest rate options and combination structures.

5.3 *Forward rate agreements (FRA's)*

A forward rate agreement, or a FRA, is a short-dated interest rate derivative, which is designed as a contract between two parties to exchange an interest rate differential on a predetermined notional principal amount. The interest calculation applies to a given future time period and the method of calculation is specified in the contract (Hull, 2000:95 97). The above-mentioned interest rate differential is the difference between the fixed contract (FRA) rate and the agreed market reference rate on which the settlement calculation is based. The market reference rate could for example be the JIBAR[6] rate.

Cash flows occur on a pre-specified settlement date, which is the start date of the contract period. The notional principal amount is not exchanged in a FRA transaction. It is simply used, along with the contract rate and reference rate, to calculate the settlement amount on the settlement date. Therefore, the exposure to both parties to the contract is limited to the settlement payment.

The buyer of the FRA is a borrower of money and agrees to a future borrowing rate. In other words, the buyer seeks protection against a rise in interest rates. The seller of the FRA is an investor of money and agrees to a future lending rate. Thus, the seller seeks protection against a decline in interest rates (Beaufort Institute, 2003 (b):4).

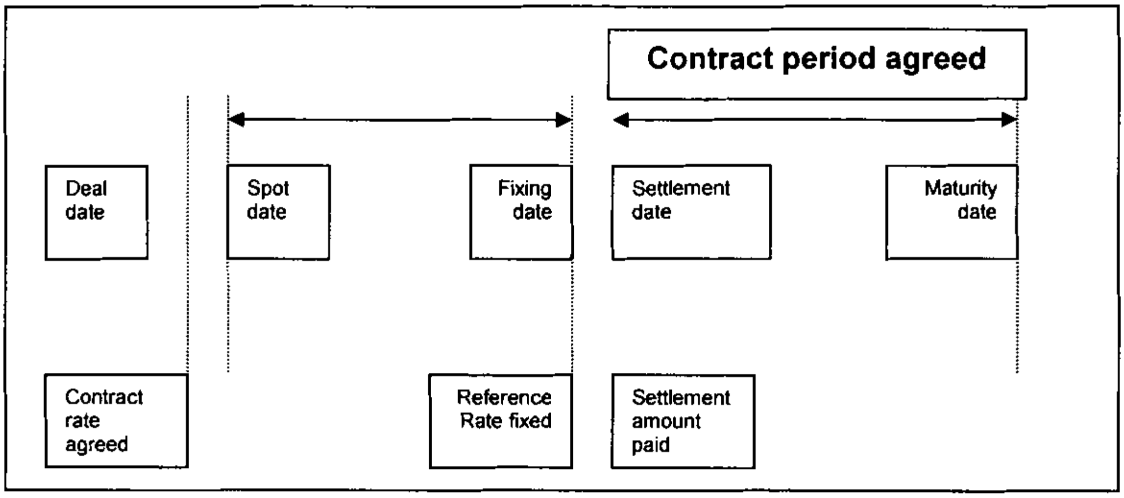
FRA's are quoted in the same way as the underlying interest rate market, i.e. as a percentage per annum, and is priced off the prevailing yield curve in the manner described in section 3.3 above (formula 3.2). Furthermore, a particular FRA is quoted with reference to the future period that it covers (Koch, 2000:391). For example, a 3x6-month FRA or a 3's against 6's FRA is a FRA which will cover a future interest rate period starting in 3 month's time and lasting for 3

[6] JIBAR is the abbreviation for Johannesburg Inter Bank Asking Rate. The 1, 3, 6 and 12 month JIBAR rates are determined each day as an average of the leading banks' NCD rates for the same periods (SAIFM, 2003:64)

months. Similarly, a 1x7-month FRA will start in 1 month's time and last for 6 months.

FRA's are not options. There is no choice on whether to make a compensating payment. It is a binding contract between two parties, structured as a mutual (reciprocal) compensation agreement. If interest rates rise between the transaction date and the settlement date of the FRA, the seller is obligated to compensate the buyer with the settlement amount. If interest rates fall, the buyer is obligated to compensate the seller of the FRA.

Figure 5.2: Characteristics of a FRA contract



Beaufort Institute (2003 (b):7)

Figure 5.2 describes the characteristics and terms that are agreed in a FRA contract, as well as the time-line. Starting on the left-hand side, the contract rate is agreed on the deal date, as are the reference rate and the contract period, which is defined by the fixing/settlement date and the maturity date. On the fixing/settlement date, the reference rate is fixed and the settlement amount is paid.

FRA contracts reset and pay in advance, i.e. the settlement date is equal to the reset or fixing date for the reference market rate and equal to the payment date of the settlement. As such, the settlement amount is calculated by applying the difference between the contract rate and the reference rate to the notional principal amount, for the stated contract period, and then discounting the resulting interest amount back to the settlement date. Therefore, the following formula is used to calculate the settlement amount (adapted from SAIFM, 2003: 57):

$$\text{FRA compensation} = \left(\frac{abs[R - C] \times d / B \times N}{1 + (R \times (d / B))} \right) \tag{5.1}$$

Where:

R	=	Reference (settlement) rate
C	=	Contract rate (FRA rate)
N	=	Notional amount
d	=	Days in contract period
B	=	Day basis (365 in South Africa)

Table 5.1: Settlement of a FRA contract

	Settlement rate GREATER than contract rate	**Settlement rate LESS than contract rate**
BUYER (liability hedge)	RECEIVER of settlement amount	PAYER of settlement amount
SELLER (asset hedge)	PAYER of settlement amount	RECEIVER of settlement amount

Beaufort Institute (2003 (b):9)

Table 5.1 describes the direction of payment of the settlement amount under different scenarios. If, on the settlement date, the settlement or reference rate is greater than the contract rate, then the buyer of the FRA will receive the settlement amount, which will have to be paid by the seller. If the settlement rate is less than the contract rate, then the buyer of the FRA will have to pay the settlement amount, which will be received by the seller.

As an example (Beaufort Institute, 2003 (b):9), consider the case where a company has a floating rate liability, which is rolled over every three months. The financial director fears that rates will increase in the short term and would like to fix the funding cost of the next rollover to eliminate the exposure to higher interest rates. The company therefore buys a 3 x 6 month FRA at 11.00% for a notional amount of R10,000,000.

On the settlement date, the reference rate is set at 11.35%, which is above the contract rate of 11.00%. The company (buyer of the FRA) will receive a settlement amount calculated as follows:

$$\text{Settlement amount} = \frac{(0.1135-0.11)\times 10{,}000{,}000\times {}^{91}\!/_{365}}{[1+(0.1135\times {}^{91}\!/_{365})]} = \text{R8,485.90} \qquad (5.2)$$

The company's net position is therefore as follows:

Borrowing cost at 11.00%	:	R274,246.58
Borrowing cost at 11.35%	:	R282,972.60
Increase in borrowing cost	:	(R 8,726.02)
Gain from FRA	:	R 8,485.90
Net increase	:	(R 240.12)*

* Difference due to timing mismatch of cash flows

If the reference rate were set at below the contract rate of 11.00% at say 10.63%, the company would have had to pay a settlement amount.

5.4 *Swaps*

Swaps are some of the most widely used hedging instruments available on the market. In fact, as stated before, the swaps market has become the largest OTC market in the world (see section 5.2). There are many reasons for this, not the least of which their flexibility with regards to the OTC market's ability to structure a swap to meet the exact requirements of the hedger.

There are many types of swaps traded across a range of markets, including the interest rate, currency, commodity and equity markets. Although each market has its own characteristics, as do each particular variant of a swap, all swaps have certain commonalities (SAIFM, 2004 (b):69):

- A swap is a contractual agreement between two parties (counterparties) to exchange a series of cash flows at specific intervals over certain period of time.

- The swap payments are based on some underlying asset or notional amount, which may or may not be exchanged.

- At the time of entering into the swap agreement, at least one of the series of cash flows is uncertain.

The following sections discuss swaps in more detail as they pertains to hedging interest rate risk. The discussion is grouped under the headings vanilla interest rate swaps, basis swaps and other types of swaps.

5.4.1 Vanilla swaps

A vanilla interest rate swap, also known as a fixed-for-floating swap or a coupon swap, is the simplest form of swap available in the market. It is defined (Koch, 2000:392) as an agreement between two parties to exchange interest payments on a certain notional amount of money. One party agrees to pay a fixed rate of interest based on the notional amount and the other party agrees to pay a floating rate of interest.

The swap agreement defines the dates when cash flows are to be paid, as well as the method for calculating the cash flows (Hull, 2000:121). The notional amount is not exchanged. The actual cash flows between the two parties will be the net interest rate differential between the two legs of the swap, usually paid at the end of each interest rate period. If, for a given interest rate period, the floating rate was higher than the fixed rate, the party paying the fixed rate under the agreement will receive compensation from the party paying the floating rate. The compensation received will be equal to the difference between the two rates applied to the notional amount for the relevant interest rate period.

In other words, the compensation is calculated in the same way as described in the previous section for a FRA agreement, except that the full payment is made at the end of the period, and not present valued to the start of the period. With reference to the formula used for a FRA, the formula for calculating the compensation for a single interest period under a swap agreement is therefore simply the following (see section 5.3, formula 5.1):

Interest period compensation = $abs[R - C] \times d/B \times N$ (5.3)

Where:

R = Reference rate

C	=	Contract rate (Swap rate)
N	=	Notional principal amount on which interest is calculated
d	=	Days in contract period
B	=	Day basis (365 in South Africa)

Plain vanilla swaps are priced off the prevailing yield curve. In fact, from a mathematical perspective, swaps can be regarded as an abbreviated method of simultaneously dealing in a number of forward contracts (SAIFM, 2003:62). At the time of entering into the agreement, the price of the swap, i.e. the fixed rate, is set so that the initial value of the swap is zero. The swap's current value is the net value of the two interest streams, fixed and floating (Lore et al, 2000: 15). The price is quoted as an annualized yield with reference to its compounding frequency. For example, most swaps reset quarterly and the price would be quoted as a NACQ – Nominal Annual Compounded Quarterly - rate. If the swap resets semi-annually, the price would be quoted as a NACS rate. Typically, the compounding frequency would be chosen to correspond with that of the underlying loan (SAIFM, 2003: 67).

To put the above in simpler terms, the interest stream for the fixed leg is known. The interest stream for the floating leg is calculated from the forward rates implied by the prevailing yield curve. Both legs are valued by calculating the present value of the interest rate streams using the prevailing discount factors calculated from the yield curve. The price or fixed rate of the swap is solved through an iterative process so that the present value of the fixed leg is equal to the present value of the floating leg.

Another way of approaching the valuation of a vanilla interest rate swap is by realizing that through entering into a fixed-for-floating swap, the payer of the fixed rate has created a synthetic bond portfolio: He is long a floating-rate bond and short a fixed-rate bond, both in the amount of the notional principal. According to Hull (2000:132), the value of the swap is then determined as follows:

$V_{swap} = B_{fl} - B_{fix}$ (5.4)

Where

V_{swap}	=	the value of the swap
B_{fl}	=	the value of the floating rate bond
B_{fix}	=	the value of the fixed rate bond

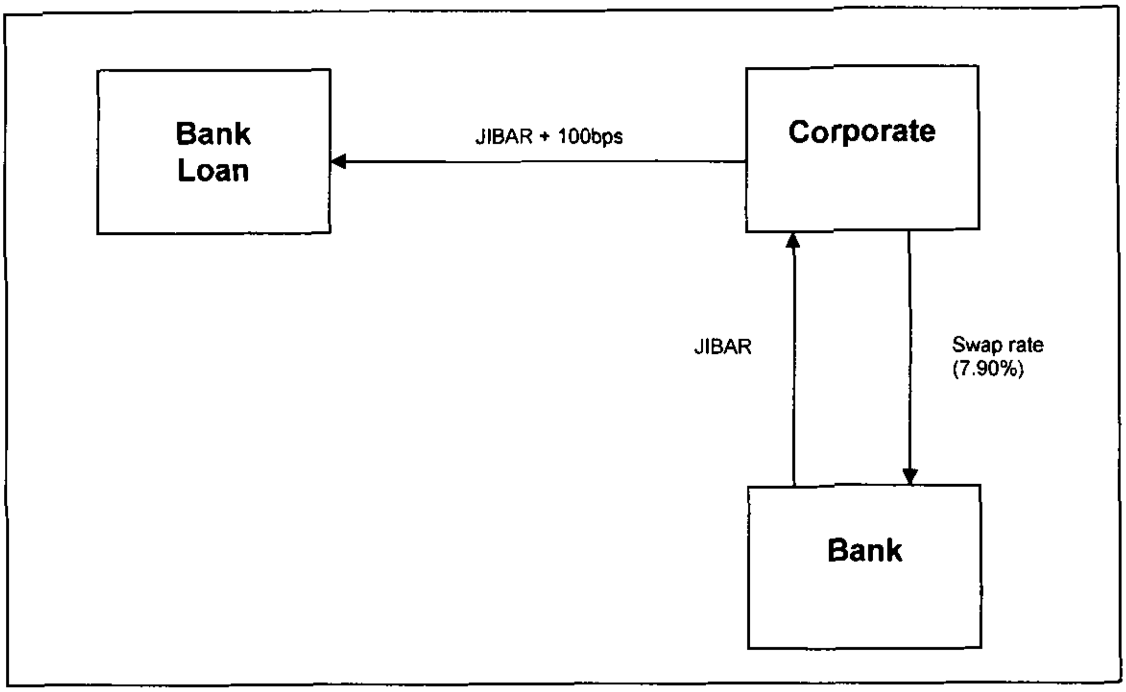
In order to achieve uniformity in the market, the large majority of interest rate derivatives in South Africa, including FRA's, swaps, caps and floors, use JIBAR as the floating rate reference rate (SAIFM, 2003:64). However, the floating reference rate can be any rate that the parties to the agreement agree to. Using the Prime rate as a reference is common in South Africa. In international markets, the norm is to use the relevant LIBOR rate.

In completion of the discussion on plain vanilla interest rate swaps, consider the following example (adapted from J.P. Morgan/Arthur Andersen, 1997:27):

> Assume that a corporate has a loan on which it pays interest at JIBAR plus 100 basis points, and that the corporate wishes to fix the interest rate risk exposure it has on the floating rate loan. In order to hedge the exposure, the corporate's treasury enters into a fixed-for-floating rate swap against JIBAR at a price of 7.90% NACQ. Once the swap is in place, the corporate will, on each payment date, pay JIBAR plus 100 bps on the loan, and 7.90% fixed under the swap agreement. However, it will also receive JIBAR under the swap agreement. The corporate's net funding cost is therefore 7.90% + (JIBAR + 100bp) – JIBAR = 8.90% NACQ.

When dealing with derivative instruments, it is often useful to express the transaction graphically. This allows for better understanding and therefore reduces the chance of an error. Figure 5.3 describes the transaction shown in the example above.

Figure 5.3: Example of a swap



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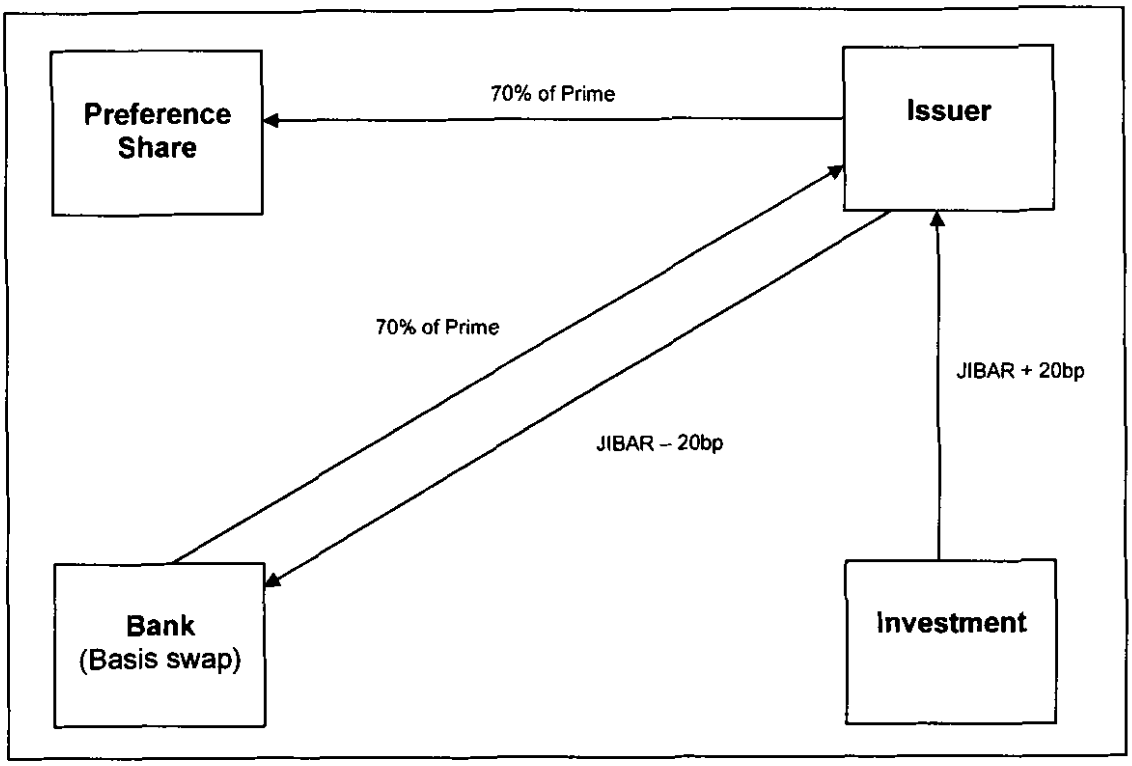
In Figure 5.3, the arrows indicate the respective interest payments and their directions. It shows how the corporate pays JIBAR plus 100 bps on the loan. It also shows the two legs of the swap agreement, one where the corporate pays 7.90% fixed, and one where it receives JIBAR. With all the interest flows graphically displayed like this, the calculation of the net cost of funding, as given in the example, becomes obvious.

5.4.2 Basis swaps

A basis swap is an interest rate swap where both legs of the swap are referenced to a floating rate of interest (Beaufort Institute, 2003(b):23). In other words, one floating rate of interest is swapped for another floating rate of interest on a notional principal amount. In South Africa, for example, the Prime rate could be swapped for JIBAR.

Consider the example where an issuer of a preference share pays a dividend linked to Prime, but receives JIBAR on his investments. The issuer therefore has basis risk. The basis risk can be hedged by converting the preference share into a JIBAR-linked liability through the use of a basis swap (SAIFM, 2003:66).

Figure 5.4: Example of a basis swap



SAIFM (2003:66)

Figure 5.4 describes the conversion in the above example graphically. It shows that there are four different interest rate payments after implementing the basis swap. As before, the arrows indicate the direction of each interest flow, with the applicable interest rates indicated next to the arrows. In Figure 5.4 it can be seen that the issuer receives JIBAR + 20 bps on the investment and pays 70% of

Prime on the preference share. Under the basis swap agreement, the issuer receives 70% of Prime and pays JIBAR minus 20 bps. The net result of the transaction is that the issuer has locked in a 40 bps interest margin, i.e. (JIBAR + 20bp) – (JIBAR – 20bp) + (0.7 x Prime) – (0.7 x Prime) = 40bps.

5.4.3 Other types of swaps

As stated earlier, swaps make up the biggest OTC market and the OTC market is characterized by flexibility and innovation. Swaps are therefore tailored to meet the exact requirements of the hedger, for example in terms of broken dates, the reference rate and the compounding frequency.

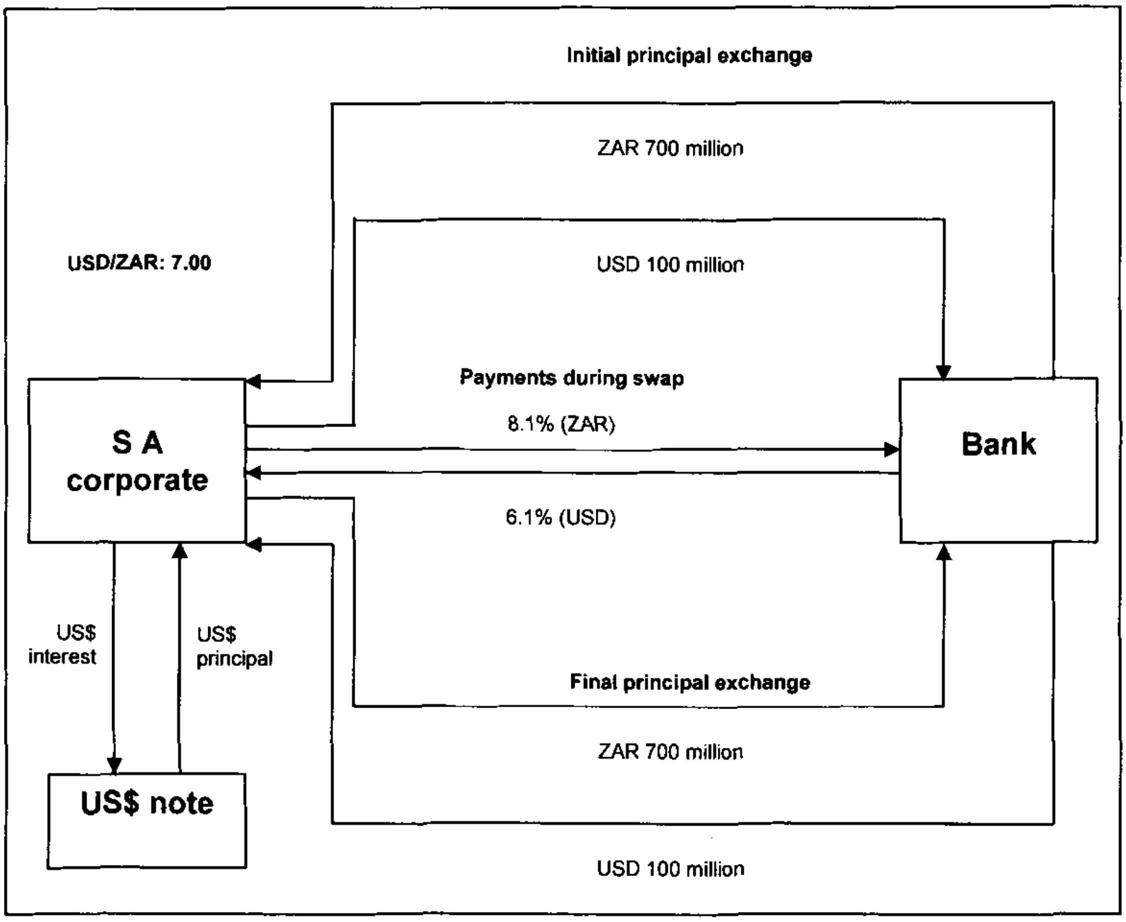
The previous section already referred to JIBAR and PRIME based swaps. Another type of swap specific to South Africa is Rand Overnight Deposit Swaps, or RODS. RODS use the daily call rate charged or paid by banks as the reference rate and are available for periods of up to twelve months (SAIFM, 2003:66).

Swaps can also be tailored in terms of the notional principal amounts. Separate notional amounts can be specified for each interest period in order to mach the notional profile of the underlying loan or investment being hedged. For example, a normal "bullet" plain vanilla swap will be inappropriate to hedge an amortising loan. In such a case, the correct hedge would be an amortising swap with a notional profile matching that of the underlying loan (Beaufort Institute, 2003(b):20).

Accreting swaps are used to hedge assets or liabilities with an accreting notional profile. Once again, the notional profile can be specified exactly in accordance to the profile of the underlying asset or liability (SAIFM, 2003:68). Similarly, rollercoaster swaps are swaps where the specified notional amount decreases in some interest periods and increases in other periods.

Lastly, cross-currency swaps are used to hedge both the exchange rate risk and the interest rate risk associated with a loan or investment denominated in a foreign currency (J.P. Morgan/Arthur Andersen, 1997:29-30). Unlike the different types of interest rate swaps discussed before, cross-currency swaps usually involves an exchange of principal. The exchange and re-exchange of principal are both done at the same fixed exchange rate.

Figure 5.5: A cross-currency swap



Author

Figure 5.5 describes the use of a ZAR/USD cross-currency swap (adapted from J.P. Morgan/Arthur Andersen, 1997:30). It can be seen in Figure 5.5 that a South African corporate has issued a USD note, on which interest has to be paid in USD. By issuing the note, the corporate received $100 million. By employing the above cross-currency swap, the South African corporate can effectively convert a fixed rate USD liability into a fixed rate ZAR liability. As before, the arrows indicate the direction of the cash flows.

At the top of Figure 5.5 there is the initial exchange of principal, whereby the corporate gives the bank the USD 100 million that it raised through the note issue and receives ZAR 700 million. During the life of the transaction, the corporate will have to pay the bank ZAR interest at 8.1% and receive USD interest at 6.1%. The corporate will use the USD interest payments received from the bank to make the interest payments on the USD note it issued. When the transaction matures, there will be a final exchange of principal at the same exchange rate of USD/ZAR 7.00, i.e. the corporate will give the bank ZAR 700 million and receive USD 100 million, which it will use to repay the capital of the USD note.

This concludes section 5.4, which was dedicated to the discussion of the different types of swaps, i.e. vanilla swaps, basis swaps, RODS, amortising swaps, accreting swaps, cross-currency swaps, etc. The following section gives a detailed discussion on options.

5.5 Options

It was noted earlier that a hedger can, with the use of derivatives, eliminate his exposure to adverse movements in the cash-market price completely by taking a derivatives position that is equal and opposite to the cash-market position. In doing this, the risk of loss is eliminated by giving up any potential for gain, with certainty as the end result. As an example, a hedger could eliminate exposure to floating interest rates on a loan with the use of an interest rate swap, as discussed in the previous section.

Alternatively, the hedger could buy an option for a premium to eliminate the risk of loss while retaining the potential for gain (SAIFM, 2004 (b):76). In so doing, the hedger's risk is limited to the premium paid for the option. If the option expires without being exercised, the hedger forfeits the premium paid for the option. However, the fact that the option was not exercised means that the underlying market, to which the hedged asset or liability relates to, has moved in favour of the hedger, who has thus made a profit on such asset or liability.

Buying an option is therefore similar to buying insurance. The owner of a vehicle will pay an insurance company a premium to insure the vehicle against loss. While this will give the owner a right to claim for damages in the event of a loss, it will be more beneficial to the owner if the need for a claim never arises.

In the following sections, the basics of options will be discussed, followed by a detailed description of the three most widely used options for hedging interest rate risk, namely Caps, Floors and Swaptions. Collars are discussed later under combination structures in section 5.6.1.

5.5.1 Option basics

An option is defined as an instrument that gives the holder (buyer) the right, but not the obligation, to buy (or sell) a specified quantity of the underlying asset at a specified price, known as the strike price of the option (Lore & Borodovsky, 2000:16).

There are two basic types of options. A call option gives the holder the right to buy the underlying asset, whereas a put option gives the holder the rig to sell the underlying asset at the strike price. Each option contract has an expiration date, or maturity. American options can be exercised at any time up to the expiration date, while European options can only be exercised on the expiration date itself (Hull, 2000:6).

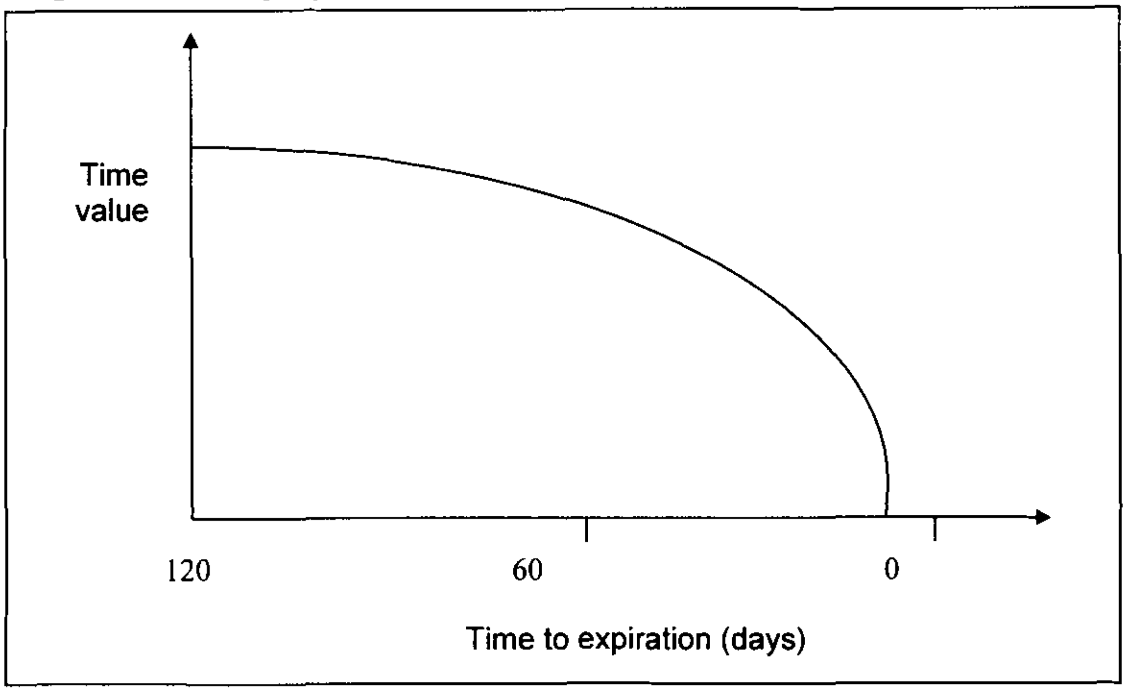
The premium of the option can be broken up into the option's intrinsic value and the option's time value (J.P. Morgan/Arthur Andersen, 1997:25). The intrinsic value of a call option is the larger of the strike price less the market price of the underlying asset, or zero. The intrinsic value of a put option is the larger of the current market price of the underlying asset less the strike price, or zero.

In other words, if X denotes the strike price, and the current market price of the underlying asset is denoted by S_t, then the intrinsic value of a call option is equal to $S_t - X$, while he intrinsic value of a put option is equal to $X - S_t$, providing that these value are greater than zero. If they are smaller than zero, then the intrinsic value is zero (Lore et al, 2000:17). The intrinsic value of an option is often described by its moneyness. An option is said to be in-the-money if it has intrinsic value. If $S_t - X$ (in the case of a call option) or $X - S_t$ (in the case of a put option) is negative, then the option is said to be out-the-money. If it is equal to zero, the option is at the money.

Time value is the difference between the option premium and the option's intrinsic value (Koch, 2000:412). It relates to the value the holder of the option has in having a choice of whether or not to exercise the option, as well as the market's perception of the probability that the option will be exercised. The time value of an option is therefore related to the moneyness of the option. The further in or out-of-the-money the option is, the less the time value of the option will be. An at-the-money option will have the maximum time value, since small movements in the underlying asset's market price will immediately begin to affect the probability of the option being exercised at maturity.

Time value is the portion of the option premium that is affected by volatility and is also that portion of the premium that decays as time passes. The closer one gets to the expiry of the option, the smaller the time value component becomes, so that it eventually becomes zero at expiry. The decay of time happens at an increasing rate as the option nears expiry (Beaufort Institute, 2003(b):9). Figure 5.6 displays this relationship between the time value of an option (y-axis) and the time left to expiry (x-axis) measured in days.

Figure 5.6: Decaying time value



SAIFM (2003:81)

The mathematics used for the pricing of options is complex and several pricing methodologies have been developed over the years. For example, the most commonly used formulas for pricing European call and put options are the Black-Scholes formulas (Hull, 2000:250).

From a hedging point of view, what is important is to understand that all option-pricing models have the same key inputs, and how these inputs affect the price of the option. The key inputs are as follows (SAIFM, 2003:81-82):

- The exercise or strike price.

- The current price of the underlying asset. Together with the strike price, this determines the moneyness or intrinsic value of the option, as discussed above. The more intrinsic value an option has, the more expensive it will be, i.e. an in-the-money option will be more expensive than an at-the-money option, which will in turn be more expensive than an out-the-money option.

- Time to expiry. The longer the time to expiry, the greater the time value portion of the premium and therefore, the bigger the premium.

- Interest rates. This is used to present value future cash flows in the pricing model. Therefore, an increase in interest rates should lead to a slight decrease in the option premium, and vice versa.

- Expected future volatility. Generally, the greater the volatility in he underlying market, the greater the premium.

The above paragraphs described the basics of options and option pricing. There are, as stated previously, many different types of options in all the different markets, ranging from vanilla to complex exotic options. In the next section, the three types of options most widely used in the interest rate environment, namely Caps, Floors and Swaptions, are discussed. Collars are discussed in section 5.6.1, since they fall under the category of combination structures.

5.5.2 Caps, Floors and Swaptions

Caps and Floors are options, but display characteristics similar to those of swaps, in that they have a notional principal amount and reset regularly to a specific reference rate, usually quarterly (NACQ) to 3-month JIBAR. With a swap, however, the reference rate at reset is compared to the fixed contract rate (swap rate), which the buyer of the swap locked into, i.e. the buyer is contractually bound to pay the fixed rate. With Caps and Floors, the reference rate is compared to the strike rate of the option, and it is at the buyer's discretion to exercise the option at each reset.

Caps are a series of options that protect the buyer, typically a borrower of money, against higher interest rates. Floors, on the other and, protect the buyer, typically an investor of money, against lower interest rates. Each option in the series of options have the same strike price, but the expiry of each option is designed to coincide with the re-pricing of the underlying loan or investment (Beaufort Institute, 2003(b):20-21).

As an example of the use of a floor, consider the case where an investor deposits money at a bank for two years on which he receives the 3-month JIBAR rate every quarter. He wishes to protect his return by buying a 2-year 11% NACQ JIBAR floor. On each reset date, the investor will have the right to exercise the option, which he will do only if JIBAR has fallen to below 11%. If JIBAR is above 11%, the investor will not exercise the option (SAIFM, 2003:96).

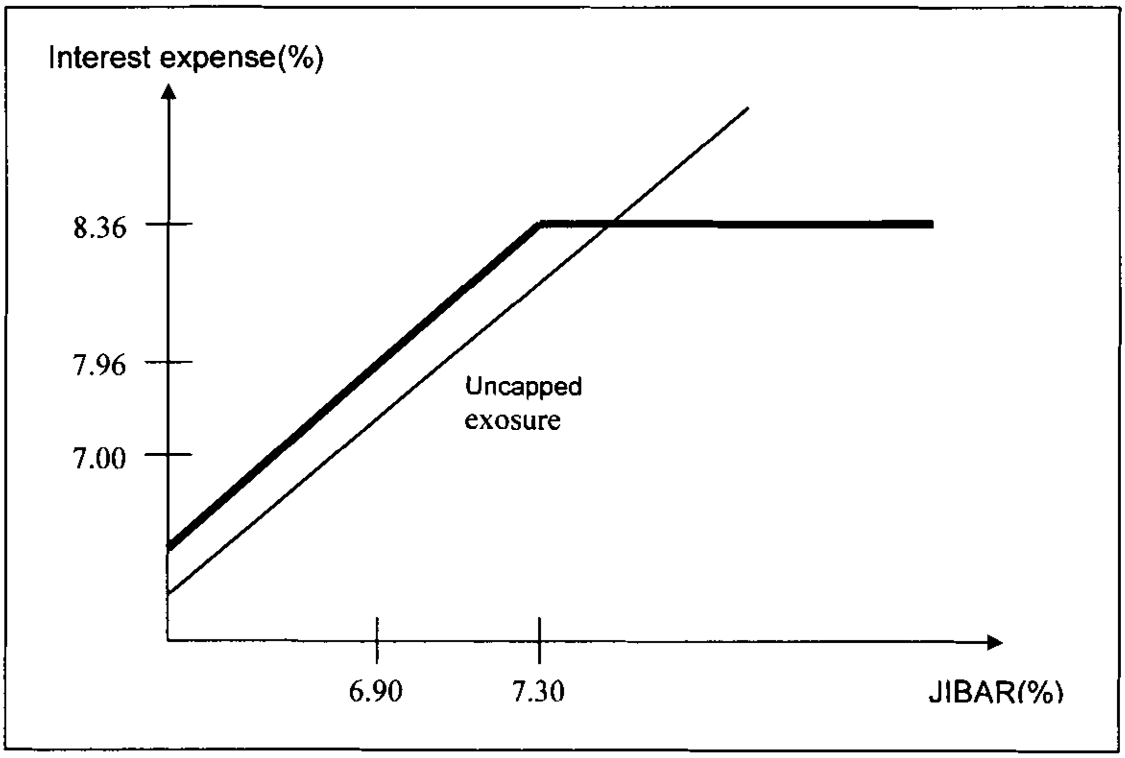
J.P. Morgan/Arthur Andersen (1997:25) gives the following as an example of the use of a cap. Consider the following (adapted from J.P. Morgan/Arthur Andersen, 1997:25):

> Assume that a corporate borrows money at JIBAR plus 30 basis points and that JIBAR is currently 7.00%. The price of a JIBAR cap struck at

7.30%, expressed in basis points, is 76 basis points. Without the cap, the corporate's interest rate exposure is unlimited. Buying the cap will change the interest rate exposure to a maximum of 8.36%, i.e. the cap strike rate plus the 30 basis points borrowing margin over JIBAR plus the 76 basis points premium for the cap.

Figure 5.7 compares the above example's capped exposure to the uncapped exposure. The thick line describes the exposure effectively capped at 8.36%, while the thin line the uncapped exposure, i.e. JIBAR plus 30 bps. It can be seen that the effective cap rate of 8.36% is reached when the market rate reaches 7.30%.

Figure 5.7: Interest rate cap



Author

Lastly, a swaption or a swap option is defined as an option that gives the holder the right to enter into either a lender's or borrower's swap at a certain price at a given time in the future (Lore & Borodovsky, 2000:24). Whereas caps and floors are series of options that give the holder the right to exercise at each reset date, a swaption is a single option. Once exercised, the holder has entered into a swap agreement with no further option rights. Like FRA's, swaps, caps and floors, swaptions are usually referenced against JIBAR (SAIFM, 2003:96).

So far, the discussion on interest rate derivatives has concentrated on single instruments that can be used for hedging purposes. In section 5.6 it will be shown how these instruments can be combined to form different combination structures, displaying their own unique characteristics.

5.6 Combination structures

It was stated before that innovation and flexibility are key features of the OTC derivatives market. As such, there are an infinite number of possible combinations of basic derivative products that will produce a new product.

Three of the most common interest rate derivative combination structures are collars, participation swaps and reverse participation swaps. They are discussed below.

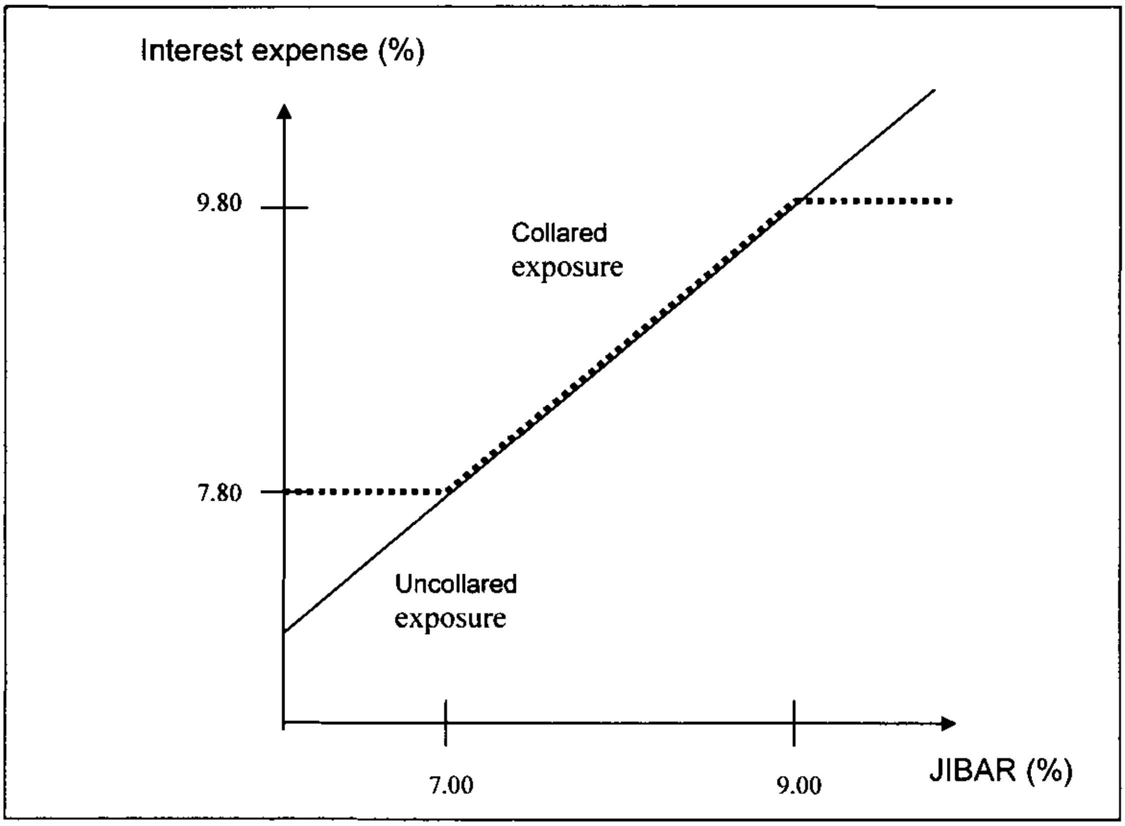
5.6.1 Collars

In order to hedge against increasing interest rates, a borrower can buy an interest rate cap for a premium, as discussed above. Caps can, however, be expensive, especially if the yield curve is upward sloping. To reduce the cost of the hedge, the borrower can sell a floor and use the premium received to subsidize the cost of the cap. The resulting position is known as an interest rate collar (Beaufort Institute, 2003(b):21).

As an example of the use of a collar, consider the following (adapted from J.P. Morgan/Arthur Andersen, 1997:28):

> Assume a borrower who funds at JIBAR plus 80 basis points decides to hedge the interest rate risk exposure by buying a JIBAR collar with the cap struck at 9.0% and the floor struck at 7.0%. After buying the collar, the borrower's funding rate will range between the floor strike plus the 80 basis points funding margin, and the cap strike plus the 80 basis points funding margin, i.e. between 7.8% and 9.8%.

Figure 5.8: Interest rate collar



Author

Figure 5.8 describes the exposure profile of the above borrower who funds at JIBAR plus 80 basis points and hedges the interest rate risk by buying a JIBAR collar with the cap struck at 9.0% and the floor struck at 7.0%. As stated above, buying this collar gives the borrower an effective funding rate that will range between 7.8% and 9.8%. This is shown in Figure 5.8 as the dotted line. The solid line shows the borrower's exposure if he does not buy the collar.

If the floor fully pays for the cap, the collar is said to be a zero cost collar. It should be noted, however, that the more the floor subsidises the cap, the narrower the collar becomes, i.e. the more the borrower forfeits his potential gain from decreasing interest rates.

5.6.2 Participation swaps

The terms participation swap and reverse participation swap (section 5.6.3), are South African terms referring to a special class of swaptions (see section 5.5.2), where the life of the option is equal to the life of the swap, and both the swap and the option run simultaneously. A participation swap is a combination of buying a swap (i.e. paying the fixed rate) and buying a cap (Smale, 2002). Typically, it would be used by a borrower of money who wants to protect against rising interest rates, but at the same time would like to benefit from declining interest rates, without having to pay the upfront premium associated with a normal cap.

Like a cap, a participation swap offers the borrower a maximum cost of funding. Unlike a cap, the borrower does not pay a premium for the optionality. Instead, the cost of the option is priced into the maximum rate of the participation swap. As a result, the maximum rate offered by a participation swap is higher than the fixed rate of a similar vanilla swap.

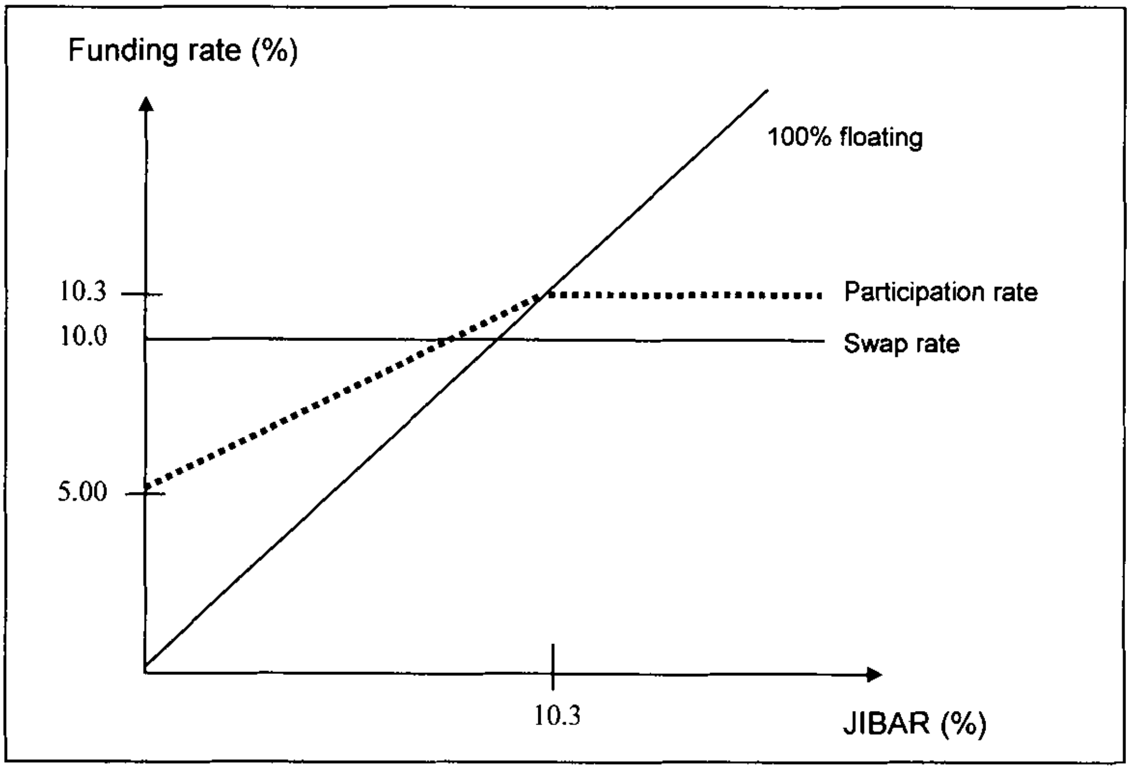
Also, unlike a cap, the borrower does not get 100% of the benefit of declining interest rates. Instead, the borrower participates in declining rates at a certain percentage, which is specified when the contract is entered into. The participation percentage can be set at any level, but the higher the percentage the higher the maximum rate of the participation swap will be in order to pay for the option.

Figure 5.9 compares the interest rate profile of a 50% participation swap with that of a swap (100% fixed) and that of being 100% floating against JIBAR. It is assumed that the maximum rate under the participation swap is 10.3% NACQ compared to the swap rate of 10.0% NACQ. For each reset period, the buyer of the 50% participation swap will receive JIBAR and pay the 50% participation rate, calculated as follows:

50% participation rate = MIN {10.3% ; (10.3% x 0.5) + (JIBAR x 0.5)} (5.5)

The equation is easily adjusted for other participation percentages. The participation rate profile is indicated on Figure 5.9 as the dotted line. The horizontal line denotes the swap rate (100% fixed) profile, while the JIBAR (100% floating) profile is indicated by the upward sloping solid line.

Figure 5.9: Participation swap



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5.6.3 Reverse participation swaps

A reverse participation swap is a combination of selling a swap (i.e. receiving the fixed rate) and buying a floor (Smale, 2002). Typically, it would be used by an investor of money who wants to protect against falling interest rates, but at the same time would like to benefit from increasing interest rates, without having to pay the upfront premium associated with a normal floor.

Like a floor, a reverse participation swap offers the investor a minimum return on investment. Unlike a floor, the investor does not pay a premium for the optionality. Instead, the cost of the option is priced into the minimum rate of the reverse participation swap. As a result, the minimum rate offered by a reverse participation swap is lower than the fixed rate of a similar vanilla swap.

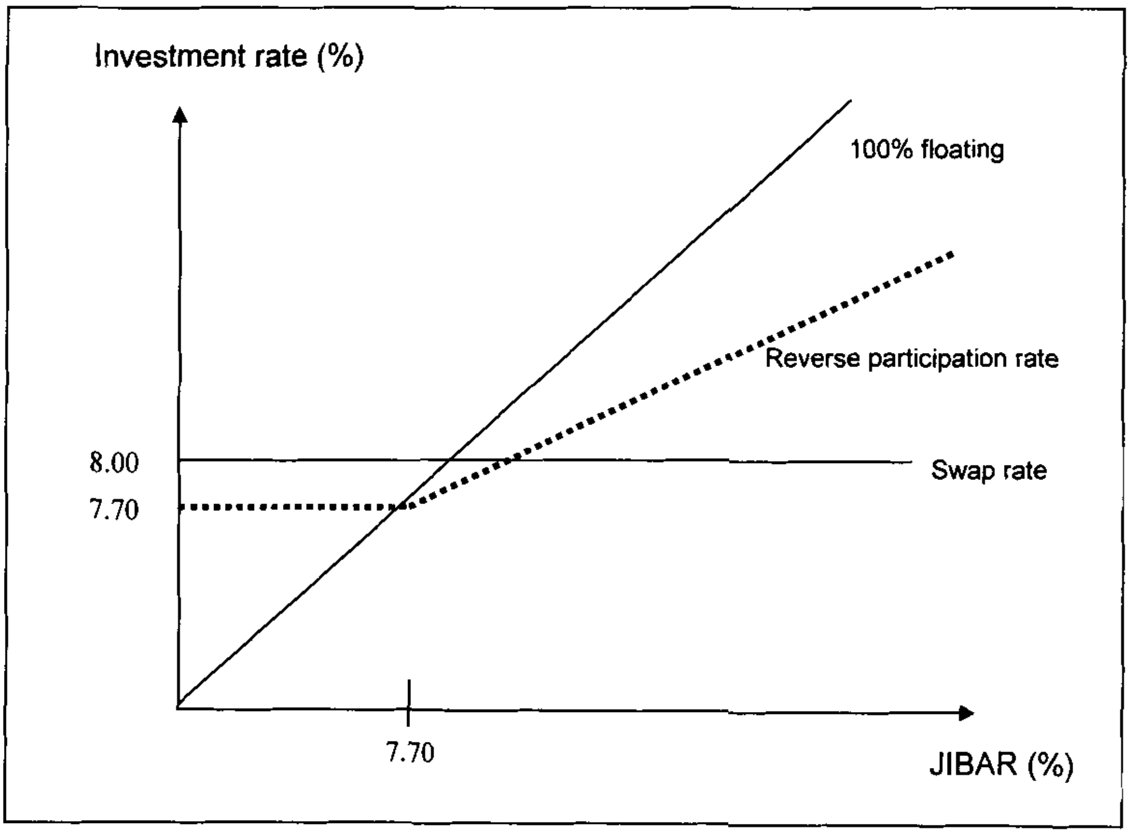
Also, unlike a floor, the investor does not get 100% of the benefit of rising interest rates. Instead, the investor participates in increasing rates at a certain percentage, which is specified when the contract is entered into. The participation percentage can be set at any level, but the higher the percentage the lower the minimum rate of the reverse participation swap will be in order to pay for the option. Figure 5.10 compares the interest rate profile of a 50% reverse participation swap with that of a swap (100% fixed) and that of being 100% floating against JIBAR.

Figure 5.10 assumes that the minimum rate under the reverse participation swap is 7.7% NACQ compared to the swap rate of 8.0% NACQ. For each reset period, the buyer of the 50% reverse participation swap will pay JIBAR and receive the 50% reverse participation rate, calculated as follows:

$$\text{50\% reverse part rate} = \text{MAX}\ \{7.7\%\ ;\ (7.7\% \times 0.5) + (\text{JIBAR} \times 0.5)\} \qquad (5.6)$$

The equation is easily adjusted for other participation percentages. The reverse participation rate profile is indicated on Figure 5.10 as the dotted line. The horizontal line denotes the swap rate (100% fixed) profile, while the JIBAR (100% floating) profile is indicated by the upward sloping solid line.

Figure 5.10: Reverse participation swap



Author

5.7 Other research and developments

Market practitioners commonly use the pricing methodologies described above, even though they are relatively old. However, as in the case of notional instruments in Chapter 4, it is important to know that a lot of research has been done in order to design better pricing methodologies. The body of research seems to center mostly around different ways to model the yield curve being used and how to include default risk in the price of the instrument.

Some of the issues discussed in section 4.7, for example the yield curve being used, are also applicable here. Section 3.3 described the term structure of interest rates and various alternative ways of modeling the yield curve. Obviously, when pricing financial instruments, as stated in the case of notionals in Chapter 4, the price will be greatly influenced by the particular yield curve model being used. In practice, market prices of traded instruments, and by implication the market yield curve, are influenced by market forces. In theory, however, there are many different ways to derive the correct price of an instrument, which may or may not differ from the market price.

Apart from the yield curve being used, option pricing models have the additional complexity of the volatility to be used. Section 4.7 already referred to the study by Black & Karansinski (1991) where they used a lognormal process for short-term rates to model the yield curve and a binary tree method to price bonds. In the same study, they showed how the lognormal rate process can also be used to model the volatility curve for pricing options.

Chen & Scott (1992) used a two factor Cox-Ingersoll-Ross model of the yield curve to develop pricing models for various interest rate options, including caps, bond options, bond future options, Eurodollar futures and options on swaps. According to them, the two-factor model has two advantages: It is flexible in fitting observed term structures and the fixed parameters can be set to model the variability of the term structure over time.

As in the case of notional instruments, derivative instruments also have associated default risk. Hull & White (1995) developed a model for pricing derivative instruments subject to default risk. In their model, they assume that in case of a default, a portion of the value of the instrument is recovered, and that the probability of default and the size of the recovery, are random variables. The model is counterparty-specific and uses information provided by bonds that the counterparty has in issue to estimate the parameters of the model.

Jarrow & Turnbull (1995) also studied the effect of default risk on the price of derivative instruments. They developed valuation techniques under the no-arbitrage principal that incorporated the risk of default, and could be applied to corporate debt and OTC derivatives. Their model had the ability to take into account two different sources of default risk, i.e. default of the underlying security and default of the counterparty.

According to Longstaff & Schwartz (2001), most Wall Street firms value and exercise American options based on a single-factor model of the yield curve, despite the fact that the yield curve is driven by multiple factors. They do this due to practical issues, which make it difficult to value options subject to multiple factors. In their study, they solve this practical problem by developing a simple but powerful simulation method for pricing American options, taking into account multiple factors.

The above-mentioned research is the tip of the iceberg and was chosen to make the reader aware of developments in the derivatives world that were not discussed earlier in this chapter. The following section summarises the chapter.

5.8 Conclusion

This chapter, Chapter 5, was dedicated to the discussion of interest rate derivatives. Derivatives were defined and their use as hedging instruments described.

The chapter then turned to a detailed discussion of the different types of interest rate derivatives that can be used to hedge exposure to interest rate risk. Linear instruments, i.e. instruments with no optionality, were discussed first. FRA's and different types of swaps like vanilla swaps and basis swaps were discussed in detail. This was followed by a discussion of option basics and interest rate options like caps and floors. Thereafter, examples were given of how different derivatives can be combined to form new combination structures like collars, participation swaps and reverse participation swaps.

As stated previously, Chapter 4 and Chapter 5 form a unit. Together, the two chapters have satisfied the third goal of the dissertation, which is to define the instruments that can be used to hedge against interest rate risk.

In the next chapter, Chapter 6, the concepts discussed in Chapters 3, 4 and 5 will be put to practical use in a corporate case study using a dynamic simulation model. This will satisfy the fourth and final goal of the dissertation, which is to demonstrate the use of the measurement tools and hedging instruments through a corporate case study, thereby satisfying the problem statement of the dissertation.

CHAPTER 6: STARTEGIC INTEREST RATE RISK MANAGEMENT IN THE CORPORATE ENVIRONMENT: A CASE STUDY

6.1 Introduction

The main focus of this dissertation has been strategic interest rate risk management. To this end, Chapter 3 was dedicated towards the definition of and tools for measuring the exposure to interest rate risk. As stated before, the proper quantification of risk is a prerequisite for the successful management of risk.

Once the interest rate risk has been properly quantified, the ALCO has to devise strategies to hedge the interest rate risk exposure. A hedging strategy can comprise of a single hedging instrument, or any combination of the available hedging instruments. These hedging instruments can be either notional instruments, as described in Chapter 4, or derivative instruments, as described in Chapter 5.

Once the ALCO has devised a set of possible hedging strategies, the strategies should be tested and evaluated to determine the most appropriate one. The ALCO should consider the appropriateness of a strategy from both a financial and a strategic point of view. For example, increasing the interest rate charged on a client's facility may be financially beneficial to the company, but from a strategic point of view, the company is likely to lose some business if it does so.

This chapter, Chapter 6, brings the concepts discussed in Chapters 3 to 5 together in a practical example. Due to the wide range of measurement tools and hedging instruments covered in the dissertation, not all of the concepts described can be covered in this chapter. The aim of the chapter is to use a selection of the tools and instruments and to demonstrate their use, in accordance with the ALCO process described in Chapter 2, with the help of a dynamic simulation model. The model has been built for a hypothetical corporate, called Lessrisk, using the ALMAN software developed by Riskflow Technologies.

First of all, Lessrisk's current balance sheet position will be examined. It is important to understand the current balance sheet position and all the exogenous factors that can influence it over time before embarking on a scenario analysis. This is followed by forecasting values of the exogenous factors to be used in the scenario analysis. As discussed in section 3.4.5, optimal risk measurement through simulation requires Monte Carlo simulations using the ARCH or GARCH methodologies (refer to sections 3.4.4 and 3.4.5). It was also stated there that for management purposes, it is often sufficient to run the simulations for three different scenarios, being management's expected scenario, as well as a high scenario above and a low scenario below the expected scenario. This is the route that will be followed in Chapter 6. Therefore, for each exogenous factor, three forecasts will be determined: a high scenario, an expected scenario and a low scenario.

The simulation model will then be run for the three different scenarios and the results on the forecasted results will be supplied. These results will then be used in the following section, along with a GAP analysis, to quantify Lessrisk's exposure to interest rate risk. Once this has been done, different possible hedging strategies will be formulated. Lastly, the different hedging strategies will be tested by running them through the simulation model. The results of the simulations can then be evaluated to determine the most appropriate strategy.

Chapter 6 will therefore attempt to achieve the fourth and last goal of the dissertation, which is to demonstrate the strategic use of the measurement tools and hedging instruments, as discussed in Chapters 3 to 5, through a corporate case study, thereby satisfying the problem statement.

6.2 Examining the current balance sheet position

The first step of the ALCO process is to review the previous month's results to see if the targets that have been set are being met. The second step is to analyse the current balance sheet position (refer to Figure 2.1). This is a very important step and should not be neglected. As the old saying goes: "You have to understand where you are coming from to know where you are going to."

The next section will deal with step 3 of the ALCO process, i.e. forecasting scenarios for the relevant exogenous factors (refer to Figure 2.1 and section 3.4.5). One of the most important outcomes of step 2 is therefore to determine exactly which exogenous factors are relevant to the business. Each item on the balance sheet should be carefully examined for sensitivity to factors outside the control of the business.

In the example that follows, the assets and liabilities of Lessrisk will be examined to determine the driving rates relevant to the company. Driving rates are interest rates that determine the interest earned or charged on a floating rate asset or liability. In terms of the terminology used in the discussion on GAP analysis (refer to section 3.4.1), they are the interest rates driving the RSAs and RSLs, i.e. the base interest rate that relates to rate sensitive items with a constant margin. For example, if the bank charges the company Jibar plus 2% on its overdraft facility, the driving rate is Jibar. Similarly, if the company extends credit to its customers at Prime plus 4%, the driving rate is Prime.

Once a complete set of driving rates has been defined, they can be programmed into the simulation model. Different scenarios can be forecasted for each separate driving rate, which can then be simulated with the use of the simulation model to see exactly what their impact will be on the results of the business and thus the exposure to interest rate risk.

Table 6.1: Opening balance sheet for Lessrisk

LESSRISK	
Balance Sheet	
	Jul-05
ASSETS	**'000**
NON-CURRENT ASSETS	**27,482**
Fixed Assets	10,455
Unit Trust Investment	11,308
Deferred Taxation	5,719
CURRENT ASSETS	**2,047,402**
Interest Sensitive Current Assets	**2,135,186**
Current Assets	**2,135,186**
Cash	17,253
Other Debtors	**9,527**
Other Staff Debtors	69
Staff Debt	1,964
Sundry Debtors	2,826
Accruals	0
Franchise Credit Card	1,883
Franchise Personal Loan	2,458
Franchise Unit Trust	325
Holding Card Debtors	**1,590,780**
Finance Pty Ltd	**325**
Credit Card	**95,287**
Personal Loans	**422,014**
Customers low 12 months	13,924
Customer low 24	28,556
Customer low 36	74,501
Customers high 12 months	73,995
Customer high 24	92,973
Customer high 36	127,287
Staff 12 months	4,029
Staff 24	3,220
Staff 36	3,529
Total Provision for Bad Debt (Loans, cards, fraud)	(108,245)
Provision Card Admin Fee	(2,084)
Credit Card JV	22,545
---- Loan to JV	28,757
---- Equity Share of Ass. Results	(6,212)
TOTAL ASSETS	**2,074,883**
EQUITY AND LIABILITIES	
CAPITAL & RESERVES - ORDINARY	**305,972**
Ordinary Share Capital	125,438
Retained Income	180,534
---- Distributable Reserves	79,545
---- Retained Income At End of Period	100,989
LONG TERM LIABILITIES	**1,733,843**
Holding (Pty) Ltd	1,733,843
---- **Long Term Loans**	**1,733,843**
CURRENT LIABILITIES	**35,069**
Creditors	5,349
VAT	2,742
Provision for Taxation	21,158
Normal Taxation	5,820
TOTAL EQUITY AND LIABILITIES	**2,074,884**

Author: Simulation model

Table 6.1 gives the current balance sheet position of Lessrisk. Accordingly, the company has a total book of R2.074 billion. The book is funded primarily with long term loans from Lessrisk's holding company to the amount of R1.733 billion. Of this amount, R200 million is a fixed rate loan at 10.93% NACM. The rest is floating at Jibar plus 2% NACM. Interest is payable monthly and any surplus cash over and above R20 million goes towards capital redemption. Any cash shortfall is funded by the holding company and increases the liability. The balance of liabilities is equity and short-term creditors.

Table 6.1 shows that Lessrisk have non-current assets to the amount of R27.482 million. These assets are not sensitive to changes interest rates. The total value of interest sensitive items is R2.135 billion. However, apart from Staff Debt, all the items listed under Other Debtors are currently zero rated, and will therefore only become sensitive to changes in interest rates if the company changes its policy.

The interest sensitive assets are therefore first of all Cash. The company has a policy to keep a cash balance of around R20 million to cover operational expenses. It is currently slightly short of that target. Any cash generated by the business in excess of this amount is transferred to the Holding company towards reduction of debt. Cash balances receive interest at Prime less 4.2% NACM. Staff Debt is a special low interest limited facility for staff members at Prime less 9% NACM.

Further investigation of Table 6.1 shows that the biggest asset on the book is Holding Card Debtors, which is the outstanding debt on in-store cards operated by Lessrisk in the retail stores of the holding company. Interest is earned on outstanding balances at the Usury High[7] rate. Finance Pty Ltd refers to another class of card debtors, also earning the Usury High rate. The third class of card debtors, Credit Card, earns Prime plus 2.5%.

Finally, the Personal Loans are categorized first according to loans made to staff members and loans made to customers. Within each category, a distinction is made with reference to the amortisation period of the loans, i.e. 12, 24 or 36 months. All the loans to staff members earn Prime plus 4% NACM. With loans made to customers, a further distinction is made between loans earning the Usury Low[8] rate and loans earning the Usury High rate.

From the analysis of the current balance sheet, it is clear that there are four driving rates relevant to the business of Lessrisk. They are Prime, 1-month Jibar, Usury Low and Usury High. It is also evident that most of the liabilities are linked to Jibar, which is a market related rate, while the majority of assets are linked to usury, which is an administrative rate determined by the government, and usually lags changes in the market rates by about 3 months on average. This has a critical impact on Lessrisk's interest sensitivity profile, as will be seen later in the GAP analysis.

Table 6.2 gives a summary of the relevant driving rates by grouping the interest sensitive balance sheet items according to their driving rates. The first column of Table 6.2 lists the relevant driving rates. The second column shows the balance sheet items affected by each of the driving rates. Lastly, the third column shows the margin above or below the driving rate for each balance sheet item.

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[7] The Usury interest rates are determined by the Micro Finance Regulatory Council (MFRC), a sub-division of the Department of Trade and Industry in South Africa (DTI), under authority of the Usury Act, which serves to regulate the micro-lending industry. There are two Usury rates: The high rate, which is applicable to balances less than R10 000, and the low rate, which is applicable to balances in excess of R10 000 (DTI, 2005).

[8] See footnote 7.

Table 6.2: Summary of driving rates

Driver	Balance sheet item	Margin
Prime	Cash	-4.20%
	Staff Debt	-9.00%
	Staff 12 months	4.00%
	Staff 24 months	4.00%
	Staff 36 months	4.00%
	Credit Card	2.50%
1-Month Jibar	Long-term floating loan	2.00%
Usury Low	Customer low 12	0.00%
	Customer low 24	0.00%
	Customer low 36	0.00%
Usury High	Holding Card Debtors Book	0.00%
	Finance Pty Ltd	0.00%
	Customer high 12	0.00%
	Customer high 24	0.00%
	Customer high 36	0.00%

Author: Simulation model

6.3 Forecast scenarios

In the previous section, the current balance sheet position of Lessrisk was examined to determine the driving rates that expose Lessrisk to interest rate risk. It was established that Lessrisk is exposed to changes in Prime, 1-month Jibar, Usury Low and Usury High.

The next step (Step 3, Figure 2.1) is to forecast different scenarios for each of these driving rates. For each rate, three different scenarios are used for simulation purposes. The expected scenario is the most likely scenario to be realized in the future. In practice, the ALCO can consolidate their own view with the views in the market to determine the expected scenario. The high scenario is the worst-case scenario according to the ALCO, while the low scenario is the best-case scenario. A forecast period of 12 months will be used. The base month is July 2005. The forecast period is therefore August 2005 to July 2006.

In reality, the ALCO should take great care in selecting the different scenarios for each driving rate. The results of the simulations, i.e. the outputs, are only as good as the quality of the inputs. For the purposes of this example, however, extreme scenarios will be used for demonstrative purposes.

Table 6.3 shows the scenarios selected for the different driving rates. The scenarios are built from the viewpoint that rates are going to increase over the next 12 months. Under the expected scenario, the rates increase by 50 basis points every 2 months with the first increase in the second forecast month. Under the high scenario, they increase by 50 basis points every month. Under the low scenario, rates decrease by 50 basis points every 6 months, starting in month 2. Note that the changes in the Usury rates lag the changes in the market rates (Prime and Jibar) by 3 months. This is in recognition of the fact that in reality the Department of Trade and Industry (DTI) determines the level of the Usury rates, and that due to administrative processes it takes time to react to changes in the market interest rates.

Table 6.3: Driving rate scenarios

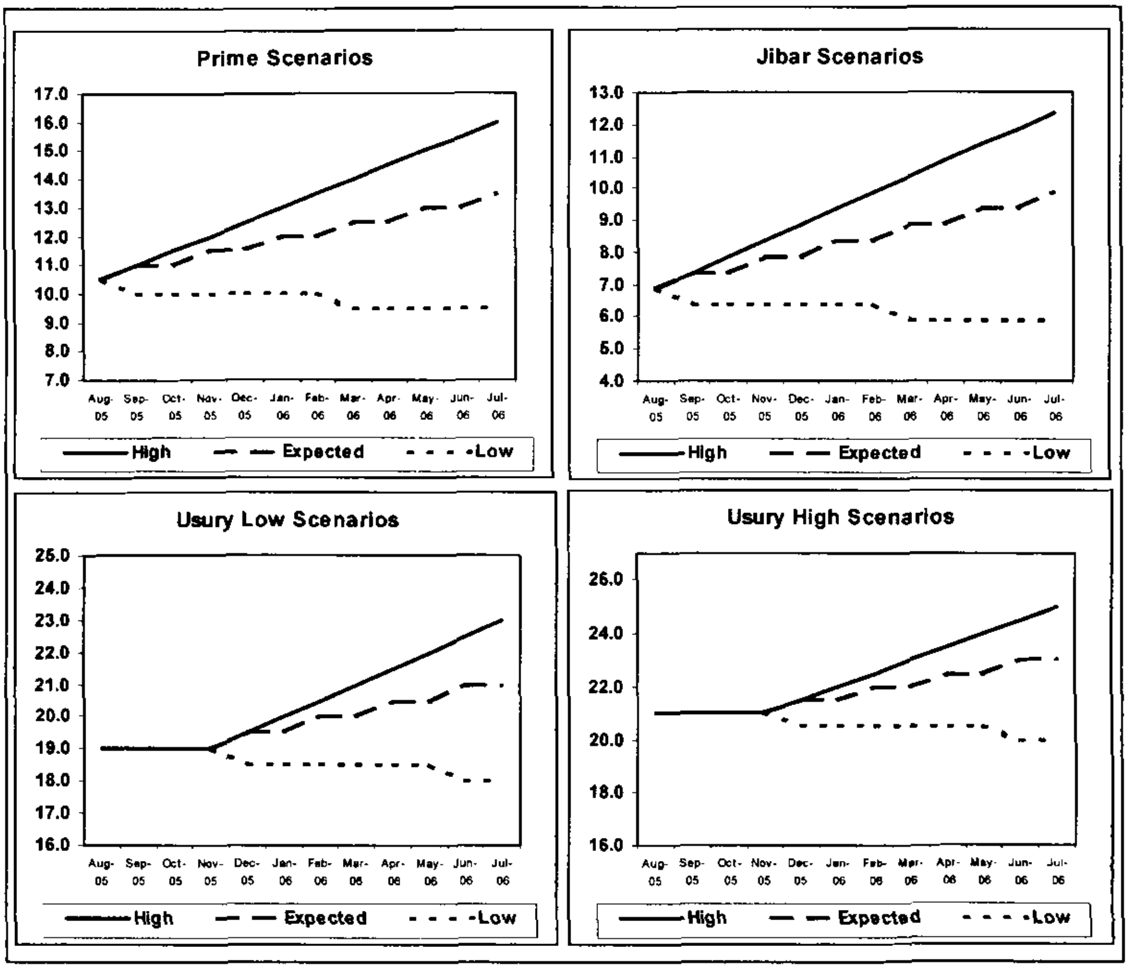
		Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06
Prime	High	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0
Currently	Expected	10.5	11.0	11.0	11.5	11.5	12.0	12.0	12.5	12.5	13.0	13.0	13.5
10.5	Low	10.5	10.0	10.0	10.0	10.0	10.0	10.0	9.5	9.5	9.5	9.5	9.5
1m Jibar	High	6.9	7.4	7.9	8.4	8.9	9.4	9.9	10.4	10.9	11.4	11.9	12.4
Currently	Expected	6.9	7.4	7.4	7.9	7.9	8.4	8.4	8.9	8.9	9.4	9.4	9.9
6.9	Low	6.9	6.4	6.4	6.4	6.4	6.4	6.4	5.9	5.9	5.9	5.9	5.9
Usury Low	High	19.0	19.0	19.0	19.0	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0
Currently	Expected	19.0	19.0	19.0	19.0	19.5	19.5	20.0	20.0	20.5	20.5	21.0	21.0
19.0	Low	19.0	19.0	19.0	19.0	18.5	18.5	18.5	18.5	18.5	18.5	18.0	18.0
Usury High	High	21.0	21.0	21.0	21.0	21.5	22.0	22.5	23.0	23.5	24.0	24.5	25.0
Currently	Expected	21.0	21.0	21.0	21.0	21.5	21.5	22.0	22.0	22.5	22.5	23.0	23.0
21.0	Low	21.0	21.0	21.0	21.0	20.5	20.5	20.5	20.5	20.5	20.5	20.0	20.0

Author: Simulation model

It is often easier to grasp the trends in graphical form. Including the above table in the ALCO pack (the information pack distributed to members of the ALCO prior to the ALCO meeting) is optional. However, the ALCO pack should at least contain a graphical presentation of the scenarios.

Figure 6.1 gives such a graphical presentation for the selected scenarios for the driving rates shown in Table 6.3. Figure 6.3 shows four graphs, each representing the scenarios of a specific driving rate. The top left corner shows the graph for the Prime scenarios and the top right corner the graph for the Jibar scenarios. At the bottom of Figure 6.1 the graph for the Usury Low scenarios is shown on the left side, while the graph for the Usury High scenarios is shown on the right side. On each of the graphs, the solid line denotes the high scenario, the dashed line denotes the expected scenario and the dotted line denotes the low scenario. Note once again the lag in the scenarios for the Usury rates.

Figure 6.1: Driving rate scenarios



Author: Simulation model

As stated before, the above scenarios are extreme, but they serve in the example to demonstrate the principles of scenario simulation and testing. In reality, the variance between the high and low scenarios will be smaller, depending on economic circumstances.

In the following section, the above scenarios will be programmed into the simulation model to determine the effect of each scenario on the future results of Lessrisk.

6.4 Forecasted financials (Scenario simulation)

In the previous two sections the driver rates were determined and 12-month forecasts were made for each under an expected, high and low scenario. The next step, which is in fact still part of Step 3 of the ALCO process (refer to Figure 2.1), is to put these scenarios though the simulation model and to see what the effect of each scenario is on certain key variables, i.e. to measure and quantify the risk. In this practical demonstration it will be used to quantify the interest rate risk exposure of Lessrisk. Once this has been done, the results can be used in Step 4 to design possible ALM strategies (see section 6.5).

The key variables that are important to Lessrisk's ALCO are net income before tax (NIBT), net interest margin (NIM), return on equity (ROE) and return on assets (ROA). These are only examples. In reality, simulation results can be obtained for any calculable variable. The following sections give a summary of the simulated results for each of these key variables, for each scenario and each forecast month.

6.4.1 Net income before tax (NIBT)

Table 6.4 summarises the simulated results for NIBT. All the figures are given in thousands. The results are presented for each month in the forecast period and for each of the scenarios. In addition, the "High – Low variance" field is the absolute value of the difference between the best-case scenario and the worst-case scenario, and is a measure of the uncertainty, or risk, inherent in the difference between the future rate scenarios. The annual totals are given at the bottom of the table.

Table 6.4: Simulation results for NIBT

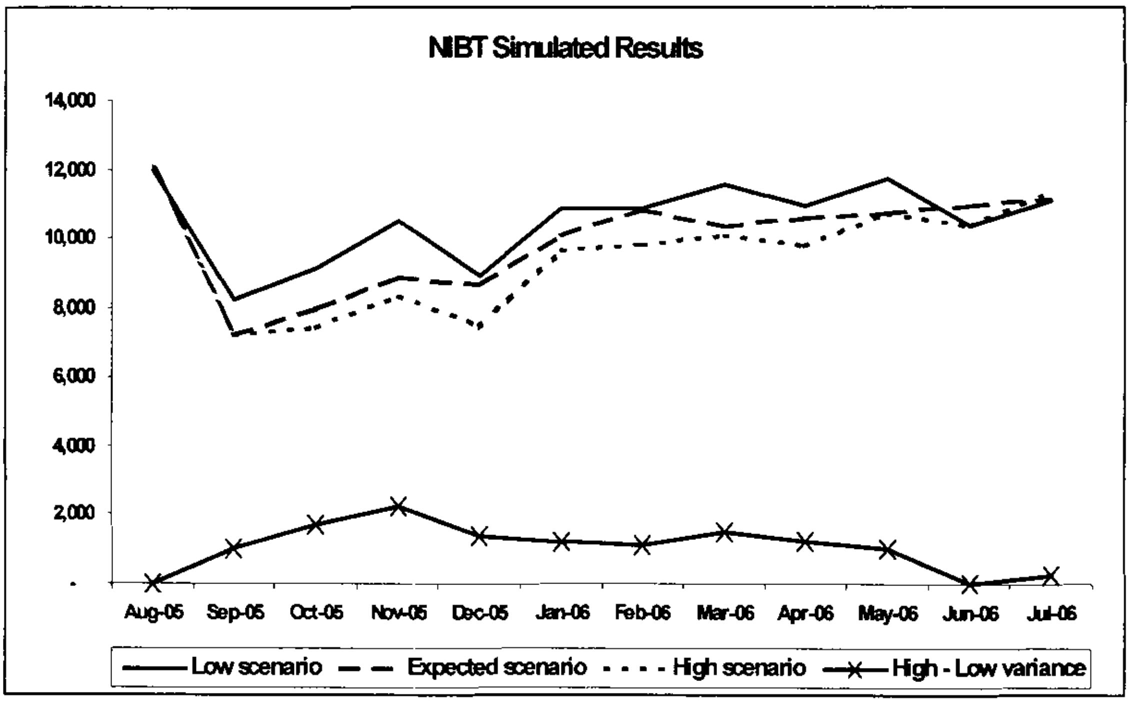
NIBT ('000)	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06
Low scenario	11,967	8,223	9,087	10,506	8,875	10,859
Expected scenario	11,967	7,188	7,943	8,836	8,649	10,038
High scenario	11,967	7,188	7,374	8,279	7,474	9,621
High - Low variance	-	1,035	1,712	2,227	1,401	1,238
NIBT ('000)	**Feb-06**	**Mar-06**	**Apr-06**	**May-06**	**Jun-06**	**Jul-06**
Low scenario	10,883	11,564	10,938	11,720	10,324	11,087
Expected scenario	10,827	10,319	10,527	10,722	10,925	11,151
High scenario	9,783	10,073	9,717	10,689	10,332	11,348
High - Low variance	1,101	1,491	1,222	1,031	8	261
Annual totals:						
Low scenario	**126,034**					
Expected scenario	**119,091**					
High scenario	**113,845**					
High - Low variance	**12,189**					

Author: Simulation model

From Table 6.4 it is clear that Lessrisk will benefit most from the realization of the low rate scenario and the least from the realization of the high rate scenario. Total NIBT for the low scenario exceeds total NIBT for the high scenario by R12.189 million. The reason for this becomes clear in the next section with the GAP analysis.

Figure 6.2 gives a graphical presentation of the results for NIBT. The solid line shows the results for the low scenario, the dashed line for the expected scenario and the dotted line for the high scenario. The crossed line at the bottom of the graph gives the results for the variance between the low and high scenarios. The same conclusion can be drawn from Figure 6.2 as from Table 6.4, i.e. that the realization of the low scenario would hold the most benefit for Lessrisk. It is interesting to note, however, that the variance is the highest during the first part of the year. It peaks in November 2005 and tapers down from there to almost zero at the end of the year.

Figure 6.2: Simulation results for NIBT



Author: Simulation model

6.4.2 Net interest margin (NIM)

Net interest margin is defined here as net interest received (interest received less interest paid) as a percentage of interest earning assets. The figures are presented as monthly-annualized percentages, i.e. the monthly value multiplied by twelve.

Table 6.5 gives the simulated results for NIM. All the figures are given as percentages to the second decimal. The results are presented for each month in the forecast period and for each of the scenarios. As before with NIBT, the "High – Low variance" field is the absolute value of the difference between the best-case scenario and the worst-case scenario, and is a measure of the uncertainty, or risk, inherent in the difference between the future rate scenarios. The annual averages are given at the bottom of the table.

Table 6.5: Simulated results for NIM

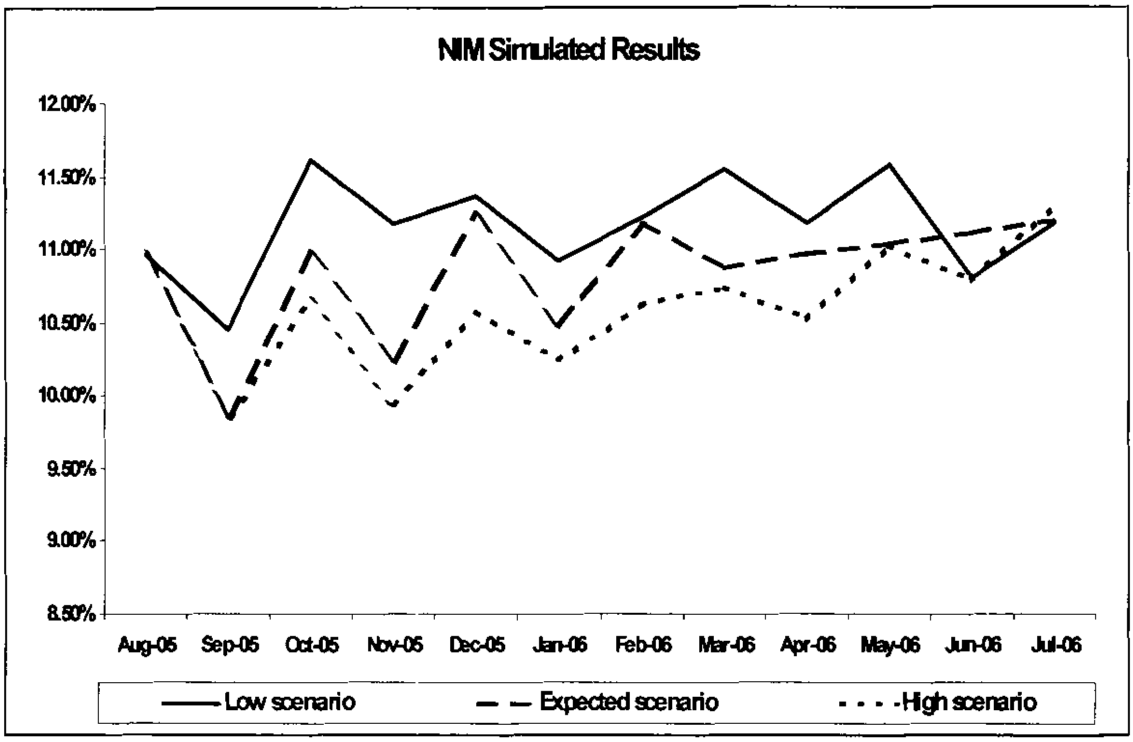
NIM (%)	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06
Low scenario	10.96%	10.45%	11.62%	11.18%	11.36%	10.93%
Expected scenario	10.96%	9.85%	10.96%	10.24%	11.23%	10.47%
High scenario	10.96%	9.85%	10.64%	9.92%	10.57%	10.25%
High - Low variance	0.00%	0.60%	0.98%	1.26%	0.79%	0.68%
NIM (%)	**Feb-06**	**Mar-06**	**Apr-06**	**May-06**	**Jun-06**	**Jul-06**
Low scenario	11.21%	11.54%	11.18%	11.57%	10.80%	11.17%
Expected scenario	11.18%	10.87%	10.96%	11.03%	11.11%	11.19%
High scenario	10.62%	10.74%	10.52%	11.01%	10.79%	11.29%
High - Low variance	0.59%	0.80%	0.66%	0.56%	0.01%	0.12%
Annual totals:						
Low scenario	**11.16%**					
Expected scenario	**10.84%**					
High scenario	**10.60%**					
High - Low variance	**0.57%**					

Author: Simulation model

It can be seen from Table 6.5 that, like in the case for NIBT above, it will be most beneficial to Lessrisk if the low scenario is realized. The low scenario yields an annual average NIM of 11.16%, which is 0.57% higher than the figure for the high scenario.

Figure 6.3 gives a graphical presentation of the results for NIM. The solid line shows the results for the low scenario, the dashed line for the expected scenario and the dotted line for the high scenario. The same conclusion can be drawn from Figure 6.3 as from Table 6.5, i.e. that the realization of the low scenario would hold the most benefit for Lessrisk. This also supports the results obtained for NIBT, which was that Lessrisk would benefit most from the realization of the low scenario and least from the realization of the high scenario.

Figure 6.3: Simulated results for NIM



Author: Simulation model

6.4.3 Return on equity (ROE)

Return on equity is defined here as the net income before tax (NIBT) as a percentage of shareholders' equity. As with NIM above, the simulated results for ROE are presented as monthly-annualised percentages.

Table 6.6 gives the simulated results for ROE. All the figures are given as percentages to the second decimal. The results are presented for each month in the forecast period and for each of the scenarios. As before with NIBT, the "High – Low variance" field is the absolute value of the difference between the best-case scenario and the worst-case scenario, and is a measure of the uncertainty, or risk, inherent in the difference between the future rate scenarios. The annual averages are given at the bottom of the table.

Table 6.6: Simulated results for ROE

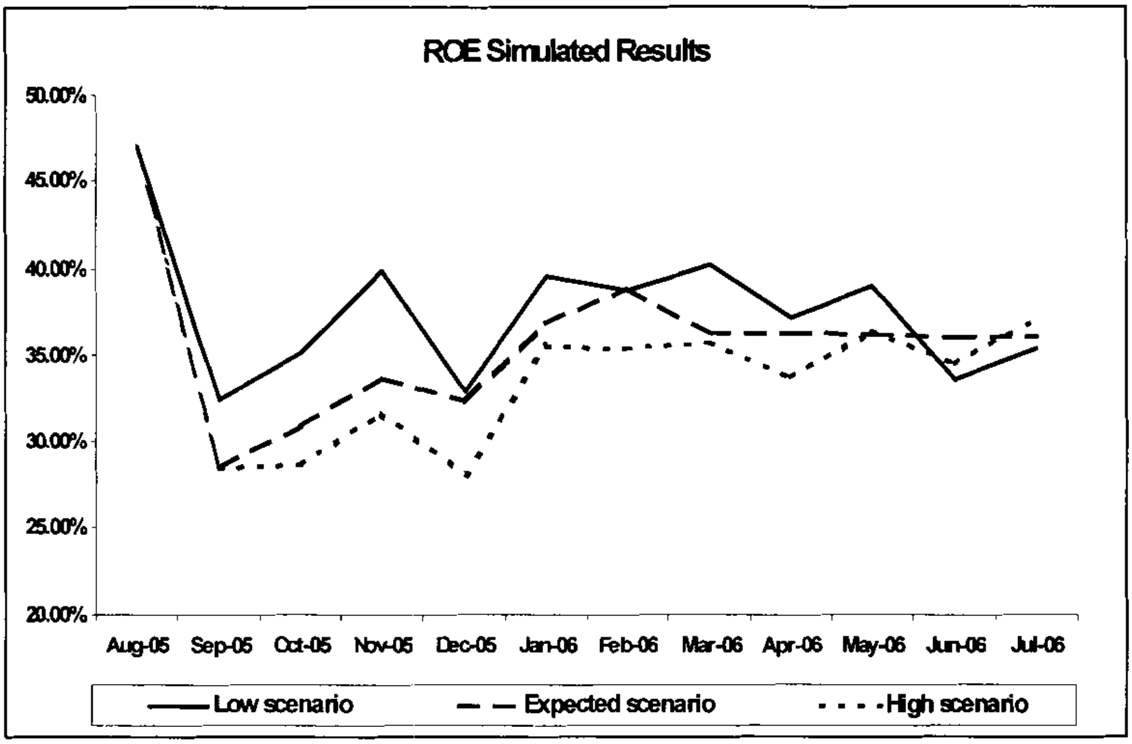
ROE (%)	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06
Low scenario	46.94%	32.47%	35.22%	39.90%	32.94%	39.54%
Expected scenario	46.94%	28.39%	30.86%	33.72%	32.37%	36.87%
High scenario	46.94%	28.39%	28.65%	31.63%	28.04%	35.51%
High - Low variance	0.00%	4.09%	6.57%	8.27%	4.90%	4.03%
ROE (%)	**Feb-06**	**Mar-06**	**Apr-06**	**May-06**	**Jun-06**	**Jul-06**
Low scenario	38.74%	40.25%	37.20%	39.01%	33.60%	35.39%
Expected scenario	38.93%	36.28%	36.24%	36.15%	36.07%	36.06%
High scenario	35.38%	35.69%	33.73%	36.39%	34.44%	37.08%
High - Low variance	3.36%	4.56%	3.47%	2.63%	0.84%	1.69%
Annual totals:						
Low scenario	**37.60%**					
Expected scenario	**35.74%**					
High scenario	**34.32%**					
High - Low variance	**3.28%**					

Author: Simulation model

It can be seen from Table 6.6 that, like in the cases for NIBT and NIM above, it would be most beneficial to Lessrisk if the low scenario were realized. The low scenario yields an annual average ROE of 37.60%, which is 3.28% higher than the figure for the high scenario.

Figure 6.4 gives a graphical presentation of the results for ROE. The solid line shows the results for the low scenario, the dashed line for the expected scenario and the dotted line for the high scenario. The same conclusion can be drawn from Figure 6.4 as from Table 6.6, i.e. that the realization of the low scenario would hold the most benefit for Lessrisk. This also supports the results obtained earlier for NIBT and NIM.

Figure 6.4: Simulated results for ROE



Author: Simulation model

6.4.4 Return on assets (ROA)

Return on assets is defined as the net income before tax (NIBT) as a percentage of total assets, also presented as monthly-annualised percentages.

Table 6.7 gives the simulated results for ROA. All the figures are given as percentages to the second decimal. The results are presented for each month in the forecast period and for each of the scenarios. As before, the "High – Low variance" field is the absolute value of the difference between the best-case scenario and the worst-case scenario, and is a measure of the uncertainty, or risk, inherent in the difference between the future rate scenarios. The annual averages are given at the bottom of the table.

Table 6.7: Simulated results for ROA

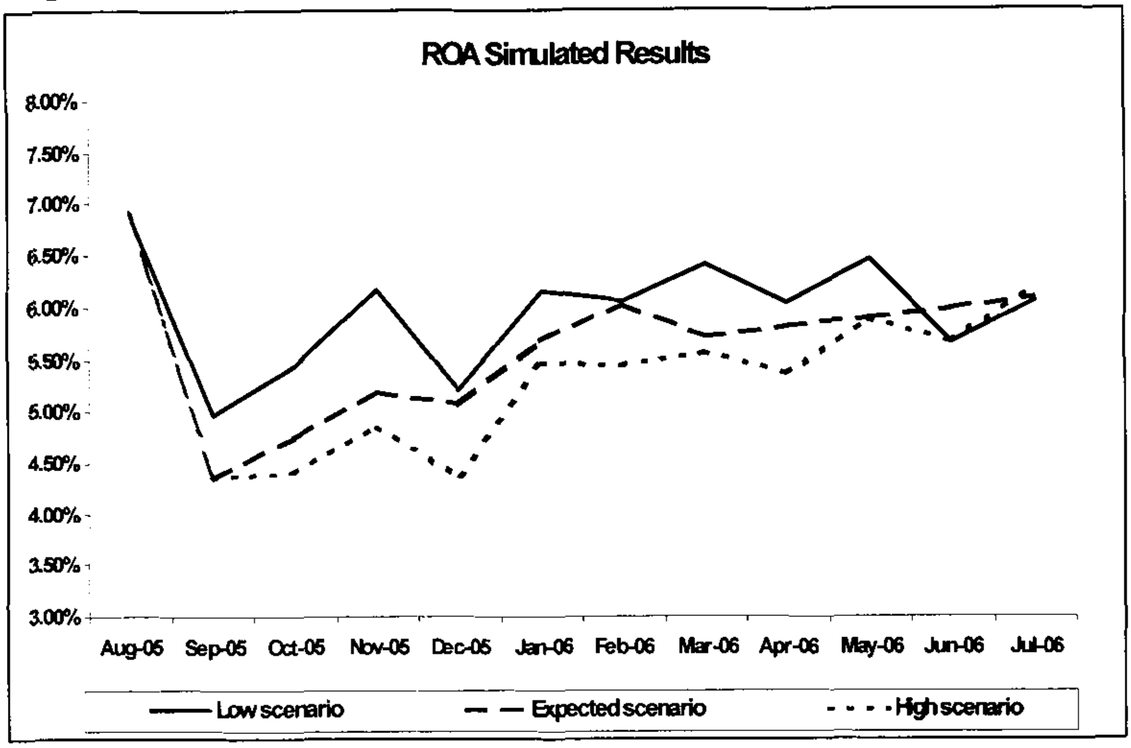
ROA (%)	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06
Low scenario	6.92%	4.97%	5.43%	6.17%	5.21%	6.15%
Expected scenario	6.92%	4.35%	4.75%	5.19%	5.07%	5.68%
High scenario	6.92%	4.35%	4.41%	4.86%	4.38%	5.45%
High - Low variance	0.00%	0.63%	1.02%	1.31%	0.82%	0.70%
ROA (%)	**Feb-06**	**Mar-06**	**Apr-06**	**May-06**	**Jun-06**	**Jul-06**
Low scenario	6.05%	6.40%	6.03%	6.44%	5.66%	6.05%
Expected scenario	6.01%	5.71%	5.80%	5.89%	5.98%	6.08%
High scenario	5.43%	5.57%	5.36%	5.87%	5.65%	6.19%
High - Low variance	0.61%	0.83%	0.68%	0.57%	0.00%	0.13%
Annual totals:						
Low scenario	5.96%					
Expected scenario	5.62%					
High scenario	5.37%					
High - Low variance	0.59%					

Author: Simulation model

It can be seen from Table 6.7 that, like in the cases for NIBT, NIM and ROE above, it would be most beneficial to Lessrisk if the low scenario were realized. The low scenario yields an annual average ROA of 5.96%, which is 0.59% higher than the figure for the high scenario.

Figure 6.5 gives a graphical presentation of the results for ROA. The solid line shows the results for the low scenario, the dashed line for the expected scenario and the dotted line for the high scenario. The same conclusion can be drawn from Figure 6.5 as from Table 6.7, i.e. that the realization of the low scenario would hold the most benefit for Lessrisk. This also supports the results obtained earlier for NIBT, NIM and ROE.

Figure 6.5: Simulated results for ROA



Author: Simulation model

Lastly, the effect of leverage is evident when comparing the results for ROA to those for ROE. Lessrisk is a highly leveraged company, with about 15% of total assets funded with equity. The effect of this can be seen in the big difference between ROA, with an annual average ranging between 5.37% and 5.96%, and ROE, with an annual average ranging between 34.32% and 37.0%.

6.5 Interest rate risk quantification (GAP analysis)

As stated before, the results obtained in the above simulations, which still form part of Step 3 of the ALCO process (see Figure 2.1), should be used to quantify the risk exposure of the business, and specifically in this case, interest rate risk exposure. From the results in section 6.4, there are two observations that can be clearly made. Firstly, there is an inverse relationship between the direction of changes in the driving interest rates and the financial results of Lessrisk, as measured by the four key variables discussed in the previous section.

The simulated results for each of the key variables, i.e. NIBT, NIM, ROE and ROA displayed the same pattern in relation to the interest rate scenarios. According to the results for each of the four variables, there is greater economic benefit to Lessrisk under the low interest rate scenario than under the high interest rate scenario.

The low rate scenario, however, is a decreasing scenario. Given that the ALCO expects interest rates to increase, as evidenced by both the expected and high scenarios, the simulated results for the key variables and the apparent inverse relationship between interest rates and the performance of the business presents a problem.

The second observation is that the variance between the results of the high scenario and those of the low scenario is quite big. The ALCO expects interest rates to follow the path as described by the expected scenario. Therefore, the expected results for the key variables over the next month are the simulated results for the expected scenario. However, interest rates are uncertain and nobody can predict the future with 100% accuracy. In reality, future interest rates are likely to range between the low and high scenarios. This uncertainty represents exposure to interest rate risk for Lessrisk.

One way of expressing the simulated results as a risk-reward profile is to take the results of the expected scenario as the reward and the variance between the high and low scenarios, expressed as the risk. The risk can also be expressed as a percentage of the reward. This is done in Table 6.8 for the four key variables, using the annual totals and averages. The table has a column for each of the key variables. For each variable, three values are given, i.e. the expected annual result, the absolute annual variance and the absolute annual variance expressed as a percentage of the annual total.

Table 6.8: A risk-reward profile

RISK-REWARD PROFILE	NIBT	NIM	ROE	ROA
Expected results:	119,091	10.84%	35.74%	5.62%
High-Low variance:	12,189	0.57%	3.28%	0.59%
Variance percentage:	10.24%	5.24%	9.17%	10.45%

Author: Simulation model

Table 6.8 therefore states that the total NIBT for the next year is expected to be R119 million with a variance around this figure of 10.24%. Average NIM is expected to be 10.84% with 5.24% variance. Average ROE is expected to be 35.74% with 9.17% variance, while ROA is expected to be 5.62% with 10.45% variance.

It is interesting to note that, as stated in section 6.4.1, the monthly variance figures are the largest during the first 6 months of the forecast period. This characteristic, along with the inverse relationship between interest rates and financial performance for the company, can be explained by examining the GAP report for Lessrisk.

Table 6.9 gives a summary of the GAP report for the different time buckets. The chosen time buckets are shown in the headings for each column. The column under "Demand" bucket summarises the assets and liabilities that react immediately to a change in interest rates. The column under the "0 – 1 month" bucket summarises the assets an liabilities that do not react immediately to changes in interest rates, but do react within the first month after a change. The other columns are all similar, each for their own time buckets.

Table 6.9 first splits the GAP into variable rate assets and liabilities and fixed rate assets and liabilities (maturing), and then shows the total GAP and Cumulative

GAP. The last two lines are the important ones when measuring Lessrisk's sensitivity to changes in interest rates.

Table 6.9: The GAP profile

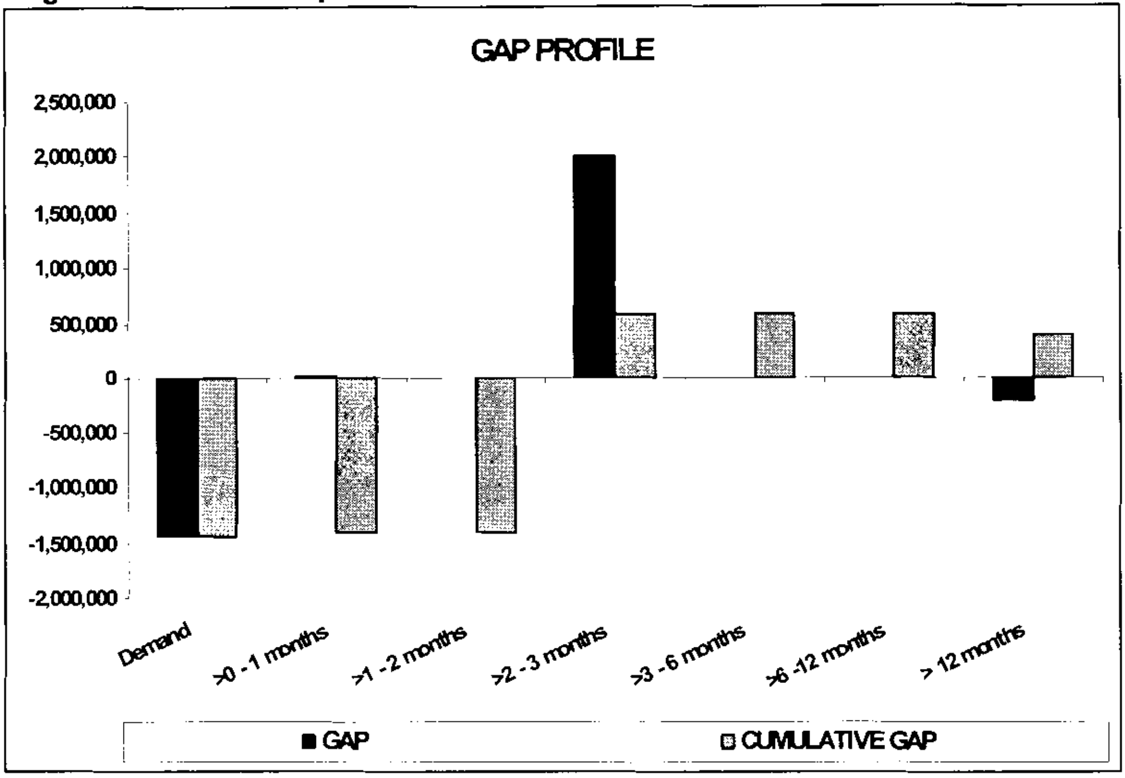
GAP PROFILE	Demand	>0 - 1 months	>1 - 2 months	>2 - 3 months
Total variable rate assets	95,287	28,031	0	2,002,341
Total variable rate liabilities	1,533,843	0	0	0
Total fixed rate assets	0	0	0	0
Total fixed rate liabilities	0	0	0	0
Variable Rate Assets-Liabs	-1,438,556	28,031	0	2,002,341
Fixed Rate Assets-Liabs	0	0	0	0
GAP	**-1,438,556**	**28,031**	**0**	**2,002,341**
CUMULATIVE GAP	**-1,438,556**	**-1,410,525**	**-1,410,525**	**591,816**
GAP PROFILE	**>3 - 6 months**	**>6 -12 months**	**> 12 months**	**TOTAL**
Total variable rate assets	0	0	0	2,125,659
Total variable rate liabilities	0	0	0	1,533,843
Total fixed rate assets	0	0	0	0
Total fixed rate liabilities	0	0	200,000	200,000
Variable Rate Assets-Liabs	0	0	0	591,816
Fixed Rate Assets-Liabs	0	0	-200,000	-200,000
GAP	**0**	**0**	**-200,000**	**391,816**
CUMULATIVE GAP	**591,816**	**591,816**	**391,816**	**0**

Author: Simulation model

As before, with the scenario analysis of the key variables, it is useful to express the results in graphical form. Doing this usually leads to a better understanding of the results. Figure 6.6 presents the GAP and cumulative GAP graphically. It is presented in the form of a bar chart, with the x-axis representing the time respective buckets and the y-axis the values, once again expressed in thousands. The black bars denote the values for the individual GAPs for each time bucket, while the gray bars denote the values for the cumulative GAP.

It was stated earlier that the fact that the majority of Lessrisk's assets are linked to the Usury rates, which lags market rates by about 3 months on average, while the majority of their liabilities are linked to the Jibar rate, will have a major effect on their interest rate risk profile. This can be seen when looking at Lessrisk's GAP profile, as described in Table 6.9 and Figure 6.6. The GAP profile explains the inverse relationship between interest rates and the financial performance of the company.

Figure 6.6: The GAP profile



Author: Simulation model

Table 6.9 and Figure 6.6 show that Lessrisk has a R1.43 billion negative GAP in the demand bucket. This means that when market rates change, Lessrisk will have R1.43 billion more liabilities than assets re-pricing at the new rate. This effect is negated in the 2 - 3 month bucket, where there is a positive GAP of R2.00 billion, putting the cumulative GAP into positive territory after 3 months. This can best be seen on Figure 6.6.

In other words if there is a decrease in interest rates, Lessrisk's net interest income will immediately increase as they start paying less on their liabilities. The decrease in earnings on assets will only filter through after 3 months. Similarly, every time there is an increase in interest rates, Lessrisk's net interest income will decline immediately as they start paying more on their liabilities. The increase will take 3 months to filter through to the asset side of the book. This is exactly what the results of the scenario analysis on the key variables showed in the previous sections.

Lessrisk's book is therefore structured for decreasing interest rates. Given the ALCO's view that rates are going to increase, this poses a problem, and the ALCO should devise strategies for hedging the interest rate risk exposure. In the next section, different possible hedging strategies will be formulated.

6.6 Possible strategy formulation

Section 2.2 referred to the important role of sound risk management practices in good corporate governance. Specifically, it was pointed out that the risk management policies and procedures should be set and controlled directly by the board. Section 2.3 described the concept of strategic management as the formulation and implementation of strategies that will deliberately position the company to benefit from likely future events, thereby gaining a competitive advantage. In light of section 2.2, such strategies have to be formulated within the policies and guidelines prescribed by the board.

In the previous section it was made clear that Lessrisk's book is structured for decreasing interest rates. Therefore, given the ALCO's view of increasing interest rates, possible strategies have to be formulated to hedge the book against increasing rates, in accordance with Step 4 of the ALCO process (see Figure 2.1).

In order to neutralize the book against changes in interest rates, the notional value of the hedge should be equal to the value of the demand GAP, i.e. R1.43

billion. However, the ALCO decides to implement a hedge with a notional value of R1 billion, after considering the following three factors:

- Due to constraints in terms of credit lines with Lessrisk's banks, they cannot afford a full hedge.

- Lessrisk currently runs a wide net interest margin and can afford to absorb a portion of the risk in the book.

- Implementing a R1 billion hedge will leave some room to benefit from decreasing interest rates should the ALCO's view on rates prove to be incorrect.

The following four possible strategies are submitted to the ALCO for consideration, all for a notional value of R1 billion and a tenor of 1 year. The first four strategies involve derivative instruments, while the last two consist of notional instruments:

- Buy a vanilla swap. The banks indicated that a 1-year 1-month Jibar swap is trading at a fixed rate of 7.0% NACM.

- Buy a 50% participation swap. The banks' indicative price for a 1-year 1-month Jibar 50% participation swap is a maximum rate of 8.0% NACM. With Jibar currently at 6.9%, the current blended rate payable by Lessrisk will be 7.45% NACM.

- Buy a Cap outright. Indicative pricing from the banks show that a R1 billion 1-year 1-month Jibar Cap, with a strike at 8.5% NACM will cost R5 million.

- Buy a zero-cost Collar. Indicative pricing from the banks indicate that a 1-year zero-cost Collar can be obtained with the Cap strike at 9.0% NACM and the Floor strike at 6.8% NACM.

- Re-finance by issuing a fixed-rate bond in the market and use the proceeds to replace the floating rate funding from the holding company. The estimation is that Lessrisk will be able to issue a bond at par at a yield of 300 basis points above the R153, which is currently trading at 7.60% NACS. In other words, in order for the market to absorb the paper, the yield on the bond will have to be 10.60% NACS. Furthermore, following from the discussion in section 4.5, for the bond to be issued at par, the coupon must equal the yield, i.e. 10.60% NACS, paying in June and December. The bond is assumed to have a maturity of five years, although the simulation period for this strategy, like all the others, will be 1 year.

- Since the biggest source of the interest rate risk is the fact that there is a 3-month lag in the re-pricing of the largest portion of the assets, the following might also be a solution: Re-finance by issuing a variable rate bond that re-prices every three months against JIBAR. However, in order for the market to absorb the paper, Lessrisk will again have to pay a margin of 300 basis points above the market rate. As in the previous case, the bond is assumed to have a maturity of five years, although the simulation period for this strategy will be 1 year.

In the following section, these strategies will be evaluated and the most appropriate one will be selected for implementation, in accordance to Steps 5 and 6 of the ALCO process (see Figure 2.1).

6.7 *Strategy evaluation, simulation and selection*

In the previous section, six possible strategies for hedging Lessrisk's exposure to interest rate risk were listed. In this section, the strategies will be evaluated and the most appropriate one will be chosen for implementation.

In principal, the ALCO approves of all the strategies, although there are one or two points of concern with the cap and collar strategies, which will be mentioned later. To decide which of the six strategies is the most appropriate, it is decided to simulate the strategies for the three different interest rate scenarios. The following paragraphs give the results of the simulations. The chosen key variable to use for strategy comparison purposes is NIBT, although any or all of the four key variables could have been used.

Table 6.10 shows the NIBT simulated results for implementing the vanilla swap. The table follows the same format as the tables used in section 6.4, i.e. it gives the monthly results for each of the three scenarios, as well as the absolute value of the difference between the high and low scenario results. In addition, Table 6.10 compares the total annual simulated results for a vanilla swap to those obtained in the base case, i.e. the results obtained for NIBT in section 6.4.

Table 6.10: Vanilla swap NIBT results

NIBT ('000)	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06
Low scenario	11,882	8,145	8,575	10,008	8,357	10,352
Expected scenario	11,882	7,111	8,283	9,167	9,420	10,792
High scenario	11,882	7,111	7,714	9,022	8,677	11,209
High - Low variance	-	1,035	861	986	320	857

NIBT ('000)	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06
Low scenario	10,357	11,036	10,013	10,759	9,389	10,116
Expected scenario	12,038	11,540	12,130	12,394	12,968	13,284
High scenario	11,867	12,605	12,605	14,133	14,117	15,734
High - Low variance	1,511	1,570	2,593	3,374	4,727	5,618

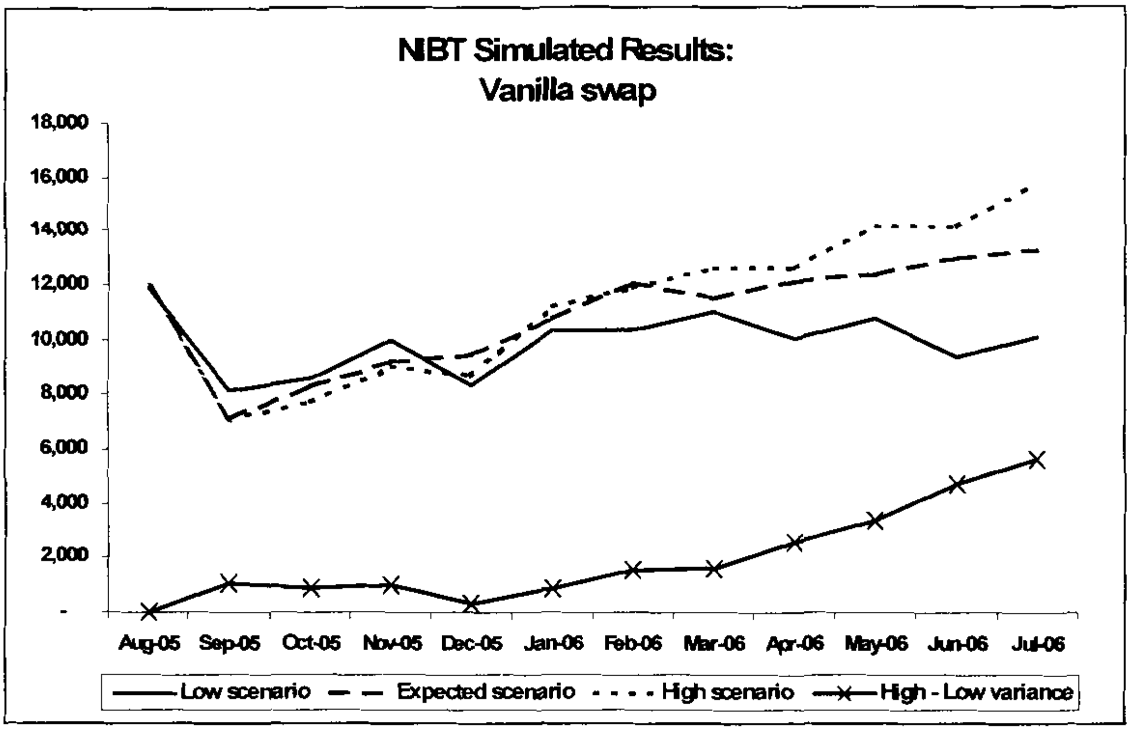
Annual totals:	Vanilla swap	Base case	Difference
Low scenario	**118,988**	**126,034**	**-7,046**
Expected scenario	**131,010**	**119,091**	**11,920**
High scenario	**136,676**	**113,845**	**22,831**
High - Low variance	**17,688**	**12,189**	**5,499**

Author: Simulation model

The NIBT results of the simulations for the vanilla swap are also given in graphical form in Figure 6.7, with the values (in thousands) on the y-axis and the months on the x-axis. As before, the solid line denotes the results for the low scenario, the dashed line denotes the results for the expected scenario and the dotted line represents the results for the high scenario. The crossed line at the bottom of the graph shows the variance between the high and the low scenarios.

From the results as presented in Table 6.10 and Figure 6.7, it is evident that the vanilla swap strategy reverses the relationship between interest rates and the financial performance of the company from a negative relationship to a positive one. This is the desired result, given the ALCO's expectation of future interest rates.

Figure 6.7: Vanilla swap NIBT results



Author: Simulation model

From Table 6.10 it can be seen that the strategy increases expected NIBT by R11.9 million from R119.09 million to R131.01 million. The price of the increase, however, is increased volatility, up by R5.49 million from R12.18 million to R17.68 million. The upside potential, however, outstrips the downside by a long margin. On the downside, expected NIBT could be reduced by R7.04 million to R118.98 million, while on the upside it could be increased by R22.83 million to R136.67 million.

Table 6.11 shows the simulated results for the 50% participation swap strategy. The table follows the same format as Table 6.10 as described above, i.e. it gives the monthly results for each of the three scenarios, as well as the absolute value of the difference between the high and low scenario results. In addition, Table 6.11 compares the total annual simulated results for a 50% participation swap to those obtained in the base case, i.e. the results obtained for NIBT in section 6.4.

The NIBT results of the simulations for the 50% participation swap are also given in graphical form in Figure 6.8, which follows the same format as Figure 6.7, i.e. the solid line denotes the results for the low scenario, the dashed line denotes the results for the expected scenario and the dotted line represents the results for the high scenario. The crossed line at the bottom of the graph shows the variance between the high and the low scenarios.

Table 6.11: 50% participation swap NIBT results

NIBT ('000)	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06
Low scenario	11,544	7,845	8,453	9,889	8,237	10,241
Expected scenario	11,544	6,814	7,740	8,640	8,662	10,057
High scenario	11,544	6,814	7,173	8,291	7,707	10,061
High - Low variance	-	1,032	1,280	1,598	530	180

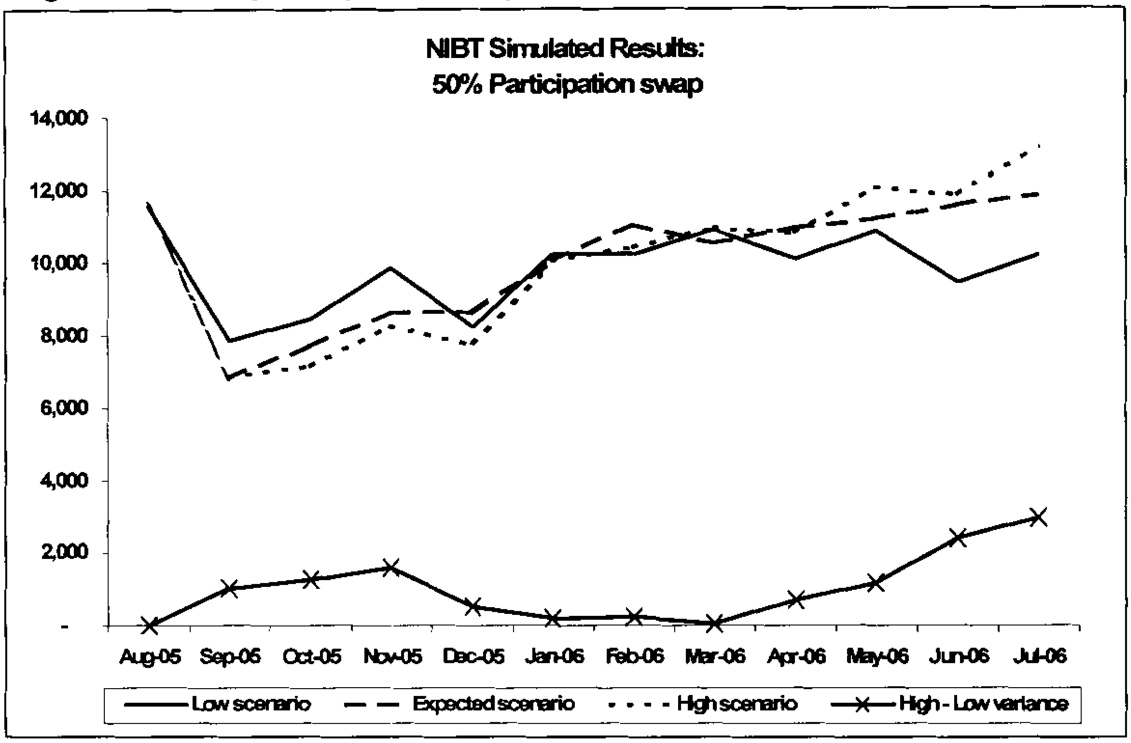
NIBT ('000)	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06
Low scenario	10,241	10,917	10,103	10,853	9,481	10,210
Expected scenario	11,060	10,556	10,964	11,180	11,578	11,834
High scenario	10,458	10,970	10,802	12,038	11,861	13,162
High - Low variance	217	54	699	1,185	2,380	2,952

Annual totals:	Vanilla swap	Base case	Difference
Low scenario	118,013	126,034	-8,022
Expected scenario	120,628	119,091	1,537
High scenario	120,880	113,845	7,035
High - Low variance	2,868	12,189	-9,322

Author: Simulation model

The results, as presented it Table 6.11 and Figure 6.8, show that the 50% participation swap strategy also reverses the relationship between interest rates and the financial performance of the company from a negative relationship to a positive one. The effect, however, is significantly smaller.

Figure 6.8: 50% participation swap NIBT results



Author: Simulation model

From Table 6.11 it can be seen that expected NIBT is only increased by R1.53 million from R119.09 million to R120.62 million. The benefit of the strategy, however, is that NIBT volatility is greatly reduced by R9.32 million from R12.18 million to R2.86 million. Thus, if reduced volatility in earnings is the ALCO's objective, then they should implement this strategy. The downside potential of the participation swap strategy is, however, slightly bigger than the upside potential.

The third strategy involves the outright purchase of a Cap for a premium of R5 million. The ALCO is of the opinion that the current volatility trading in the market is relatively high and that the option premium therefore does not offer good value. Furthermore, the upfront cash flow requirement of R5 million poses a problem. As stated in section 6.2, the company has a policy to keep R20 million in cash to cover operational expenses. Any cash generated over this amount goes towards redemption of capital on their loan from the holding company. However, despite these concerns, they will consider the strategy if the simulation results show a significant benefit.

Table 6.12 shows the simulated results for the cap strategy. The table follows the same format as Table 6.10 as described above, i.e. it gives the monthly results for each of the three scenarios, as well as the absolute value of the difference between the high and low scenario results. In addition, Table 6.12 compares the total annual simulated results for a cap to those obtained in the base case, i.e. the results obtained for NIBT in section 6.4.

Table 6.12: Cap NIBT results

NIBT ('000)	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06
Low scenario	6,958	8,211	9,084	10,513	8,896	10,856
Expected scenario	6,958	7,175	7,940	8,844	8,673	10,034
High scenario	6,958	7,175	7,370	8,287	7,843	10,363
High - Low variance	-	1,036	1,713	2,225	1,053	493

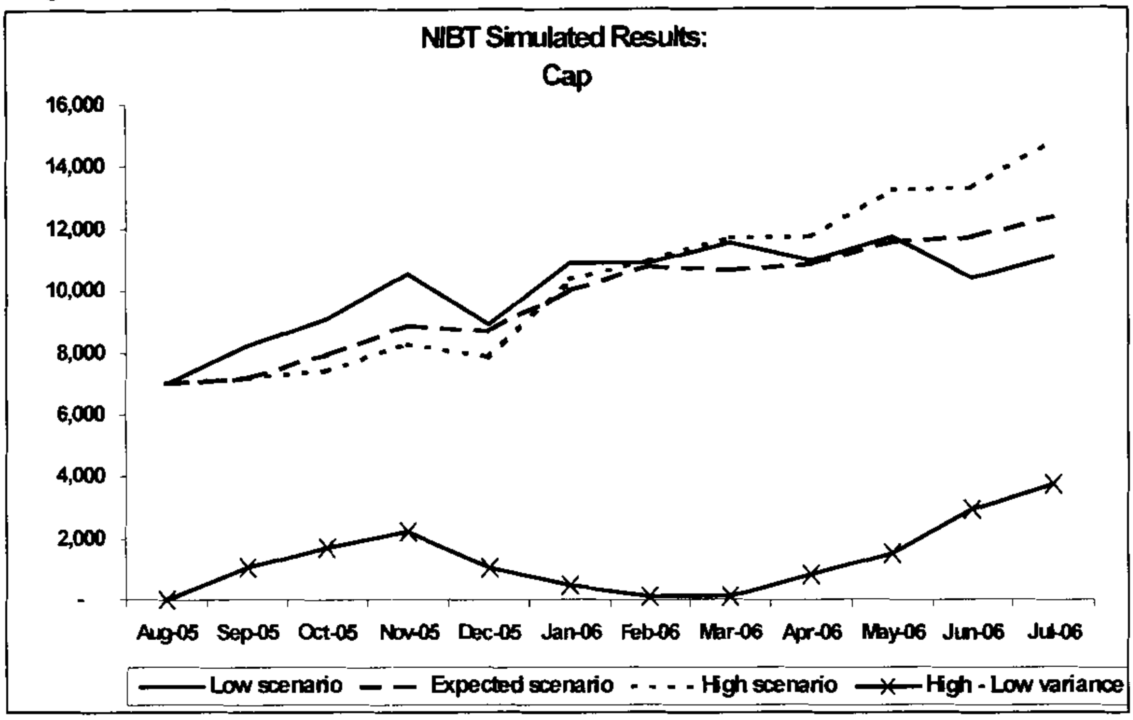
NIBT ('000)	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06
Low scenario	10,853	11,545	10,928	11,719	10,332	11,076
Expected scenario	10,789	10,634	10,848	11,497	11,695	12,351
High scenario	10,945	11,688	11,723	13,229	13,249	14,787
High - Low variance	92	143	795	1,510	2,917	3,711

Annual totals:	Cap	Base case	Difference
Low scenario	**120,969**	**126,034**	**-5,065**
Expected scenario	**117,439**	**119,091**	**-1,652**
High scenario	**123,617**	**113,845**	**9,772**
High - Low variance	**2,648**	**12,189**	**-9,541**

Author: Simulation model

The NIBT results of the simulations for the cap are also given in graphical form in Figure 6.9, which follows the same format as Figure 6.7, i.e. the solid line denotes the results for the low scenario, the dashed line denotes the results for the expected scenario and the dotted line represents the results for the high scenario. The crossed line at the bottom of the graph shows the variance between the high and the low scenarios.

Figure 6.9: Cap NIBT results



Author: Simulation model

From Table 6.12 it can be seen that expected NIBT is actually decreased by R1.65 million from R119.09 million to R117.43 million. The strategy however does offer the benefit of a reduction in NIBT variance by R9.54 million from R12.18 million to R2.64 million. However, if the ALCO's expectations of future interest rates are realized, the strategy will reduce the NIBT, as seen above. Therefore, if reduced volatility in earnings is the ALCO's objective, then they should rather implement the previous strategy, i.e. the 50% participation swap. These results confirm the ALCO's suspicion that caps are currently expensive due to the high volatility trading in the market.

The next strategy is a zero-cost collar. The strategy solves the problem of the upfront cash flow encountered in the cap strategy. However, the ALCO is of the opinion that Cap struck at 9.0% is too high and does not offer enough protection against increasing rates. They will, however, consider the strategy if the simulation results show a significant benefit.

Table 6.13 shows the simulated results for the zero-cost collar strategy. The table follows the same format as Table 6.10 as described above, i.e. it gives the monthly results for each of the three scenarios, as well as the absolute value of the difference between the high and low scenario results. In addition, Table 6.13 compares the total annual simulated results for a zero-cost collar to those obtained in the base case, i.e. the results obtained for NIBT in section 6.4.

The NIBT results of the simulations for the zero-cost collar are also given in graphical form in Figure 6.10, which follows the same format as Figure 6.7, i.e. the solid line denotes the results for the low scenario, the dashed line denotes the results for the expected scenario and the dotted line represents the results for the high scenario. The crossed line at the bottom of the graph shows the variance between the high and the low scenarios.

Table 6.13: Collar NIBT results

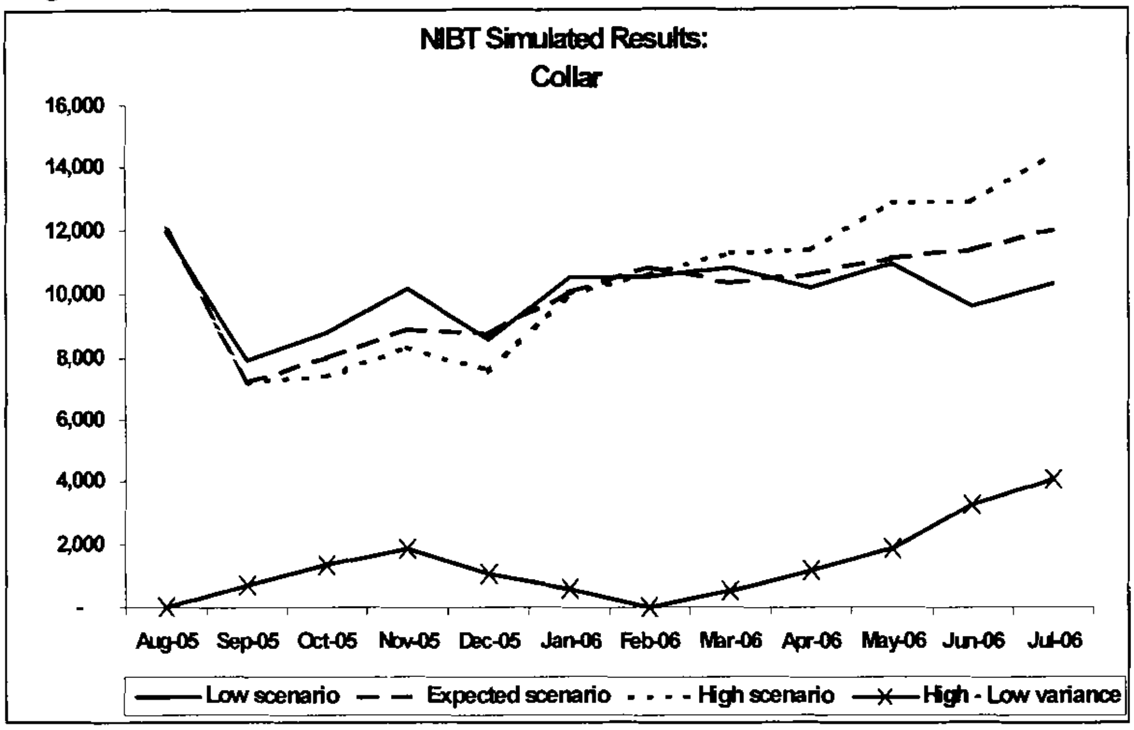
NIBT ('000)	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06
Low scenario	11,973	7,929	8,769	10,206	8,581	10,552
Expected scenario	11,973	7,203	7,972	8,877	8,712	10,078
High scenario	11,973	7,203	7,405	8,323	7,545	9,995
High - Low variance	-	725	1,364	1,884	1,036	557

NIBT ('000)	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06
Low scenario	10,537	10,800	10,204	10,967	9,601	10,317
Expected scenario	10,835	10,342	10,563	11,117	11,324	11,966
High scenario	10,564	11,305	11,351	12,842	12,872	14,395
High - Low variance	26	505	1,147	1,875	3,271	4,078

Annual totals:	Collar	Base case	Difference
Low scenario	**120,436**	**126,034**	**-5,598**
Expected scenario	**120,963**	**119,091**	**1,872**
High scenario	**125,771**	**113,845**	**11,926**
High - Low variance	**5,335**	**12,189**	**-6,854**

Author: Simulation model

Figure 6.10: Collar NIBT results



Author: Simulation model

From Table 6.13 it can be seen that expected NIBT is increased by R1.87 million from R119.09 million to R120.96 million. The strategy also offers the benefit of a reduction in NIBT variance by R6.85 million from R12.18 million to R5.33 million. In addition, the upside potential of the strategy is R11.92 million, more than twice the downside potential of R5.59 million. Therefore, the results show that the zero-cost collar strategy offers a good balance between reduced variance and expected size of NIBT. Hence, despite the ALCO's original doubts regarding this strategy, the results of the simulations compel them to seriously consider this strategy.

Table 6.14 shows the simulated results for the fixed-rate bond strategy. The table follows the same format as the previous tables described above, i.e. it gives the monthly results for each of the three scenarios, as well as the absolute value of the difference between the high and low scenario results. As before for the other strategies, Table 6.14 also compares the total annual simulated results for a fixed rate bond to those obtained in the base case, i.e. the results obtained for NIBT in section 6.4.

The NIBT results of the simulations for the fixed rate bond are also given in graphical form in Figure 6.11, which follows the same format as the figures for the previous strategies, i.e. the solid line denotes the results for the low scenario, the dashed line denotes the results for the expected scenario and the dotted line represents the results for the high scenario. The crossed line at the bottom of the graph shows the variance between the high and the low scenarios.

Table 6.14: Fixed-rate bond NIBT results

NIBT ('000)	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06
Low scenario	10,551	6,604	7,340	8,863	7,233	9,142
Expected scenario	10,551	6,347	7,072	8,479	8,361	10,038
High scenario	10,551	6,347	6,939	8,351	8,084	10,482
High - Low variance	-	257	401	512	851	1,340

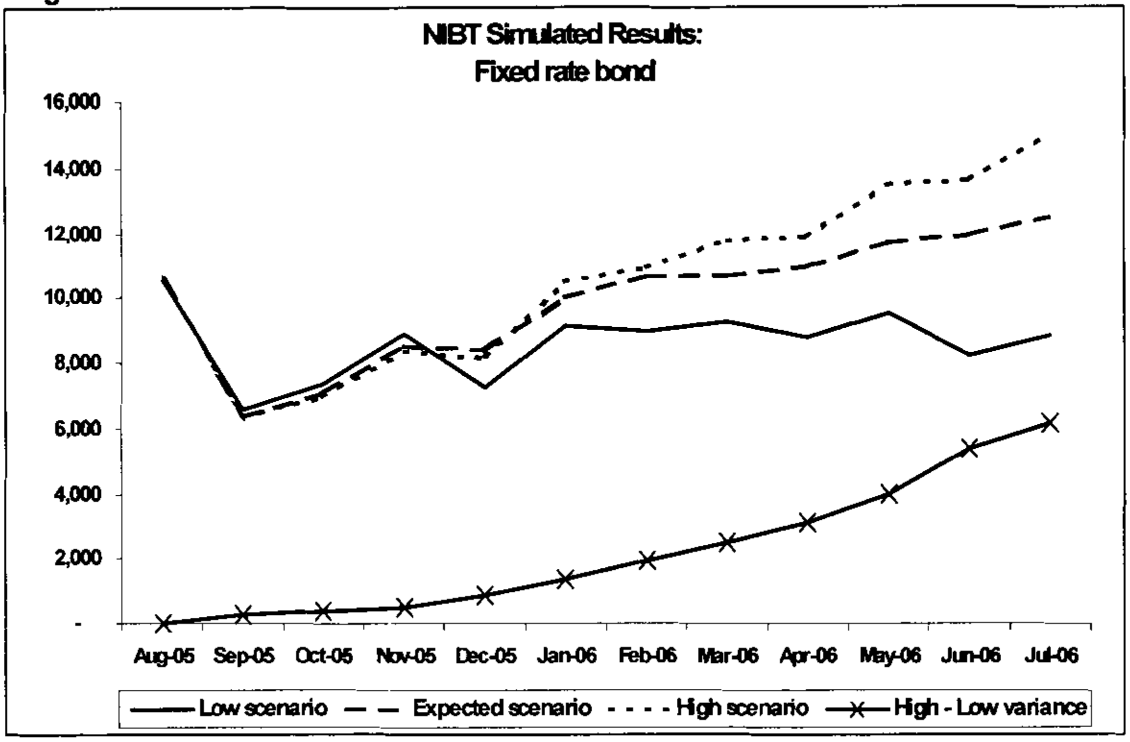
NIBT ('000)	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06
Low scenario	8,970	9,274	8,762	9,514	8,231	8,804
Expected scenario	10,662	10,662	10,940	11,675	11,937	12,470
High scenario	10,926	11,752	11,872	13,481	13,597	14,980
High - Low variance	1,956	2,478	3,111	3,967	5,366	6,177

Annual totals:	Fixed bond	Base case	Difference
Low scenario	103,286	126,034	-22,748
Expected scenario	119,194	119,091	104
High scenario	127,362	113,845	13,517
High - Low variance	24,076	12,189	11,887

Author: Simulation model

The results, as presented in Table 6.14 and Figure 6.11, show that the fixed-rate bond strategy also reverses the relationship between interest rates and the financial performance of the company from a negative relationship to a positive one. The effect, however, based on the simulated results, is not very desirable, as explained below.

Figure 6.11: Fixed-rate bond NIBT results



Author: Simulation model

From Table 6.14 it can be seen that expected NIBT is only increased by R104 thousand from R119.09 million to R119.19 million. At the same time, NIBT volatility is greatly increased by R11.88 million from R12.18 million to R24.07 million. Furthermore, the downside potential of the fixed-rate strategy is almost twice as big as the upside potential. The reason is that Lessrisk is perceived by the market as a risky investment, hence the rather large 300 basis point credit spread. Issuing a bond is therefore a very expensive exercise for Lessrisk[9].

Bear in mind, however, that issuing the bond fixes Lessrisk's cost of funding for a period of five years, whereas the other strategies are only for a period of one year. Over a five-year period, this strategy could prove to be profitable. On the other hand, if interest rates decline and stay relatively low for the full period, this

[9] In addition to the credit spread, there are also marketing costs to consider. These include a prospectus, a "road show", underwriting fees, brokerage fees, etc.

strategy could be the downfall of Lessrisk. Given this gamble, and the fact that the risk-reward profile over the forecast period is very poor, this strategy is just not worth it.

Table 6.15 shows the simulated results for the variable rate bond strategy. The table follows the same format as the previous tables described above, i.e. it gives the monthly results for each of the three scenarios, as well as the absolute value of the difference between the high and low scenario results. As before for the other strategies, Table 6.15 also compares the total annual simulated results for a variable rate bond to those obtained in the base case, i.e. the results obtained for NIBT in section 6.4.

The NIBT results of the simulations for the variable rate bond are also given in graphical form in Figure 6.12, which follows the same format as the figures for the previous strategies, i.e. the solid line denotes the results for the low scenario, the dashed line denotes the results for the expected scenario and the dotted line represents the results for the high scenario. The crossed line at the bottom of the graph shows the variance between the high and the low scenarios.

Table 6.15: Variable rate bond NIBT results

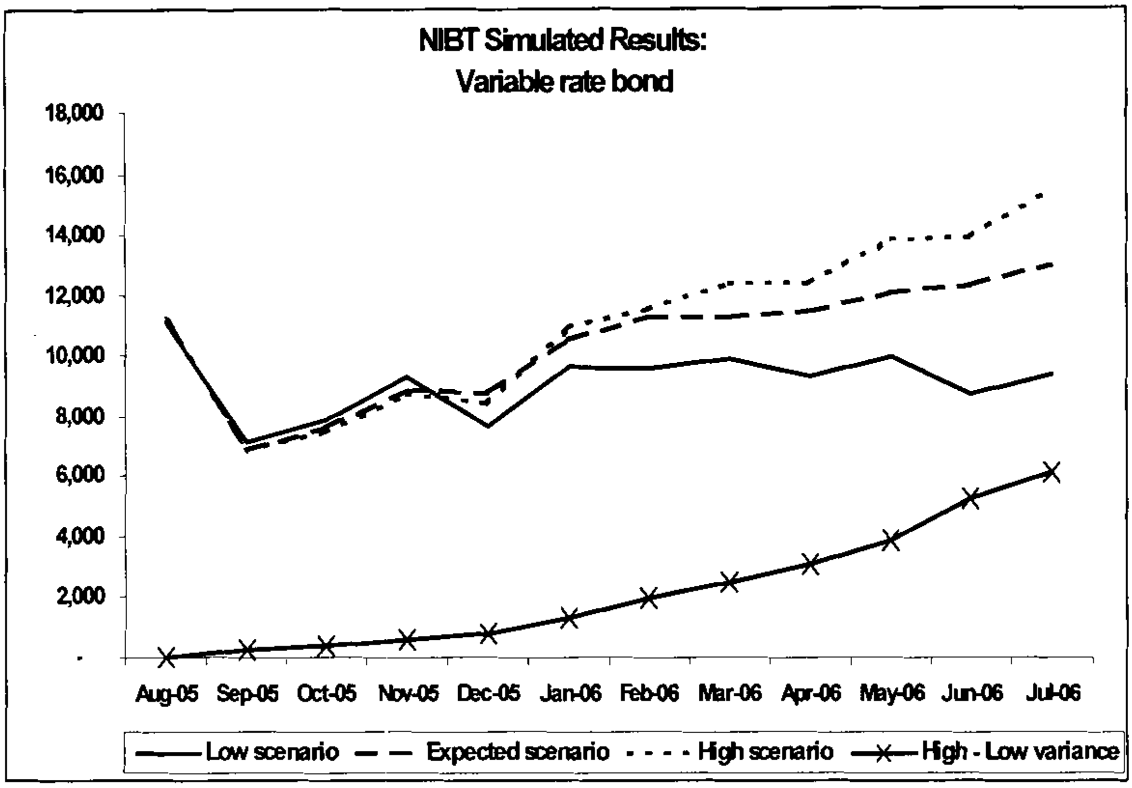
NIBT ('000)	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06
Low scenario	11,148	7,142	7,854	9,281	7,665	9,649
Expected scenario	11,148	6,885	7,574	8,860	8,753	10,523
High scenario	11,148	6,885	7,435	8,720	8,451	10,955
High - Low variance	-	257	420	561	786	1,305

NIBT ('000)	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06
Low scenario	9,587	9,890	9,284	9,976	8,677	9,350
Expected scenario	11,284	11,285	11,432	12,054	12,302	12,978
High scenario	11,551	12,378	12,343	13,812	13,903	15,462
High - Low variance	1,963	2,488	3,059	3,836	5,226	6,112

Annual totals:	Variable rate bond	Base case	Difference
Low scenario	**109,505**	**126,034**	**-16,529**
Expected scenario	**125,078**	**119,091**	**5,987**
High scenario	**133,043**	**113,845**	**19,198**
High - Low variance	**23,538**	**12,189**	**11,349**

Author: Simulation model

Figure 6.12: Variable rate bond NIBT results



Author: Simulation model

The results, as presented it Table 6.15 and Figure 6.12, show that the variable rate bond strategy, like all the previous strategies, also reverses the relationship between interest rates and the financial performance of the company from a negative relationship to a positive one. However, even though the simulated results show that this strategy is much more profitable than the fixed-rate bond strategy, the results are not nearly as favourable as for the first two strategies.

From Table 6.15 it can be seen that expected NIBT is increased by R5.98 million from R119.09 million to R125.07 million[10]. At the same time, NIBT volatility is greatly increased by R11.34 million from R12.18 million to R23.53 million, almost as much as for the fixed-rate bond strategy. Unlike the fixed-rate bond strategy,

[10] As in the case of the fixed-rate bond, these figures exclude the various costs associated with the marketing of the bond.

however, the downside potential of the variable rate strategy is smaller than the upside potential.

It must be noted, however, that these results are based on the current forecasted interest rates. Unlike the other strategies discussed above, issuing the variable rate bond does not fix Lessrisk's cost of funding. Lessrisk will be exposed to interest rate risk for a period of five years. If interest rates increase dramatically over the next five years, Lessrisk's cost of funding will increase accordingly, thereby putting pressure on the interest rate margin.

This risk is mitigated by the fact that the asset book is also linked to a variable interest rate, i.e. the Usury rate. It is important, however, to remember that the assumption that there is a 3-month lag between changes in the market rates and changes in the Usury rate is in fact an assumption, and not a law. In reality, there is nothing that will ensure that this assumption holds true or even that the magnitude in changes between the different rates will be the same. Given this risk, as well as the big increase in expected volatility in earnings, this strategy, like the cap and fixed-rate bond strategies, does not seem very attractive.

Based on the simulated results for the above strategies, it should be clear that the choice of six different strategies has been narrowed down to a choice of three strategies, i.e. implementing the vanilla swap, implementing the 50% participation swap or implementing the zero-cost collar. The ALCO's ultimate choice of strategy will depend on their over-riding objective or strategic plan. If they have a strong belief that their increasing view of future interest rates is correct, then the ALCO should implement the vanilla swap strategy, since this strategy will maximize the benefit to the company if their interest rate view is realized.

If, however, they would like to create more certainty about the future by reducing the expected volatility in earnings, then they should implement either the 50% participation swap or the zero-cost collar. Of the two, the zero-cost collar seems to be the best strategy, since the expected NIBT is slightly higher than in the case of the 50% participation swap. Even though this comes at a price of higher variance in NIBT, the upside potential of the zero-cost collar is more than twice its downside potential, and also more than 1.5 times the upside potential of the 50% participation swap.

6.8 Conclusion

This chapter, Chapter 6, served to give a practical demonstration of the implementation in a corporate of the interest rate risk measurement tools and hedging instruments discussed in Chapter 3 to 5.

With the use of a simulation model built for a hypothetical corporate called Lessrisk, a step-by-step approach was taken to demonstrate the practical application of the theoretical concepts discussed in the preceding chapters. As stated in the introduction, the practical case study used a selection of the material presented in the dissertation in order to serve as an example. The tools and instruments not covered in Chapter 6 could be demonstrated in similar fashion.

In accordance with the ALM process described in Chapter 2, Chapter 6 started off by examining Riskless's current balance sheet position. This was followed by forecasting values for the relevant exogenous factors to be used in the scenario analysis. For each factor, three forecasts were determined: a high scenario, an expected scenario and a low scenario.

The simulation model was then run for the different scenarios. The results were used along with a GAP analysis to quantify Lessrisk's exposure to interest rate risk. Once this was done, different possible hedging strategies were formulated and tested by running them through the simulation model. The results of the simulations were then evaluated to determine the most appropriate strategy.

Chapter 6 was an attempt to achieve the fourth and last goal of the dissertation, which was to demonstrate the use of the above measurement tools and hedging instruments through a corporate case study, thereby satisfying the problem statement. In the next and final chapter, Chapter 7, the dissertation will be concluded by a summary of the material covered in the study.

CHAPTER 7: CONCLUSION

7.1 Introduction

As the title suggests, this dissertation explored strategic interest rate risk management from a corporate ALM point of view. The first few chapters were dedicated to the concept of ALM in general, i.e. the definition, history and corporate need for ALM. This set the stage for Chapters 3 to 6, which were dedicated to the main focus of the dissertation. The main focus, as stated several times throughout the dissertation, and suggested by the title, is strategic interest rate risk management.

Chapter 1 served to set the background for the dissertation. It started off by describing asset and liability management, commonly referred to as ALM, is a term often used and a concept that has become an integral part of today's business environment. Yet, few people are clear on exactly what the term ALM refers to. The material was presented from the viewpoint of a corporate ALM practitioner. It was therefore imperative that, before delving into the detailed aspects of strategic interest rate risk management within ALM, the dissertation endeavoured to give the reader a clear image of what the term ALM means.

In order to paint a full picture of the concept of ALM, a two-stage approach was taken. First of all, the concept of ALM was defined very clearly in order to give the reader a thorough understanding of what the term entails. This was followed by a brief history of ALM and its development to serve the needs of the banking sector. A summary of each of these stages is given below.

7.1.1 Definition

Asset and liability management, or ALM, is a process for managing all the assets and liabilities of a bank (or corporate) under one umbrella, instead of managing assets and liabilities separately. This allows the ALCO to take into account all the different risks faced by the institution, on both sides of the book, including correlations between different types of risk.

The ALM process is the process by which an institution's assets and liabilities, along with their associated risks, are managed simultaneously. Put differently, it is the coordination of the interrelationships between the sources and uses of funds in short-term financial planning and decision-making (Haslem, 1984: 116). "In its most pristine sense, asset/liability management involves the coordination of all balance sheet categories in a way that maximizes shareholder value" (Graddy et al, 1985: 495). The ALM process is the responsibility of the Asset and Liability Management Committee, or ALCO. The ALCO is the nerve centre of any bank and is responsible for the strategic risk management of the bank.

ALM is not only practiced by banks, but across diverse settings. Apart from other participants in the financial sector, like derivative dealers, pension funds and insurance companies, ALM is also employed in non-financial sectors, for example in the corporate retail sector. Today, ALM is widely used in the corporate environment, since many corporates are involved in activities originally associated with banks.

In fact, one of the goals of this dissertation was to demonstrate the need for ALM in the corporate environment and an entire chapter, Chapter 2, was devoted towards achieving this goal. Further more, Chapter 6 showed through a practical case study how the ALM model developed for banks can be successfully applied to the corporate sector.

7.1.2 The history of ALM

In the early part of the 1980's the financial system in the United States of America experienced one of the biggest financial crisis in the history of that country. During this time, the bank failure rate in the USA saw a dramatic increase. From 1946 to 1982, only 187 banks failed (about 6 banks per year). In 1982, 42 banks failed, followed by 48 bank failures in 1983. In the first eight months of 1984, 54 banks failed (Graddy et al, 1985: 459).

The sudden increase in bank failures was evidence that the traditional bank management models were no longer sufficient. Subsequent investigations showed that the failures could mainly be ascribed to the separation principle, whereby bank assets and bank liabilities were managed separately, i.e. decisions pertaining to asset composition can be made independently of decisions about how to raise funds to support those assets (Mason, 1979: 225).

The institutions that survived the time of crisis had either an active social club or a tee room. Unbelievable as this may sound further studies have shown that this was indeed the case. In institutions that had a social club or a tea room, the short comings of the separation principle were overcome through the social interaction between the asset managers and the liability managers. This made them aware of each other's situations and lead to integrated strategies.

Today it is a well-known fact that the risks that financial institutions face is inter-related, and this was precisely what led to the downfall of the financial institutions in the early eighties. Since assets and liabilities were managed separately, the risks associated with each were also managed separately. The interaction between the different types of risk was therefore not given the attention it deserved, with disastrous consequences. In the case of a bank, both assets and liabilities are paper claims, and the independence assumption does not reflect reality.

The revelation of the importance of the interaction between the different types of risk, and therefore the important relationship between the assets and liabilities that these risks are associated with, gave birth to the field of Asset and Liability Management, or ALM, whereby assets and liabilities are managed together along with their associated risks.

Today ALM is widely used throughout the financial industry and increasingly so by corporates. Over the decades the process of ALM was refined to the point where there is now a generally accepted model for implementing ALM in any organization. Whereas the specifics and complicity of each step in the process may differ from one organization to the next, the basic framework can be applied universally. This basic framework was discussed in detail in Chapter 2.

7.2 The problem statement and goals revisited

The problem statement and goals to be addressed in the dissertation were defined in Chapter 1. For the sake of clarity, they are re-stated in the following two sections.

7.2.1 Problem statement

Since corporates act in similar ways to banks and are faced with the same risks, these risks have to be managed properly in order to ensure the survival of the corporates. How can the ALM methodology developed for banks be applied successfully in the corporate sector to manage interest rate risk?

7.2.2 *Goals of the dissertation*

The dissertation strived to meet four goals:

- To show the need for ALM in the corporate environment.

- To define the tools that can be used to measure interest rate risk.

- To define the instruments that can be used to hedge interest rate risk.

- To demonstrate the use of the above measurement tools and hedging instruments through a corporate case study, thereby satisfying the above problem statement.

7.3 The need for ALM in the corporate environment

As stated above, Chapter 1 served to set the stage for the rest of the dissertation by defining the concept of ALM and giving a brief history of its development. In addition, it outlined the problem statement, goals and layout of the dissertation.

Having set the stage, Chapter 2 was devoted towards achieving the first goal of the dissertation, which was to show the need for ALM in the corporate environment. In addition, Chapter 2 also outlined the basic framework for ALM. In the paragraphs that follow, a brief overview is given of the concepts discussed in Chapter 2.

Many corporates and agricultural companies today are involved in activities traditionally associated with banks: They borrow money on one hand, externally or internally, and lend it out on the other. In this way, corporates and agricultural companies acquire assets and liabilities with the same characteristics as those of banks, giving rise to the same risks that banks are faced with, and therefore to the need of ALM.

Banks, however, are regulated, and regulators enforce prudent risk management policies and procedures. Corporates, however, are not regulated, apart from the stipulations of the Companies Act. The question thus arises: Why should corporates go through the costly exercise of implementing the systems and processes, including ALM, required for sound corporate governance, if they are not required to do so by law?

Chapter 2 proceeded to justify the need for ALM in the corporate environment by giving detailed answers to the above question. The first and most obvious answer to this question is that unmanaged risks will invariably lead to unexpected losses of unknown quantity. By entering into traditional banking activities and then ignoring the substantial associated risk, the company is simply setting a time bomb for itself and putting its profitability at risk. It follows that if corporates wish to engage in traditional banking activities, they need to manage the associated risks like banks do. ALM is an established and proven method that banks use to manage their risks and profitability, and therefore it is prudent for corporates engaged in the same activities, to do the same.

Styger & van der Westhuizen (2002: 3) links the profitability of a bank to ALM as follows: "The critical factor in achieving high bank profitability is the development of an analytical framework of asset and liability management which highlights key relationships and identifies major underlying influences." The profitability of a corporate engaged in banking activities can be linked to ALM in a similar way.

The second and less obvious answer is that corporates are dependent on capital injections in the form of bank funding, equity and paper issued in the market. How well a company manages its risks has a definite impact on how the company is perceived by the market. The cost of capital is directly linked to the company's perceived risk of default in the market.

The way the market views a particular firm is determined by how well the firm performs on issues related to sound corporate governance. There is, however, no regulatory environment for corporates by which a firm's compliance to corporate governance can be measured. In order to address this issue, the King Committee on Corporate Governance issued their first report in 1994, which contained the Code of Corporate Practices and Conduct. The Code is not legally binding, but if a company wishes to be perceived by the market as following best international practices, it has to comply with the Code. In 2002, the King Committee issued a second report, known as the King 2 report.

Using a number of extracts from the Institute of Directors (IOD) in Southern Africa's Executive Summary of the King Report (2002: 6 – 44), Chapter 2 made it clear that in terms of the King 2 report, sound corporate governance is a key aspect by which the business world of today judges companies and that such companies will do well to comply. It was also made clear that one of the main elements of sound corporate governance is an ongoing, integrated process of risk management, controlled directly from the board, and that the board should use generally recognised risk management models. One of the most widely used models is the ALM process, as described in Chapter 2.

Lastly, it was argued that apart from the very important function of risk management, there is another and perhaps equally important function of ALM. This is to help with the strategic decision making process in the company. Strategic management is forward-looking and has the goal of positioning a company in such a way that its ability to reach the strategic goals and objectives in the future is optimized.

One of the most important tools that managers use for effective strategic management is scenario analysis. This enables management to be pro-active by considering in advance different scenarios for key variables affecting the business and to plan accordingly. Today's technology provides powerful simulation systems through which different scenarios and strategies can be tested. Vosloo (2003: 24) says the following: "Maintaining competitive advantage and ensuring long-term survival depends on an institution's ability to pro-actively and rapidly change but also being able to accommodate change. This can be achieved using scenario-planning theory…as it becomes a key component in an institution's ability to accommodate change."

As seen in the practical case study in Chapter 6, the use of scenario analysis falls squarely in the realm of ALM. From the above paragraphs, it follows that ALM forms an integral part of strategic management.

7.4 The tools that can be used to measure interest rate risk

In Chapter 1 the term ALM was defined and a brief history of its development for the banking sector was given. The problem statement, goals and layout of the dissertation were also described. Chapter 2 endeavoured to satisfy the first goal of the dissertation, which is to show the need for ALM in the corporate environment.

In Chapter 3, the dissertation turned to its main focus, which, as stated before, is interest rate risk. It first of all gave a clear and comprehensive definition and description of interest rate risk. This was followed by a detailed discussion of the term structure of interest rates and the different theories surrounding it. Lastly, some of the most important and widely used tools for measuring interest rate risk were described in detail. In doing so, Chapter 3 aimed to achieve the second goal of the dissertation, which was to define the tools that can be used to measure interest rate risk.

Interest rate risk was defined as the risk that earnings will decline due to movements in interest rates (Bessis, 1998: 8). Many items on the balance sheet generate income and expenditure, which are linked to interest rates. Since interest rates are unstable, earnings are subject to interest rate risk. Interest rate risk does not only apply to variable rate loans or investments. Other sources of interest rate risk arise when fixed rate loans or investments have to be renewed on maturity, when using discounted cash flow models to value portfolios, or when assets have embedded options, such as the early repayment option on certain loans. In the last case the risk is referred to as indirect interest rate risk, since it does not arise directly from changing interest rates, but rather from the behaviour of customers in response to such changes (Bessis, 1998: 9).

Interest rate risk, like any other risk, can only be managed or hedged properly if it has been properly measured and quantified. The rest of Chapter 3, in accordance with the second goal of the dissertation, was therefore dedicated towards detailing several interest rate risk measurement tools. These include the interest rate gap, duration, duration gap and dynamic simulation models. In the paragraphs that follow, a brief overview of the discussions on these measurement tools is given.

According to Kelly (1988: 124) banks typically run a mismatched book, which means that they are funding long-term assets such as loans with short-term funds, or vice versa. Another term often used to describe mismatching is known as "running a gap". Gaps exist when assets and liabilities re-price or mature at different times. The term re-pricing refers to a change in the interest rate applicable to the asset or liability.

Traditional static GAP analysis is a type of analysis that measures the amount of interest rate risk that an institution is exposed to at a certain point in time. It does so by comparing the interest rate sensitivity of assets with that of liabilities over different time intervals or "time buckets". GAPs are calculated for each time bucket based on the aggregate balance sheet data at a fixed point in time (Koch, 2000: 304-305). In other word, GAP analysis does not take into account future growth strategies for the book. It takes a snapshot of the balance sheet at a specific point in time and calculates an interest rate GAP for each time bucket, based on that snapshot. These GAPs are then used to determine by how much net interest income will change if rates change.

According to Kelly (1989: 131-132), duration is an alternative method to GAP analysis for the management of interest rate risk. Koch (2000: 232) defines duration as a measure of the effective maturity that incorporates the timing and size of a security's cash flows. It is a measure that captures the combined effect of interim payments, market rate and maturity on the security's price volatility. Duration is an indication of how price sensitive a security or portfolio is to changes in interest rates. The greater the duration of the security or portfolio is, the greater the price sensitivity, and vice versa.

If the duration of the portfolio of assets is longer than the duration of the portfolio of liabilities, then earnings will fall if interest rates rise, and vice versa. Conversely, if the duration of the assets is shorter than the duration of the liabilities, rising interest rates will lead to increased earnings. The opposite is true should rates decline. From a duration analysis point of view, interest rate sensitivity is eliminated if the duration of assets is equal to the duration of liabilities.

The discussion on duration gap analysis was an extension on the discussion on duration. Duration gap (DGAP) analysis compares the duration of a portfolio of assets with the duration of a portfolio of liabilities in an attempt to ascertain how the market value of shareholder's equity will change when the level of interest rates change. Whereas funding GAP analysis focuses on rate sensitivity or frequency of re-pricing, duration gap analysis focuses on price sensitivity.

This approach overcomes the major flaw in GAP analysis, as described by Bessis (1998: 208): "With the gap model, all flows within periods are supposed to occur at the same date. This generates errors due to reinvestments or borrowings within the period. The accurate condition of immunization of the interest margin over a given horizon depends upon the duration of the stream of flows of the period."

The greater the DGAP is, the greater the potential variation is in the market value of equity (MVE) for a given change in the level of interest rates. If DGAP is positive and interest rates decline, the MVE will increase. However, an increase in interest rates will lead to a lower MVE. If DGAP is negative, rising interest rates will increase the MVE, while decreasing interest rates will lower the MVE. The closer DGAP is to zero, the smaller the effect of changing interest rates will be on the MVE (Koch, 2000: 345).

Value at risk, or VAR, is a statistical approach to measuring risk. J.P. Morgan/Arthur Andersen (1997: 52-53) defines VAR as the maximum expected loss, within a specified confidence interval, of a portfolio's value resulting from adverse market movement that could occur in normal markets over a defined unwind period.

At first glance, calculating VAR for a portfolio seems simple enough. According to Bessis (1998: 72 – 73), there are three basic inputs to a VAR model, namely the loss volatility, tolerance level and assumption on the loss distribution. Once these inputs have been decided on or calculated, and assuming that losses are normally distributed, the VAR of the portfolio is simply a multiple of the loss volatility, where the multiple is determined by the loss distribution and required tolerance level.

In practice, however, it is a lot more complicated. First of all, the assumption of the normal distribution, though easy to use, is not always accurate. Secondly, the real distributions could have so-called "fat tails". Fat tails point to the possibility of extreme losses that are very infrequent and not observable, which makes the modeling of losses very difficult, if feasible at all. Lastly, the loss distribution of a portfolio should take into account that the losses on a portfolio are dependent on several underlying parameters, instead of just one, as well as the risk diversification in the portfolio. The section on VAR listed several suggestions on how the above problems could be addressed. It also discussed various other studies, theories and methodologies relating to VAR.

Dynamic simulation models are built using specialized software, like ALMAN from Riskflow Technologies, which were used in the case study in Chapter 6. These models are used to forecast the financial statements into the future, as well as various risk reports, stepping through time month by month in accordance with the variable input scenarios. The methodology of dynamic simulations was made clear Chapter 6.

Koch (2000: 305) defines simulation as follows: "An analysis of possible outcomes for net interest margin resulting from selecting hypothetical values for key variables that influence the re-pricing of assets, liabilities, and off-balance sheet items and conducting forecasts to determine the effects of changes in these variables on a bank's net interest income." According to Bessis (1998: 169), simulations are the only way to determine the influence of all combined parameters.

Simulations model the balance sheet and margins in order to quantify the impact of different interest rate scenarios and other uncertainties on the risk-reward trade-off. Once a set of scenario inputs has been defined, the simulation model is used to determine the values of the target values for each of the scenarios. Strategies can then be compared with each other in terms of their profitability and the volatility thereof across the different scenarios, i.e. by doing a risk-reward comparison. Simulating different strategies can thus optimize funding and hedging solutions by choosing the most appropriate strategy based on the results. Where other risk measurement methodologies rely on assumptions that often hide risks, simulation models rely on scenarios that reveal risks. As such, they pose a significant improvement in risk measurement (Bessis, 1998: 187).

7.5 The instruments that can be used to hedge interest rate risk

Chapter 3 achieved the second goal of the dissertation by defining interest rate risk and describing the tools that can be used to measure and quantify the extent of the exposure to interest rate risk. Once the exposure to interest rate risk has been properly measured, the ALCO has to devise and implement strategies for hedging against possible losses resulting from such exposure.

ALM is dynamic and ALCO's are required to be innovative. The number of possible hedging strategies is infinite and can comprise of one or a combination of many different hedging instruments. These instruments can be grouped into two broad classes: notional instruments and derivative instruments. Chapter 4 and Chapter 5 formed a unit and were dedicated to describing the different notional and derivative instruments that can be used in interest rate hedging strategies.

The use of notional instruments as funding or investment products by themselves does lead to exposure to interest rate risk. In fact, interest rate derivatives are often used to hedge against the risk inherent in notional instruments. However, from a portfolio or ALM perspective, notional instruments can also be used as an alternative to derivatives in order to hedge interest rate risk. Bessis (1998: 350) says that for any given asset, there is only one funding solution that totally removes the liquidity and interest rate risk of that asset. It is the funding solution that replicates the time profile of flows and that replicates the interest rate type.

Chapter 4 discussed several notional instruments that can be used to hedge interest rate risk in detail. The discussion was grouped under the headings of discount products, negotiable certificates of deposit (NCD's), fixed-income securities and other types of notional instruments.

Discount products are products where the investor pays less than the full face value of the investment on the value date and receives the full face value at maturity. The difference between the purchase price and the redemption value constitutes the return to the investor.

Negotiable Certificates of Deposit, or NCD's, were developed to enhance the liquidity in the interbank deposits market. NCD's are bearer instruments, which means that they can be traded with other banks or lenders in the secondary market. NCD's are usually issued for tenors less than one year, in which case interest is payable on maturity. NCD's can, however, be issued for tenors longer than one year. In this case, interest may be paid either at maturity or half-yearly in arrears, i.e. on a coupon-bearing basis.

A bond, or fixed-income security, represents an obligation of the borrower, or issuer, to make periodic payments of interest and to repay the borrowed amount, or face value, on a specified future date. The coupon rate, or nominal rate, of a bond is the rate at which the periodic interest payments are made. The issuer pays interest either semi-annually or annually. The par face value of a bond is the amount that the borrower promises to repay on or before the maturity date of the particular issue.

Due to innovation, there are many different variations of each type of financial instrument. These instruments are created by ether changing a characteristic of the original "vanilla" instrument, as is the case with variable rate bonds, or by combining different types of instruments, called hybrid instruments, like preference shares and convertible bonds. Hybrid instruments usually employ embedded derivatives. These instruments were also described in Chapter 4.

Whereas Chapter 4 was dedicated to describing the different notional instruments that can form part of a hedging strategy, Chapter 5 was dedicated to derivative instruments that can be used for the same purpose. As noted before, Chapter 4 and 5 formed a unit designed to satisfy the third goal of the dissertation, which was to define the instruments that can be used to hedge against interest rate risk.

Using derivatives to hedge is often cheaper and certainly a lot less cumbersome than hedging with notional instruments. Buying an interest rate swap, or any other derivative for that matter, is as simple as calling a few banks for quotes an accepting the best quote. The whole process is done telephonically and can be concluded in a matter of minutes, providing that credit lines, ISDA and FICA documentation are in place.

Further more, using derivative instruments is flexible. Unlike the equity and commodity derivative markets, interest rate derivatives are predominantly traded off-exchange in the OTC market. The swaps market, for example, is the largest OTC market. As such, they can be structured to meet the exact requirements of the client, such as broken dates, i.e. dates that do not conform to a formal exchange delivery date, as well as other unique or non-standard requirements.

With the use of derivatives, hedgers exposed to adverse movements in the cash-market price can eliminate the exposure completely by taking a derivatives position that is equal and opposite to the cash-market position. In doing this, the risk of loss is eliminated by giving up any potential for gain, with certainty as the end result. Alternatively, the hedger could buy an option for a premium to eliminate the risk of loss while retaining the potential for gain.

Following a detailed definition of the term derivatives, Chapter 5 turned to detailed descriptions of various interest rate derivative products. A forward rate agreement, or a FRA, is a short-dated interest rate derivative. It is designed as an agreement between two parties to exchange an interest rate differential (only) on a predetermined notional principal amount during a given time period, based on an agreed future interest rate basis during the given time period.

Swaps are some of the most widely used hedging instruments available on the market. There are many types of swaps traded across a range of markets, including the interest rate, currency, commodity and equity markets. Although each market has its own characteristics, as do each particular variant of a swap, all swaps have certain commonalities. A swap is a contractual agreement between two parties (counterparties) to exchange a series of cash flows at specific intervals over certain period of time. The swap payments are based on some underlying asset or notional amount, which may or may not be exchanged. At the time of entering into the swap agreement, at least one of the series of cash flows is uncertain.

A vanilla interest rate swap, also known as a fixed-for-floating swap or a coupon swap, is the simplest form of swap available in the market. It is defined as an agreement between two parties to exchange interest payments on a certain notional amount of money. One party agrees to pay a fixed rate of interest based on the notional amount and the other party agrees to pay a floating rate of interest.

A basis swap is an interest rate swap where both legs of the swap are referenced to a floating rate of interest. In other words, one floating rate of interest is swapped for another floating rate of interest on a notional principal amount. In South Africa, there is a growing demand for swaps that exchange the Prime rate for JIBAR.

Other types of swaps that were discussed in Chapter 5 included RODS, accreting swaps, amortising swaps, rollercoaster swaps and cross-currency swaps. The latter is used to hedge both the exchange rate risk and the interest rate risk associated with a loan or investment denominated in a foreign currency.

Instead of completely eliminating risk with the use of a swap, the hedger could buy an option for a premium to eliminate the risk of loss while retaining the potential for gain. In so doing, the hedger's risk is limited to the premium paid for the option. If the option expires without being exercised, the hedger forfeits the premium paid for the option. However, the fact that the option was not exercised means that the underlying market to which the hedged asset or liability relates to, has moved in favour of the hedger, who has thus made a profit on such asset or liability.

The three most widely used options for hedging interest rate risk are Caps, Floors and Swaptions. Caps are a series of options that protect the buyer, typically a borrower of money, against higher interest rates. Floors, on the other and, protect the buyer, typically an investor of money, against lower interest rates. Each option in the series of options have the same strike price, but the expiry of each option is designed to coincide with the re-pricing of the underlying loan or investment.

A swaption, or a swap option, is defined as an option that gives the holder the right to enter into either a lender's or borrower's swap at a certain price at a given time in the future. Whereas caps and floors are series of options that give the holder the right to exercise at each reset date, a swaption is a single option. Once exercised, the holder has entered into a swap agreement with no further option rights.

It was stated before that innovation and flexibility are a key features of the OTC derivatives market. As such, there are an infinite number of possible combinations of basic derivative products that will produce a new product. To demonstrate this, Chapter 5 ended with a discussion on three of the most common interest rate derivative combination structures. These were collars, participation swaps and reverse participation swaps.

As stated previously, Chapter 4 and Chapter 5 formed a unit. Together, the two chapters have satisfied the third goal of the dissertation, which was to define the instruments that can be used to hedge against interest rate risk.

7.6 Practical example: A corporate case study

The main focus of this dissertation has been strategic interest rate risk management. To this end, Chapter 3 was dedicated towards the definition of and tools for measuring the exposure to interest ate risk. Also included in Chapter 3 was a detailed discussion on the yield curve. As stated there, understanding the yield curve and the forces that determines its shape, is fundamental to the effective management of interest rate risk, as well as the pricing and valuation of interest rate derivative instruments.

Once properly quantified, as described in Chapter 3, the ALCO has to devise strategies to hedge against the interest rate exposure. A hedging strategy can comprise of a single hedging instrument, or any combination of the available hedging instruments. These hedging instruments can be either notional instruments, as described in Chapter 4, or derivative instruments, as described in Chapter 5.

Once the ALCO has devised a set of possible hedging strategies, the strategies should be tested and evaluated to determine the most appropriate one. There are various ways to choose the optimal strategy, e.g. ARCH and GARCH Monte Carlo models, as well as scenario analysis with the use of simulation models. The method used in Chapter 6 was to compare the results obtained for simulating the different strategies for each of the three chosen interest rate scenarios.

Chapter 6 brought together the concepts discussed in Chapters 3 to 5 in a practical example. Due to the wide range of measurement tools and hedging instruments covered in the dissertation, not all of the concepts described in the previous chapters were covered. The aim of Chapter 6 was to use a selection of the tools and instruments and to demonstrate their use, in accordance to the ALCO process described in Chapter 2, with the help of a dynamic simulation model. The model has been built for a hypothetical corporate, called Lessrisk, using the ALMAN software developed by Riskflow Technologies. The tools and instruments not covered in Chapter 6 could be demonstrated in similar fashion.

Following the ALCO process set out in Chapter 2, Lessrisk's current balance sheet position was first of all examined. It is important to understand the current balance sheet position and all the exogenous factors that can influence it over time before embarking on a scenario analysis. This was followed by forecasting three different scenarios for the future monthly values for each of the exogenous factors to be used in the scenario analysis. The scenarios used, as stated, were extreme scenarios designed for illustrative purposes. For each exogenous factor, a high scenario, an expected scenario and a low scenario were defined.

The next step was to run the simulation model for the different scenarios and to supply the results obtained for a define set of key variables. These results were then used in the following section, along with a GAP analysis, to quantify Lessrisk's exposure to interest rate risk. Once this was done, different possible hedging strategies were formulated for consideration by the ALCO. These strategies were then tested by running them through the simulation model. The results of the simulations were then evaluated to determine the most appropriate strategy.

Chapter 6 was therefore an attempt to achieve the fourth and last goal of the dissertation, which was to demonstrate the use of the measurement tools and hedging instruments, as discussed in Chapters 3 to 5, through a corporate case study, thereby satisfying the problem statement.

7.7 Conclusion

Chapter 1 started off by giving a broad definition for the term ALM. This was done in recognition of the fact that the reader needed a clear understanding of the concept of ALM in order to fully comprehend the more detailed discussions that follow in later chapters. The chapter also described the history of the development of ALM, primarily in the banking sector, and briefly referred to the diverse environments that ALM is practiced in today. In addition, the problem statement, goals and layout of the dissertation were defined.

Chapter 2 endeavored to achieve the first goal the dissertation, which was to prove the need for ALM in the corporate environment. The chapter explored how the corporate sector is engaged in activities traditionally associated with banks and why this has given rise to an ALM approach in the corporate environment. It has shown that corporates are faced with the same risks that banks are faced with, including, but not limited to, interest rate risk. Referring to various issues such as potential losses, profitability, sustainability, corporate governance, market perception and strategic management, Chapter 2 has proven that an ALM approach in corporate management is no longer a luxury, but indeed a necessity.

In Chapter 3, the dissertation started to focus on interest rate risk and attempted to address the second goal of the dissertation, which was to define the tools that can be used to measure interest rate risk. This chapter first of all defined interest rate risk and then described the term structure of interest rates. This was followed by a detailed discussion of several interest rate risk measurement tools. These included the interest rate gap, duration, duration gap, value at risk (VAR) and dynamic simulation models. These are all tools that the ALM practitioner can employ in order to properly quantify the company's exposure to interest rate risk.

As stated before, in order for any risk to be managed properly, it must first be understood, measured and quantified. Chapter 3 has shown how this can be achieved for interest rate risk.

Chapters 4 and 5 formed a unit, which together attempted to achieve the third goal of the dissertation: to define the instruments that can be used to hedge interest rate risk. Chapter 4 was dedicated to the discussion of notional instruments while Chapter 5 took a detailed look at interest rate derivatives. Chapter 4 first of all defined the term "notional instrument" and described the use of such instruments for hedging purposes by the ALCO. The chapter then went into more detail on the different types of notional instruments and their characteristics.

In Chapter 5, a closer look was taken at the different derivative instruments that can be used to hedge against interest rate risk. Derivatives were defined and their use as hedging instruments described. The chapter then turned to a detailed discussion of the different types of interest rate derivatives that can be used to hedge exposure to interest rate risk.

In the last chapter, Chapter 6, several of the concepts discussed in Chapters 3, 4 and 5 were put to practical use in a corporate case study using a dynamic simulation model. Using the ALMAN simulation software, courtesy of Riskflow Technologies, a model built for a hypothetical company was used to quantify the company's exposure to interest rate risk under different scenarios. The whole process was covered, including simulating and evaluating different hedging strategies and choosing the most appropriate one. In doing so, Chapter 6 achieved the fourth and final goal of the dissertation, which was to demonstrate the use of the measurement tools and hedging instruments through a corporate case study, thereby satisfying the problem statement of the dissertation.

The dissertation therefore explored and achieved all four of the stated goals one by one. Through this process, the problem statement was successfully addressed. By achieving its stated goals, the study has shown how corporates engaged in similar activities as banks and faced with the same risks, can manage these risks properly and ensure their survival by implementing the ALM methodology developed for banks.

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