THE INTEGRATION OF PERFORMANCE MEASUREMENT AND ASSET-and-LIABILITY MANAGEMENT

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For my family

Shani, Leandrey, Denica and the *twins*

"..as we know, there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns - the ones we don't know we don't know... it is the latter category that tend to be the difficult ones."

--Donald H. Rumsfeld: US
Secretary of Defence (1932 -)

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ABSTRACT

The financial intermediation function that a bank performs dictates the existence of a risk-reward trade-off embedded within a bank's balance sheet. The process of risk management focuses on achieving the broader organisational objectives relating to this risk-reward trade-off.

Measuring the contribution of risk to profitability is pivotal in assessing the optimality of a bank's risk-reward trade-off. Conventional accounting-based performance measures such as return on assets and return on equity do not incorporate the risk effects as part of the performance assessment. Risk-adjusted performance measurement assessments, such as risk-adjusted return on capital, acknowledge the impact of risk in measuring the profitability of a bank.

Interest rate risk is an important source of bank profitability. The Asset-and-Liability Management function of a bank is tasked with the management of interest rate risk in the 'banking book' of its balance sheet. Managing interest rate risk demands that the sources of interest rate risk for example, reprice risk, yield curve risk, option risk and basis risk are clearly identified and measured. The impact of interest rate risk can be assessed from two perspectives namely, the earnings perspective and the economic value perspective. Measuring the impact of interest rate risk conventionally involves a number of techniques, each of which has inherent strengths and weaknesses. Simulation modelling techniques deploying earnings-at-risk and economic value of equity analyses respectively, most accurately quantifies the earnings and economic value perspectives to the effects of interest rate risk. The methods of repricing gap analyses and duration analyses present efficiency constraints in measuring interest rate risk although complimentary to developing a complete interest rate risk metrics framework.

Matched-Term Funds Transfer Pricing is an important component in measuring the risk-adjusted net interest margin for the risk-adjusted performance measurement process. Matched-Term Funds Transfer Pricing system isolates the business units from the effects of interest rate risk by transferring the interest rate risk or mismatch spread (profit or loss) to the Central Funding Unit or Asset-and-Liability Management unit. Business units are therefore allocated the net interest margin components relating to the controllable risk elements for which management responsibility is assumed.

Business units use the risk-adjusted performance measurement results to develop balance sheet and pricing strategies that are sensitised to asset and liability management and interest rate risk management objectives through the Matched-Term Funds Transfer Pricing mechanism. These business strategies should be included in the measurement of interest rate risk by the asset-and-liability management simulation model. The asset-and-liability management process can therefore optimise the interest rate risk management process. The integration of the Matched-Term Funds Transfer Pricing, Asset-and-Liability Management and banking book interest rate risk management processes institutes a risk-optimisation approach to risk management compared against the conventional risk-control perspective to the function of risk management.

UITTREKSEL

Die finansiële intermediasiefunksie wat 'n bank vervul vereis dat 'n risiko-vergoeding oorweging ingesluit is in 'n bank se balansstaat. Die risiko bestuursproses fokus daarop om die groter organisatoriese doelwitte ten opsigte van die risiko-vergoeding oorweging te bereik.

Die meting van die bydrae wat risiko tot die winsgewendheid maak staan sentraal in die beoordeling van die optimaliteit van 'n bank se risiko-vergoeding oorweging. Konvensionele rekeningkundige gefundeerde prestasie maatstawwe soos opbrengs op bates of opbrengs op kapitaal inkorporeer nie die effek van risiko's as deel van die prestasie beoordeling nie. Die beoordeling deur 'n risiko-aangepaste prestasie meting metode soos risiko-aangepaste opbrengs op kapitaal, bevestig die impak van risiko in die meting van 'n bank se winsgewendheid.

Rentekoersrisiko is 'n belangrike bron van 'n bank se winsgewendheid. Die Bate-en-Laste Bestuurfunksie van 'n bank het as opdrag die bestuur van die rentekoersrisiko in die balansstaat van die bankbedrywighede. Die bestuur van die rentekoersrisiko vereis dat die oorsprong van die rentekoersrisiko, bv. herprysingsrisiko, opbrengskrommerisiko, opsierisiko en basisrisiko duidelik identifiseer en gemeet moet word. Die impak wat rentekoersrisiko tot gevolg het kan uit twee perspektiewe beoordeel word, naamlik die inkomsteperspektief en die ekonomiese waardeperspektief. Die effek of gevolge van rentekoersrisiko kan konvensioneel deur verskeie metodes gemeet word. Elk van die metingsmetodes van die rentekoersrisiko het inherente sterkpunte en swakhede. Simulasie- modelleringstegnieke wat gebruik maak van die verdienste-ter-risiko en die ekonomiese waarde van aandeelhouersfondse, kwantifiseer onderskeidelik die effek van rentekoersrisiko die mees akkuraatste in terme van die verdienste- en ekonomiese waarde perspektiewe. Die herprysings- gapinganalises en tydsduuranalises ondervind effektiwiteits beperkinge in die meting van rentekoersrisiko, maar komplimenteer die ontwikkeling van 'n omvattende rentekoersrisiko metingsraamwerk.

Gepaste-Termyn Fonds Oordrag Koste is 'n belangrike komponent om die risiko-aangepaste netto rentemarge te meet vir die risiko-aangepaste prestasie metingsproses. Die Gepaste-Termyn Fonds Oordrag Koste stelsel isoleer besigheids eenhede teen die impak van rentekoersrisiko deur die rentekoersrisiko of wanparingsmarge (wins of velies) na die Sentrale Befondsingseenheid of Bate-en-Laste Bestuureenheid oor te plaas. Besigheidseenhede word dus geallokeer met die gedeelte van die netto rentemarge wat betrekking het op die beheerbare risiko-elemente waarvoor die besigheidseenheid bestuurs verantwoordelikheid aanvaar.

Besigheidseenhede gebruik die resultate van die risiko-aangepaste prestasiemetings om balansstaat en prys strategieë te ontwikkel wat sensitief is t.o.v. die bate-en-laste bestuur sowel as die doelwitte van rentekoersrisiko bestuur. Dit word bereik deur die gebruik van die Gepaste-Termyn Fonds Oordrag Koste meganisme. Die besigheids strategieë moet ingelsuit word in die bate-en-laste bestuur simulasiemodelle in die meting van rentekoersrisiko. Die bate-en-laste bestuursproses kan dus die rentekoersrisiko bestuurs proses optimaliseer. Die integrasie van die Gepaste-Termyn Fonds Oordrag Koste, die Bate-en-Laste Bestuur en die bankbedrywighede rentekoersrisiko bestuursprosesse, gee aanleiding tot 'n risiko-optimaliserings benadering tot die risko bestuursproses. Dit kontrasteer die konvensionele risiko-beheer benadering tot die risiko bestuursfunksie.

TABLE OF CONTENTS

DEDICATION ii

ACKNOWLEDGEMENTS iii

ABSTRACT iv

UITTREKSEL vi

TABLE OF CONTENTS viii

LIST OF ACRONYMS xi

LIST OF FIGURES xii

LIST OF TABLES xiii

1. BACKGROUND AND MOTIVATION 1

1.1 INTRODUCTION 1

1.2 BACKGROUND 2

1.3 PROBLEM STATEMENT 17

1.4 OBJECTIVES OF THE STUDY 18

1.5 RESEARCH METHODOLOGY 18

1.6 DISSERTATION OUTLINE 19

1.7 CONCLUDING REMARKS 22

2. RISKS AND RISK MANAGEMENT IN BANKS 23

2.1 INTRODUCTION 23

2.2 THE RISK/REWARD TRADE-OFF 24

2.2.1 RISK 25

2.2.2 REWARD 33

2.2.3 RISK VS. REWARD 37

2.3 FINANCIAL RISKS AND RISK MANAGEMENT 40

2.3.1 BANKING RISKS 41

2.3.2 RISK MANAGEMENT 47

2.3.2.1 RISK MANAGEMENT DEFINED 47

2.3.2.2 TECHNIQUES FOR DEALING WITH RISK 48

2.3.2.3 THE RISK MANAGEMENT PROCESS 50

2.4 SUMMARY 55

3. BACKGROUND TO PERFORMANCE MEASUREMENT AND RISK-ADJUSTED PERFORMANCE MEASURES 57

3.1 INTRODUCTION 57

3.2 PERFORMANCE MEASUREMENT 58

3.3 RISK-ADJUSTED PERFORMANCE MEASUREMENT 67

3.4 SUMMARY 76

4. ASSET AND LIABILITY MANAGEMENT IN BANKS 78

4.1 INTRODUCTION 78

4.2 ASSET-AND-LIABILITY MANAGEMENT 79

4.2.1 ALM DEFINED 82

4.2.2 ALM RISK QUANTIFICATION 90

4.3 INTEREST RATE RISK 102

4.3.1 INTEREST RATE RISK DEFINED 103

4.3.2 SOURCES OF INTEREST RATE RISK 104

4.3.3 PERSPECTIVES OF INTEREST RATE RISK 109

4.4 SUMMARY 115

5. INTEREST RATE RISK MEASUREMENT IN ASSET AND LIABILITY MANAGEMENT 117

5.1 INTRODUCTION 117

5.2 METRICS FOR IRR MANAGEMENT 119

5.3 GAP ANALYSIS 122

5.4 DURATION ANALYSIS 138

5.5 SIMULATION MODELLING 154

5.5.1 EARNINGS-AT-RISK ANALYSIS 162

5.5.2 ECONOMIC VALUE OF EQUITY ANALYSIS 169

5.6 SUMMARY 188

6. FUNDS TRANSFER PRICING AND THE ROLE OF FUNDS TRANSFER PRICING IN ASSET/LIABILITY MANAGEMENT IN BANKS 190

6.1 INTRODUCTION 190

6.2 FUNDS TRANSFER PRICING (FTP) 191

6.2.1 THE MEASUREMENT PROBLEM 195

6.2.2 THE CENTRAL FUNDING UNIT (CFU) CONCEPT 203

6.2.3 FTP METHODS 206
6.3 FUNDS TRANSFER PRICING – THE MATCHED-TERM APPROACH 219
6.4 SUMMARY 234
7. THE APPLICATION OF ASSET AND LIABILITY MANAGEMENT, FUNDS TRANSFER PRICING AND BANK PERFORMANCE 236
7.1 INTRODUCTION 236
7.2 THE ALM SIMULATION MODEL 238
7.3 ALM – INTEREST RATE RISK MEASUREMENT 243
7.3.1 GAP ANALYSIS 245
7.3.2 DURATION ANALYSIS 249
7.3.3 EARNINGS-AT-RISK ANALYSIS 252
7.3.4 ECONOMIC VALUE OF EQUITY ANALYSIS 256
7.4 MATCHED-TERM FUNDS TRANSFER PRICING 263
7.5 SUMMARY 278
8. RESEARCH SUMMARY AND CONCLUSIONS 280
8.1 INTRODUCTION 280
8.2 THE RESEARCH OBJECTIVES AND SUMMARY OF MAIN FINDINGS 280
8.2.1 THE RESEARCH OBJECTIVES 280
8.2.2 THE INVESTIGATIVE QUESTIONS 281
8.2.3 WHAT IS THE RISK-REWARD TRADE-OFF AND WHY MANAGE RISKS IN BANKS? 281
8.2.4 WHAT IS BANK PERFORMANCE MEASUREMENT? 285
8.2.5 HOW CAN RISK BE INTEGRATED IN PERFORMANCE MEASUREMENT? 286
8.2.6 IN ORDER TO MANAGE IRR HOW IS IRR MEASURED IN ALM? 287
8.2.7 HOW CAN FTP BE APPLIED TO MEASURE THE RISK-ADJUSTED NIM AND TRANSFER ALL MISMATCH SPREAD TO THE CFU? 288
8.2.8 HOW CAN THE INFORMATION FROM THE FTP PROCESS BE APPLIED IN THE ALM RISK MEASUREMENT PROCESS? 289
8.3 LIMITATIONS OF STUDY 290
8.4 OBJECTIVES AND RESULTS 291
8.5 SUGGESTIONS FOR FUTURE WORK 292
9. REFERENCES 293

LIST OF ACRONYMS

ALCO – Asset-and-Liability Management Committee

ALM – Asset-and-Liability Management

CF – Cash Flow

CFU – Central Funding Unit

EAR – Earnings-at-Risk

EV – Economic Value

EVE – Economic Value of Equity

FC – Funding Center

FTP – Funds Transfer Pricing

IRR – Interest Rate Risk

LQR – Liquidity Risk

MTFTP – Matched-Term Funds Transfer Pricing

NII – Net Interest Income

NI – Net Income

NIM – Net Interest Margin

NMD – Non-Maturity Deposits

NPV – Net Present Value

OAS – Option Adjusted Spread

P&L – Profit and Loss

PV – Present Value

RAPM – Risk-Adjusted Performance Measurement / Risk-Adjusted Performance Measures / Risk-Adjusted Profitability Measurement

RAROA – Risk-Adjusted Return on Assets

RAROC – Risk-Adjusted Return on Capital

RARORAC – Risk-Adjusted Return on Risk-Adjusted Capital

ROA – Return on Assets

ROC – Return on Capital

ROE – Return on Equity

RORAC – Return on Risk-Adjusted Capital

RSA – Rate Sensitive Assets

RSL – Rate Sensitive Liabilities

LIST OF FIGURES

CHAPTER 1

Figure 1.1 The financial system and financial intermediation. 3

CHAPTER 2

Figure 2.1 High volatility Bank A 29

Figure 2.2 Low volatility Bank B 30

Figure 2.3 The risk-reward trade-off 39

Figure 2.4 Principal banking risks 42

Figure 2.5 The pyramid of risk management. 51

Figure 2.6 The internal risk management process 53

CHAPTER 3

Figure 3.1 The profitability measurement hierarchy 60

Figure 3.2 The RAROC equation 73

CHAPTER 4

Figure 4.1 Major risk components 87

CHAPTER 5

Figure 5.1 Convexity 149

Figure 5.2 Dynamic simulation analysis results - EAR 165

CHAPTER 6

Figure 6.1 Components of the NIM 195

Figure 6.2 Interest rate risk (IRR) 201

Figure 6.3 Funds bought and sold from the Funding Center or Central Funding Unit 204

Figure 6.4 Multiple Pool Method – marginal rates based on the Treasury Yield Curve 214

Figure 6.5 Graphical presentation of the Matched-Term FTP Method 222

CHAPTER 7

Figure 7.1 The SVAL Model Framework 241

Figure 7.2 Model component structure 242

Figure 7.3 Chart static gap of Typical Bank – no behavioural assumptions 247

Figure 7.4 Chart static gap of Typical Bank – NMD behavioural assumptions 248

Figure 7.5 Typical Bank interest rate scenarios 254

Figure 7.6 Typical Bank projected 12-month NII based on 100bp EAR sensitivity 254

LIST OF TABLES

CHAPTER 3

Table 3.1 The elements of relationship profitability 64
Table 3.2 Banker's dilemma – investment decisions and performance measures 68

CHAPTER 5

Table 5.1 The repricing gap report 126
Table 5.2 Reprice gap analyses exposure direction 127
Table 5.3 Applying repricing gap analyses to measure NII sensitivity 128
Table 5.4 The calculation of the weighting factors 132
Table 5.5 Gap analyses for Case Study Bank 135
Table 5.6 Case Study Bank NII by Quarter 135
Table 5.7 Macaulay duration of a five-year fixed rate 10%-$10,000 loan 141
Table 5.8 Macaulay duration and modified duration calculations 146
Table 5.9 Market values for different market rates 147
Table 5.10 Projected earnings under nine scenarios 164
Table 5.11 Dollar EAR dispersion under nine scenarios 164
Table 5.12 Percentage point EAR variance under nine scenarios 164
Table 5.13 Net Interest Income sensitivity 165
Table 5.14 Discount rate calculations under Current Rate Discount method 175
Table 5.15 Discount rate calculations under Path Dependent Discounting method 178
Table 5.16 EV discounting method differences in discount rates 179

CHAPTER 6

Table 6.1 NIM at the transaction level 197
Table 6.2 The measurement problem 198
Table 6.3 Single Pool Method 208
Table 6.4 Double Pool Method 211
Table 6.5 Multiple Pool Method 214
Table 6.6 Multiple Pool Method – historical weighted-average rates 215
Table 6.7 Matched Rate FTP calculations 218

CHAPTER 7

Table 7.1 Balance sheet of Typical Bank 243
Table 7.2 Static Gap of Typical Bank – no behavioural assumptions 246
Table 7.3 Static Gap Typical Bank – NMD assumptions 248

Table 7.4 Macaulay and modified duration – Typical Bank 250
Table 7.5 Effective duration and effective convexity – Typical Bank 251
Table 7.6 Typical Bank 12-month NII and net income comparative report 255
Table 7.7 Variable rate product using the Current Rate Discounting method 257
Table 7.8 Fixed rate product using the Current Rate Discounting method 258
Table 7.9 EVE base scenario analysis using Current Rate Discounting 261
Table 7.10 EVE alternative scenario analysis using Current Rate Discounting 262
Table 7.11 EVE alternative scenario analysis using Path Dependent Discounting 262
Table 7.12 EVE sensitivity to a 200 basis point parallel rate shock using Current Rate Discounting 263
Table 7.13 EVE sensitivity to a 200 basis point parallel rate shock using Path Dependent Discounting 263
Table 7.14 Typical Bank divisional balance sheets – Retail Division and Corporate Division. 264
Table 7.15Retail Division amortising mortgage loan – annual adjustable rate 265
Table 7.16 Retail Division amortising instalment sale loan – variable rate account 266
Table 7.17 Retail Division amortising instalment sale loan – fixed rate account 267
Table 7.18 Corporate Division fixed deposit – contractual maturity at fixed rate 268
Table 7.19 Transfer margin report for Typical Bank 269
Table 7.20 Transfer margin reports for Retail Division and Corporate Division 272
Table 7.21 Typical Bank Funding Center summaries per division 275
Table 7.22 Funding Center spread report for Typical Bank 277

CHAPTER 1

BACKGROUND AND MOTIVATION

1.1 INTRODUCTION

The ultimate objective of any business is to make money and in particular to create wealth for its owners or shareholders. Shareholders require above average and consistent returns on their investment in a business venture and will continually assess alternative investment opportunities. This requires that the management of a business should focus on those aspects driving its profitability, continuously striving to endeavour in activities that will enhance its profits and thereby creating a competitive advantage over its competition. This is particularly applicable to banks. Banks perform an important intermediation function in the financial system of an economy. By intermediating between surplus and deficit units in the economy a bank's balance sheet have mismatches between the interest rates that it receives on loans and that what it pays on deposits. These interest rates can change randomly and in an unstructured fashion during the economic cycle. The bank's net interest margin is therefore exposed to interest rate risk. Banks derive a considerable portion of their profitability from its net interest margin and should coherently and continuously assess the factors i.e. interest rate risk that may negatively impact its profitability. Due to the potentially severe impact of interest rate risk on the profitability of a bank, it requires prudent management.

Thus, banks are managers of risks and are therefore exposed to a risk-reward trade-off. The assessment of the profitability a bank must encompass a process that will effectively identify, monitor and control the factors or risks, and in particular interest rate risk, that may negatively impact its profitability. This information is required to formulate its strategies and business processes in order to mitigate its overall risk exposures whilst optimising its profits. As part of the processes which has at goal to optimise its profits based on the risks taken, the bank must assess its interest rate risk exposures originating from its financial intermediation activities. This must be done as part of its performance measurement and asset/liability management (ALM) processes. It is important to establish the *raison d'être* for banking from which the processes of performance measurement and ALM are necessitated. Therefore, in section 1.2 a background to the financial system and the role of banks' financial intermediation will be discussed to elucidate why banks are exposed to risk. This also provides a background as to how risk (in

specific interest rate risk) impacts profitability and why interest rate risk should be measured and managed.

1.2 BACKGROUND

According to Kelly (1993:13-14) in the economic cycle, goods and services are produced and sold for local consumption or export and other goods and services are imported. Stigum and Branch (1983:13) state that households, business firms and government are constantly receiving and using funds. Business firms receive funds from selling its production outputs and use the funds to cover its costs of production and its investment in equipment and factories. Kelly (1993:14) adds that in this process of economic activity workers receive wages from the income produced by companies. Government will receive taxes from the companies and workers to further promote economic activity and to provide infrastructure, education, safety and security to its people. In an economic system the ownership of the constantly circulating stock of money is distributed among various economic units including businesses, households, financial institutions, government and semi-government organisations. However all money is not held physically in the possession of its owners, but by financial institutions under the instruction of the money's owners. This is mainly done for the benefit to the owner of convenience, safekeeping and investment (Kelly, 1993:14).

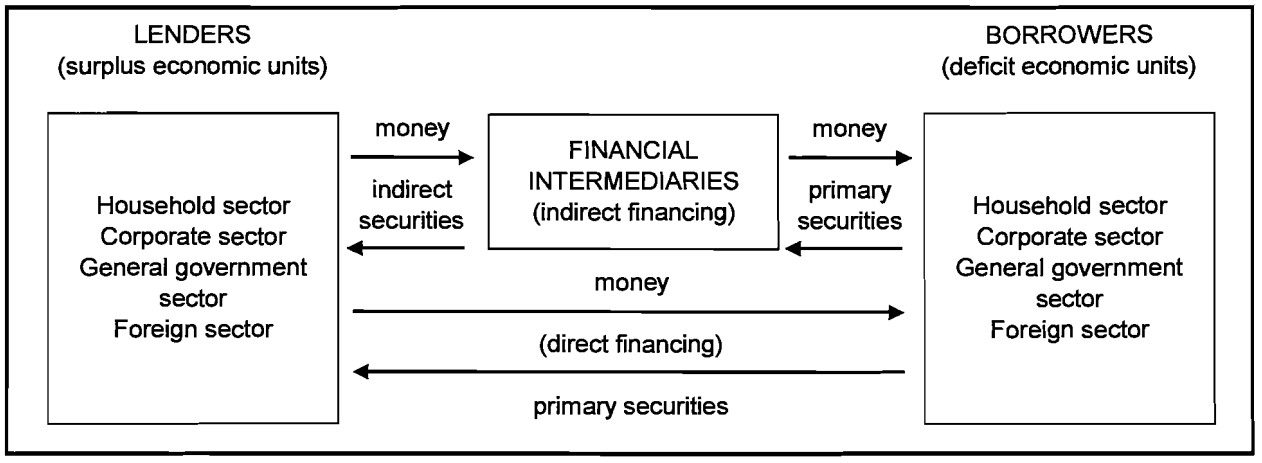
According to Kelly (1993:14) the financial system is an integral part of the economic system of a country. Accordingly, the financial system comprises a framework of complex arrangements and procedures arising from inevitable, innumerable and diverse acts of investment, disinvestment and monetary payments occurring unceasingly throughout the economic system. In supplement, Faure *et al.* (1991:1) defines the financial system as a complex set of arrangements that adopt the lending and borrowing of funds by non-financial economic units. In addition, the financial system embraces all arrangements relating to the intermediation by financial institutions in the lending and borrowing of funds by non-financial economic units. These intermediation arrangements facilitate the transfer of funds between economic units, provide additional funds as required and create debt markets to ensure the price and allocation of funds are determined efficiently. This definition of the financial system by Faure *et al.* (1991:1) identifies the four essential elements of a financial system, namely:

- The lenders and borrowers which are commonly the non-financial economic units.
- The financial institutions, which intermediate the lending and borrowing process.

- The financial instruments that are created to satisfy the various needs of the participants in the financial system.
- The financial markets which are the institutional arrangements and conventions that exist for the issue and trading (dealing) of the financial instruments.

Following the identification of the four elements of the financial system it is derived from Faure *et al.* (1991:2) that all financial institutions and financial markets exudes the characteristics associated with financial intermediation in the financial system. This is also reported by Kelly (1993:19). Figure 1.1 presents the functioning of the elements within the financial system.

Figure 1.1 The financial system and financial intermediation.



Source: (Faure *et al.*, 1991:2)

Stigum and Branch (1983:14) state that consumers are quite often in possession of gross savings given that their income is more than their capital expenditure. These economic units are therefore surplus of funds. According to Kelly (1993:15) surplus economic units are households, businesses, non-profit organisations and government or public sector entities, whether domestic or abroad, with surplus funds at their disposal. Therefore, these entities possess savings, which they wish to invest. The surplus unit or ultimate lender can be further described as a non-financial economic unit that generate investable funds. In addition, Faure *et al.* (1991:1) states that it is unlikely that the savings achieved by non-financial economic units from income will be perfectly matched by their desired investment. Surplus economic units will achieve higher savings from income than planned investment of expenditure.

Kelly (1993:15) states that deficit units are households, businesses, non-profit organisations and government or public sector entities, whether domestic or abroad, which have insufficient funds to finance their various needs. In addition, Stigum and Branch (1983:14) adds that deficit units

are exposed to economic conditions and often need funds to finance capital expenditure/consumption, given that its income generated are insufficient to fully finance its economic activity or consumption. Faure *et al.* (1991:1) explains that deficit units or ultimate borrowers are those non-financial economic units which have insufficient savings to meet their investment or expenditure demands. Accordingly, Faure *et al.* (1991:2) explains the following four categories of non-financial economic units may at various different times find themselves being either surplus or deficit units in the economy:

- Household sector
- Corporate sector
- Government sector
- Foreign sector

Stigum and Branch (1983:14) state that profits generated or income received from economic activity, often does not cover capital expenditure required to expand business activities. Economic growth requires funds to expand production and economic activity. According to Kelly (1993:14) economic growth requires the growth in the stock of money in that deficit units require funds to expand its production/consumption capacity which are not met in full by their income. In addition, Stigum and Branch (1983:16) explain that deficit units require that the funds of surplus units flow through the financial system in order to cover the funds shortage of the deficit unit. Therefore, the funds of surplus units must be absorbed by supplying the funds required by deficit units in the form of debt or equity capital. These funds flow through the economy leaves a residual of newly created financial assets and liabilities. According to Kelly (1993:17) the money created through economic activities which resides under the ownership of private individuals, businesses or government is usually entrusted to financial institutions such as banks, life assurance companies or pension funds. All of these financial institutions are business enterprises that furnish financial services to the community they service, through the process of intermediation.

Stigum and Branch (1983:17) state that deficit funds units receive funds from surplus funds units. Financial intermediation is the process of bringing together surplus and deficit units within the financial system and satisfying the financial needs and requirements of both parties (Kelly, 1993:17). Faure *et al.* (1991:3) adds that the existence of surplus and deficit economic units requires the existence of a financial conduit, in order to transfer the funds of surplus units to the deficit units in the economy. The reconciliation between the needs of these units may be

achieved through either direct financing or indirect financing. Stigum and Branch (1983:17) state that a deficit unit may perform an external financing activity by borrowing directly from the funds surplus unit. This is called direct financing. Faure *et al.* (1993:3) explains that direct financing is conducted by a broker who will in return for a commission distribute the claims of borrowers among the lenders. Direct financing requires that the risk, return and term requirements of the lender perfectly match these requirements of the borrower. Stigum and Branch (1983:17) add that the deficit unit may typically sell equity or debt paper (primary security) directly to the surplus unit.

However, Faure *et al.* (1993:3) states that generally there would be a conflict regarding these requirements between lenders and borrowers. Financial intermediaries will perform indirect financing which resolves the conflicts between lenders and borrowers. This is achieved by creating markets in financial instruments specific for the needs of lenders and borrowers (Faure *et al.*, 1991:3). This is also reported by Stigum and Branch (1983:17) explaining that externally financing the funds requirements of deficit units involves indirect financing. The flow of funds from the surplus unit to the deficit units is therefore facilitated by a financial intermediary.

According to Kelly (1993:17-19), financial institutions intermediate between multiple surplus and deficit units. This is achieved by pooling the funds of surplus units and making it available to deficit units. In the process of financial intermediation, some financial institutions can issue or sell claims/securities to savers or surplus units and make these obtained funds available to deficit units. Claim issuing institutions therefore issue financial claims/securities against themselves in favour of the funds obtained from surplus units by making these funds available to deficit units, which in turn require additional funds for economic activity they engage or for consumption. The pooling of funds from surplus units and issuing claims/securities to make funds available to deficit units are also reported by Stigum and Branch (1983:19). Faure *et al.* (1991:4) argues that the collective funds from surplus units are made available to deficit units by the intermediation function performed by banks. Giarla (1991:16) agrees stating that the pooled funds of depositors are loaned to deficit economic units by the bank purchasing their direct claims/securities.

According to Kelly (1993:18) other institutions may act as a broker between surplus and deficit units by bringing together investors or savers and business units requiring funds. In some cases investors might bypass financial intermediaries by investing directly in business concerns i.e.

through direct financing, but whichever channel is followed the funds of surplus units reach deficit units requiring funds, via the intermediation process.

Therefore, according to Kelly (1993:19) two generic groups of financial intermediaries can be identified within the financial system namely, claim-issuing institutions and non-claim-issuing institutions. Claim-issuing institutions issue their own claims or securities to savers or surplus units. Non-claim-issuing institutions are for example the money brokers conducting direct financing activities and who receive commissions for matching individual savers and deficit units who do not issue claims against themselves.

According to Kelly (1993:19-20) the claims issued by claim-issuing intermediaries, in specific banks, are in the form of:

- Indirect Claims: According to Stigum and Branch (1983:17) indirect securities typically represent the indirect claims issued by the intermediary against themselves when acquiring the deposit from a surplus economic unit. Banks as a financial intermediary solicits and obtains the surplus funds from surplus units by offering a claim against itself in exchange for the funds deposited with the bank. Kelly (1993:19) explains that when a surplus unit invests funds with an intermediary, the surplus unit acquires an asset from the intermediary in the form of a financial claim. This financial claim represents and replaces the surplus unit's previously uninvested cash. Financial intermediaries therefore obtain funds whereby they purchase direct claims by issuing indirect claims against themselves. Faure *et al.* (1991:3) states that banks, by issuing indirect claims against themselves, acquire funds from depositors and in the process assist in resolving the conflict between surplus and deficit economic units in terms of their required risk, return and term requirements.

  Stigum and Branch (1983:18) state that these indirect claims or indirect securities are for example, demand deposits, time deposits, money market and mutual fund shares and the cash value of insurance policies. In addition, (Kelly, 1993:20) state that indirect securities/claims include current accounts, savings accounts and call accounts, fixed deposits, certificates of deposit, life and other insurance policies, pension fund contribution benefits, retirement annuities, and units in unit trusts.

- Direct Claims: According to Kelly (1993:20) claims issued by households, organisations, businesses and government and its public enterprises against themselves, are all debt and equity securities. These include financial instruments such as mortgages, asset backed instalment sale and lease/rental agreements, shares, debentures, promissory notes, bills of exchange, bankers' acceptances, negotiable certificates of deposit (NCDs), Treasury bills, annuities, and corporate and government bonds. Indirect claims are the assets of surplus units and the liabilities of financial intermediaries. Conversely, the direct claims a financial intermediary purchase represents its assets and the liabilities of the deficit unit. (Kelly, 1993:20). This is also discussed by Faure *et al.* (1991:3) and confirmed by Stigum and Branch (1983:18), stating that primary securities acquired by financial intermediaries from deficit units represent their direct claims in the financial system.

Faure *et al.* (1991:3) state that certain benefits are produced to the economic system through the financial intermediation activities performed by, for example, banks. These benefits are mainly achieved in that banks convert unacceptable claims on borrowers (by lenders) into acceptable claims on themselves. According to Kelly (1993:32) the advantages derived from financial institutions' intermediation function can be summarised by segregating between the advantages for surplus units and those for deficit units. The advantages for surplus units or lenders/depositors are:

- Giarla (1991:16) explains that loans are often required for differing periods than what surplus units are willing to provide funds. Banks bridge this gap by providing financial products that satisfy the requirements of depositors in terms of their liquidity requirements. Kelly (1993:32) explains that the indirect claims issued by financial institutions have a wider range of maturities than the maturities for which direct securities are typically issued. This is confirmed by Stigum and Branch (1983:19) explaining that financial intermediation allow the pooling of funds which enables a continuous supply of funds which can be lent out for longer periods than that required by depositors.

- Financial intermediaries accept funds for periods as short as one day, or for as long as many years.

- Indirect securities are available in many denominations. Stigum and Branch (1983:19) confirms this argument stating that financial intermediation bridge the requirements of minimum denominations from surplus units to the requirements of deficit units by issuing indirect claims.

- The saver can transact very small amounts with a financial intermediary whereas this would not be practical in transacting directly with a deficit unit such as a business. Faure *et al.* (1991:3) adds that intermediation allows that small amounts of funds can be packaged in larger volumes and lent to deficit units, thereby creating liquidity for the lender.

- Claims issued by financial intermediaries have less risk of default. Faure *et al.* (1991:3) states that by investing in a diverse portfolio of primary securities greater risk diversification is achieved than what would be available to an individual lender. Kelly (1993:32) states that financial intermediaries are able to reduce risk by investing the funds received from many savers or surplus units in a wide range of different securities. Diversification reduces overall risk in an efficient manner. A bank may loan funds to various borrowers. This reduces the risk or loss at default of one bad loan in a portfolio of various loans than when compared to the risk of an individual saver, which is fully exposed to lending a substantial amount of its savings to a single borrower. Such diversification efficiency is only readily available to financial institutions by being able to reduce the risks associated to lending activities by spreading funds over many loans (Kelly, 1993:32). Stigum and Branch (1983:19) stating that some risks are attached to primary securities or direct claims which most surplus units are not willing to bear. Giarla (1991:16) states that through diversification and the application of expertise in the field of for example, credit risk assessment, banks can attract the deposits of surplus units by making the requirements of deficit units more acceptable.

- Faure *et al.* (1991:3) further explains that by providing liquidity and risk diversification through intermediation activities, lenders have the opportunity to invest surplus funds which would otherwise not have been possible. Giarla (1991:16) agrees, arguing that intermediation decouples the funding and investment decisions of non-financial economic units which enables funds to flow into investments across the economy in a beneficial manner.

According to Kelly (1993:34) deficit units in the economy may gain the following advantages due to the intermediation activities performed by financial institutions:

- A wider range of maturities are offered. Institutions are able to obtain claims from deficit units in a wider range of maturities than that available to individual savers or investors. Institutions make loans for as short a period as overnight, or for as long as many years. In addition, Giarla (1991:16) argues that various interest rates are also offered i.e. fixed and variable interest rates whichever may suit the demand of the bank's clients.

- Larger amounts. Institutions can also obtain claims in larger amounts than individuals typically can, owing to their pooled funds.

- Safety. The intermediation process of financial institutions enables individuals to invest and businesses to borrow safely, and the overall borrowing/lending process of the system to function smoothly. Faure *et al.* (1991:3) explains that banks allow the transfer of funds between surplus and deficit units in a safe and secure manner.

- Disparity between income and expenditure. By facilitating the availability of funds, financial institutions overcome to a large extent the disparity between regular income and essential expenditure. This makes it possible for consumers to spend relatively large amounts on durable goods and for businesses to acquire capital while repaying the credit from future income. Faure *et al.* (1991:3) explains that income received by economic units is often insufficient to cover consumption expenditure or capital expenditure. Stigum and Branch (1983:14) concurs stating that economic expansion requires additional funds which are not always fully supplied by internal revenues. Financial intermediation has the ability to provide the funds required by deficit units.

- Range of denominations. Intermediaries offer savers a wide range of denominations. A single Rand or one-million Rand can be invested. There is also a large variety of maturities and returns. For example, investments can be made in savings accounts with low yields but the funds are available in full on demand. Conversely, the surplus unit may invest in time deposits in which yields are higher but where the funds are required to remain on deposit for a given period such as six months, or longer.

- Economies of scale. The pooling of funds allows certain administrative economies of scale in that it is less costly to administer one R 10 million loan than it is to administer ten R 1 million loans.

- Liquidity. Finally, instruments acquired from financial institutions may be converted into cash with little or no loss. Financial institutions, through their expertise, contribute to the optimum allocation of funds from surplus units amongst deficit units. Therefore financial institutions has the ability to attract savings that otherwise would not have been accessible to deficit units (Kelly, 1993:34). According to Faure *et al.* (1991:3) and confirmed by Giarla (1991:16) deficit units that has access to surplus unit's funds are given the comfort of liquidity offered by banks to the depositors of funds.

According to Stigum and Branch (1983:20) banks are very important financial intermediaries in the financial system in that banks facilitates the efficient flow of funds between surplus and deficit economic units. Cull (2005:72) explains that banks play an important role in both the financial system and the economy of a country. Banks allocate funds from savers to borrowers, provide specialized financial services and reduce the cost of obtaining information about both savings and borrowing opportunities and are therefore a key component of the financial system. ABSA (1992:22) argues that banks are the custodians of the general public's money. Funds are accepted mainly in the form of deposits and banks will pay out these accepted funds on their clients' instructions. Banks therefore accept deposits and make available credit through lending activities to various sectors of the economy. Banks also provide payment and clearing facilities, provide foreign exchange as authorised currency dealer and offer trading activities in the money market, capital market and derivative market. Cull (2005:72) states that the conducting of financial services by banks to their clients contributes to improving the overall efficiency of the economy.

Stigum and Branch (1983:20) state that banks are by far the largest financial intermediary and receive large quantities of funds in the form of deposits which they use to make loans to its customers (deficit units). Banks through their lending activities also create new money in that deposits are lend to borrowers which in turn deposits the funds with a bank or make a payment to a third party which deposits the funds with a bank. According to Kelly (1993:14) economic growth is accompanied by the growth in the stock of money. What is notable is that 'new' money enters into circulation as the economy grows. Bank credit i.e. borrowing from banks, is

the most notable source of new money in the economy. Kelly (1993:14) states that credit enables businesses and consumers to finance growth in production and consumption. Bank credit is simply instant new money.

By providing credit to borrowers from funds received from depositors banks perform an important intermediation function in the financial system. This dictates that the failure of a bank will result in losses not only to shareholders but most importantly to depositors. The RBA (2008) state that a stable financial system requires that financial intermediaries, markets and market infrastructure establish a smooth flow of funds between surplus and deficit economic units. Financial system instability is any material disruption to the intermediation process and may have severe implications on the economy. The safeguarding of the financial system and financial stability is therefore paramount and require identifying vulnerabilities in advance and taking mitigating actions if possible. The BCBS (2006**a**:2) states that weakness in the banking system may threaten the stability of a country's financial system. The APRA (2001:2) argues that bank supervisory and regulatory authorities are concerned with this role of being the watchdog over banks' activities given their intermediation role and its impact on the financial system. In addition, the APRA (2001:2) states that the objectives of prudential bank supervision and regulation are to ensure institutional and financial system-wide safety and stability.

Falkena *et al.* (2001:2) notes that the term financial regulation is used most often in a generic sense that encompasses regulation (the establishment of specific rules of behaviour), monitoring (observing whether the rules are obeyed), supervision (the more general behaviour of financial firms) and enforcement (ensuring the rules are obeyed). According to Falkena *et al.* (2001:2) the general philosophy with the regulation of financial markets implies that the regulatory authorities and the regulated parties both have an interest in the creation and maintenance of an effective and efficient regulatory system.

It is acknowledged by the BCBS (2006**a**:2) that any weakness in the banking system of a developed or developing country can threaten the stability of the financial system both domestically and/or internationally. The Basel Core Principles comprises of 25 principles that are deemed necessary to ensure that a financial supervision system is effective (BCBS, 2006**b**:2-5). In specific, Principle 7 relating to the risk management process dictates that comprehensive risk management processes must be in place to satisfy supervisors that all material risk exposures are identified, evaluated, monitored and controlled in order to mitigate these risk exposures. The capital adequacy (the available capital to cover unexpected losses) of a bank

must be assessed in terms of these risk exposures (BCBS, 2006**b**:3). This principle is enforced by the revised Framework of the BCBS (2006**b**:2) stating that it instils risk-sensitive capital requirements based on the internal risk-management systems and processes of banks. This will further ensure the adoption of stronger risk management practices by the banking industry. This is also confirmed by the legislation governing banks in South Africa. The Regulations relating to Banks as re-enacted and amended from time to time under section 90 of the Banks Act 1990 (SA, 1990:96), provides under Regulation 1, for the establishment of basic principles to the maintenance of effective risk management by banks and controlling companies (SA, 2008:8). The SARB Regulations therefore instructs that specific risk information and information regarding the financial health of a bank must be reported to the SARB. This dictates that all necessary risk management processes and board approved policies and procedures must be in place to identify, measure, monitor, control and report amongst others, the risks referred to in Regulation 39(3) (SA, 2008:661).

Kelly (1993:303) argues that the general concept that banks are the managers of risk applies, given that risk taking is inherent to the business of banks. The role that risk-taking plays in banking is probably more than in any other industry. The business of banking is primarily one of credit, in which the continual trust and confidence of the public is essential. This argument by Kelly (1993:303) is confirmed by the BCBS (2006**a**:2) explaining that the participants in the financial system therefore requires the official surveillance over a system in which credit and credibility are the binding factors. Although the banking sector may be just one part in the overall financial system, the failure of only one bank may cause disruption to the entire financial system (BCBS, 2006**b**:2; Kelly, 1993:303).

According to the BCBS (2006**a**:2) weakness in the banking system of a country may threaten the financial system stability both domestically and internationally. Therefore, banks form an integral part in contributing to the stability of a country's financial system. Effective bank supervision will contribute to strengthening financial system stability (BCBS, 2006**b**:2). According to Falkena *et al.* (2001:11) given the important role that banks perform in the financial system it is of the utmost importance that banks manage their profitability and the risks associated to their profitability optimally. The RBA (2008) argues that bank failures may have catastrophic results for a country's economy and financial system. This dictates that banks' management must ensure that it manages its risks effectively. The SARB (2008) agrees in that banks must ensure that their profitability is not adversely affected by the risks they endeavour to

such an extent that it renders the bank unfit (unprofitable) as a going concern. The failure of a bank will adversely affect the stability of the financial system.

According to Kelly (1993:304), supervision should aim at ensuring a climate of long-term profitability for banks. The compliance to any legal requirements alone will not guarantee the financial soundness of banks. The BCBS (2006**a**:5) argues that effective banking supervision should foster overall financial stability but can not guarantee stability or prevent bank failures. Bank supervision therefore can not provide assurance against bank failures. Ultimately the soundness of the banks is the responsibility of the management of such institutions. According to Kelly (1993:304) the SARB supervision can only promote better management, especially of the risks inherent to the business of banking. Successful and sound banking requires that the management of banks adequately manage and control the various risks. This is confirmed by ABSA (1992:32) arguing that various risks are the result of the amalgamation of banking activities. This requires that risks are managed on a prudent and efficient manner.

Banks are exposed to various risks as a result of their financial intermediation activities during which they transform the unacceptable risk and return requirements of surplus units into acceptable terms for deficit units. According to Cade (1997:5) the business of banking implies that risks are taken from which a better or worse result can be achieved. The fundamental aspect of risk taking is that the existence of risk does not imply a loss and therefore dictates that if risk is managed losses may be limited or profits can be increased. Bessis (1998:16) states that a risk-reward trade-off exists in the business of banking and that increased risk should be accompanied by higher reward. However, increased risk also dictates the probability of increased losses. It is argued by Uyemura and Van Deventer (1993:3) that it is critical in the examination of the risk-reward trade-off that the risk involved and the reward associated with such risk must be measured. Ong (1998:13) agrees stating that risk and reward measures must be integrated. Therefore, the risk-reward trade-off measurement is intertwined based on the measurement of risk and the associated reward. In order to assess potential investment, loan and deposit opportunities the bank must assess its reward/return based on the risks associated to such activities.

It is therefore argued that banks are exposed to varied risks and that in order to manage the profitability of the bank; the risks must be identified, measured and controlled in reflection of the risks' impact on profitability. Bessis (1998:5) states that banks are exposed to financial risks

i.e. credit risk, interest rate risk, liquidity risk; market risk, foreign exchange risk and solvency risk. These risks are the primary banking risks but banks are also exposed to operational risk, compliance risk and strategic risk as noted by Sadgrove (2005:20). It is therefore required that risks are managed as part of the risk control perspective to dealing with risks.

Culp (2001:209) argues that effective internal risk management processes will directly and indirectly unlock shareholder value in that alternative product and business opportunities can be identified with significant efficiency gains, innovation and growth. According to Culp (2001:209) this implies that the risk management process assist the bank to optimally manage its business activities, thereby increasing its profitability and therefore directly contributing to creating wealth for its shareholders. Stott and Watson (1992:16-17) state that this requires that banks must constantly measure their performance and profitability especially given that competitive pressures and market volatility continuously impacts its bottom line. The management of the bank must ensure that the available resources of the bank are applied and allocated optimally. This can be achieved by a performance measurement and risk management process that provides information to management from which optimal profitability and risk orientated strategies are developed.

Weiner (1999:2) argues that the role of performance measurement is to supply management with the necessary information on which to base its decisions and the bank's business strategy. Conventional accounting measures such as net income, asset growth, return on assets (ROA) and return on equity (ROE) does not explain much about the risk-reward trade-off, that is, how risks contribute to profitability (Stott & Watson, 1992:16-17). Ong (1998:14) stress that in order to measure the performance of the bank's products or business lines it must be done from a comparable (risk) basis. This dictates that profitability must be measured based on the risks associated to generating the return. According to Ong (1998:14) the profitability must be measured on a risk-adjusted basis. This is known as a risk-adjusted performance measurement (RAPM) process and the measure of risk-adjusted return on capital (RAROC) is the typical measure of risk-adjusted performance.

According to Ong (1998:14) and confirmed by Haubenstock and Aggarwal (1997:179), measuring the risk-adjusted net interest margin (NIM) requires the use of a funds transfer pricing system. According to Weiner (2000**b**:15) the funds transfer pricing system enables the measurement of the funding spread and lending spread, but also the mismatch spread

representing the effects of interest rate risk (IRR) on the NIM. The ALM process is particularly concerned with and responsible for managing the NIM and in specific IRR. Managing the IRR of the bank requires that ALM effectively identify and measure the effects of IRR. This is also advocated by the BCBS (2006**a**:4) supervisory Principle 16 relating to interest rate risk in the banking book. Principle 16 dictates that supervisors must be satisfied with banks' systems in place to identify, measure, monitor and control interest rate risk in the banking book. Supervisors must also ensure that a Board approved strategy is implemented by senior management of the bank which are appropriate for the size and complexity of the bank (BCBS, 2006**b**:4). The management of IRR is dictated by bank supervisors and from the risk-reward trade-off perspective in that it has to be incorporated in the RAPM process and the risk management process of the bank (BCBS, 2006**b**:4; Haubenstock and Aggarwal, 1997:179).

According to the BCBS (2004:5) the identification of IRR requires that the sources of IRR are defined. The sources of IRR is a result of mismatch/repricing risk within the balance sheet which indicates a timing difference between the price changes of assets and liabilities. Basis risk, yield curve risk and option risk are also sources of IRR. According to the OCC (1998:8) repricing risk is often the most apparent source of IRR. The effects of IRR are measured primarily in terms of the earnings perspective and the economic value perspectives (BCBS, 2004:5-7). According to the OCC (1998:10) various methods are available to measure the effects of IRR. IRR measurement techniques attempt to measure the effects of IRR on the reported earnings and book capital of the bank. The differentiating factor between the IRR measurement techniques is their respective abilities to accurately quantify the earnings and economic value perspectives of IRR. The techniques for measuring IRR are:

- Gap analysis
- Duration analysis
- Simulation models

According to the BCBS (2004:14-15) each of these IRR measurement techniques are a refinement in the previous techniques ability to measure the earnings and economic value effects of IRR. According to the BCBS (2004:30) simulation techniques applied in the assessment of IRR can be seen as an extension and refinement of the more simplistic IRR analysis options such as gap and duration analysis. Thus, simulation models are the most effective IRR measurement technique to accurately quantify the earnings and economic value effects of IRR. According to the OCC (1998:54) and confirmed by Gavin (2001:61) simulation models enables

the application of static and dynamic analyses in that the current balance sheet and future endogenous and exogenous assumptions are included to forecast the effects of IRR. It is argued by Matz (2005) that enabled by this ability of simulations models to forecast future balance sheets and income statements, the earnings and economic value effects are captured respectively by conducting earnings-at-risk (EAR) and economic value of equity (EVE) analyses.

According to the BCBS (2004:6) IRR affects both the short-term accounting earnings and the long term economic value of a bank. Shareholders are significantly focused on the receipt of dividends based on the bank's financial performance. Reduced earnings or profitability due to interest rate fluctuations can threaten the financial stability of a bank. Given the importance of meeting profitability targets and the impact that IRR may have on the profitability of a bank, it requires that the contribution of IRR to the NIM are measured. Weiner (2000**b**:15) states that in order to incorporate performance measurement results in IRR management and strategy formulation of the bank requires the utilisation of a funds transfer pricing (FTP) system to quantify the risk-adjusted NIM and to transfer the IRR contribution of the NIM to the ALM unit. According to Weiner (1999:56) the FTP system is therefore an integral part to the management of IRR and provides the critical link between the overall performance/profitability measurement of products and business units and the ALM IRR policy of the bank.

Hodnett (2000:38) explains that various methods of FTP are available to a bank, such as the single pool method, the double pool method, the defined-spread method and the matched-term FTP (MTFTP) method. Hodnett (2000:39) and Weiner (1999:54) argue that these methods range from very simplistic and easy to implement to very data intensive and more complex. The main differentiating factor between these methods is their accuracy in isolating and transferring mismatch spread or IRR effects to the central funding unit (CFU). According to IPS-Sendero (2006**c**:24) the MTFTP method is the most accurate FTP method to apply when the CFU concept is applied which dictates the broader objectives of the Asset/Liability Committee's (ALCO) IRR management strategy that a dedicated unit is responsible for managing the IRR/mismatch profitability under the directives of the ALM function. IPS-Sendero (2006**c**:24) states that the MTFTP results most accurately measure the risk-adjusted NIM contribution of products and business units for the RAPM process. Furthermore, it has the ability to transfer the mismatch/IRR component of the NIM to the CFU and therefore isolate the business units from the effects of IRR in their performance measurement.

According to Haubenstock and Aggarwal (1997:186) the RAPM process assists bank management to make better pricing, strategy and business decisions to drive shareholder value through objectives to increase profitability. The input to the simulations models in ALM to quantify IRR should therefore be based on the strategies and pricing decisions formulated on the RAPM results. Haubenstock and Aggarwal (1997:175) argues that by incorporating the risk-adjusted profitability analysis and therefore the MTFTP results in the ALM IRR management process, the evolutionary step from conventional risk control to risk optimisation can be achieved. According to McGuire (1997:66) the integrated FTP (RAPM) and IRR management process enables the bank management to use risk information to develop strategies that best determines which risks and at what levels of risk to engage that will deliver the highest return to shareholders. According to Weiner (1999:56) the FTP process links the profitability measurement and ALM IRR management efforts of a bank. IRR management can therefore be integrated with business strategies which aim at delivering above average shareholder returns.

1.3 PROBLEM STATEMENT

The shareholders in a bank require optimal return on their investment. This dictates that bank management must continuously ensure that the bank's resources are optimally utilised from a profitability perspective. The intermediation function performed by banks exposes them to a risk-reward trade-off given that by taking risks banks generate profits but also potential losses. Therefore, a bank must manage its risks to avoid losses but also to optimise its returns. In assessing potential profitable opportunities for the bank by making loans and taking deposits, a bank's management must ensure that profits are assessed from a risk-adjusted basis. The ALM process of a bank is concerned primarily with the management of IRR and liquidity risk. Given that changes to interest rates (resulting in IRR) may have a severe impact on profitability it is a fundamental focus area of risk management for which the ALCO through the ALM function are responsible. Therefore, in assessing the impact of IRR on both historic profitability and future exposures a process must be established that assesses both the risk and return profile pertaining to IRR for the bank. This edict the integration of IRR management in the ALM and performance measurement processes in order to establish a process of IRR optimisation. A process of risk optimisation will ensure that optimal strategies are formulated based on information that incorporate the risk and associated reward on a consistent and comparable basis.

The research question, derived from the above problem statement, is:

"What processes and/or methodologies can be applied to link and integrate performance measurement and interest rate risk management in ALM, in order to supply the information required to develop strategies that will optimise a bank's risk-reward trade-off?"

1.4 OBJECTIVES OF THE STUDY

In order to address the research question stated in section 1.3, the following investigative questions need to be answered:

- What is the risk-reward trade-off and why manage risks in banks?
- What is bank performance measurement?
- Why must risk be integrated in performance measurement?
- In order to manage IRR how is IRR measured in ALM?
- How can FTP be applied to measure the risk-adjusted NIM and transfer all mismatch spread to the CFU?
- How can the information from the FTP process be applied in the ALM risk measurement process?

The above will be answered in the context of providing the reader with an overview pertaining to the areas of ALM and performance/profitability measurement, with specific reference to IRR. This will elucidate the facilitation of a risk optimisation approach by integrating ALM and performance measurement. A practical ALM simulation model and FTP system will be used to demonstrate the quantification of IRR under the various IRR measurement methods and the MTFTP process as a RAPM component.

1.5 RESEARCH METHODOLOGY

The dissertation's research is primarily based on a literature study. Topical literature are sourced from published books, industry newsletters and electronic/internet articles. An empirical study is also performed and presented to provide a practical application of the research conducted in the literature study. The empirical study utilises the application of the IPS-Sendero SVAL and FTP software to provide supportive examples of the various IRR measurement techniques and the

FTP analytics (Matched-Term Funds Transfer Pricing) in calculating a risk-adjusted NIM, as presented in the literature study.

1.6 DISSERTATION OUTLINE

Banks are managers of risks and therefore derive a considerable part of their profits from risk-taking activities. The role that banks play as financial intermediaries in the financial system dictates that through them assuming direct and indirect claims (their assets and liabilities), the risk and return requirements of surplus and deficit economic units are converged onto the bank. This was discussed as part of the background to this dissertation in section 1.2.
Therefore, in order to manage its profitability a bank must manage the risks, and in specific the IRR it endeavours. In defining the business strategies for a bank, most often the financial outcomes are projected, from which the strategies with the highest return are assumed to be the most profitable. Strategies formulated in this manner ignore the potential impact of risk. Conventional risk management focuses on controlling risks. By integrating the impact of risk in the measurement of profitability and applying such information in the risk management process, strategies are formulated with due consideration for the bank's risk and profitability. This evolves the risk management process to become a risk optimisation process. ALM is tasked with managing IRR and by isolating and managing the profits attributable to IRR, and applying balance sheet and pricing strategies based on risk-adjusted information, an optimal IRR management process can be instilled through the ALM function of a bank. This dissertation examines the performance measurement and ALM IRR management processes and methodologies to elucidate how a process of overall risk optimisation and in specific IRR optimisation can be established. The remainder of this dissertation is structured as follows:

Chapter 2 examines the risk-reward trade-off that banks face in order to elucidate the origin of banking risks. The importance of managing banking risks are derived from the existence of the risk-reward trade-off and therefore requires the identification of the primary banking risks and further discussion around the process of risk management.

The terms, performance and profitability, should be read as being tantamount within this dissertation. The importance of performance measurement is presented in chapter 3. The shortcomings of conventional accounting-based performance measures such as ROA and ROE, net income, budget comparisons and cost-accounting perspectives are discussed. These

measures of profitability are inadequate mainly due to that they do not provide a comparative measure of profitability given the risks assumed for the product, customer or business unit being measured. The need for risk-adjusted profitability analysis is presented through the adoption of a RAPM process. The quantification of expected losses and unexpected losses from which the allocation of capital is derived for the RAPM process, are not examined by this dissertation. The utilisation of a FTP system and the risk management systems of a bank are identified as critical components available to direct management objectives and strategies. The FTP system is primarily used to risk-adjust the NIM of the bank in calculating the risk-adjusted return within the RAPM process. The FTP system is also presented as having the ability to isolate business units from IRR in their performance measurement results by transferring all IRR to the ALM unit which are responsible for managing IRR.

Chapter 4 examines the role of ALM in banks and focus primarily on the management of IRR. The rationale of ALM is discussed to elucidate the primary focus area of ALM, namely the management of IRR. It is acknowledged that the management of liquidity risk is also a fundamental focus area and responsibility of ALM, but demands a separate and dedicated research attempt in order to do the topic of liquidity risk justice. This dissertation is limited to primarily IRR as far as performance measurement/FTP and ALM is concerned.
A detailed definition of IRR is presented in terms of the sources and the perspectives to the effects of IRR. The sources of IRR namely, reprice risk, yield curve risk, basis risk and option risk are discussed. The earnings and economic value perspective to the effects of IRR on a bank is discussed to highlight that any IRR measurement technique must have as objective to assess IRR from both perspectives. The basic IRR measurement techniques of gap analysis and duration analysis are mentioned, which are typical static measures of IRR available to ALM. Simulation modelling as an advanced and dynamic approach to measuring IRR is also identified in analysing the earnings and economic value effects of IRR. The techniques for measuring IRR are discussed in chapter 5.

Chapter 5 discuss the IRR measures commonly applied by banks to assess the exposure of their balance sheets to the effects of IRR. Repricing gap analysis is presented as the most common and basic assessment of IRR. Duration analysis is discussed as an alternative IRR measurement technique to Gap analysis that has the ability to better capture the economic value effect of IRR. Resulting from an attempt to alleviate the shortcomings of both gap and duration analysis a background to simulation modelling as a measure of IRR is also presented in chapter 5. The

application of EAR and EVE analyses as measures of the earnings and economic value perspectives of IRR provided by simulation modelling are examined. The EAR analyses attempts to provide a quantum on the near-term sensitivity of the bank's balance sheet to IRR. The basic methodologies in assessing IRR through the EAR analyses are discussed which include the forecast of balance sheet assumptions and interest rates. Various interest rate scenarios and parallel interest rate shocks/movements are presented to derive the sensitivity of earnings to IRR. EVE analyses gauge the long-term effects of IRR on the bank. The calculation methodologies to EVE analyses are discussed to elucidate the evaluation of the economic value effect of IRR on a bank.

Managing the IRR through the ALM function of a bank therefore attempts to quantify/measure the effects of IRR. This dictates that the contribution of IRR to the NIM of the bank is the responsibility of the ALM unit. The RAPM process through the FTP mechanism are therefore an ideal tool to allocate the IRR profits to the ALM unit but also to sensitise the business units of the bank to the ALM (IRR) policy.

The FTP process is a critical component of the RAPM process. The concept of FTP is discussed in chapter 6. Various methodologies are available to implement a FTP system. The application of a FTP system that attempts to solve the measurement problem of creating a comparable measure of performance/profitability of a bank's various units requires the introduction of the CFU concept. The MTFTP method are identified as the FTP method that optimally isolate and transfer the mismatch (IRR) spread from the measured products, customers or business units and thereby most accurately quantify their risk-adjusted profitability (NIM). This allows that only the controllable risks' profitability contribution for which the business unit are responsible for managing are assessed within the performance measurement process. The risk-adjusted profitability information from the MTFTP process is therefore applied in the RAPM process to formulate business and pricing strategies. By setting the MTFTP methodology and market-based yield curve derived transfer rates the ALM unit can sensitise the business units to the ALM (IRR) policies of the bank. The formulated strategies and pricing information can be applied back to the ALM simulation model as input in quantifying the IRR exposure for the bank.

Chapter 7 presents an empirical study which focus on applying the various IRR measurement techniques to a practical simulation model based on the balance sheet data for Typical Bank. The effects of non-maturity deposits are discussed highlighting the importance of assumption formulation for accounts with an indeterminate repricing and maturity profile. This is presented

as part of the gap analysis performed on Typical Bank. The IRR for Typical Bank is also assessed in terms of duration analysis presenting the enhancements and shortcomings of each method pertaining to quantifying Typical Bank's exposure to IRR. Dynamic simulation analyses in terms of EAR and EVE analyses are presented as the most effective measures of IRR from both the earnings and economic value perspectives. The effects of prepayments or customer options and liquidity risk are not explored given the technical nature of these considerations that warrants a dedicated study on these topics. The profitability measurement pertaining to the NIM of Typical Bank and segregated Corporate Division and Retail Division are presented in the FTP discussion of the empirical study. The MTFTP results are presented highlighting the risk-adjusted NIM for Typical Bank's business units and the products of the balance sheet. It is argued that this information is applied in the formulation of business and pricing strategies (as part of the broader RAPM process) which is applied back to the simulation model as input in quantifying Typical Bank's IRR exposures.

A summary of this study and the findings of the research conclude the thesis in chapter 8, followed by a list of references used in the text.

1.7 CONCLUDING REMARKS

This chapter described the background to the dissertation explaining that banks facilitate a process of financial intermediation in the financial system, and by doing so assume various risks from which their profit is originated. The background to the dissertation presented a foundation for understanding the origin of assumed risks in banking and that profitability is correlated to the risks taken. This is fundamental in elucidating the role of performance measurement and IRR management by the ALM function of a bank. From this background the research question was put forward primarily with a focus on IRR management within the ambit of risk-adjusted performance measurement and ALM. This chapter also provided the objectives of the research and the research methodology applied in this dissertation. The chapter concludes with an explanation of the structure of the dissertation demarcating the focus areas.

Chapter 2 discusses the risk-reward trade-off that banks face to elucidate the importance that a banks profits originates from the risks it endeavours. The primary banking risks are identified and a general perspective to risk management is assessed.

CHAPTER 2

RISKS AND RISK MANAGEMENT IN BANKS

2.1 INTRODUCTION

In chapter 1 as part of the background to this thesis, the financial system was discussed in terms of a bank's role as a financial intermediary. This elucidated the business of banks as a financial institution operating in the financial system, fulfilling the intermediation function between the needs of surplus and deficit economic units. In this process of financial intermediation banks convert the incompatible needs of surplus and deficit units into financial assets and liabilities. This is achieved by issuing claims on themselves and bridging the gap between investable funds of surplus units and the funding needs of deficit units. Through the process of indirect financing or financial intermediation banks transform the risk profiles of deficit and surplus units into contracts with terms acceptable to both parties.

Chapter 1 also discussed the significance of financial intermediation in an economic system and that it is important that banks are managed prudently in ensuring financial system stability. Bank supervisors and regulators focus their efforts on contributing and ensuring the health of the banking system. It was identified that financial regulation and supervision presents a strong motivation for conducting risk management. The continued profitability and prudent risk management of banks are critical in ensuring the stability of the banking system. Supervisory objectives are highlighted as contributing to ensuring financial system stability by ensuring banks are managed effectively by means of the appropriate risk management practices, oversight and regulatory requirements. However, these supervisory requirements and objectives do not guarantee that banks will not fail. The incessant profitable and solvent existence of the bank is the primary responsibility of bank's management themselves.

According to Giarla (1991:16-17) banks as a financial intermediary makes its money by supplying the products that satisfy its customers' needs. By intermediating between the required risk profile of surplus and deficit units the various risks are repackaged in financial products. The bank prices these products appropriately and diversifies whatever assumed risks it can. The remaining risks are either assumed or may be hedged. A bank therefore makes its money by assessing what loan and deposit products its customers want and then sets prices relative to the associated risks with such products. Stigum and Branch (1983:2) argues that banks gather funds,

substitute their credit for that of borrowers, assume interest rate risk (IRR) due to maturity transformation and other risks associated with the uncertainties they face. For performing these activities associated with financial intermediation, banks should expect to receive some reward. This reward is the source of a bank's profits. Koch and MacDonald (2000:120) argue that a bank's profitability may vary directly with the riskiness of its intermediation activities. Although some risks may be avoided others are inherent to the business of banking. This dictates that by increasing the risks the bank is exposed to may increase the profit but may also increase the probability of potential losses. According to Giarla (1991:17) the bank should therefore have knowledge of the risk and return characteristics of its assets and liabilities. Thereby decisions need to be made about the level of risk and its resultant profit. This requires that risks must be effectively quantified regarding the associated profits assumed. Risk management and risk-adjusted analysis can be applied to quantify the risks of each product. This will assist effective risk-based prices in order to optimise profits for a desired level of risk.

This chapter's objectives are:

- to explore the risk/reward trade-offs that banks face, elucidating the fact that risks contribute to the profitability of a bank resulting from its intermediation activities. This will be achieved by dissecting and discussing the components in the risk/reward trade-off namely risk and reward. This is discussed in section 2.2.
- to present the financial risks assumed by banks and the role of risk management in banking. The banking risks and risk management are discussed in section 2.3.

2.2 THE RISK/REWARD TRADE-OFF

Kelly (1993:33) explains that in the transformation of the financial needs between surplus and deficit units, the issuing of direct and indirect claims together with influences from exogenous market forces on the resultant position of the bank's business, leads to a risk/reward trade-off that the bank must manage. Part of the return that an investment generates is attributable to the risk premium earned which is affiliated to the overall riskiness of the investment. Diversification allows larger lenders such as banks to spread risk across their clients or borrowers and therefore may charge a lower risk premium within its interest charge to its borrowers than when compared with individual lenders.

Banks, through expertise and experience, may also be in a better position to assess the risks associated with borrowers than the individual surplus unit. Therefore, in general lower expected returns are associated with lower risks and high returns with high risks (Kelly, 1993:33). According to Giarla (1991:14) in order to justify taking more or higher levels of risks the associated increase in returns must balance the trade-off the bank face in its decision to pursue or reject business that reflect elevated levels of risk. Sadgrove (2005:13) states that the level of acceptable risk depends on the resultant reward. The best business opportunity is one where the risk is low and the reward is high. Business opportunities that have low risk and low reward are generally not worth pursuing. Similarly, where the risk is greater than the anticipated profit/reward the risk outweighs the potential gains and thus pursuing the business opportunity is inefficient. In addition, Giarla (1991:14) argues that the more negative potential consequences exist for any given action, the bigger and more generous the consequence of such action should be in order to justify such an action. Therefore the more risk is involved the bigger the reward must be to justify the action or investment for that matter.

The following section decomposes the basic elements behind the risk/reward trade-off in order to fully evaluate the importance of this concept being the underpinning to ALM and performance measurement for a financial institution.

2.2.1 RISK

Life in general is full of risks and risks are everywhere, according to Culp (2001:3). Most people have a sense for risk in whatever situation or circumstance it may manifest itself. The uncertainty of controllable and uncontrollable factors or events that lead to a degree of uncertainty is simply the materialisation of risk. By managing the risk involved some reasonable intermediate solutions can be adopted which is designed to reduce the risk without eliminating it completely (Culp, 2001:3).

According to Vaughan (1997:7) every field of knowledge has its own specialised terminology, and terms which has simple meanings in everyday usage but may take on different and complicated connotations when applied in a specialised field. This typically applies to the term risk. Culp (2001:15) states that risk is a concept rather than a statistical construct and that each definition of risk may vary with the perspective in which it is applied.

The basic concept of risk is defined by Culp (2001:14) as being the source of any randomness that may have an adverse impact on a person or a business. According to Vaughan (1997:8) risk is variously defined as:

- the chance of loss;
- the possibility of loss;
- uncertainty;
- the dispersion of actual from expected results;
- the probability of any outcome different from the one expected (Vaughan, 1997:8).

Sadgrove (2005:5) states that risk is the possibility that a hazard may cause loss or damage. However, according to Vaughan (1997:8) the two most common elements shared in current definitions of risk irrespective of the discipline in which it is defined, are indeterminacy and loss. These two elements of the definition of risk are discussed as follows:

- Vaughan (1997:8) states that in all definitions of risk the notion of an indeterminate outcome is implicit. When a risk exists there must be at least two potential outcomes. For instance, if it is known that a loss would definitely occur then there would be no risk. For example, with an investment in capital assets there is the realisation that the asset is subject to depreciation and therefore the value of the asset will decline. Here the outcome is certain and there is no risk. It is therefore implied that uncertainty is involved when assessing the potential outcomes. Sadgrove (2005:5) concurs arguing that risk presents a possibility of loss which dictates that the result of the existence of risk is uncertain. According to the IRM (2002:2) risk is the combination of the probability of an event and its consequences.

- At least one of the possible outcomes is undesirable. This may be a loss in the generally accepted sense where an individual will lose something he possesses. It may also mean that the gain from an investment is smaller than what was potentially possible. For example, an investor who fails to take advantage of a given opportunity 'loses' the gain he might have made (Vaughan, 1997:8). According to Sadgrove (2005:5) risk offers both opportunity or up-side and potential danger or down-side to the situation in which it manifests. According to the IRM (2002:2) all undertakings have the potential that the events and their respective consequences constitutes both opportunities for benefit (upside) or threat to success (downside).

For the purpose of defining risk in banking or financial terms, Vaughan (1997:8-9) defines risk as a condition of the real world in which there is an exposure to adversity. More specifically he explains that risk is a condition in which there is a possibility of an adverse deviation from a desired outcome that is expected or hoped for. In this definition of risk, note first that risk is a condition of the real world; it is a combination of circumstances in the external environment. Therefore in this combination of circumstances there is the possibility of loss. The fact that the outcome may be something other than what is hoped for constitutes the possibility of loss or risk.

Vaughan (1997:9) notes further that the term 'uncertainty' is often used in connection with the term 'risk'. The most widely held meaning of uncertainty refers to a state of mind characterised by doubt, based on a lack of knowledge about what may or may not happen in the future. Uncertainty is therefore a psychological reaction to the absence of knowledge about the future. The existence of risk is the condition or combination of circumstances in which there is a possibility of loss. When risk exists it creates the uncertainty within individuals when that risk is recognised.

It was noted by Culp (2001:16) that the concept of risk is dependent on the perspective applied to risk, when attempting to establish a definition of risk. Culp (2001:16-29) provides three different perspectives for how to conceptually define risk:

- Event-Driven definition of risk: Culp (2001:16) explains that this perspective defines risk differently based on the type of event that can result in a loss.

- Diversifiability perspective of risk: According to Culp (2001:26) this perspective differentiates between only two types of risk – the risk that a company can diversify or hedge and the risk that it cannot. Diversifiable or idiosyncratic risks are the risks that only affect a specific instrument or bundle of cash flows. Systematic risk in contrast refers to the changes in the values of assets and liabilities that are driven by the movement in some risk factors that affect all bundles of cash flows.

- Financial versus business risk perspective: Culp (2001:29) states that the third perspective on risk distinguishes between financial and business risk. Financial risks are

those risks that a firm is not in the business of bearing. Business risks are risks that the firm must assume in order to operate its primary business.

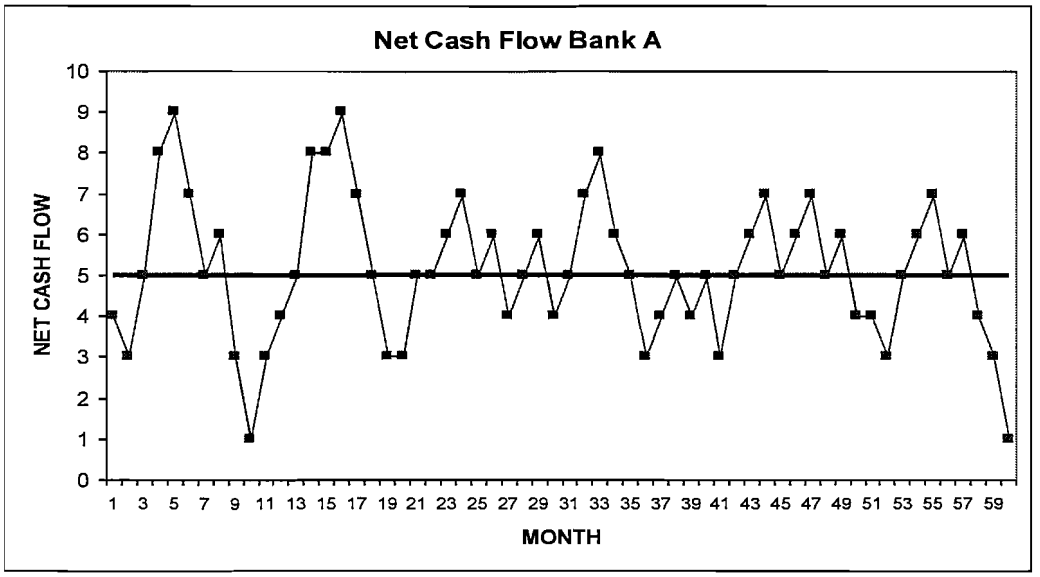
Another perspective to the definition of risk is given by Uyemura and Van Deventer (1993:13). Risk in any formal sense must reflect the concept of uncertainty. Risk is the volatility as measured by the standard deviation of the net cash flows of a business unit (Uyemura & Van Deventer, 1993:14). This definition iterates that risk is a factor of uncertainty. From this perspective it is noted that risk is a quantifiable probability of uncertainty. Furthermore, the net effect as a result from the uncertainty is quantifiable for the bearer of risk. This compliments the three perspectives in defining risk as explained by Culp (2001:16-29). These three risk definition perspectives of risk according to Uyemura and Van Deventer (1993:13-14) and Culp (2001:16-29) explores the ability to quantify the risk exposure given the potential quantification of alternative outcomes.

Vaughan (1997:10) explains in support of the views of Culp (2001:29) and Uyemura and Van Deventer (1993:14), that risk may be greater in some situations than in others. Some alternative outcomes may involve 'more risk' or 'less risk' than another. But how can this degree of risk be measured? The most commonly accepted meaning for 'degree of risk' would relate to the likelihood of occurrence. Intuitively events associated with a high probability of loss would be considered more risky than events with lower associated probability of loss. Payant (1999:458) argues that in assessing the severity of risk the standard deviation applied to the likelihood or probability of the risk occurring should be applied. Crouhy *et al.* (2001:187) agrees that risk assessment should incorporate the probability that the risk will manifest. Therefore, the degree of risk is measured by the probability of the adverse deviation from what is hoped for

Given that in the hope of the individual that no loss will occur, it means that the probability of a deviation from what is hoped for (which is a measure of risk) varies directly with the probability that a loss will occur. The probability linked to the deviation of the outcomes from what is hoped for is a measure of risk. According to Vaughan (1997:11) the deviation of the outcome hoped for can be reflected on in statistical terms of a standard measure of dispersion or also known as variance or standard deviation. In particular, when the standard deviation is used as a measure of dispersion from what is hoped for the risk is measurable and it can be established if more or less risk exists for a given situation (Vaughan, 1997:10-11).

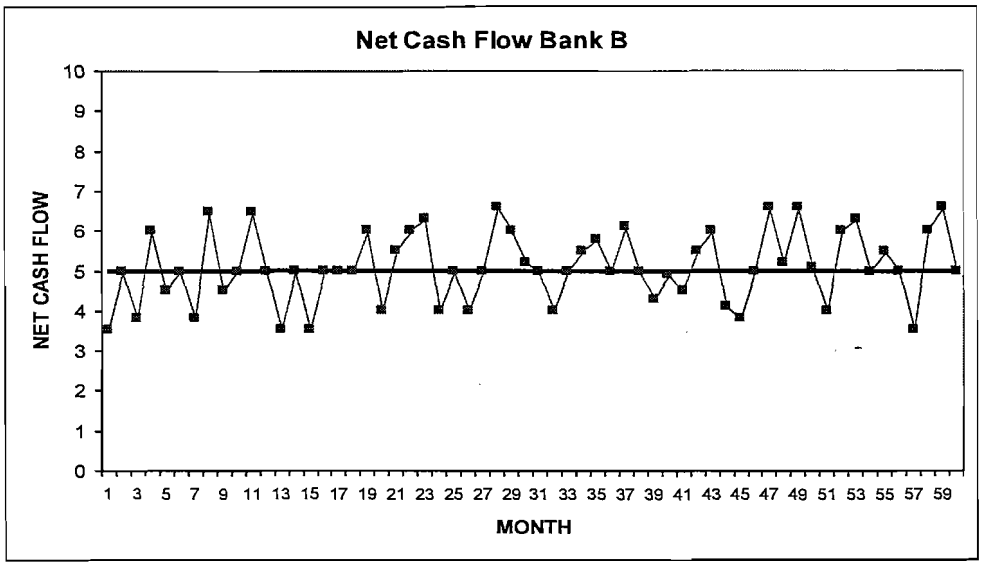
In support of the use of variance and standard deviation as a measure of risk as proposed by Vaughan (1997:11), Uyemura and Van Deventer (1993:14) explain the quantification of conceptual risk by using the statistical method of volatility. The uncertainty equivalence from a statistical perspective (volatility) is explained by a simple case study of two business units. The business units may be a product of a bank, two branches or even two different banks. The concept of volatility is illustrated by comparing two banks that have the same expected average cash flow over a long period. This may also apply to their average profitability for a period. The averages might be the same but the volatilities over time might be significantly different. This is illustrated in figure 2.1 and figure 2.2. According to Uyemura and Van Deventer (1993:15) it is clear from figure 2.1 and figure 2.2 that Bank A has a more risky attribute in its financial performance than compared to Bank B. The standard deviation of the net cash flows over a long period or business cycle is quantified in order to get a comprehensive analysis. Both banks have the same expected average cash flows over time but the extent of changes in each month's net cash flow for Bank A is more considerable than when compared with that of Bank B. The standard deviation of the net cash flows can therefore be described as each Bank's risk attribute or exposure (Uyemura & Van Deventer, 1993:15).

Figure 2.1 High volatility Bank A



Source: (Uyemura & Van Deventer, 1993:14)

Figure 2.2 Low volatility Bank B



Source: (Uyemura & Van Deventer, 1993:15)

Uyemura and Van Deventer (1993:17) argue that when the concept of volatility, standard deviation and risk is further conceptualised a more rigorous definition of risk can be compiled. Risk is the covariance matrix of returns with the market. This technical definition take account of the concept that markets only expect returns originating from the systematic or non-diversifiable risks, when compared to the full range of investment alternatives that is available in the market (Uyemura & Van Deventer, 1993:17). However, Cade (1997:2) argues that risk in banking can be simply defined as an exposure to uncertainty of the outcome. The exposure denotes a position or a stake in the outcome without which any interest in the position is merely academic. The outcome is the consequence of a particular course of action. The uncertainty concept can be reflected in the volatility of potential outcomes plotted on a probability distribution curve for which the normal measure of dispersion would be either the variance or standard deviation.

It is argued by Cade (1997:3) that the wider the standard deviation, the higher the volatility and therefore the greater the risk. The dispersion of values from the arithmetic mean is therefore associated with the potential outcomes and how far they are realised from the expected or anticipated outcome. However, if the deviation from the expected is the determinant of risk, and the volatility as encapsulated by standard deviation is an index of risk, it can be argued that irrespective of how ominous an expected outcome may be, it is not a risk (Cade, 1997:2-3).

This reaffirms the argument by Vaughan (1997:8) that the notion of risk must be based on the concept that it has an indeterminate outcome. It is easy to understand the appeal to use volatility or standard deviation as a definition of risk, given that such an established mathematical approach provides a quantified picture of risk and a basis for making decisions about the risk. Cade (1997:4) argues however that there are a number of objections to this. In the first place such a confident analysis of potential outcomes is only practical in applications where reliable historical databases are available such as in portfolio or trading environments. Payant (1999:460) agrees that historical observations are required about all the risk factors influencing the outcome. This also requires that the observations of the risk factors applied must be from markets that are liquid and readily accessible.

According to Cade (1997:4) the use of variance or standard deviation is secondly only valid as a measure of portfolio risk when the statistical skewness is not a problem. Matten (1996:131) agrees explaining that due to skewness of a distribution of outcomes may misstate the true riskiness of a measured unit. Thirdly, the statistical methodology is open to outright challenge on the ground that it implies that the past is a good resemblance of the future. Furthermore, the degree of reliance on historical volatilities cannot capture the pace of modern change. According to Crouhy *et al.* (2001:198) the historical observations of risk factors applied in the derivation of risk outcomes are based on the assumption that future movements in risk resembles historic observations.

The analysis of risk has now ability to incorporate assumptions of the future distribution of risk factors. Payant (1999:460) agrees that especially when financial risks are measured that multiple factors may drive the quantum of the risk outcome experienced in the future. The historic observations of for example price changes do not capture all aspects affecting risk. According to Cade (1997:4) the fourth argument is a direct objection to the usage of volatility as a definition of risk in that risk should not be confused with the means of measuring its dimensions. The concept of uncertainty is distinct from the statistical terms in which it is attempted to capture its extent. Therefore risk is not volatility per se but rather the uncertainty of the potential outcomes as reflected in its volatility pattern. This argument is applicable to typical historic Value-at-Risk (VaR) and stochastic or Monte Carlo methods of quantifying risk (Cade, 1997:4).

Culp (2001:5) explains that if the fact is recognised that risky changes can be beneficial and that passivity is avoided during a time of risk, it is acknowledge that something can be done about

risk. This action can leave the entity better off after the risk occurred than before it happened. This is indicative that if people operate in a way that is neither careless nor over-cautious to risk, their risk management actions basically avoid three basic common fallacies about risk. The three risk fallacies according to Culp (2001:6-10) are:

- Fallacy 1: Risk is always bad. According to Sadgrove (2005:5) risk can have a positive or negative result. Culp (2001:6) explains that risk has both up-side and down-side. Depending on the risk position of an entity it may either benefit or suffer from the manifestation of risk The IRM (2002:2) agrees that both positive and negative aspects exist to the exposure to risk.

- Fallacy 2: Some risks are so bad that they must be eliminated at all cost. Culp (2001:7-8) argues that risk must be evaluated in a probabilistic context and not merely in terms of the consequences. In the analysis of the risk, people must equate the benefit of the risk reduction with the cost associated with reducing the risk. According to Sadgrove (2005:5) any business entity that ignores the duality of risk runs may end up with attempting to obliterate the mere existence of any risk. Managing the risks to which an entity is exposed the costs associated with risk can be controlled. In addition, Culp (2001:8) adds that risk management must consider not just the benefit of reducing risk, but also the cost of risk reduction. It may be feasible to move from high risk to lower risk but it is hardly ever feasible to move to zero risk. According to Sadgrove (2005:14) the cost and benefit to mitigating the risk exposure of an entity must be analysed to assess the optimum position. In the end risk can not be completely eliminated at a reasonable cost and therefore requires not the elimination but the management of the risk.

- Fallacy 3: Playing it safe is the safest thing to do: According to Culp (2001:8) the risk-averse entity prefers certainty to uncertainty when the uncertainty involves an outcome that is worse than the outcome in the certainty case. However, playing it safe does not always yield the proper risk management solution, especially if incomplete information is available. The same principle can be applied to investment decisions and risk management for profit or stable earnings. Is more risk for higher reward good or bad (Culp, 2001:10)?

It can therefore be argued that if the risk involved in an action or decision is assessed and known to the risk-taker, then the reward associated with the risk is critical in determining if the reward is sufficient to warrant taking the risk. The quantification of the significance of the reward is therefore the balancing factor in the risk/reward trade-off.

2.2.2 REWARD

Koch and MacDonald (2000:114) state that the president or chairman of the bank's board is often asked to reflect on the performance of bank's activities. Shareholders are always interested in the reward on their investment in the bank. According to Uyemura and Van Deventer (1993:17) the concept of reward or more commonly referred to as return, is commonly associated by bankers with some standard measures of performance. Net income (NI) and net interest income (NII) targets, return on assets (ROA) or return on equity (ROE) are some of the most widely used concepts to value the performance achieved by the activities performed in a bank.

According to Matten (1996:141) the return generated by business activities should incorporate all income and costs. This is normally accounted for in the accounting processes of the organisation and communicated to shareholders. Koch and MacDonald (2000:94) state that the income statement of a bank is directly correlated to its business activities performed and reported on its balance sheet. Therefore, traditionally the income statement reflects the profitability of the bank's activities and is by default applied in measuring its reward. Each of these measures of return or reward has its own merits and also weaknesses. According to Uyemura and Van Deventer (1993:17) the perspective that needs to be taken on this definition of return is essentially twofold: decision-making (ex ante) and performance measurement (ex post). Therefore, the measure of reward or return must be able to be used as a tool when confronted with new business opportunities. This is to establish the feasibility and profitability of such opportunities, given the fact that all that is available is forecasted risks and returns.

Koch and MacDonald (2000:94) explains that NI, which represents the final income received after all expenses including taxes are paid, is the most common measure of reward or profitability. Koch and MacDonald (2000:104) also state that the NII, as the difference between the interest income and interest expense, are a main source of profit and varies over time when interest rates change. It is generally assumed that all proposed new business activities will show

positive expected earnings over the life of the activity. Uyemura and Van Deventer (1993:17) agree that if this simple concept did not hold true then the value proposition would never be considered. By using NI as a measure of reward, mostly all potential business opportunities would be accepted. This is attributable to the fact that net income, especially on an accounting basis tends to ignore or at least understate the risk consequences especially during the early stages of the activity.

According to Uyemura and Van Deventer (1993:18) ROA has traditionally been of considerable importance because of the banking industry's fixation with the asset levels of its balance sheet. By using the ratio of earnings or net income to total assets or ROA renders two problems. Firstly, some activities do not have assets as conventional balance sheet measures. These may include cash management, safe deposit box rentals, securities sales and trust services. Typical financial service therefore does not reflect any asset value on the bank's balance sheet. Weiner (1999:58) state that banking services that do not have any asset values play an important role in the value offering to the customer and contribute to a bank's profitability. ROA as a measure of reward will therefore ignore these services in its assessment of reward. The second problem is that the simplest and fastest way to improve the ROA is to reduce the portfolio of business. Uyemura and Van Deventer (1993:18) argue that there is little incentive in this mechanism to pursue any new business, unless the new opportunity will improve the ROA of the business unit. Therefore, any new activity must have an expected ROA at least above that of the current portfolio's average, which is at best an arbitrary standard. Weiner (1999:58) agrees that the ROA measure of reward will only drive new business with a return higher than the current portfolio's and can potentially ignore business the enhanced future profitability.

Weiner (1999:59) states that ROE is the ratio of net income to equity or capital. As a measure of reward ROE has some intrinsic advantages over that of net income and ROA. The biggest strength of ROE is that it is a step towards the risk-adjusted return concept. It has the same pitfall however as the ROA measure in that the easiest way to increase the ROE is to return the equity to shareholders that supported the business activity. According to Uyemura and Van Deventer (1993:18) business units may attempt to decrease their reliance on equity by increasing its deposit base which may prove counter productive. The assignment of capital may however be linked to the unit's associated risks that may direct and ensure that risk conscious decisions are made. According to Matten (1996:9) capital protects the entity against risk and is often applied in return measures such as ROE. On the contrary, no new business will be accepted unless it

supersedes the current average ROE of the business unit or product (Uyemura & Van Deventer, 1993:18).

Bessis (1998:19) describe the reward achieved from banking activities from two perspectives, very similar to Uyemura and Van Deventer (1993:18). The reward achieved is basically classified in two types of earnings measures:

- Accounting measures
- Market-based measures

De Rosa and Goodman (1991:146) agree explaining that when the reward associated to risk is measured it can be done from either accounting or market value perspectives. Accounting measures are typically NII or NI and market value is an economic value measure of reward.
According to Bessis (1998:19-20) the accounting measures include the NII, NI, and typical ROA and ROE measures. The accounting measures are typically based on the income statement results which provide profitability measures based on a universal framework, which is well known and monitored according to well established rules. Bitner (1992:103) state that established accounting rules establish a standard perspective to measuring return. Bessis (1998: 19-20) explains that these accounting measures are calculated as margins of contribution at various levels of the income statement. The financial earnings are the interest margin which is the difference between the interest revenue and interest expense. The overhead operating costs are fixed to an extent. Therefore the instability in the net income is mainly generated by the net interest margin. Operating expenses are mostly managed, budgeted and monitored and therefore controlled according to standard managerial practices without the constant reference to risk, which characterise the financial items.

According to the BCBS (2004:6) the earnings or reward of a business is typically measured by accrual or reported earnings based on the accounting standards. Both NII and NI are applied traditionally to measuring the reward associated with risks. Banks that have significant income generated by non-interest products and services specifically focus on NI as an accounting measure given that changes in customer or economic circumstances may materially affect its profitability or reward. De Rosa and Goodman (1991:146) also states that NI and NII is the traditional approach to measuring earnings or reward based on accounting measures. Consequently, Bessis (1998:20) states that the ROE (and ROA) is accounting measures and is often used as a proxy for the market return on equity. The critical aspect is that the ROE and market return on equity should be in line with shareholder expectations. If the management of

the bank set specific targets based on these measures, they will serve as basis to determine the pricing policy and business strategy of the bank (Bessis, 1998:19-20).

The accounting measures have several limitations, according to Bessis (1998:20). The biggest problem is that accounting measures will capture the earnings or performance over a given period of time. They do not give a measure on the long-term profitability of existing business transactions. According to the BCBS (2004:7) the accounting perspective measures earnings changes over a set period of time. Often accounting measures will ignore the overall impact of risk on profitability. In addition, Bessis (1998:20) state that the market conditions are also ignored, which can be used as economic benchmark for actual returns. For example, a fixed rate loan booked at a historical interest rate derived from a yield curve reflective of rates at the time of origination will have less value today if interest rates have increased. It will earn less than an identical loan based on current market conditions due to the fact that the loan's earnings rate will adjust upwards as interest rates increase. The BCBS (2004:7) state that fixed rate loans refunded when interest rates are much higher may represent a drain on the resources of a bank.

According to Bessis (1998:20-21) the mark-to-market valuation can be applied to correct such limitations of the accounting measures. The mark-to-market value of assets less the mark-to-market value of liabilities is the net present value (NPV). NPV is a market-based measure of performance. The NPV is a global measure of the value of the balance sheet. The computation of the NPV should be based on relevant discount rates which are mostly computed from current market interest rates. The benefit of present value calculations is that all cash flows over the life of all assets and liabilities are captured and used in the computation of the NPV, and is therefore not restricted to a given time horizon.

The BCBS (2004:7) state that the economic value or present value of all cash flows on the balance sheet is incorporated to calculate the net worth of the organisation. According to De Rosa and Goodman (1991:145-146) the market value of assets minus the market value of liabilities under various scenarios of discount rate is an economic measure of the balance sheet's performance. This is confirmed by Bitner (1992:103) stating that the present value of all cash flows represents the institutions market value. The NPV or mark-to-market value is therefore a good measurement of economic performance (Bessis, 1998:20-21). In addition, the BCBS (2004:7) states that the economic value of an instrument represents an assessment of the present value of its net expected cash flows. Thus, the NPV or economic value of a bank's balance sheet

equals the present value of the expected net cash flows calculated as the difference between the expected cash flows on assets minus expected cash flows on liabilities. Furthermore, De Rosa and Goodman (1991:146) state that market value is an economic measure of reward. When risk is assessed in terms of the reward it generates, the economic/market value of equity is calculated as the difference between the economic/market value of assets less the economic/market value of liabilities.

According to the BCBS (2004:7) it is however important to measure the reward embedded in the risks undertaken by applying both measures. The accounting measure focuses on current performance and is more focused on the short- term earnings. The market based measures like economic value of equity or NPV is used to provide the long-term view on profitability. According to Bessis (1998:21) both accounting and market measures of return/reward should be applied in assessing profitability.

Giarla (1991:23) argues that a pragmatic approach to reward measures must be taken. Therefore, it is critical to understand the level of risk an activity assumes and this has to be considered in the measurement of the subsequent reward achieved. What this alludes to is the fact that the risk-adjusted approach to the performance measure must be incorporated. This requires that both the risk and reward is quantified from an interdependent perspective. According to Weiner (1999:59) the measurement of reward is inter-reliant on the risks taken to generate the reward. Sadgrove (2005:13) state that in assessing what is an acceptable level of risk depends highly on the associated reward. The institutions must therefore assess its risk-reward trade-off it is willing to accept.

2.2.3 RISK VS. REWARD

Cade (1997:5) states that in order to understand the fundamental principle of banking but as such of any business activity, it is important to confirm that the risks involved do not always imply a loss. If the risk produces an outcome that is different than what was expected, the outcome is not necessarily to be considered as a loss. In some circumstances the risk will lead to a gain or a profit. From this perspective Cade (1997:5) explains that static or pure risk will only have a downside or loss associated with the deviation from what was expected, but for dynamic or speculative risks the deviation from the expected can produce either a better or worse result.

This is also reported by Vaughan (1997:13) stating that business generally has at goal to generate profit.

Profit is generated mostly by the investment of assets, whether in the form of monetary capital, intellectual resources and entrepreneurial skill or simply exercising choice based on information available. This investment in assets has the generation of profit at goal but if things do not realise according to anticipated outcome, losses may be incurred. Given a business' exposure to adversity or simply risk, the consequences sometimes involves financial loss and sometimes not. In addition, Bessis (1998:16) states that in the banking industry, the risk-reward trade-off is ever constantly present. In theory risk taking generates higher expected earnings. For example, high interest margin loans to risky customers increases the profitability of the bank over the short-term, but it will also increase the probability of future losses. Simply put, the reward for higher risk is always positive until the risk turns into reality which refers that risk-taking behaviour can generate losses. The risk-reward relationship therefore exists but it must be understood as a relationship between anticipated risks with an expected profitability (Bessis, 1998:16).

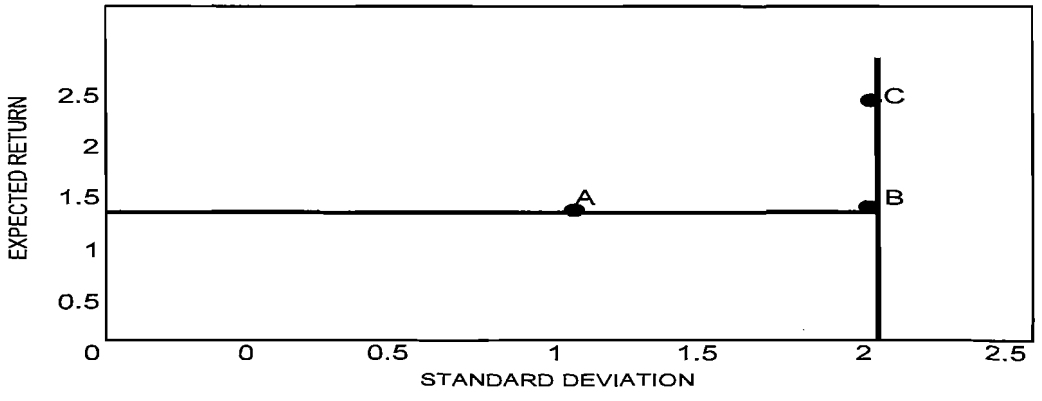
Uyemura and Van Deventer (1993:3) states that in the examination of the risk-reward trade-off it is indicative that the risk involved and the perceived reward associated with such risk must be measured. When considering the degree of risk as discussed in section 2.2.1, the risk measurement technique applied is critical. The same principle applies to the assumed profit or reward being measured. The measure applied to the reward must be adequate for its intended purpose. Giarla (1991:22) agrees stating that yield, income or even risk levels may be applied. It is acknowledged that multiple measures of the risk-reward trade-off exist. Bessis (1998:184-185) agrees stating that endless potential risk-return combinations may exist, but argues that the selected profiles must be optimised by means of a decision making process that is based on a set level of risk. This means that the computation methodology must be agreed and the resultant risk appetite be quantified. According to Bessis (1998:185) the selection of risk level or risk appetite is a management decision which is mostly qualitative in nature. In addition, Ong (1998:13) states that any reward measure must be constructed from predefined risk measures. Therefore, risk and return are intertwined in their respective methods in establishing the risk/reward trade-off.

However, in order to simplify the explanation of the concept, Uyemura and Van Deventer (1993:3) uses an example involving standard deviation and expected return in the form of net

income. According to Bessis (1998:184) the risk quantification methodology applied is potentially the deviation or volatility of the potential outcome. This is supportive of the risk quantification method applied in the risk/reward trade-off as presented by Uyemura and Van Deventer (1993:3). Bessis (1998:184) states that in general, a large number of potential results can be calculated.

Figure 2.3 as presented by Uyemura and Van Deventer (1993:3), illustrates three potential risk-reward positions that a bank might face. The risk involved is shown on the x-axis as the standard deviation from the expected result. The y-axis is the associated net income result of the business activity or strategy. Position A shows relevant less risk than position B and position C, at one standard deviation. The strategy pertaining to position B and C both culminates in two standard deviations of risk. The net income, R2.5 million, of position C however is more than position A and position B which both receive R1.5 million worth of net income. In comparing position A and B, it is clear that strategy A should be preferred above that of position B given that A has less risk associated with the same level of profit as position B. It is also clear that position C is better than position B, given the same level of risk will entail higher net income for position C. Therefore the strategy relating to position B will under no circumstances be adopted. Uyemura and Van Deventer (1993:4) explains that when comparing position A and C, it is however not that simple. Point C has a higher expected return and also more risk than point A. Both points A and C is perfectly legitimate options.

Figure 2.3 The risk-reward trade-off



Source: (Uyemura & Van Deventer, 1993:3)

The position or strategy chosen is ultimately a function of the risk/reward preferences or risk appetite of the bank. The risk/reward relationship's objective is to convey the fact there is no way to maximise expected profit whilst minimising the associated deviation from the expected

outcome, alias the risk. Banks can only make risk-reward trade-offs and in the process attempt to maximise the returns for the selected aggregate level of risk endeavoured (Uyemura & Van Deventer, 1993:3-4).

It is derived from the discussions of Bessis (1998:184-185) and Uyemura and Van Deventer (1993:3-4) that the establishment of bank's risk appetite or deemed prudent level of risk is therefore critical in selecting the consequential risk/reward profile or strategy. This renders organisations vulnerable to the management actions and levels of expertise and competence of the bank's management. Sadgrove (2005:12) argues that an institution must endeavour to find the trade-off between risk and reward that maximise the company's profits for the level of risk it assumes. Invariably it leads to the question as to what is a prudent risk/reward profile. What may be seen as a prudent risk mitigation strategy with a desirable reward trade-off for one bank may not be for another. It therefore requires that prudent and effective risk management practices are established. This is also advocated by the BCBS (2006**a**:3) stating that supervisors must ensure that banks have comprehensive risk management processes in place that identify, evaluate, monitor and control or mitigate all material risk exposures. In section 2.3 the various financial risks and the process of managing risk will be discussed.

2.3 FINANCIAL RISKS AND RISK MANAGEMENT

In chapter 1 it was discussed that the role of banks as financial intermediaries in the financial system and supervisory and regulatory influences, necessitates that banks have adequate management focus, skills and systems to identify, measure, monitor and control risks in line with their complexity and risk-appetite. Furthermore, it was established in chapter 2, section 2.2 that reward or profitability is correlated to the risk. Supervisors are also concerned with all the varied risks to which the banks are exposed resulting from its intermediation functions performed. This section discusses the financial risks within banks and the concept of risk management.

According to Vaughan (1997:13) financial risk involves the relationship between an organisation and the expectation of income or profit on invested assets or business activity that may be lost or not realised. Vaughan (1997:13) states that financial risk involves the following three elements:

- the organisation or individual exposed to loss.

- the asset or income whose destruction or dispossession which will cause the exposure to and realisation of financial loss.
- the threat or peril of risk that is the source of the loss (Vaughan, 1997:13).

In the context of this research, the financial institution in specific a bank is exposed to the risk of adverse deviation from its expected outcome or profit. This deviation is potentially due to financial risks that cause the undesired outcome as a result of the impact it have on the balance sheet's assets and liabilities. According to Vaughan (1997:13) it must be noted that not all risks that a bank is exposed to have a direct financial impact. Often any financial consequences or loss is secondary or incidental. Section 2.3.1 will give a broad overview on the financial risks that bank's may encounter. The concept of risk management and what it involves will also be discussed.

2.3.1 BANKING RISKS

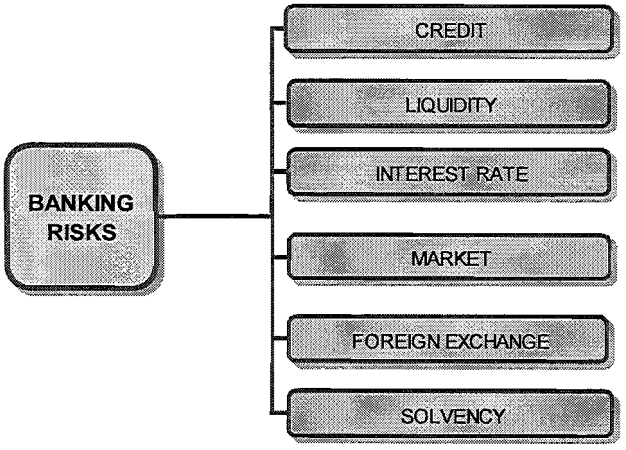
The principal banking risks are defined by Bessis (1998:5) as the distinct sources of uncertainty that may cause an adverse impact on profitability. These financial risks relate to market movements, whereas other risks i.e. reputation risk, operational risk and sovereign risk are also highly important and may have detrimental financial consequences but does not necessarily always have a direct financial implication. Rosen and Zenios (2006:4) state that financial losses may result from unpredictable future events that will cause a bank not to meet its financial targets. Such financial risks include market risk which includes price and interest rate risk, liquidity, credit risk and operational risk. Koch and MacDonald (2000:121) also state that banks are exposed to credit risk, liquidity risk, market risk, operating risk, reputation risk and legal risk. Sadgrove (2005:20) defines financial risks as foreign exchange risk, interest rate risk, liquidity risk, profitability risk, credit risk and costs risk. Financial risks identified by the IRM (2002:3) include interest rate risk, foreign exchange risk, credit risk and liquidity risk.

Figure 2.4 presents the principal banking risks as noted by Bessis (1998:5). The principal banking risks as described by Bessis (1998:5) are:

- Credit Risk: The fundamental function of the intermediation function performed by banks is to lend funds to deficit economic units. This exposes the bank to the risk that the counterparty or deficit unit does not repay the loan. According to Bitner (1992:77) the

risk that loans are not repaid on time and in full represents credit risk. Bessis (1998:5) defines credit risk as the risk that the customer defaults or fails to comply with the agreed obligation to service debt in terms of interest and/or the principal repayments. A partial or total loss can be triggered by a client defaulting. Van Greuning and Bratanovic (2000:125) state that credit risk is the chance that a debtor will not repay interest and/or the principal loan amount according to the terms of the credit agreement. The risk is that the payment of these amounts may be delayed or not paid at all. A considerable part of a bank's balance sheet may be exposed to credit risk.

Figure 2.4 Principal banking risks



Source: (Bessis, 1998:5)

Bessis (1998:6) has the opinion that credit risk is possibly the oldest financial risk. Credit risk is the possibility of default by a counter party in a financial transaction. Significant losses may be experienced even when a small number of clients default which may lead to insolvency. According to Bitner (1992:77) the bank is exposed to the possibility that it will not receive the principal and/or interest payment due on an investment or loan. This risk become more evident when the economy enters a period of recession and the income to the disposal of the borrower is more volatile. A simple example is that a decline in sales reduces the revenue of a business, therefore making it difficult for the corporation to service it debts. A financially weak business will not be able to pay the principal and/or interest due on their loans. Normally when this occurs, the bank will potentially incur a financial loss. Although this is one of the primary risks encountered in banking, the management of credit risk is mostly beyond the responsibility of ALM. Due to its specialist requirement and close link to lending

activities of the bank it is normally embedded in the lending or investment areas of the bank. It originates directly with the commercial choice of the customer and generally does not depend on the normal movement of financial markets (Bitner, 1992:77).

Although credit risk is the oldest of all bank risks and most familiar it remains even at present times difficult to quantify (Bessis, 1998:6; BCBS, 2006**c**:91). It is worthwhile to note that the focus of the 1998 Basel Capital Accord was to ensure that banks have sufficient capital to cover losses primarily as a result of credit risk exposures. The revised Framework under Basel II Pillar I, have at goal to further enhance the quantification of capital requirements for primarily credit risk, operational risk and traded market risk (BCBS, 2006**c**:2-5).

- Liquidity Risk: The ultimate risk in banking according to Bitner (1992:94) is the failure of the bank to have access to the funds or cash needed to meet deposit withdrawals or service its debt obligations. The risk or inability for the bank to meet its obligations or commitments when they fall due is called liquidity risk. According to Van Greuning and Bratanovic (2000:158) liquidity risk means that a bank has insufficient funds to meet its obligations. The BCBS (2008:1) states that liquidity risk is the inability to fund increases in assets and to meet obligations when they fall due. Bessis (1998:7) also considers liquidity risk as a major risk for banks.

  Extreme illiquidity results in bankruptcy, and hence the fact that liquidity risk is a fatal risk. However, the extreme illiquidity scenarios are often a result of the materialisation of other risk. For instance, significant losses resulting from defaulting customers (credit risk) may raise doubt over the future of the bank. This may result in massive deposit withdrawals from the bank, which the bank is unable to honour (Bessis, 1998:7). Kelly (1993:348) explains that a bank's inability to meet its commitments is due to liquidity risk. The lack of a suitable buffer of liquid assets to provide the needed cash to cope with unexpected events will lead to the bank's failure. Often, liquidity risk may arise from the mismanagement of other financial risks such as credit risk or interest rate risk.

  The BCBS (2000:1) argues that liquidity risk is also having difficulty to raise adequate funds to cover lending activities. According to Bessis (1998:7) often the reasonability of the cost to liquidity is a factor. Market liquidity i.e. the availability of funds from

depositors and credit lines and the internal liquidity of the bank, are factors which will influence the ability of the bank to raise funds. The internal structure of funds is often also the rationale for the definition of liquidity risk (Bessis, 1998:7). This is also reported by Van Greuning and Bratanovic (2000:158) stating that the maturity of assets and liabilities in an unmatched fashion may render a bank short of funds to cover its cash flow commitments.

According to the BCBS (2000:6-7) the mismatch between the maturity profile of assets and liabilities also is a source of liquidity risk. In specific, if the short-term asset values are not sufficient to cover the short-term liability values or unexpected cash outflows, then liquidity risk is evident. Having sufficient liquidity is therefore the safety cushion available to help the bank to gain time in order to meets its commitments under difficult conditions. According to Bessis (1998:8) the unmatched timing of cash flows from short-term assets and short-term liabilities or unexpected cash outflows represents liquidity risk.

- Interest Rate Risk: Interest rate risk (IRR) is the risk that changes in interest rates will have a negative effect on the NII or earnings potential of the bank and the value of its assets, liabilities and capital (Kelly, 1993:320). Bessis (1998:8) explains that IRR is the risk of declines in earnings due to changes in interest rates. Van Greuning and Bratanovic (2000:177) states that interest rate risk originates from the fact that when interest rates change the interest income and interest expense of the bank changes. The net effect of these interest rate changes may result in either an increase or decrease NII.

  Bessis (1998:8) argues that in the intermediation function of banks it is important for surplus units to receive an acceptable or market related return on their deposits. Deficit units are paying for funds provided by the bank at an interest rate reflective of their credit standing or grading. The time value of money is also important in the quantification of reasonable or market related interest rates either paid on deposits or received on loans from customers. The net result is that if the market rates change there will be a change in the interest paid by the bank to depositors and the interest earned by the bank from borrowers. The NII which is the net position of interest earned less interest paid is therefore exposed to changes in the market rates. According to the BCBS (2004:5) IRR is the exposure of the financial condition of bank to adverse interest rate

movements. Accepting IRR is a normal part of banking activities and can be a considerable contribution to the profitability of a bank. On the contrary, excessive IRR may pose a significant threat to a bank's earnings and capital base.

- Market Risk: Bessis (1998:9) describes the risk of adverse deviations in the market value (mark-to-market) of the trading portfolio during the period required to liquidate or realise the transaction, as market risk. Earnings on the trading portfolio are profits and losses (P&L) arising from the transaction in the trading portfolio instruments. According to Cade (1997:161) the movements in the price of an instrument affects its market value and any change in market prices therefore lead to a deviation of the instruments market value. According to Van Greuning and Bratanovic (2000:190) the volatility of prices of investments held in a trading portfolio will result in changes to the profits and losses generated by the portfolio.

  Van Greuning and Bratanovic (2000:191) explain that the mark-to-market valuation refers to the repricing of instruments to reflect the changes in asset prices due to market price movements. According to Bessis (1998:10) the assessment of market risk is based on the instability of market parameters such as interest rates, foreign exchange rates or stock exchange indexes and commodity prices. Cade (1997:161) argues that observed historic price deviations may be applied to measure market. This is an approximation of how the market value (present value) of an instrument changes when market prices change. Bessis (1998:9) explains further that market risk exists for any given period of time. Any decline in the value will result in a market loss for the corresponding period equal to the difference between the beginning and ending mark-to-market values of the instrument.

  The holding period of the instrument is not a good measure to value market risk. The reason being that at any moment the portfolio or instrument can be liquidated or it may even be decided to hedge the future potential changes in its value. The risk is that the market value can change during this period required to liquidate the instrument. Cade (1997:167-168) agrees stating that the potential changes/volatility to market prices over the period required to sell an instrument represents the potential deviation of the instrument's market value. This deviation represents the P&L attributable to market risk.

Therefore the market risk is limited to the liquidation period and various instruments have different liquidation periods (Bessis, 1998:9).

- Foreign Exchange Risk: According to Cade (1997:174) the changes to the financial position of an instrument attributable to changes in foreign exchanges rates represents foreign exchange risk. Bessis (1998:10) states that currency or foreign exchange risk is the risk of observing losses due to changes in exchange rates. Losses are incurred due to changes in exchange rates when lending or funding activities of the bank is linked to exchange rates or the values of assets and/or liabilities are expressed in foreign currency. Both banking and trading activities may be exposed to foreign exchange risk. More common to the operations in foreign currency is the market risk to changes in the currency. This implies that due to the change in the market parameter of an instrument, which is the exchange rate in a spot currency transaction, the value of the instrument or commodity will change (Bessis, 1998:11).

- Solvency Risk: According to Bessis (1998:11) the risk of being unable to cover losses with the available capital of the bank is referred to as solvency risk. In its basic definition, solvency risk is the risk of default of the bank, and is identical to the credit risk incurred by counterparties of the bank. Cade (1997:24) state that solvency risk is the lack of capacity to meet external liabilities by realising assets at current value. Bessis (1998:11) states that solvency is the end result of optimal capital available and of all risks taken i.e. interest rate, credit, liquidity, market, foreign exchange and operational risks.

  Solvency risk is of particular interest for the regulatory regime. The capital adequacy standards set by the regulators through the 1988 Capital Accord and the revised Framework of Basel II, has as objective to determine what level of capital should be available in relation to the overall risk exposure of the bank. Bitner (1992:215) argues that capital is required by banks to act as a cushion to absorb the shock of losses. If a bank did not have capital any loss would impair its ability to honour depositors' claims. According to Bessis (1998:11) the principle of capital adequacy is the basis for the direction of risk management. It also sets a strong case why risk management is needed and for the rigorous approach and requirements that supervisors and regulators demand from banks.

The major challenge of risk management is to implement these principles and define the quantitative measure required to ascertain the adequate capital level. The Basel II revised Framework is moving towards an economic capital approach which is driven by the risk-based capital concept which is an objective measure of the actual risks of the individual bank (BCBS, 2006**c**:2).

2.3.2 RISK MANAGEMENT

It was established in section 2.2 that the risk/reward trade-off necessitates that banks take responsibility for managing their risk exposures associated with their intermediation activities. It was also established in chapter 1 that supervisors and regulators are concerned with the stability and effectiveness of the financial system and therefore require the performance of prudent risk management practices by banks. This section focuses on the concept of risk management in order to establish a basis of understanding as to what risk management entails.

2.3.2.1 RISK MANAGEMENT DEFINED

Bessis (1998:23) states that the goal of risk management is to optimise the risk-reward trade-off and to plan, and fund, the business of the bank in a manner suitable to shareholders. According to the IRM (2002:2) risk management is a central part of a bank's strategic management. Risk management is the process by which the risk attached to a bank's activities is methodically addressed with the goal of achieving a sustained benefit from such activities.

Risk management is according to Bessis (1998:23) both a set of tools and techniques and a process that is required to implement the bank's strategy. It covers all types of financial risks including operational risk. Vaughan (1997:30) defines risk management as a scientific approach to dealing with pure risk by anticipating possible losses (expected and unexpected) and designing and implementing procedures that minimise the occurrence of the losses or the financial impact of the losses that do occur.

Sadgrove (2005:5) argues that risk management is a process of understanding risks and from this understanding of risk develop and execute strategies that will try and control, share or reduce the risks. According to Vaughan (1997:30) part of implementing the procedures to

minimise losses or the financial impact from realised losses is the tools applied in order to achieve the goal of managing the risk. Two broad approaches can be applied in dealing with risk namely risk control and risk financing. This is discussed as part of the techniques for dealing with risk.

2.3.2.2 TECHNIQUES FOR DEALING WITH RISK

The realisation of risk whether expected or unexpected, is undesirable by most individuals and institutions. Therefore affected parties need to do something about risk. According to Vaughan (1997:31) the organisation can attempt to deal with risks through two broad approaches, namely:

- Risk control: Controlling risks involves techniques that are designed to minimise the risks to which the organisation is exposed. The least possible cost should be contracted in order to minimise such risks (Vaughan, 1997:31). According to the IRM (2002:10) the primary element of risk treatment is risk control. Any proposed control of risks should be measured against the potential costs relating to the control actions and the economic effect if no control actions are taken. The loss due to risk if no action is taken must be compared to the cost of taking risk control actions to determine whether or not to implement the proposed actions. The sophistication of risk control efforts differ widely. Typical techniques include risk avoidance and risk reduction.

- Risk financing: According to the IRM (2002:11) a method of obtaining financial protection against risk is through risk financing. According to Vaughan (1997:31) in contrast to risk control, risk financing focuses on the availability of funds to meet losses incurred. Risk transfer and risk retention techniques are applied because the risk that cannot be avoided or reduced must be enacted upon. Sometimes this means that some of the risk may be retained and some of it might be transferred.

According to Vaughan (1997:18) the techniques available to manage risk from the risk control approach are:

- Risk avoidance: if the organisation refuses to accept the risk/s for even a moment, then the risk is avoided. The exposure is not allowed or permitted to come into existence. This is mainly accomplished by not engaging the action that manifests the risk. The IRM

(2002:10) argues that by avoiding risk as a method of controlling risk, the exposure to risk is essentially eliminated. Sadgrove (2005:24) state that by choosing not to accept risk, risk can be avoided. A typical example is if one does not wish to lose ones savings in a hazardous business venture then rather invest ones funds where there is less risk involved i.e. a savings account with a bank. Vaughan (1997:18) states that the avoidance of risk is one technique for dealing with risk but is a rather negative technique. For this reason especially for banks it is a somewhat unsatisfactory approach. If risk avoidance is applied extensively the bank would be deprived of many profit opportunities.

- Risk reduction: Sadgrove (2005:24) argues risk can be minimised by changing the actions that lead to risk exposure. Vaughan (1997:18) states that risk may be reduced in two ways. Risk prevention and risk containment. Risk prevention and loss-prevention measures are typical safety programmes that attempts to deal with risk by preventing the loss or reducing the chance that it will occur. Risk containment techniques are for example medical care or collateral requirements on loans. Risk containment has at goal to reduce further losses or elevated risk levels once the risk has manifested. Some techniques are designed to prevent the loss whereas others attempt to control the severity of the loss if the risk does occur. The loss prevention must not cost more than the potential losses themselves.

According to Vaughan (1997:19-20) the techniques available to manage risk from the risk financing approach are:

- Risk retention: According to Vaughan (1997:19) this is possibly the most common method for dealing with risk. Organisations face an unlimited number of risks and in most cases nothing are done about them. When positive actions are not taken to avoid, reduce or transfer the risk then most of the possibility of loss involved in that risk is retained. Risk retention can be conscious or unconscious. Conscious risk retention is when the risk is perceived and not transferred or reduced. When the risk is not recognised then it is unconsciously retained, and in this case the financial consequences of the possible loss are unknowingly retained. Sadgrove (2005:25) states that risk is normally accepted when it is within acceptable and agreed tolerance levels. Risk retention is a legitimate method of dealing with risk and most often the best way.

- Risk transfer: risk transfer may be used to deal with both pure and speculative risk. This entails that the risk is moved from one entity to another. Sadgrove (2005:25) states that a typical risk transfer technique is the process of hedging. Hedging involves the method of risk transfer accomplished by buying and selling financial instruments for future delivery. Insurance contracts also typifies risk transfer by means of which a premium is paid by one party, and the counterparty indemnifies the first party up to a certain agreed limit for the specified loss that may occur (Vaughan, 1997:19).

- Risk sharing: When risk is shared the exposure is transferred from an individual entity to the group. It is a form of both risk transfer and risk retention. According to Sadgrove (2005:25) risk sharing is also known as risk spreading and similar to risk transfer. Risk sharing is typically experienced in insurance by which the risk is shared by the members to the insurance device (Vaughan, 1997:20).

2.3.2.3 THE RISK MANAGEMENT PROCESS

Culp (2001:209) explains that risk management is conventionally perceived as a cost center with the primary purpose of ensuring that financial risks are reduced in a bank. This risk reduction is usually achieved with the aid of expensive software and systems and risk transformation products. Therefore, the classical view of risk management is one of being a necessary evil. An alternative risk culture on the other hand will leverage their internal risk management processes into significant efficiency gains and new product development opportunities. Financial risk is not a problem to be solved but rather a vital business component and a critical source of innovation and growth. According to Haubenstock and Aggarwal (1997:176) risk management within an organisation enables the use of information to better understand its business and to proactively manage adverse exposures. According to the IRM (2002:4) risk management protects and adds value to the shareholders of the organisation by supporting its key strategic objectives.

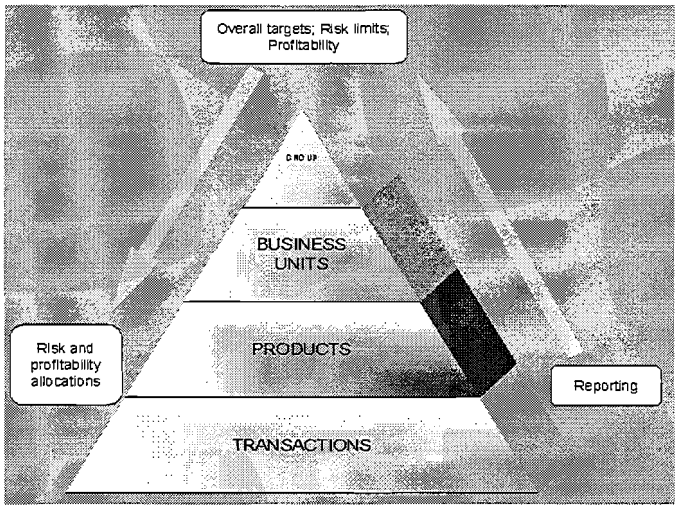
Improved decision making, strategic planning, the efficient allocation and use of capital and protecting/enhancing the value of the firm are some of the benefits of risk management. Culp (2001:209) agrees stating that some significant benefits are available to organisations that endear their internal risk management processes as a source of potential direct and indirect share holder benefit. The risk culture as defined by the Board's approach to risk together with the

ultimate management of its financial and business risks is pivotal to unlocking these benefits for shareholders. It transpires that the risk management process should be embedded in the normal business processes of the organisation (Culp, 2001:209).

According to Bessis (1998:31) risk management is both a top-down and bottom-up process. At the top level target earnings and risk limits are defined. Top-down or from the top to bottom, the global goals are translated into signals to business units and management in charge of customer transactions. The monitoring and reporting of the risks are bottom-up orientated. It starts at the transaction level and ends with consolidated risks, revenues and volumes of transactions (total balance sheet). The process involves the entire banking hierarchy from top to bottom, in order to turn global targets into business signals. From bottom to top it aggregates risks and profitability in order to monitor them (Bessis, 1998:31).

Bessis (1998:31) explains that a global view of risk management is offered by the image of a pyramid, combined with the effect of risk diversification by moving up the hierarchy. The risk diversification has the effect that the overall risk is less than the simple arithmetic addition of all original risks generated at the transaction level which is at the base of the pyramid. Therefore the risks diversify from the bottom to the top. The benefit of risk diversification entails that risks taken at the transaction level could be increased up to the amount consistent with capital. When the risks are aggregated a significant fraction of the overall risk are diversified away. Quantifying the diversification effects is a major challenge to modern risk management. Figure 2.5 further illustrates the important effect of risk diversification (Bessis, 1998:31).

Figure 2.5 The pyramid of risk management.



Source: (Bessis, 1998:32)

Bessis (1998:32-33) further explains that in order to ensure that signals are conducted both up and down the risk management pyramid, special devices are needed. Without such devices there would be a missing link between the global objectives of the bank and the actual operations conducted at the business unit levels and down to the individual transaction. Giarla (1991:22) adds that risk-adjusted analyses on the return and the capital required to support an investment, gives a bank management the necessary data to make profitable decisions which maximises shareholder wealth and the value of the bank. Improper financial decisions can be made without risk-based analysis.

Ong (1998:13) state that return must be measured in relation the associated risks taken to generate such returns. Risk-adjusted analysis incorporate the risk-reward trade-off embedded within all business transactions. Haubenstock and Aggarwal (1997:175) argue that risk information must be used to determine what types and combinations of risk should be taken. The trade-off between risk and return, the correct pricing for risk and the allocation of capital based on the risk exposures can also be established through effective risk-adjusted analysis. According to Bessis (1998:33) two specific organisational devices are required to transfer the signals and collect information and aggregate it for comparison with the global targets. These devices are:

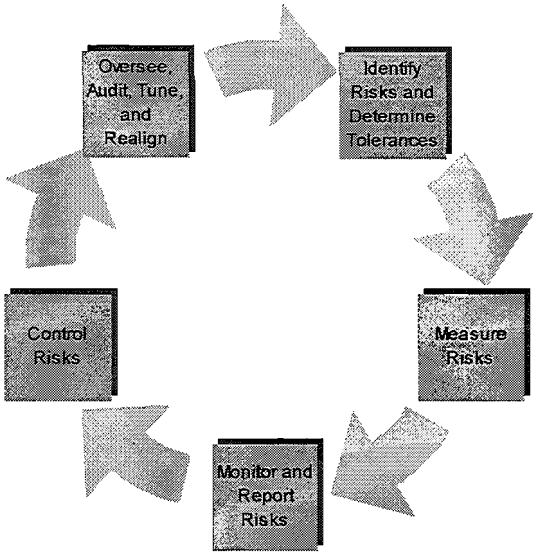
- The funds transfer pricing system between business units and central functions is used amongst others to calculate the economic margins and to set financial performance objectives. This device will be the primary focus for discussion in Chapter 6. It also serves a pivotal role to have comparative risk-based reporting against accounting-based earnings reports. This ensures effective measurement of the risk-reward trade-offs undertaken through existing transactions and business units' activities.

- Risk systems and processes that quantify risk. The global risk is allocated to the capital allocation system whereby the available capital is allocated according to risk, across the business units or transactions. Therefore risk is quantified and capital is allocated based on the risk associated with the business units' activities (Bessis, 1998:33).

According to Culp (2001:210) risk management as an organisational process involves a series of sequential steps. Some organisations structure the processes or steps more formal than others but

all firms manage risks, intentionally or unknowingly, in a five step process. This approach is intrinsically endorsed by the BCBS (2006**a**:3) Principle 7 for effective banking supervision, stating that banks must have risk management processes in place that identify, evaluate, monitor and control/mitigate all material risks. This also includes efficient board and senior management oversight. Figure 2.6 illustrates the sequential steps in the internal risk management process as proposed by Culp (2001:210-213).

Figure 2.6 The internal risk management process



Source: (Culp, 2001:210)

According to Culp (2001:210-213) the steps in the internal risk management process are:

- Identify risks and determine tolerances: Culp (2001:210) explains that the process by which an organisation recognises and detects the different financial risks, to which it is exposed through its normal course of business, is called risk identification. According to the IRM (2002:5) risk identification relates to the process of recognising the organisation's exposure to uncertainty. Risk identification should follow a methodical approach to ensure that all business activities are identified so that all risks flowing from these activities can be defined.

  According to Culp (2001:211) all risks must be identified and senior management and directors of the organisation must agree tolerable risk levels that are required for the operation of the company's primary business. This should be made explicitly clear by the firms' key stakeholders, management, directors and even major creditors. This is also

reported by the BCBS (2006**a**:3) explaining that the Board and senior management has the responsibility to ensure risk is properly identified.

- Measure risks: Culp (2001:211) explains that risk measurement involves the quantification of the risk exposures in order to compare such exposures to the company's defined risk tolerances. Without optimal risk measurement and also measures of risk it can be very difficult to determine if too much risk of some risk type are taken and maybe not enough risk of another risk type. According to the IRM (2002:6) risk should be estimated or quantified based on its probability of occurrence and the potential consequences.

- Monitor and report risks: According to the IRM (2002:8) risk analysis must be compared against risk criteria established by the management of an organisation. All risks must be evaluated to make decisions about the significance of the risks and whether each risk should be accepted or mitigated. According to Culp (2001:212) the risks to which a company is exposed to can change for two reasons. Firstly a change to the companies' assets and liabilities which entails a change in the quantity, profile and nature of the business conducted. Secondly the factors affecting the cash flows of the assets and liabilities may change which will change the risk exposure. Therefore the optimal frequency of risk monitoring and reporting is necessary in the risk management process.

  This frequency depends on the nature of risks as well as the ability of the company to fine-tune its risk-taking activities. The IRM (2002:9) state that the evaluation and reporting of risk should ensure that management know about the most significant risk the organisation face and the possible effects on performance and shareholder value. The BCBS (2006**a**:3) also state that risk management function of a bank must ensure that risk is frequently evaluated, monitored and reported.

- Control risk: Risk control is closely associated with risk monitoring but is more focussed on the actions taken to keep the actual risk profile at or below the agreed risk tolerance levels. The IRM (2002:10) argues that risk treatment relates to the process of selecting and implementing measures to modify risk. Risk control/mitigation, risk avoidance, risk transfer and risk financing are typical risk treatments that may be applied. According to Culp (2001:212) this indicates that effective risk control is only possible if effective risk

monitoring and reporting is in place. Therefore risk exposures have to be compared to risk tolerance levels in order to determine whether actions should be taken to reduce those risks.

- Oversee, audit, tune and realign: The final component of the risk management process is risk audit, risk oversight and the fine tuning of the risk management process. This includes external audits of the risk management policies and procedures to internal reviews of the quantitative risk exposure measurement models. This final step in the internal risk management process is in essence the process by which the company deal with whether or not the risk management process is working properly and efficiently (Culp, 2001:213).

2.4 SUMMARY

Chapter 1 and chapter 2 established a background to the motivational factors for conducting performance measurement and ALM in banks.
Given the business of banks in the financial system, the generation of its assets and liabilities are motivated by the opportunity of profit. Therefore risks are endeavoured for which a bank's management and shareholders require adequate reward. The concept of risk and reward was discussed. Bank management and directors must make a judgemental decision about their assumed level of risk for the required reward. The risk-reward trade-off that banks face are recognised by regulators and supervisors focussed on ensuring continued financial system stability.

The various financial risks to which banks are exposed resultant from their intermediation activities were identified and discussed. The concept of risk management was discussed together with the techniques and process which may be applied banks to instil a prudent process of managing its risk exposures.

The intermediation function banks perform in the financial system requires them to conduct prudent and effective risk management to identify, measure, monitor and control the consequential risk exposures. Supervisory authorities are founded on the principles of ensuring financial system stability through continued monitoring, supervision and regulation of banking activities. This was discussed in chapter 1. In order to ensure its continued profitability banks

must ensure their risk/reward trade-off is assessed and managed by prudent risk management strategies. The specific financial risks must therefore be managed in a structured and defined risk management process with all required policies and procedures in place to ensure its effectiveness. This requires that risk-adjusted measures are applied to the risk management process. All these factors contribute to the necessity of conducting performance measurement and ALM in banks.

With the *raison d'être* for ALM as background, chapter 3 will discuss the function of performance measurement. This will present a background to measuring the profitability or reward generated by endeavouring into the various risks associated with the financial intermediation function banks perform.

CHAPTER 3

BACKGROUND TO PERFORMANCE MEASUREMENT AND RISK-ADJUSTED PERFORMANCE MEASURES

3.1 INTRODUCTION

It was established in chapter 1 and chapter 2 that risk identification, measurement, management and monitoring are central to the successful overall management of financial intermediation and banking in specific. Furthermore, it was discussed that banks intuitively perform an intermediation function between surplus and deficit units in the economy. The risk/reward trade-off to which a bank is exposed requires that risks are managed to ensure a bank's continued profitability. Therefore, a significant portion of a bank's profitability originates from the successful management of financial risks originating from its intermediation activities. The profit performance/contribution of each area of a bank is therefore related to the risks it manages and controls.

According to Stott and Watson (1992:16-17) competitive pressures and market volatility requires banks to measure their performance to ensure they make the best use of available resources i.e. funds, infrastructure, expertise and capital. Conventional accounting based performance measures i.e. ROA and ROE typically do not explain much about the contribution risk to the overall profitability of a bank. Performance measures must incorporate the risk perspective as part of measuring the associated reward. This is referred to as risk-adjusted performance (profitability) measurement (RAPM). Giarla (1991:17) states that in the measurement of the anticipated profitability of various potential business opportunities for a bank, the respective risks associated to the business must be assessed. Risk-adjusted analyses is therefore required to measure on a comparative basis the opportunities most appropriate to a bank's risk appetite. Risk-adjusted analyses quantify risk and allow to price products with thee risks in mind in that profitability can be maximised for a desired level of risk. According to Ong (1998:11) a RAPM framework attempts to quantify the risk and return of a product, a unit or a portfolio on a comparative and even basis. This requires that the appropriate risk measures are applied in quantifying the risks within the balance sheet. The risk measures applicable to asset/liability management (ALM) will be discussed in chapter 4 and chapter 5. Conversely, the return or profit that is subject to these intrinsic risks can only be fairly analysed if the returns

and invested capital are measured in conjunction with the specific risks undertaken (Ong: 1998:14).

It is the objective of this chapter to:

- Provide a background to performance measurement and establish why typical accounting-based performance measures are inadequate to assess profitability.
- Introduce risk-adjusted performance measurement (RAPM) as a process of establishing comparable profitability information.
- Identify FTP as a RAPM component pertaining to the NII and typically available to the ALM function of a bank.

This chapter will focus on the basic premise of performance measurement. The terms of profitability measurement and performance measurement are treated as synonymous for the simple reason that bank management conventionally will measure performance of its operations predominantly by its contribution to profitability. For the purpose of this dissertation the focus on performance or profitability measurement is in particular on the NII portion of the overall profitability measurement process as accounted for as part of the NI of a bank. Furthermore, this dissertation will not focus on the mechanisms relating to costing and risk-based capital or economic capital allocation in the performance measurement process. However, it is acknowledged that both the cost allocation (non-interest income and expense), provisions for expected losses and economic capital components are of critical importance in the broader RAPM concept. The background to performance measurement is discussed in section 3.2. Section 3.3 discuss the RAPM concept and also identifies FTP as a function involved with ALM and fundamental to the RAPM process.

3.2 PERFORMANCE MEASUREMENT

What is performance measurement? According to Weiner (1999:1) the term performance measurement is widely used. Most financial firms have specific criteria developed against which to measure their profits. Cost accountings systems are typically developed to evaluate the contributions to overall profitability generated by various departments, products or services. Profitability measurement in banks however goes beyond traditional measurement and even cost accounting. It is a process of self-evaluation and self-improvement aimed at helping financial

institutions grow and manage internal change to meet the demands of the competitive market place (Weiner, 1999:1).

According to Weiner (1999:2) the ultimate objective of the performance measurement system is to give management better information with which to make decisions. This also results in acquiring better information for measuring responsible managers' performance. The process can also give a comparative framework to measure what is good performance and bad performance. Matten (1996:7) ads that investors/shareholders invest in the bank's equity and requires a return superior to alternative investment opportunities. Any performance measure applied therefore needs to supply information on the effectiveness of deploying shareholders' investment. In addition, Ong (1998:14) explains that performance measures must enable management to evaluate relative business lines, products and customers from a comparable basis in order to make efficient decisions.

Stott and Watson (1992:16) state that pressure on banks to improve profitability requires a comparable assessment of the optimal selection of new business deals and/or products to transact given that capital is often static and heavily contested between the various business units within a bank. According to Matten (1996:26) comparing the various activities of a bank and its branches and divisions requires that risk-adjusted analyses are applied. The risks being taken by various areas of the bank requires that when their performance is measured the process must incorporate in a consistent and comparable basis the contribution of risk to profit and how capital is used. Weiner (1999:2) states that the need for measuring performance relates to the following areas of consideration for the financial institution:

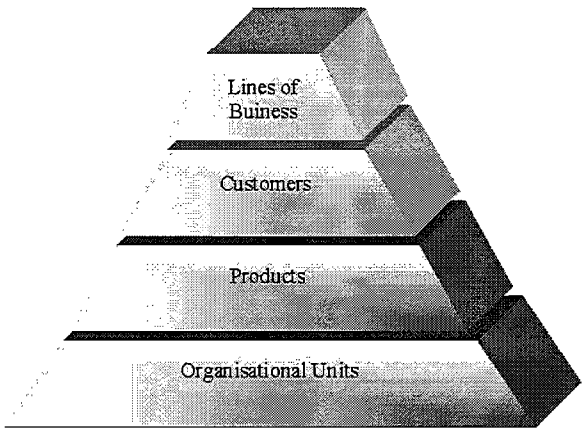
- Meeting overall measurement objectives.
- Providing a basis for incentive-based compensation.
- Assisting in the allocation of scarce resources.
- Helping instil a product- and customer-oriented culture.
- Supporting certain regulatory reporting requirements.

According to Weiner (1999:6) the process of profitability measurement in financial institutions requires that a logical series of steps are performed. Each of these steps builds on prior efforts in order to ensure that the overall future objectives are met in a systematic fashion. Figure 3.1 represents the profitability measurement hierarchy. It starts with organisational units at the base which is also the starting point. It then builds in the next logical steps from products to

customers and finally lines of business. Stott and Watson (1992:20) state that organisational, business unit or branch performance measurement is expanded to include product and customer combinations. This acknowledges that risk incurrence and revenue streams are originated at the point of intermediation between customers and bank products/services.

Weiner (1999:6) explains in figure 3.1 that organisational units are the departure point in the profitability measurement process. The organisational units typically reflect the way that the institution is managed. Frequently, defined profit centers are used which is a combination of cost and revenue centers, typically accounted for in this structure in the general ledger system of the institution. Product measurements supply relative profitability information. Most importantly these measurements supply information on product, activity and functional unit cost, all of which are required to measure profitability of the customer, product and organisation. According to Bessis (1998:261) profitability measurement focuses on the reporting and comparison of profits between business units, products and customers within the organisation.

Figure 3.1 The profitability measurement hierarchy



Source: (Weiner, 1999:6)

Koch and MacDonald (2000:175) argue that profitability measurement can be performed at the customer, the product and the delivery system such as branch or business line. Profitability measurement information at these levels of the institution can be valuable in guiding strategic business decisions. In addition, Weiner (1999:6) states that customer profitability measurement recognises the fact that customers use products and services one unit at a time. This requires that the institution must have good information on product- and activity-level unit costs. In addition the customer-level net interest margin (NIM) information is needed to manage profitability at the customer level. Lines of business are groups of products that are bundled together based on

specific identified customer behaviour. The defined business lines are typically based on the strategic directions and objectives of the institution.

According to Smith (1999:4) traditional banking has employed fragmented processes dealing with risk measurement and management, budgeting, strategic planning and marketing. Often the responsibility of measurement and reporting is allocated to individuals who often perform these functions independently from each other. This result in that more often than not the left hand does not know what the right hand is doing, causing the effectiveness of these processes being negatively impacted.

According to Weiner (2000**a**:32) profitability measurement in a financial institution is not easy to implement. The problem is that some very difficult measurement and allocation issues exist specifically in banks. The problem is further exaggerated by some banks not doing anything at all and some others allowing the use of an accountant's approach to the measurement process. Typically when the accounting and finance functions are in charge of the measurement process, textbook-accurate allocations are produced. The numbers produced are often not believed to accurately reflect the activities they are intended to measure. The danger is that although the numbers are technically accurate they are factually irrelevant information to be used in business and customer management decisions (Weiner, 2000**a**:32).

Smith (1999:5) explains that the budgeting process is mostly performed once a year with significant input from financial accountants. The typical bottom-up approach is followed but quite often senior management's review result in a top-down approach being facilitated when the numbers get changed to align with their objectives. This lead to a complete breakdown in confidence and accountability for the numbers by the managers charged with carrying out the plans. During the year multiple additional budget reviews and refinements take place to include and adjust for unforeseen and material occurrences. The budget is therefore realigned to be closer to reality. Eastburn (2000:2) argues that some organisations don't plan their business based on balance sheet, rate and spread assumptions. Historical revenue trends are often applied and sometimes simple rule-of-thumb is used to calculate yields and balances to determine a business unit's budgeted revenue. The dynamics of the existing balance sheet cash flows and its repricing characteristics are not taken into account in formulating the budget numbers. Smith (1999:5) states that the problem created is that conventionally the budget is applied to measure actual performance against. But against which budget should the responsible parties be

measured against? Some firms deploy the use of a monthly forecast. Therefore a performance review are undertaken in the form of comparing actual to budget and actual to forecast.

According to Eastburn (2000:2) these approaches often causes incompatibility between performance measurement, strategic planning and budgeting. Smith (1999:5) states that the problem is in which measurement should be used for incentive compensation purposes?
According to Weiner (2000**a**:33) the allocation of costs to product and customers are often a contentious issue in banks. Smith (1999:5) argues that often business units are not involved in determining and agreeing the allocation of costs. The business unit may perceive to be disenfranchised and powerless in controlling their own performance outcomes. Valentine (1999:63) argues that the NIM is not the only source of profitability to a bank. Non-interest income and non-interest expenses also contribute to the overall return of the bank. Fees and commission are charged on banking transaction, sometimes in the place of interest. Certain overheads and expenses are also realised in offering banking products and services. Typically, staff, systems and branch property/rental costs are incurred in generating profits.

According to Weiner (2000**a**:33) most costs in a financial institution are step-fixed costs. Step-fixed costs are neither fixed nor purely variable. An investment is required in a resource that can process a finite number of transactions and thereafter it can process no more. The next incremental transaction will require the acquisition of an additional resource. The methods of allocation of these fixed-step costs can dramatically affect the resulting measurement of for example, account level profitability (Weiner, 2000**a**:33). Stott and Watson (1992:22) argue that cost allocation should be developed with care and oversight and involvement of business units given that few hard and fast rules exist. Activity based costing can assist in defining an appropriate cost allocation basis. Costs pertaining to an activity such as approving a new loan transaction by a loan officer are allocated based on the effort expended in the activity. Standard unit costs or activity based costing is the most reasonable way to allocate costs, according to Weiner (2000**a**:33).

Standard unit cost however requires the estimation of the capacity of people and therefore becomes more than just a cost accounting challenge. Multiple business unit operations are required to be involved and not only the accounting departments. This will ensure that capacities are estimated correctly and the resulting unit cost information may be better used to plan and manage resources and make better decisions (Weiner, 2000**a**:33). According to Koch and

MacDonald (2000:175) by allocating the total costs and revenues to products, customers and business units of the institution, management can obtain a better indication of the segmental net income. Activities that support the bank, its products and its customers are therefore measured based on its overall profitability contribution.

According to Weiner (2000**a**:33) solving the cost-accounting problem is a major move forward in the implementation of performance measurement and typically a customer relationship management (CRM) process. This includes the process of allocating traditional operating expenses but also the charges for funds used i.e. loans and the credits allocated for funds provided i.e. deposits. The allocation of charges and credits for loans and deposits are critical when determining the NIM contribution of balance sheet transactions to profitability (Weiner, 2000**a**:33). However, according to Smith (1999:6) most organisations struggle with these performance measurement issues and some never move beyond organisational profitability on to product and customer profitability.

According to White (2000:42) the elements used to calculate customer or relationship profitability are no different than the elements used to calculate product or organisational profitability. These elements include:

- Average daily balances
- Float
- NIM including IRR adjustments
- Provision for credit risk losses
- Non-interest income
- Allocated operating expenses

Interest income, interest expense, loan loss provision, average balances and non-interest income and non-interest expenses which are applied in the profitability measurement process, are also reported by Van Greuning and Bratanovic (2000:85-90). According to White (2000:42) an appropriate level of equity may also be assigned for deriving applicable ratios and to improve comparability with other relationships, products or business units. Table 3.1 presents the elements of relationship profitability. The balance sheet values are based on the average daily balances. These balances are applied against their respective interest yields to compute the income statement's NII which is the difference between the interest income and interest expense. The net interest margin (NIM) represents the NII stated as a margin or yield calculated

as dividing the NII by the average earning assets. Expected losses are accounted for in the provision for loan losses. Operating expenses are all the costs and expenses associated with the operations of the bank allocated to the appropriate areas or units. The net result presents the net income or profit contribution of the bank (White, 2000:42).

Koch and MacDonald (2000:104-109) also state that the income statement values are a primary source of return information in profitability analyses. The difference between interest income and interest expense (NII) are a significant source of return for a bank. Operating costs and other income, taxes, dividends and loss provisions are other income statement elements applied in the calculation of the net income.

Table 3.1 The elements of relationship profitability

Average daily balances	
Commercial loans	34,000
Installment loans	11,000
Checking	10,500
Certificates of deposits	45,000
Interest income	
Interest income on loans	4,084
Credit for funds provided	3,384
Margin-related fees	304
Total interest income	7,772
Interest expense	
Interest expense on deposits	2,525
Cost of funds on loans	2,476
Total interest expense	5,001
Net interest income	2,771
Provision for loan losses	425
Adjusted net interest margin	2,346
Net service charge income	233
Operating income	2,579
Operating expenses	
Variable expenses	894
Fixed expenses	549
Profit contribution	1,136

Source: (White, 2000:43)

Hodnett (1999:20) explains that a bank repackages risk for profit while managing any residual exposure. The commercial rationale for a bank is therefore to take risk and in the process to be adequately and profitably rewarded for doing so. The commercial rationale for a bank is therefore directly correlated to the risk/reward trade-off discussed in chapter 2 (p24). Shareholders invest in the bank's stock or equity and require an above average return for the risks to which their investment is exposed. According to Hodnett (1999:20) the risk/reward relationship is typically ignored by banks who measure their performance against ratios such as:

- Asset growth;

- Return on assets (ROA)
- Cost to income and other typical efficiency ratios (Hodnett, 1999:20).

According to Hodnett (1999:20) traditional accounting-based performance measurement tools as mentioned above typically do not measure risk accurately. In the extreme, the use of these measures may lead to damaging business strategies deployed in the bank concerned. Matten (1996:26) explains that homogenous business activities are easily measured from a comparative basis given the amount of capital allocated or invested in such activities and the nature of the products and lending activities were mostly identical. Applying return on assets (ROA) performance measures was providing adequate information in making business decisions.

According to Stott and Watson (1992:16) homogenous lending activities lend itself to that asset growth was a critical focus point for banks. Large sums of money were lent to borrowers in an attempt to ensure balance sheet growth and increased market share. The ROA measure of performance was adequate to measure banks performance as it was complimentary to asset growth and market share measures. Weiner (2000**b**:15) argues that ROA is a useful measure when banks or business units have a similar risk profile but it fails to consider risk as part of the profitability equation. Two units may use the same amount of funds (loans) and produce the same return but without an assessment of risk and the required capital each unit uses to cover its losses, a comparable measure of profitability does not exist.

According to Hodnett (1999:20) and Seitz and Yeager (1991:47) deregulation, which led to financial product innovation, and risk-based capital requirements with the introduction of the 1988 Capital Accord forced banks to reconsider their performance measurement techniques to connect risk and return. The allocation of capital to act as buffer against losses due to risk exposures, fundamentally required performance measures to assess the efficiency (availability and usage) of capital in terms of risk. Matten (1996:26) states that the Basel I (1988 Capital Accord) regulations forced banks to hold regulatory capital calculated on risk-based assets values. Banks were forced to hold a minimum level of capital to absorb losses based on the relative levels of risks the banks endeavoured. Stott and Watson (1992:16) also state that the Basel Committee Capital Adequacy guidelines forced banks to focus and manage the availability and usage of their capital.

Haubenstock and Aggarwal (1997:175) state that banks have always attempted to measure risk and reward in their business decisions, but this was mostly done intuitively or based on crude information systems such as the bank's accounting systems. Seitz and Yeager (1991: 50) state that accounting-based rate of return measures such as ROA and ROE or ROC ignore important costs, fail to consider product life and ignore the timing of benefits. Successful banks will allocate scarce capital with accuracy given the importance of achieving a competitive advantage over competitors and increasing shareholder value. Traditional accounting measures do not consistently results in the most profitable allocation and use of capital. ROA and ROC/ROE may suffer from similar problems in that it may for example indicate a misleading profitability observation for less- or unprofitable products.

Stott and Watson (1992:16) also reports that off-balance sheet products and derivative instruments were developed and extensively traded by banks. This caused that accounting based performance measures and ROA became obsolete as these instruments do not readily translate into balance sheet assets. In addition, Stott and Watson (1992:17) explain that some products and services banks offered did not represent any balance sheet assets and therefore ROA measures were infinite. Therefore, return on equity (ROE) or return on capital (ROC) measures was employed to measure performance. According to Giarla (1991:22) measuring performance of a bank requires an assessment of risk and capital required to cover potential losses from such risks. The performance measure applied can therefore directly influence management and business decisions.

Matten (1996:26) states that modern banks are engaging in multiple heterogeneous activities and therefore it is difficult to measure these activities' performance. The reason for this is that various risks at differing risk levels and amounts of capital are invested in these various activities. Measuring the performance of these activities requires a comparable measure incorporating the risk effect on both return and capital. This requires that both return and capital should be applied in the performance measure on a risk-adjusted basis. Ong (1998:11) agrees stating that risk and return is interrelated and the measurement of performance should acknowledge this relationship.

Bessis (1998:22) state that both types of information, risk and profitability should be incorporated in measuring the performance of a product, business unit or bank. This requires however that accounting information is adapted to reflect the contribution of risk. Bessis

(1998:261) further states that classical accounting-based profitability measures such as NII, NI, margins, ROA and ROE/ROC do not allow a comparable measurement between the profitability of for example products and branches. Only measures that incorporate the risk/reward perspective to performance are meaningful.

Bessis (1998:22) also explains that risk-adjusted measures of profitability are required given that information about both risk and profitability is combined. Accounting returns must be risk-adjusted to make various measured units i.e. products or branches comparable based on risks undertaken. Capital is required to cover adverse deviations of losses over and above of what is expected. Therefore capital must be available to cover unexpected losses originating from risk exposures. Risk effects must be incorporated on both return/profitability and capital when measuring performance. According to Ong (1998:14) the profitability of various products or units must be assessed on a risk-comparable basis by measuring returns in conjunction with the specific risks undertaken to generate the returns.

3.3 RISK-ADJUSTED PERFORMANCE MEASUREMENT

Giarla (1991:19-22) explains that the importance of risk-adjusted analysis are explained by the so called 'banker's dilemma'. Assume that a banker is faced with three potential investments or loans and that the available capital to support its investments is the main constraint. Table 3.2 represents the three loans indicating a fixed-rate mortgage loan yielding 11 percent, a consumer loan yielding 12 percent and a commercial loan with a yield of 14.5 percent. The cost of financing represents the bank's funding related interest expense or funding cost. According to Giarla (1991:20) the performance measure the banker applies must produce the best choice of investment. The banker will use the following decision rules to consider the best investment:

- For two investments with the same risk characteristic the banker will select the loan with the highest expected return.
- The chosen investment's expected return (incorporating its associated risk and costs) should exceed the bank's marginal financing/funding cost.

These selection criteria are comparable to the risk/reward trade-off discussion of Uyemura and Van Deventer (1993:3) in chapter 2, section 2.2.3 (p39). Giarla (1991:20-22) explains that the three investments presented in Table 3.2 are not directly comparable given they all have varied risk profiles. The banker must therefore adjust for the risk dimensions within each loan opportunity. Therefore, the risk dimensions are quantified as it relates to the credit risk, interest

rate risk and option risk. The associated margin or NII and net spread or NI (NII minus associated expenses) is calculated.

When the ROA performance measure is applied the banker will select the consumer loan given that it has the highest yield of 1.80 percent. The banker may however consider the expenses associated with each loan and by still applying the ROA measure, but adjusting the return calculation to incorporate the non-interest expenses, will select the commercial loan yielding 0.85 percent. The shareholders require a return on their investment and the regulators require a risk-based capital allocation to all these potential loans to cover losses. The ROE measure are applied but adjusted the return and capital for the associated risks. The risk-adjusted analysis identifies the mortgage loan as the optimal investment with a risk-adjusted ROE of 24.25 percent. Had any of the other performance measures been applied a sub-optimal investment selection would have been made. Risk-adjusted analysis supplied the banker with the required information to make the optimal decision that will maximise shareholder value Giarla (1991:22).

Table 3.2 Banker's dilemma – investment decisions and performance measures

	Mortgage loan (%)	Consumer loan (%)	Commercial loan (%)
Yield	11.00	12.00	14.50
Funding cost	-8.00	-8.00	-8.00
Interest rate risk	-1.00	-0.50	-0.75
Credit risk	-0.50	-1.50	-4.00
Option risk	-0.60	-0.20	-0.40
Margin (ROA measure)	0.90	1.80	1.35
Associated expenses	-0.25	-1.50	-0.50
Net spread	0.65	0.30	0.85
Adjust fro capital requirement:			
Required capital	4.00	8.00	8.00
Return on Capital (ROE)	24.25	11.75	18.63

Source: (Giarla, 1991:19)

According to Hodnett (1999:20) the relationship between risk and reward is adopted by risk-based management systems. Risk-based profitability measurement recognises the relationship between the return earned and the risk undertaken to generate the return. These new performance measurement approaches is referred to as risk adjusted performance measures (RAPMs) or risk adjusted performance measurement (RAPM). According to Ong (1998:11) risk and return must be measured on an integrated basis. This integration is established through a

RAPM framework that quantifies the risk and return measurement of disparate units or products on a comparative and even basis.

Stott and Watson (1992:17) argues that measuring products on a comparable basis allows for the allocation of capital and resources to the product which will realise the highest expected return for the level of risk undertaken. Haubenstock and Aggarwal (1997:175) agree that by measuring the risk and return of various products or units on a comparable and integrated basis allows for better investment decisions and the usage of capital.

Bessis (1998:262-265) states that the RAPM methodology is based on the measurement of the profitability of a transaction, portfolio or business area, both historic and prospective, on a risk adjusted basis. In reference to the term return in performance measurement, Hodnett (1999:20) explains that a clear distinction is made between optimum return and maximum return. Optimum return refers to the maximum return for a given, acceptable level of risk. It embraces the concept of risk which is not the case in the concept of maximum return. Any measurement of absolute return without taking consideration of the risk taken to achieve the return ignores the risk/reward trade-off. The relationship of the risk in generating the return is fundamental to the development of a performance measurement methodology and is the basis of a RAPM process (Hodnett, 1999:20). According to Bessis (1998:16) increasing the lending to high risk customers may lead to higher earnings but also expose the bank to higher potential losses. Maximising profits invariably dictates that maximum risk should be taken. The risk/reward relationship directs however that risk management should focus on optimising profitability given that risk is part of generating return.

Hodnett (1999:20) states that a bank must measure its return or profitability relative to the amount of risk undertaken to achieve the return in order to have a performance measurement tool that is a meaningful comparative measure of return. RAPM is a tool that will assist the bank in its strategic decision making process. According to Hodnett (1999:20) the following questions can be answered with the information gathered from the RAPM model:

- Is the return commensurate with risk taken?
- Are resources allocated to achieve the maximum return for the level of risk undertaken?
- Is the absolute level of risk acceptable to the financial institution (Hodnett, 1999:20)?

In addition, Bessis (1998:261) states that any performance measure that do not take risk into account in its quantification methodology the performance measure fails to supply information to the following three questions:

- How can the performance of individual transactions, products or business units be measured against each other without risk-adjusted analysis to make them comparable?
- How can risk be priced if it is not measured based on its profit contribution?
- How can risk be allocated to transactions or business units in the performance measurement process?

According to Bessis (1998:261) a RAPM process addresses these issues through the three main functions of a RAPM process:

- Risk and return/profitability are quantified and reported across customer, products and business lines for comparison purposes.
- The RAPM analysis assists with the pricing for risk.
- Profit and capital is assigned and allocated across customers, products and business lines based on their associated risk characteristics.

According to Haubenstock and Aggarwal (1997:176-177) regulators requires that banks must have risk management processes in place to measure and control risks, but also a management process that analyse the results in order to improve the allocation of resources and improve risk-adjusted returns. Risk optimisation is the process of applying analytical tools and a strategic process with the goal of improving shareholder value. According to Bessis (1998:16) the goal of risk management is to optimise the risk/reward trade-off to create wealth for shareholders and the bank. The various risks to which banks are exposed must be identified, measured and monitored/managed. This was discussed in chapter 2. However, according to Bessis (1998:22) the risk/reward trade-off is multidimensional and requires that the associated reward is also measured from a risk perspective.

Haubenstock and Aggarwal (1997:175) argue that often the focus of risk management processes is more related to risk measurement and control. Risk management must use risk information to better understand the business and to proactively manage risk exposures. Risk optimisation is the evolutionary step forward from risk measurement and control. Risk optimisation regards the capacity to manage risk as a proactive way of increasing shareholder value and to generate a competitive advantage. Bankers constantly need to make pricing decisions based on the trade-

off between risk and reward. The risk optimisation approach makes use of risk information to accurately determine what types and combinations of risk to take and to determine the precise risk/reward trade-off and optimal price for the risk taken. Through risk optimisation a competitive advantage is established by applying comprehensive risk management that is integrated with the business strategy and which delivers above average shareholder returns. RAPM is a framework that enables risk optimisation in financial institutions. Ong (1998:14) agrees stating that when a risk-adjusted approach, that uses risk and return measures for determining the profitability and risk profile of the bank, are in place the process of balance sheet optimisation need to be performed. The RAPM approach uses both risk and return as measures by applying a process of 'risk adjustment' that places returns of varied value generating activities on a comparable playing field.

RAPM therefore makes available the information needed to analyse returns/profits on a risk-comparable basis. The return calculated using the risk-adjustment is generically called the risk-adjusted return on capital, or RAROC. The risk adjustment is applied to both the return and capital components of the RAPM. Economic capital is used as the appropriate capital measure and often implied as to the capital component of the RAPM, but regulatory capital is also sometimes applied (Ong, 1998:14).

According to Bessis (1998:261) economic capital is reflecting the balance sheets embedded risk. Risk-adjusted returns are represented by the adjusted net income for expected losses. The RAROC is the main RAPM indicator. Matten (1996:26) argues that allocating capital on a risk-adjusted basis, whether based on a regulatory or internal model, enhances a performance measurement process. Risk-adjusted returns are also required to reflect the allocation of returns based on risks taken. Koch and MacDonald (2000:175) states that measuring business lines requires that risk-adjusted returns and risk-adjusted capital must be calculated from the balanced balance sheet and income statements of the measured entity. Some measure of return is compared to the allocated capital applied in generating the return. Both return and capital must acknowledge the underlying risks endeavoured.

Haubenstock and Aggarwal (1997:177) state that there are various acronyms and terms referring to RAPM's, such as:

- RAROC – risk- adjusted return on capital
- RORAC – return on risk-adjusted capital

- RARORAC – risk-adjusted return on risk-adjusted capital
- ROEC – return on economic capital

The RAROC, RORAC, RARORAC and ROEC risk-adjusted performance measures are also reported by Stott and Watson (1992:18) and Matten (1996:59). In addition to these RAPM's Stott and Watson (1992:18) and Matten (1996:59) further supply the following RAPM's:

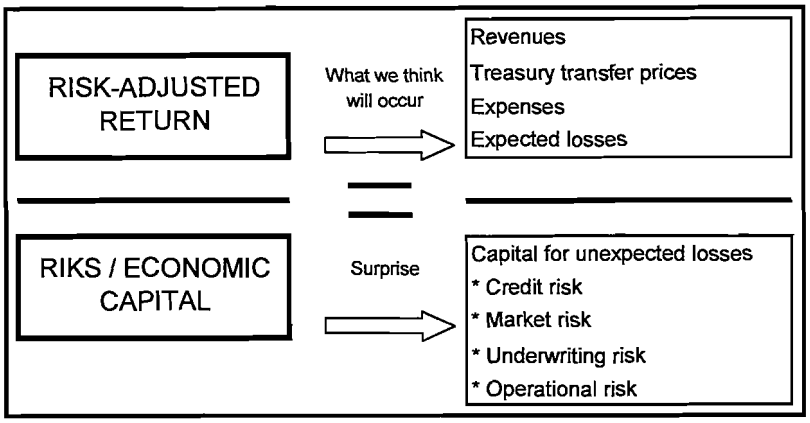
- RORAA – return on risk-adjusted assets (where assets are risk weighted).
- RAROA – risk-adjusted return on assets.

According to Haubenstock and Aggarwal (1997:178) the key RAPM ratio is RAROC or in more pedantic terms also referred to as RARORAC. The denominator of the risk/reward ratio is a measure of economic capital or equity. The amount of equity capital needed is the amount that is sufficient to protect the bank from unexpected losses. According to Matten (1996:62) the economic capital or risk capital is the quantum of capital necessary to cushion the bank against unexpected losses originating from credit risk, operational risk and market risk.

Bessis (1998:262) states that the risk-based capital as the denominator in the RAROC/RARORAC measure is determined by the capital a bank should have available to cover unexpected losses. In addition, Ong (1998:14) also states that risk capital or economic capital should cover all unexpected losses under extreme loss conditions. Not only credit risk losses should be incorporated but also other conceivable and quantifiable losses originating from the bank's activities.

Koch and MacDonald (2000:176) argues that the RAROC numerator represents the risk-adjusted return that means that expected losses and other expenses are subtracted from revenues. According to Haubenstock and Aggarwal (1997:178) expected losses are assumed to have been provided for in the return/profit value (income statement) and must be included in the measure of true or economic returns. The costs from a credit default perspective is represented by the expected loss originating from engaging in credit providing activities and this is normally accounted for in the 'reserves' and 'provisions' of the bank's income statement. Therefore, the numerator is a reflection of the risk-adjusted return/profits which include the charge for bad debts or write-offs and accounted for as loan-loss provisions or impairments. The RAROC ratio is presented in figure 3.2 as reported by Haubenstock and Aggarwal (1997:178) and Ong (1998:14).

Figure 3.2 The RAROC equation



Source: (Haubenstock & Aggarwal, 1997:178; Ong, 1998:14)

In addition, according to Ong (1998:14) the RAROC ratio is calculated by dividing the risk-adjusted return (numerator) by the risk-adjusted capital/equity (denominator). The return must incorporate the cost of doing business reflected in for example, the tax provisions, transaction expenditure and other infrastructure costs such as buildings, equipment etc. The return must incorporate further the risk adjustments relating to the transfer prices and expected loss adjustments.

Bessis (1998:262-264) explains that the risk-adjusted return can be defined at various levels for example the NIM including/excluding non-interest income (fees and commissions). Return may also be calculated before or after operating costs. The performance measurement objectives of the bank must determine the return calculation's parameters i.e. whether the NIM or NI are applied in the RAROC calculation. However, Bessis (1998:262) states that in order to link return and capital the expected and unexpected losses should always be applied in the RAROC calculation. Expected losses are provided for in the return calculation and unexpected losses are covered by economic capital and therefore incorporated in the risk-disputed capital component of the ratio (Bessis, 1998:262-264).
According to Matten (1996:62) the return should be adjusted to take account of the various risks similar as the economic capital. The bank's funds transfer pricing process can play an important role in allocating the NIM to various risk taking activities.

According to Bessis (1998:262) the RAROC ratio can also be calculated by adjusting the earnings by the expected loss (EL) as presented in the loan-loss provisions and dividing by the capital at risk (CAR) which is a measure of capital required to cover unexpected loss (UL). The RAROC formula as presented by Bessis (1998:262) is stated as:

$$RAROC = \frac{\text{Earnings} - \text{EL}}{\text{CAR}} \tag{3.1}$$

This is also reported by Matten (1996:62). According to Matten (1996:62) the RAROC ratio or any other RAPM ratio i.e. RORAC etc. can be stated by a simple combination of calculation variables. The RAPM ratio as a generic model is presented as the following formula:

$$RAPM = \frac{\text{revenues} - \text{costs} - \text{expected loss}}{\text{VaR}} \tag{3.2}$$

According to Matten (1996:62) the value at risk (VaR) in the denominator of the RAPM equation is a measure of the capital necessary to cushion the bank against unexpected losses. According to Matten (1996:62) the VaR is also called the risk capital or economic capital indicating the value of capital at risk of being lost due to unexpected losses.

According to Haubenstock and Aggarwal (1997:178) the RAPM model is designed to allow the institution to evaluate customers, products and business streams from an equal footing. In order to make the risk-adjustments to the return and capital a key issue is the definition of the risks to which the bank are exposed. Haubenstock and Aggarwal (1997:178) advise that risks are identified and quantified using the appropriate measurement methodologies associated with each risk type. In the risk measurement process the unexpected loss components are measured and various risk mitigating strategies are developed. The RAPM process determines the performance of the overall risk/reward trade-off of the bank and in essence its overall profitability and capital efficiency. In developing and deploying an operational and reliable RAPM model the two key components as defined by Haubenstock and Aggarwal (1997:179) are the following:

- The ability to correctly match the revenues, costs and risks on a transaction or portfolio basis over a defined period of time.
- A clear differentiation between expected losses and unexpected losses.

Accordingly, Haubenstock and Aggarwal (1997:179) explain that in order to effectively determine the risk-adjusted NIM a matched maturity funds transfer pricing system is used. In addition, a full overhead (cost) allocation system are required together with a methodology and process of assigning loan-loss provision based on expected losses. The last component relates to the denominator of the RAPM ratio (RAROC/RARORAC) which reflects the need for a capital

system for assigning risk-adjusted capital (economic capital). Stott and Watson (1992:21-22) argue that a funds transfer pricing system is an important component of the RAPM process to allocate the risk-adjusted NIM. The risk-adjusted return should also be based on an effective cost-allocation system that assign overhead and costs from non-income generating areas of the bank to products, customers and business units. Non-interest revenues should also be allocated to products, customers and business units. Matten (1996:141) also states that revenue streams and costs must be allocated based on sound methodologies and that a robust system for doing so is a precursor to an effective RAPM process.

According to Stott and Watson (1992:21-22) the allocation of return should cover decisions about revenue allocation, cost allocation and funds transfer pricing (FTP). The FTP process must be applied consistently to all products and areas to adequately recognise the risks and costs involved in order to achieve a measure for comparison of relative performances. According to Matten (1996:145) the risk-adjusted return component of a RAPM model can be calculated by applying two techniques. These techniques are fundamental to quantifying the profitability contributions of risks at the time when they are incurred to the banking book. The banking book conventionally applies the accrual accounting method which raises scepticism about applying market valuation methods. The two techniques according to Matten (1996:145-149) are:

- The application of a statistical derived method of calculating loan-loss reserves or provisions to quantify the expected losses to the return component of the RAPM ratio.
- FTP at market rates which result in the interest rate risk (mismatch) being transferred from the measured unit to the central treasury. This is done to eliminate the measured unit's NII sensitivity due to interest rate changes.

In addition, according to Weiner (2000**b**:15) the two basic mechanisms to the implementation of a customer or relationship profitability measurement process or system is funds-transfer pricing and activity-level standard unit costing. Customer-level capital assignment is the third mechanism to complete a performance measurement system that is capable of measuring the profitability contribution of individual customers and products on an adequate basis of comparison i.e. from a risk-adjusted basis. Sophisticated profitability systems must be able to accept and record transaction cost and volumes of everything. This includes from the number of cheques written to the number of deposits made.

Credit risk codes are usually needed to support any provision for loan loss expenses or capital impairment. Repricing and maturity information is needed for the FTP process. Of particular

importance to the ALM function is the profitability measurement element relating to the NIM. Fundamental to the ALM process is the mechanism relating to FTP given its attempt to risk-adjust the NII/NIM and transfer the interest rate risk volatility to the ALM or treasury unit. In addition, Weiner (1999:13) states that ALM is integrated in the performance measurement process and RAPM in specific, via the FTP process. Payant (1994:1) agrees that combining FTP with a cost accounting system for non-interest income and expense allocation and a capital allocation method, completes a financial institution's profitability measurement system. White (2000:42) also states that the performance or profitability measurement process whether organisational, product, customer or relationship profitability measurement, starts with measuring the NIM. This includes providing an interest income credit for the relationship or product providing funds to the bank, as well as an interest expense charge for any loans made or funds used. This mechanism is intended to more accurately measure the NIM profitability based on risk contribution and is typically referred to as FTP (White, 2000:42).

3.4 SUMMARY

Conventional accounting based performance measures for example, net income, cost to income ratios, budget versus actual comparisons, asset growth etc. are not good measures of performance. The ROA, ROE/ROC performance measures were developed to assess the performance of homogenous business lines and products and at best recognised the regulatory risk-based capital requirements when analysing profitability. Increased share holder profitability pressures, heterogeneous business activities, complex financial product innovations and capital constraints require that performance measures incorporate the risk/reward trade-off banks face in its methodology.

RAPM is the process of quantifying the risk-adjusted return and risk-adjusted capital (economic capital) in order to supply comparable profitability information on the existing and potential new business opportunities for the bank at the customer, transaction, product, business unit and business line level. The key components in the RAPM model is identified as being the NII or NIM which are adjusted for the expected loss component typically accounted for as loan loss provisions, the activity based cost allocation process of non-interest income and expenses (operating expenses and overheads) and an economic capital allocation system.
RAROC (RARORAC) is the predominant RAPM that supply comparable risk based profitability information that allows risk optimisation and enables strategy formulation that will

deliver above average returns to shareholders. FTP is a critical component of the RAPM process given its proficiency to quantify the risk-adjusted NII/NIM and in the process remove interest rate risk sensitivity from the measured unit to the treasury or ALM department. The NIM accounts for the largest portion of a typical bank's overall profitability. It requires that the NIM is managed properly. By evaluating the funds used and provided at the customer level, an institution can acquire the information needed to better formulate strategies that will enhance the NIM on an overall basis.

The NIM calculation at the customer level is a critical step in customer profitability measurement. By assigning charges and credits for funds used and provided the bank may assign responsibility more accurately to the management of IRR. This is typically the task of the ALM department or ALM process. The ALM process is therefore integrated within the RAPM process through the FTP mechanism. Chapter 4 will discuss the ALM function and specifically IRR management in banks to assist the explanation of the linkage between ALM and performance measurement (RAPM). The ALM IRR measurement process need to link with the FTP and RAPM results to ensure the process of quantifying and managing IRR is optimised.

CHAPTER 4

ASSET AND LIABILITY MANAGEMENT IN BANKS

4.1 INTRODUCTION

In the previous chapters the process of intermediation between surplus and deficit units in the economy was presented as a fundamental function and business rationale of current banking institutions. Given the nature of this intermediation function that banks perform it was noted that banks are exposed to inherent risks. Having a clear understanding of banks' role in the financial system and the origin and nature of the intermediation function performed, bank supervisors are concerned with the stability of the financial system. Bank regulation and supervisory influences demands a dedicated and efficient management perspective to the risk-reward trade-off in order to ultimately ensure financial system stability. This forms compelling evidence for the need of prudent risk management practices.

Through the background in section 1.2 of chapter 1 and the objectives of chapter 2, a *raison d'être* to asset/liability management (ALM) was established. In chapter 3 the measurement of profitability/performance from a risk-adjusted basis was presented as a fundamental technique in managing the risk-reward trade-off banks faces. It was established that conventional accounting-based performance measures i.e. budget comparison, asset growth, return-on-assets (ROA), return-on-equity (ROE) and cost-to-income ratios are deemed inadequate in making risk and strategic management decisions to drive the optimisation of shareholder value/capital. It was presented that risk-adjusted performance measurement (RAPM) techniques such as RAROC or RARORAC applies risk-adjustments to both return and capital/equity in order to quantify the risk-reward information needed. The ALM process was presented as a key risk management area that centralise the interest rate risk (IRR) or mismatch component of the risk-adjusted returns as applied in the RAPM ratios. Funds transfer pricing (FTP) was identified as the technique of quantifying the risk-adjustment to the net interest margin (NIM).

According to Rosen and Zenios (2006:4) risk management provides the tools to measure risks and the techniques to assist an organisation to make rationale decisions about the risks' consequences. Haubenstock and Aggarwal (1997:175) argue that risk management must use risk information to better understand the business and to proactively manage risk exposures. Risk optimisation is the evolutionary step forward from risk measurement and control. Risk

optimisation regards the capacity to manage risk as a proactive way of increasing shareholder value and to generate a competitive advantage for a bank. Through risk optimisation a competitive advantage is established by applying comprehensive risk management that is integrated with the business strategy and which delivers above average shareholder returns. Bessis (1998:16) states that the goal of risk management is to optimise the risk-reward trade-off. Risk that turn into reality may generate losses. In banking, profits are associated with risks and therefore require prudent management given that the level of risk is always in relation to expected profitability. The BCBS (2006**a**:3) states that banks must have effective risk management processes in place. In particular, interest rate risk management processes and systems must be in place to identify, measure, monitor and control interest rate risk in the banking book.

Chapter 4 will focus on ALM and IRR given its importance to the RAPM process through the FTP mechanism that centralise the IRR-adjusted return component to the ALM area of the bank. Chapter 5 will discuss the techniques for measuring IRR. This will present that through the ALM process and IRR measurement the risk optimisation component relating to risk measurement and control will be established. In conjunction with the FTP discussion in chapter 6 the integration of profitability measurement and ALM will be elucidated. This will establish the rationale to converge the ALM and RAPM (through FTP) processes into the concept of risk optimisation, as presented by Haubenstock and Aggarwal (1997:175).

The objectives of chapter 4 are the following:

- To provide insight to the ALM field of study for banks.
- To establish an understanding of IRR in the banking book as pertaining to ALM.

Chapter 4 will establish the importance of the ALM process in managing the risk/reward trade-off for the bank. Section 4.2 will define ALM and present the various approaches to ALM risk measurement. IRR will be discussed in section 4.3 elucidating the sources of IRR and the various perspectives to IRR measurement and management.

4.2 ASSET-and-LIABILITY MANAGEMENT

According to Bessis (1998:1) the evolution from regulators regarding risk-based capital requirements is a major incentive for the development of new tools and risk management

techniques. Hodnett (1999:20) argues that stricter capital requirement standards require that banks focus on the inherent riskiness of their activities. Seitz and Yeager (1991:47) argue that risk-based capital requirements and deregulation of financial markets required that banks had to focus on how risk may affect profitability, shareholder value and the scarce capital of the bank.

Matten (1996:26) concurs that capital is a scarce resources and that risk exposures may negatively impact the value of capital and the net worth of a bank. Risk-based capital requirements imposed by regulators require that risk is measured and managed in an effective way. In addition, (Bessis, 1998:16) states that the risk-reward trade-off is fundamental to the rationale of the intermediation performed by banks and underpins the whole concept of risk management for banks. Banks, by taking risks, transforming and embedding them in banking products and services, through its intermediation functions performed, can by managing these risks establish a decisive competitive advantage.

Matten (1996:3-4) states that the collapse of the Bretton Woods agreement lead to an increase in foreign exchange and ultimately manifested in higher currency and interest rate volatilities. Central banks were forced to use their control over the supply and price of funds to banks as the only available monetary policy tool. The strain on the banking system was enormous given that banks at that point in time were highly regulated. Strict control over banking licenses and the prices on deposit's and loans were enforced by central banks after the Great Depression in the US of 1933 and the hyperinflation economic climate and resultant political changes in Europe during the 1930's. According to McGuire (1997:62) the Federal Reserve Bank System controlled all monetary activities in the United States and in specific the setting of deposit interest rates.

Banks' balance sheets were fairly uncomplicated and financial market activities from banks were heavily regulated. According to Bitner (1992:4-5) banks had very limited competition given that banks' interest rates were regulated. The term '3-6-3 banking' was established indicating that bank paid 3 percent on deposits, received 6 percent on loans made and a profit of 3 percent. In addition, Matten (1996:4) states that banks' margins were fixed given that deposits' interest rates were regulated. Therefore, competitive pressures were minimal until the evolution of financial markets created alternative funding instruments at unregulated interest rates. Alternative investments to traditional bank deposits lead to disintermediation and a transformation of banks' balance sheets. The solution to these banks' problems was

deregulation. Regulation Q had to be abolished to enable banks to compete for deposits against alternative deposit products in the money and bond markets. According to Bessis (1998:4) Regulation Q, which capped rates payable on deposits, created an unfair competition between banks and money market funds. Deregulation drastically increased the number of new and innovative financial products offered and increased market volatility originating from market-driven forces became a common occurrence.

According to Koch and MacDonald (2000:302) the effects of deregulation through the abolishment of Regulation Q, were increased interest rate volatility and difficulty for banks to manage their NIM. With interest rates paid on deposits and charged on loans no longer controlled by the regulators, interest rate fluctuations influenced banks' earnings and the values of stockholders' claims. According to Bitner (1992:3-7) banks started to experience volatile earnings as a result of changes in interest rates that would occur frequently, during and after the abolishment of Regulation Q which controlled interest rates on customer deposits in the USA. Most of the bankruptcies during the 1970's and early 1980's resulted from poor interest rate risk management. Only some of the largest and sophisticated banks had developed in-house interest rate risk management processes.

McGuire (1997:63) argues that volatile interest rates, the onset of inflation and advances in financial products and computing technology, required the management of IRR. The performance of banks was directly influenced by fluctuations of market-determined interest rates. Inflation and various market crises drove interest rate volatilities and levels to new heights.

Bitner (1992:5-7) states that with higher yields experienced against all believes in 1976, most banks started to understand the importance of interest rate risk management. Regulators became increasingly concerned about the health of financial institutions which resulted in new banking regulations. These new regulations forced senior management of banks to have detailed interest rate risk management policies and processes which included, an ALM committee and simulation models that adequately capture the bank's earnings and value exposure to interest rate risk.

According to Koch and MacDonald (2000:302) banks' management had to implement strategies to reduce the impact of changing interest rates on their profitability. IRR management became a very important focus point for bank risk management. McGuire (1997:63) also states that

advances in cost-effective computing power and software advances made IRR measurement capabilities accessible to most banks. According to Bitner (1992:5-7) the importance of profitability exposures to changes in interest rates and regulatory influences was therefore fundamental to the development of risk management and ALM in particular, and therefore the science of ALM has evolved very rapidly since the early 1980's.

4.2.1 ALM DEFINED

In order to define ALM it is necessary to reflect on the history of risk management and how it evolved. The discussions in the preceding sections forms an indicative prelude to what ALM is all about and how it can be defined.

ALM is defined by Mark (1997:156) as a structured decision-making process for matching and mismatching the mix of assets and liabilities to maximise the bank's net worth while assuming reasonable amounts of gap and liquidity risk. In this definition of ALM, gap risk is a term used in reference to interest rate risk. Gap analysis as a method of quantifying interest rate risk will be discussed as part of understanding interest rate risk analysis. Bessis (1998:31) defines ALM as a subset of risk management that focuses on the quantitative management of interest- and liquidity risk at the global level.

Bitner (1992:12) states that ALM involves viewing the balance sheet as a very complex interest rate arbitrage. This implies that funds are obtained from various sources at varied interest rates and then employed in a variety of assets at rates high enough to cover interest paid on the deposits and the operating expenses of the bank in order to produce a profit for shareholders. ALM is explained by Uyemura and Van Deventer (1993:2) as a financial risk management process of any financial institution, which includes the risk assessment in all dimensions i.e. policy setting, the structuring of the bank's balance sheet repricing and maturity schedules, undertaking hedging positions and internal profitability measurements.

Another definition or perspective of ALM is given by Ong (1998:1) which states very simplistically that ALM is all about the trade-off between risk and reward. It is therefore a function that focuses on taking risks in innovative ways in order to achieve the desired reward. Dattatreya (1991:38) describes ALM as the systematic approach that attempts to provide a degree of protection to the bank from intermediation originated risks and that makes the risks

more acceptable. In this process, ALM provides the framework to define, measure, monitor, modify and manage interest rate risk. According to Bitner (1992:14) the ALM function involves planning, directing, and controlling the flow, level, mix, cost, and yield of the consolidated funds of the bank. These tasks and responsibility must be interwoven with the overall objectives of achieving the bank's financial targets and controlling the associated financial risks.

Uyemura and Van Deventer (1993:2) explain that conventional thinking from bankers and many CEOs about ALM relates to the maximisation of profits and to minimise risks. This way of thinking regarding what ALM is all about, is close but missing the crux of ALM fundamentally. The reason for this understanding to be dangerously wrong is that this implies that it is possible to derive strategies that will increase the profit of the bank without undertaking any additional risk at the same time. It is a well-known fact in the real world that this situation does not hold true. This was discussed as part of the risk-reward trade-off concept in chapter 2, section 2.2. Generally, any action to increase profits will go hand-in-hand with increasing the risks undertaken to create such profits. ALM is more focused on optimally analysing and understanding the risk-reward trade-offs than achieving the alchemy implied by maximising profit and minimising risks.

Bessis (1998:16) states that risk-taking is a condition for bank profitability. The focus of ALM as a risk management process should be on optimising the risk-reward trade-off. Hodnett (1999:20) agrees that maximisation of profit indicates taking on potentially unacceptable levels of risk. Optimum return however means the maximum return for an acceptable level of risk. The risk-reward trade-off is therefore integral to ALM. Bessis (1998:22) states that the objective of risk management is to optimise the risk-reward trade-off. According to Uyemura and Van Deventer (1993:4) the purpose of ALM is to maximise the risk-adjusted returns to shareholders over the long run. According to Uyemura and Van Deventer (1993:4), what are important from this definition of ALM is that it focuses on the risk-reward trade-off and that value is created for shareholders over the long-term. Rosen and Zenios (2006:17) agrees explaining that ALM is an important part of risk measurement and risk control of market risk or IRR, credit risk, liquidity risk and profitability. The risks and potential rewards of the balance sheet's products must be assessed in order to achieve a maximisation of the bank's risk-adjusted returns to the capital investments of its shareholders. In addition, Ford (1999**a**:416) states that ALM must structure the balance sheet to achieve long-term maximisation of the economic value of the balance sheet. Conversely, ALM's short-term goal is to maximise the NIM whilst maintain an acceptable level

of risk. Managing or structuring the balance sheet must be done with the necessary flexibility to adjust for unanticipated IRR, liquidity risk and other market scenarios.

Although the definition of ALM as supplied by Ong (1998:1) is unsophisticated and precise it is by no means trivial if the risk-reward concept is recapped from chapter 3, section 3.2. Ong's (1998:1) definition of ALM is therefore in support of definitions supplied by Uyemura and Van Deventer (1993:4). Ong (1998:1) states that it might be argued that because the risk structure and the sources of profit for a bank are quite varied, this definition includes all financial and non-financial risks in the assessment of the risk-reward trade-off. Practically this is not always the responsibility or focus of ALM but stress the point that it has to be incorporated in the results/analysis conducted in ALM.

According to Principle 3 of the Basel supporting document on the management of interest rate risk, the BCBS (2004:3) stress that clear segregation of duty and responsibility for the risk management process must be established, to ensure that potential conflict of interest is avoided. From this recommendation it supports the notion that specialist functions should exist within the bank to manage specific types of risk.

The CEBS (2006:7) explains that in the setting of interest rate risk policy in large and more complex institutions, the function of measuring, monitoring and controlling interest rate risk is usually called Asset-and-Liability Management (ALM). The function of ALM is usually assigned to an independent risk control unit. The ALM unit assumes the responsibility of measuring, monitoring and managing interest rate risk. In some cases the institution will have a committee, usually called the Asset and Liability Committee (ALCO) with delegated powers directly from the bank's Board of Directors, responsible for all major interest rate risk hedging and new asset and liability decisions. The CEBS (2006:7) also notes that most supervisors recognise the fact that various levels of centralisation of ALM exist within institutions, e.g. in some cross border groups or multinational banks some may have a centralised management and assessment function whilst others do not.

According to Mark (1997:156) the objectives of ALM are:

- to stabilise net interest income (NII) which reflects accounting earnings;
- to maximise shareholder wealth (economic earnings); and
- to manage liquidity.

In addition to the broad ALM objectives as stated by Mark (1997:156), Ong (1998:3) explains that ALM has the following five fundamental objectives that should be striven to be achieved:

- The ALM process must preserve and enhance the net worth of the institution: The objectives of ALM should not limit its scope to merely risk assessment but should also focus on strategy formulation that will result in an increase of economic value or earnings of the balance sheet.

  According to Rosen and Zenios (2006:18) various 'what if' scenarios must be assessed in order to ascertain the strategy that will optimise the earnings or economic value of the bank's balance sheet. In addition, Ong (1998:3) states that the ALM function should focus on enhancing the net worth of the bank under uncertainty whilst satisfying certain constraints. The uncertainty can take the form of changes to interest rates, volatility in portfolio earnings and changes in general economic conditions; while the constraints could represent limited funding availability, regulatory requirements or higher expectations in levels of return and performance. The primary concern of ALM should be this ability to balance the uncertainty and constraints while achieving increased economic value or earnings (Ong, 1998:3).

  According to Rosen and Zenios (2006:17) the ALM function of bank must manage the balance sheet of the bank in order to increase its net worth. The return on allocated or assigned capital to business units by ALM must be optimised through effective product pricing and identifying hedging opportunities to mitigate risk.

- ALM is a quantification of the various risks in the balance sheet: Dattatreya (1991:38) explains that through the intermediation function performed, the bank is exposed to many risks such interest rate risk, currency risk, capital risk, credit risk, liquidity risk etc. Interest rate risk falls neatly in the ALM framework because the risk is quantifiable for the balance sheet in its entirety and for which appropriate hedging vehicles are available. According to Rosen and Zenios (2006:17) ALM should take cognisance of all risks in the balance sheet given their potential impact on profitability and the net worth of the bank. However, ALM typically takes a more focused view on specific IRR and liquidity risk. Dattatreya (1991:39) agrees stating that ALM focus on IRR and liquidity risk.

Ford (1999**a**:416) argues that various risks exist in the balance sheet and that these risks' impact on the NIM and economic value of the bank must be measured. According to Ong (1998:4) the delicate process of ensuring that the net worth of the bank is enhanced or at least preserved, presupposes the organisations ability to measure the myriad of risks both on- an off-balance sheet. The balance sheet which represents the financial position of the bank as a whole contains a wide variety of risk elements and their interrelationships to one another. With the development of more accurate statistical methods and the mark-to-market ability created by the development of actively transacted markets, the ability was developed to adequately quantify and manage the embedded risk of the balance sheet and therefore facilitate prudent risk management.

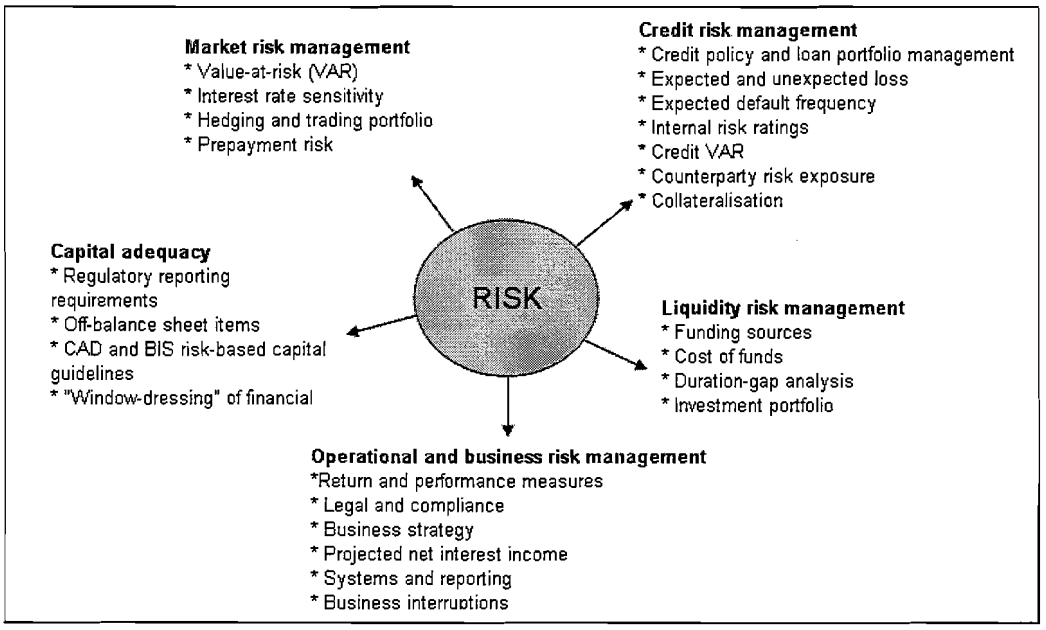
According to Rosen and Zenios (2006:17) the enterprise-risk-management (ERM) perspective may be applied to ALM that focuses on all risks embedded in the balance sheet. This dictates that all risks and their respective collective impact on the earnings and value of bank must be measured and managed. Figure 4.1 illustrates the major risk components of market risk (IRR), liquidity risk, operational risk, credit risk and capital adequacy (capital risk) (Ong, 1998:4).

- ALM must streamline the management of regulatory capital: Regulatory capital adequacy requirements refers to the minimum level of capital needed to ensure the bank's solvency levels are maintained and is therefore geared to absorb losses associated with credit risk defaults and other risks i.e. market risk and operational risk. According to Rosen and Zenios (2006:16) through ALM can by means of FTP and risk measurement assist with the more effective allocation of risk-based capital i.e. credit risk capital.

Ford (1999**a**:417) states that ALM should assess the appropriate levels of capital required to cover unexpected losses. According to Ong (1998:5) all assets should be classified according to their intent of acquisition i.e. whether the asset was bought to be hold-to-maturity; as a trading security; or if it is available-for-sale. The reason for this classification is to clearly identify the assets in order to leverage the balance sheet for interest rate and liquidity risk. These strategies formulated will ultimately impact the level of capital required and also influence the final associated credit risk given that the

balance sheet composition or mix can change. Furthermore the general impact that ALM must have in optimising the balance sheet gives it a direct impact on capital management. It is noted that with the Basel II (BCBS, 2006**c**:8) requirements for minimum capital adequacy requirements, dedicated capital management functions are needed but with some assistance from ALM in specific to facilitate capital planning and optimisation.

Figure 4.1 Major risk components



Source: (Ong, 1998:4)

- ALM should provide liquidity within the organisation: Ford (1999**a**:416) argues that ALM must make decisive decisions about how to fund the balance sheet. The liquidity of the bank must ensure that new loans can be funded and that deposit withdrawals can be honoured and replaced.

Ong (1998:6) argues that ensuring that short-term cash inflows and cash outflows are more or less balanced to ensure no funding or liquidity crisis emerges, is one of the roles of ALM. All banks need a certain amount of liquidity to ensure that short-term liability payments are met. This implies access to quick short-term low cost funding but also intrinsically that the assets must be structured to have sufficient short-term cash in-flows. In other words, liquidity in its simplest form should be managed on both sides of the balance sheet (Ong, 1998:6).

Bessis (1998:119) agrees, stating that liquidity management extend to the funding of deficits and the investment of surpluses in relation to the growth in the balance sheet and the demand for existing deposits. A safety cushion of liquid assets can be established to provide liquidity during unexpected large funding deficits.

- ALM should actively and judiciously leverage the balance sheet: Haubenstock and Aggarwal (1997:175) argue that banks through effective risk management (ALM) can optimise the risk-reward trade-off. The relevant risk information will supply the bank's management with the required information to allocate resources and capital to the business activities that will be most profitable given the risks they engage.

  According to Rosen and Zenios (2006:15-16) financial risks are quite often interdependent and that ALM that focus on all balance sheet risks (the enterprise-risk view of ALM), can identify their interdependence and exploit natural hedges that appear in its balance sheet. This leads to more efficient operations and capital allocations. Giarla (1991:9) also states that the role of risk management and therefore ALM is to support the intermediation function of the bank in a way that will enhance profitability.

  Ong (1998:6) states that the profitable side of risk management is associated with ALM. Banks can assume the intermediation function as their primary business given they have an effective ALM function. The risk-reward trade-off is a fundamental point; if there is no reward why take the risk. By leveraging its own balance sheet, thereby enhancing its value whilst at the same time assuming reasonable levels of risk, the bank can derive an advantage over its competitors (Ong, 1998:6). In addition, Dattatreya (1991:38) states that the more leveraged a bank are the more critical the ALM function is to the bank. The ALM function must ensure that the net worth of the bank is not only protected but also enhanced.

According to Bessis (1998:32) the major focus areas of ALM include:

- The measurement and monitoring of interest rate and liquidity risks:
  - Setting up targets for volume and earnings of the operations
  - Setting of interest rate risk limits
- The funding and control of balance sheet constraints:

- liquidity constraints
- debt policy
- capital adequacy ratio and solvency

- The hedging programmes for both liquidity and interest rate risks.

According to Kelly (1993:320) finds the focus of ALM on the bank's NIM given that a material portion of a bank's profit is generated from its net interest margin (NIM) or net interest income (NII). The NII is the difference the bank receive for interest earned on its loans to clients (assets) and the interest paid on funds received from depositors (liabilities). The NIM is simply the difference between the interest received and interest paid (or NII) divided by the average assets which earned the interest received. Therefore it is clearly of paramount importance for effective and dynamic ALM, that is, for the bank to manage its assets and liabilities simultaneously, to maximise the NIM. Ford (1999**a**:416) agrees in that ALM should focus on maximising the NIM but at an acceptable level of risk. According to Dattatreya (1991:37) the intermediation function of banks exposes their net worth or profitability (NIM) to IRR. ALM provides the necessary framework to define, measure, monitor, modify and manage IRR. According to the view of ALM by Kelly (1993:321), ALM focuses on controlling the NIM of a bank.

It is therefore evident that interest rate risk management forms the foundation of ALM given the potential down-side risk to the NIM if interest rates change. Furthermore, the fundamental responsibility of the bank's management is to ensure the maximisation of shareholders' wealth. Any change to interest rates can materially influence the bank's profitability and market value of its assets and liabilities. Kelly (1993:320) concludes that the goal of ALM is to formulate strategies and take actions that will structure the bank's balance sheet in such a way that contributes to its financial goals. In reference to the term 'maximisation' of 'shareholders' wealth it was reported by Uyemura and Van Deventer (1993:2) that ALM focuses on maximising profitability to shareholders within acceptable risk levels.

Hodnett (1999:20) agrees that ALM should maximise profit within acceptable levels of risk and therefore take the risk-reward trade-off in considering any strategies. According to Bessis (1998:16) the existence of the risk-reward trade-off for banks dictates that risk management and therefore ALM, should focus on the optimisation of shareholders' wealth.

According to Gavin (2001:60) ALM is nothing more than managing the risk to earnings as a result of changes in financial markets (i.e. interest rates or foreign exchange rates) that are caused by the mix of assets and liabilities of the bank. The risk does not come from the floating rate loan or the fixed deposit, but from the fact that the floating rate loan is funded by the fixed rate term deposit. In other words mismatch also results from the pricing requirements from lenders and borrowers i.e. whether the client has an appetite for changes in interest rates would determine whether a fixed or floating rate would be preferred (Gavin, 2001:60).

Mark (1997:156) describes that ALM involves the intentional mismatching of the maturity/repricing of assets and liabilities for profit whilst a reasonable amount of risk. For example, instead of trying to acquire new term-matching deposits, banks will often make long-term corporate loans and fund it with short-term wholesale money. The concept of riding the yield curve is a source of gap or mismatch risk. In simplicity, it refers to the standard management practice of carrying an asset further along a positive sloping (short-term rates lower than longer-term rates) yield curve than the liability funding the asset (Mark, 1997:156).

Liquidity risk is also fundamental to the ALM function as a result of the focus on managing the bank's balance sheet. The reason for this management responsibility of liquidity risk by ALM is founded from the control by ALM over the intermediation function from a NIM perspective. Any structural change in the assets and liabilities will directly have an influence on the proficiency of the bank to meet its cash flow commitments (Kelly 1993:320).

According to Dattatreya (1991:39) ALM can also measure and monitor liquidity risk and provide suitable strategies to manage liquidity risk. Ford (1999**a**:418) also states that IRR and liquidity risk is interrelated and that managing IRR has an impact on liquidity given that different maturity of assets and liabilities are generated given interest rate differentials. Given the scope and limitations of this dissertation, liquidity risk management is acknowledged to be an integral part of ALM but will not be discussed in detail, although frequently referenced due to its overall importance.

4.2.2 ALM RISK QUANTIFICATION

According to the OCC (1998:10) accurate and timely measurement of risk and in particular interest rate risk (and liquidity risk) is necessary for proper risk management and risk control. A

bank's risk measurement system must be able to identify and quantify the major sources of the bank's interest rate risk exposure. Such a risk management system should also enable management to identify risk from the bank's customer activities. According to the BCBS (2006**a**:3) banks should have comprehensive risk management processes that identify, measure and control all material risk exposures.

The BCBS (2006**a**:4) also states that IRR in the banking book systems should be able to identify, measure and control IRR and that a well defined Board approved IRR management strategy exist. According to Van Greuning and Bratanovic (2000:179) sound bank management requires that banks have appropriate risk measurement, monitoring and control functions and policies in place. Risk management policies and procedures must be commensurate to the complexity of the bank's activities and the IRR and other risks to which it is exposed. In addition, the OCC (1998:10) states that the nature and mix of a bank's business lines and the characteristics of its activities from an ALM perspective (interest rate risk and liquidity risk) will dictate the type and complexity of the risk measurement or quantification system required (OCC, 1998:10).

Quantification measures of risk are the basis on which risk management is built. Multiple measure of risk exists and they all aim at estimating the variation or difference of a given target variable, such as earnings for instance, generated as a result of changes in a random parameter such as interest rates. Bessis (1998:51) states that there are a number of specific quantitative indicators of risk that are commonly used. The specific quantitative indicators of risk are grouped in three types:

- Sensitivity: Bessis (1998:51) states that sensitivity analysis captures the deviation of a target variable generated by a unit movement of a single market rate i.e. an interest rate movement of 1%. Sensitivity is the ratio of the variation in for instance earnings to a given variation of an underlying random parameter that generates this variation. For instance the NIM sensitivity to a 1% change in interest rates is for arguments sake 0.25%. The CGFS (2005:8) and Matz (2005) explain that sensitivity analysis specifies financial parameters which are moved instantaneously by a unitary amount for example, a 10% decline or a 10 basis point increase in interest rates. This approach is a hypothetical perspective to potential future changes in the risk factor(s).

According to Koch and MacDonald (2000:302) sensitivity analyses measure the target (i.e. net interest income) sensitivity to a change in a target variable such as interest rates or embedded option balances. In addition, Bessis (1998:51) explains that sensitivity as a measure of risk is only an approximation since it gives the change in value only for a small variation in the underlying parameter. Multiple factors can potentially impact the value of an instrument and all these factors can potentially change at different times and by different units. However, given that sensitivity is simple to calculate and interpret, they are widely used (Bessis, 1998:54).

- Volatility: Bessis (1998:56) explains that volatility captures the variation around the average of any random parameter or target variable, on both the upside and the downside. It is a common statistical measure and specific the standard deviation of the values of the variables. Standard deviation is the square root of the variance of a random variable. Both are easily obtained from a time series of observations (Bessis, 1998:56). The application of volatility and in specific standard deviation as a measure of risk is also reported by Uyemura and Van Deventer (1993:14). This was discussed in chapter 2, section 2.2.1. In addition, Vaughan (1997:11) also reported that risk, or the deviation from the outcome that is hoped for, can be measured by the statistical measures of variance and standard deviation.

- Downside measures of risk: According to Bessis (1998:61) the focus is on adverse deviations only, and is expressed as the worst case value of some target variable such as earnings, with some probability attached to that value. The difficulty is to assess the probability of such a scenario given that the chances of observing such a scenario are subjective.

According to the CGFS (2005:6) scenario analysis clearly define the incremental changes to the financial risk parameters that are affected by the scenario. The changes are usually not unitary incremental changes to various risk parameters such as interest rates, target balances and pricing spreads. In addition, Matz (2005) states that scenario analyses can attach probability weightings to the occurrence of the variables associated to the scenario. This dictates that the results from the manifestation of the scenario can be analysed in a probabilistic fashion. Bessis (1998:61) further explains that in assessing the scenario's probability someone else might have a different perception of the

environment uncertainty and may therefore argue another scenario as more relevant and /or more likely. According to Bessis (1998:61) assumptions have to be made on the probability distribution of the underlying events and the factors that might cause such an event from which potential losses are generated.

In the preceding sections of chapter 4 it is evident that risk management and ALM in particular is a necessity for any bank. It was also discussed that ALM is part of the profitable approach to risk management. Ford (1999**a**:416) states that decisions have to be made flowing from the intermediation function performed by banks. When a new transaction is accepted the bank makes decisions about the pricing of the deal and its funding, liquidity interest rate risk and capital implications. Rosen and Zenios (2006:8) agrees stating that ALM must assess the pricing, funding and capitalisation impact of transactions in order to maximise the risk-adjusted returns of the balance sheet. Dattatreya (1991:38-39) supports this notion in stating that ALM assists the bank in its conduct in the financial intermediation activity, to quantify the risks and therefore price competitively for these risks in order to maximise profits for a determined and desired level of risk.

The typical risks that ALM will be responsible for are primarily interest rate risk and also liquidity risk which is a direct result of the intermediation function performed the results of which reported in the balance sheet of the bank. Bessis (1998:22) also reported this stating that ALM must focus on the optimisation of the risk-reward trade-off and in the process develop and implement the strategy of the bank. According to Meyers (1988:11), in order to understand the nature of risk, which is the uncertainty about future profits, bank managers and therefore ALM need answers to the following five questions:

- How much risk does the bank currently have?
- How much risk is the bank willing to accept?
- What is the cost of bringing the risk within acceptable levels?
- What strategies are available to bring the risk within acceptable levels?
- How and why will earnings change as market interest rates change?

Meyers (1988:12) proclaims that in order to answer these questions the balance sheet of the bank has to be analysed in order to fully understand its structural composition. Furthermore, all the factors that drive changes in NII must be taken into account. According to Meyers (1988:12)

the most important of these factors are market rates (changes in interest rate levels; changes in spreads between key rates; interest rate volatility; changes in the shape of the yield curve), bank product pricing (credit quality etc.) and future business volumes.

Dattatreya (1991:54) states that it is therefore clear that a broad range of uncertain outcomes have to be assessed in order to quantify the risk for the bank. Simulation of different scenarios can assist in the ALM process by providing insight into the future behaviour of the assets and liabilities under various market conditions. Simulations can deal with more complex market conditions and assumptions or strategy outcomes than can analytical methods (Dattatreya, 1991:54). According to Meyers (1988:13) the only way to assess probable NII for risk analysis or performance measurement purposes, is to simulate it. This is the only way to deal with all of the factors which drive changes in NII.

According to McGuire (1997:64) measuring IRR effects on earnings or NII is most effectively performed with an ALM simulation model. The existing balance sheet profile and future performance influencing factors are incorporated from which future balance sheets and income statements are computed. Koch and MacDonald (2000:320) also state that simulation models incorporate a dynamic assessment of changes to NII by simulating all influencing factors across various interest rate movements. According to Meyers (1988:13) the function of a simulation model is to transform the assumptions and strategic business decisions of the bank into future financial analyses. The art lies in the capability of managers to identify and assess strategies. Therefore the simulation model must project future financial performance for each alternative strategy and possible rate scenario.

Bessis (1998:169) agrees with Meyers (1988:13) that basic financial analyses i.e. gap analysis provides NIM sensitivity under very restricted assumptions and with a unique scenario of a projected constant balance sheet. According to Cade (1997:157) the answer to assessing the impact of risk on the bank in less flawed and more comprehensive techniques than static gap and duration analysis is found in simulation analysis. According to the BCBS (2004:30) various inputs can be made to the simulation model to assess on a more dynamic/realistic basis the sensitivity of the NII to changes in the balance sheet and interest rates. Simulation models are a more sophisticated IRR measurement technique applied in ALM.

Cade (1997:157) explains that simulation analysis entails modelling the characteristics of all of the bank's assets and liabilities. The modelled balance sheet is then subjected to a continuous series of forward scenarios in which they exhibit likely and unlikely growth and behavioural patterns and interacting with an assortment of interest rate projections. Boulier (1998:25) argues that simulation modelling is the only risk measurement and analysis tool that allows the future to be introduced in the assessment of risk. This is achieved by means of supplying the internal factors i.e. business growth or production and external or market-related factors for example interest rate changes with a futuristic perspective. Therefore, the various assumptions driven scenarios are formulated to achieve simulations from which the results or analysis is a benchmark for the quantum of associated risk for the bank.

The BCBS (2004:30) states that both endogenous and exogenous factors can be forecast from which earnings sensitivities or changes to the NIM can be assessed. The assessment of IRR can therefore include future balance sheet strategies for growth and repayments of loans, but also anticipated market/interest rate changes and predict through 'what if' scenarios the impact to the bank's NII. In addition, Cade (1997:157) states that the object of this modelling process is to test what could happen to the balance sheet structure, NII, present value and other financial targets for up to three years ahead, under both reasonable and unreasonable conditions. According to Cade (1997:157) the choice of both internal and exogenous factors and alternative economic and environmental assumptions is limited only by the imagination, preferences and resources available to the process.

Bessis (1998:169) states that various interest rate and balance sheet scenario projections with several funding and hedging solutions must be combined, in order to explore various assumptions and projections of interest rate risk and liquidity risk. According to Bessis (1998:169) the impact of target variables that influence NII and liquidity must be analysed under various scenarios in order to optimise the strategy, hedging and funding policies of the bank. Simulations are required because the impact of all combined parameters is impossible to determine without the modelling of the balance sheet and resultant income statement margins. Simulation models are a robust tool that can accommodate a large number of scenarios. Simulations require modelling of the balance sheet and income statement to quantify the impact of interest rate changes and other uncertainties on the risk-reward trade-off.

Boulier (1998:25) states that although simulations are mostly deterministic and scenario-based, modern day simulation approaches rely increasingly more on stochastic modelling of the environment variables (internal and external factors) that influence the future performance path of the bank. Stochastic modelling involves the generation of a large number of random samplings to quantify the probability distribution an accounting or financial outcome at a certain time horizon. The simulation process is therefore a dynamic approach and an enhancement to the static or existing data (static/current position) based analysis performed by typical duration and gap analysis (Boulier, 1998:25).

According to the BCBS (2004:30) static simulation or static risk analysis only incorporates the cash flows from the existing balance sheet positions or transactions, Dynamic simulations also incorporate assumptions about the anticipated changes to the bank's business activities, strategies and interest rates over the simulation's forecast time-frame. In addition, Cade (1997:157-158) states that dynamic analysis incorporates the future anticipated changes in the parameters that influence the balance sheet and income perspectives of the bank. A dynamic simulation process permits the most searching possible examination of a bank's interest rate risk sensitivities and the formulation of the ultimate optimal strategies. According to Cade (1997:158) risk can never be totally neutralised in the intermediation function that a bank performs but with simulation models the benefit of greater awareness that comes from extensive simulations, can be used to take action to limit the bank's vulnerabilities (Cade, 1997:158).

Simulation modelling is also advocated by the regulators and supervisors i.e. the Bank of International Settlements. The BCBS (2004:3) Principle 6 for the management and supervision of interest rate risk, states that: "It is essential that banks have interest rate risk measurement systems that capture all material sources of interest rate risk and that assess the effect of interest rate changes in ways that are consistent with the scope of their activities. The assumptions underlying the system should be clearly understood by risk managers and bank management." In addition the BCBS (2006**c**:8) explains that by incorporating elements of economic capital (Basel II and internal capital management processes) and other internal models i.e. IRR simulation models in the regulatory framework, provides a positive stimulant towards improving risk awareness, measurement and management of risk.

According to BCBS (2006**c**:8) this introduces opportunities for convergence in regulatory approaches and the market discipline of risk measurement and management. The concept of risk modelling and therefore simulation modelling has gained widespread acceptance and attention,

not only by regulators and supervisors but also in the scientific field and various sectors of the financial system, according to the BCBS (2006**c**:16). The internal modelling of risk allows the development of conceptually consistent models for the same risk types within financial conglomerates. Observers suggest that internal risk modelling allows for better risk aggregation and the quantification of the diversification effects across entities within a bank (BCBS, 2006**c**:16).

According to Bessis (1998:170) the simulation process covers the following basic sequence:

- Interest rate scenarios
- Balance sheet projections
- Calculation of income statement margins
- Optimisation of funding-hedging solutions based on risk analysis.

According to Koch and MacDonald (2000:321) the ALM simulation model framework includes the following six steps:

- Forecast interest rates.
- Identify the changes in asset and liability mix and balances under various interest rate scenarios.
- Forecast embedded options such as loan prepayments and deposit withdrawals under various scenarios.
- Identify the changes in repricing behaviour of assets and liabilities under various rate environments.
- Calculate the NII results under the same interest rate scenarios.
- Compare forecast NII under the various interest rate and business scenarios.

Interest rate risk in the banking book (IRRBB) is a particular focus area of Pillar 2 of the BCBS (2006**b**:212) revised Framework. IRRBB is a potentially significant risk which merits the support of capital and that banks' internal systems must be used as principal tool in measuring the IRRBB as part of the supervisory review process. It also refers that supervisors should ensure that banks hold adequate capital reflective of the level of their IRR (BCBS, 2006**c**:212). According to the CEBS (2006:7) the Internal Capital Adequacy Assessment Process (ICAAP) of an institution dictates that it is the institutions responsibility to adequately manage IRRBB and

allocate internal capital in support of the level of IRR experienced. The proposed management of IRRBB is consistent with the IPS-Sendero (2006**a**:33) view of an adequate ALM framework and the available tools in such a framework. This framework involves the identification, measurement, monitoring and controlling of IRRBB.

According to IPS-Sendero (2006**a**:33) the simulation of all probable economic circumstances and risk component scenarios are necessary to achieve the goals of ALM. This is done to ensure that the net interest income and economic earnings value of the balance sheet remain stable and positive. IPS-Sendero (2006**a**:33) recommends that the following three steps should be followed to create a sound ALM framework:

- Assess risk: Determine the risk involved in the balance sheet structure.
- Measure strategic risk and reward: Develop a metric of measuring the effects of rate changes and other factors on the anticipated returns (rewards).
- Integrate management reporting: Set up an effective system by which to report the variation in income and value for the bank (IPS-Sendero, 2006**a**:33).

According to IPS-Sendero (2006**a**:33) the most critical component within this ALM framework is first of all to develop the tools in order to identify, measure and understand the risk components within the structural balance sheet. The following tools are specifically designed and advised to be used in ALM risk quantification. Simulation modelling is therefore pivotal in establishing these tools for application in the ALM process. According to IPS-Sendero (2006**a**:33) these tools are:

- Static and dynamic repricing and liquidity gap analysis. A simulation model is needed to achieve an accurate and technically sound dynamic gap analysis.
- Income simulations for the NII and NIM.
- Duration, Modified Duration and economic value simulation analysis.

With the release of the revised Basel Capital Accord, various principles on the management of interest rate risk are advocated. According to Lopez (2004:2) the Federal Reserve Bank of San Francisco issued a summary paper based on the guidelines proposed by the Basel II Capital Accord and the supporting paper of the BCBS (2004:1) regarding the general principles on IRR

management. The intent of the summary paper is to supply guidance in the supervisory process of interest rate risk management (Lopez, 2004:2).

According to Lopez (2004:2) the principles support the idea that bank's internal risk assessments should whenever possible form the basis of supervisory oversight of their IRR profiles. These principles advocate that banks must have in place comprehensive management systems that measure and control IRR exposures effectively. According to Lopez (2004:2-3) the Federal Reserve Bank of San Francisco IRR management principles are based on- and in support of the 15 BCBS (2004:3) principles for the management of IRR, and can be grouped in four general categories:

- IRR management oversight issues: The principles states that a bank's board of directors should approve IRR strategies and policies and that senior management effectively monitors, communicates and control these risks. IRR managers should be independent from the risk-taking functions of the bank to avoid potential conflicts of interest (Lopez, 2004:2). This is reported in Principles 1 to 3 of IRR management of the BCBS (2004:3).

  According to the BCBS (2004:3) Principle 1 requires that the board of directors must approve IRR management strategies and policies. Senior management is required under Principle 2 to ensure that IRR management policies and procedures are established to manage/control and limit IRR. Principle 3 requires that clear accountability and a separation of duties exists for the parties involved in managing IRR.

  The OCC (1998:2) states that effective board and senior management oversight of a bank's interest rate risk activities is the cornerstone of an effective risk management process. It is the responsibility of the board and senior management to understand the nature and level of interest rate risk taken by the bank and how that risk fits within the overall business strategy of organisation.

- Adequacy of bank policies and procedures: Senior management must ensure that the bank's IRR policies and procedures are clearly defined and consistent with the nature and the complexity of the bank's activities. Risk tolerance must be defined for the bank as a whole but also at divisional levels or disaggregated business unit levels, by policies

identifying specific interest rate instruments and activities that are permissible (Lopez, 2004:2).

According to the BCBS (2004:3) Principles 4 states that IRR policies and procedures must be clearly defined and commensurate to the nature and complexity of the bank. New products must be assessed for their inherent riskiness before they are introduced to the market. This is to ensure that adequate procedures and controls are in place to manage the IRR exposures of these new products. Principle 4 and Principle 5 therefore focus on adequate risk management policies and procedures.

According to the OCC (1998:3) the bank's senior management is responsible for both daily and longer-term strategic IRR management. Therefore, senior management should develop and implement policies, procedures and operations that translate the board's goals, objectives and tolerances towards IRR into operating standards within the bank.

- IRR monitoring and control: The BCBS (2004:3) states in Principles 6 to 10 of effective IRR management that banks must ensure that IRR is measured effectively and that all the required monitoring and control functions are in place. According to Lopez (2004:3) banks must capture all material IRR exposures within their risk management systems. The BCBS (2004:3) states in Principle 6 that it is essential for banks to have adequate IRR management systems in place that captures all sources and effects of IRR. According to the OCC (1998:3) senior management must oversee the implementation and maintenance of systems that identify, measure, monitor, and control the bank's IRR. Banks' senior management must also establish effective controls over the IRR management process.

  Lopez (2004:3) also states that operating limits and related practices, which ensure all IRR exposures are within levels consistent with internal policies, must be enforced. All IRR modelling assumptions and parameters must be well documented and updated with reasonable frequency. The BCBS (2004:3) states in Principle 7 that IRR limits must be enforced to ensure exposures are contained.

  Lopez (2004:3) further states that the bank must have adequate information systems for reporting accurate IRR exposure information on a timely basis to the board of directors

and senior management. Principle 9 of the BCBS (2004:4) requires that adequate information systems are implemented for measuring, controlling and reporting IRR exposures. Stress-testing should be regularly applied to assess the bank's interest rate sensitivity and to examine the bank's key modelling assumptions.

The BCBS (2004:3) also states that banks must assess their IRR under stressful market conditions (Principle 8). Principle 10 of the BCBS (2004:4) requires that the effectiveness of these IRR management systems must be ensured through regular independent evaluations. It is therefore undoubtedly clear that simulation models are pivotal for the management of IRR and therefore a fundamental tool in the ALM risk management armoury (Lopez, 2004:3).

- Supervisory concerns: Lopez (2004:3) states that given bank's own systems form the basis of supervisory oversight, supervisors should receive sufficient and timely information with which to evaluate the bank's IRR systems. This is confirmed by Principle 11 of the BCBS (2004:4) that supervisory authorities should obtain timely and sufficient information from banks to evaluate their IRR exposures.

  Lopez (2004:3) further states that banks must also disclose publicly information regarding their aggregate IRR exposures and their IRR management policies. The recommendation to disclose IRR exposures and policies to the management of IRR is also made under Principle 13 of the BCBS (2004:4). Principle 12 of the BCBS (2004:4) requires that bank hold capital commensurate of their level of IRR.

  Furthermore, Lopez (2004:3) states that in order for the facilitation of supervisory monitoring of IRR across multiple institutions, banks should use standardised rate changes in their assessment of IRR from their internal risk measurement systems. Supervisors also expect institutions to examine multiple scenarios in evaluating their IRR exposures (Lopez, 2004:3). According to the BCBS (2004:3) Principles 14 and 15 supervisory authorities should also ensure that the IRR measurement systems of the bank adequately capture IRR in the banking book. If a bank does not hold adequate capital in respect of it IRR exposures the supervisory authority should take remedial action against the bank.

The concept of risk modelling and therefore simulation modelling has gained widespread acceptance and attention, not only by regulators and supervisors but also in the scientific field and various sectors of the financial system, according to the BCBS (2006**c**:16). The internal modelling of risk allows the development of conceptually consistent models for the same risk types within financial conglomerates. Observers suggest that internal risk modelling allows for better risk aggregation and the quantification of the diversification effects across entities within a bank (BCBS, 2006**d**:16).

According to the BCBS (2006**c**:16) an internal risk model is also the tool to more efficiently allocate capital across business lines and legal entities. With the alignment to the revised Capital Accord (Basel II) the field of risk modelling is undergoing rapid change. The development of the new regulatory frameworks allows for greater recognition of internal modelling in the risk-based capital adequacy assessment process. Based on the experience of regulators and consultation with the industry, the value of internal modelling development is assessed by the continuous improvement of the capital framework of respective industries (i.e. banking, insurance and investment) and institutions (BCBS, 2006**d**:16).

Therefore, further support of simulation modelling and ALM lies in satisfying the supervisors and contributing to ultimate financial system stability. This will further ensure that risks are managed profitable in order to optimize the risk-reward trade-off and establish a competitive advantage for the bank. It is imperative in order for the ALM process to be effective that simulation modelling techniques are applied in the management of interest rate risk. Section 4.3 investigates IRR in more detail.

4.3 INTEREST RATE RISK

Interest rate risk (IRR) was briefly discussed in chapter 2, section 2.3.1 (p43) as part of a generic overview of the primary banking risks endeavoured through the function of intermediation. In order to fully understand the identification, quantification, measurement and management of IRR from a non-traded or banking book perspective, it is worthwhile to achieve a more comprehensive understanding of the topic through further exploration in answering the question - what is IRR? This will assist in understanding the importance of IRR management in the ALM risk measurement process but also the FTP process that transfers IRR to the ALM area.

Understanding the extent of IRR will also assist in the discussion of the FTP pertaining to IRR as applied in the RAPM process. This can be achieved by elaborating further on the brief definition of IRR as supplied by Kelly (1993:320) and Bessis (1998:9) in chapter 2, section 2.3.1. This section will explain IRR from and ALM perspective and present the various measurement techniques specifically used to identify and quantify IRR. These measurement techniques are typical of the risk measurement and control perspective of risk (IRR) management applied in conventional risk measurement approaches as reported by Haubenstock and Aggarwal (1997:175) in chapter 3, section 3.3 (p70). This will elucidate the need to incorporate the RAPM process in the ALM IRR management process.

4.3.1 INTEREST RATE RISK DEFINED

Lopez (2004:1) defines IRR as the change in a bank's portfolio value due to interest rate fluctuations. According to the CEBS (2006:5), IRR is the current or prospective risk to both the earnings and capital of institutions arising from adverse movements in interest rates. This indicates that both the earnings and value perspective is focal to the analysis of IRR. Therefore it implies that IRR does not only have a short term effect but also a long term effect on profitability. The BCBS (2004:5) explains that the exposure of a bank's financial condition to adverse movements in interest rates is the result of IRR. Cade (1997:16) defines IRR as the vulnerability of the NII, or the portfolio present values, to changes in interest rates.

Boulier (1998:22) expands on the definition of IRR in that he assesses that IRR is a subsection of the market risk faced by the bank. The market risk consists of three types of exposures namely, IRR, currency risk and liquidity risk. In particular, IRR stems from the fact that interest rates paid to depositors and the yields earned on loans can change at different speeds.
Boulier (1998:22) explains that if a fixed rate loan is financed through a variable rate deposit the IRR originates from the fact that variable rate deposit's interest paid will change and the fixed rate loan's yield will not change. Therefore, an adverse movement in the NII is expected when interest rates increase.
Interest rate risk is defined by Wikipedia (2008) as the risk that the relative value of a security will worsen due to an increase in interest rates. What is worth noting is that this definition is applied to a security, typically a bond, which has an inverse value relationship to the direction of interest rates. The same concept of IRR can be applied to a bank's balance sheet where changes

in interest rates (irrespective whether it is upwards or downwards) will have a negative impact on the value or profitability of the bank.

Meyers (1988:11) defines IRR as the exposure of the bank's earnings and capital to movements in market rates of interest. Interest rate risk is also referred to as gap market risk by Mark (1997:156). The gap market risk, or IRR for that matter, arises from the directional risk, the spread risk and the option risk embedded in the gap. Directional risk embedded in the gap market risk is explained by Mark (1997:156) as the mismatch risk of the interest rate sensitivity of the bank's assets and liabilities. The amount of the gap market risk is related to the extent by which the NII or value changes as a result of changes to interest rates.

Van Greuning and Bratanovic (2000:177) states that when interest rates fluctuate the earnings and expenses as well as the economic value of the bank's assets and liabilities change. Interest rate risk is speculative in nature given that the movements in interest rates can result in either a profit or a loss. This view is consistent to the OCC (1998:1) definition of IRR. The OCC (1998:1) states that IRR is the risk to earnings and capital of the bank due to the movement of interest rates.

4.3.2 SOURCES OF INTEREST RATE RISK

If the various definitions of IRR is analysed the OCC (1998:8) states that two fundamental issues comes to the fore. Firstly, IRR is not only a one sided result due to changes in interest rate but it also manifests through the structure of the balance sheet due to intermediation activities performed. The effect is realised when interest rate changes occur. According to Ford (1999**a**:417-418) banks will fund short (accept short-term deposits) and lend the money out to its customers at longer terms, thus creating a term-mismatch between its assets and liabilities. Koch and MacDonald (2000:302) also state that the composition of the balance sheet assets and liabilities impact the bank's NIM when interest rates change.

Secondly, the OCC (1998:8) states that the effect of IRR as a result of how interest rate movements interact with the structural balance sheet position is perceived from both an earnings and economic value perspective. Therefore, the sources of IRR are a primary part to ensure the proper identification of IRR. The systems and the processes for example, the simulation model by which the bank identifies and measures risk or for that matter the impact on the earnings or

economic value of the bank, should be appropriate to the nature and complexity of the bank's operations(OCC, 1998:8). According to the BCBS (2004:14) the structural composition of a bank's balance sheet is a significant source of IRR. The mismatch in timing and quantum of balances repricing at different and changing levels of interest rates will affect the bank's NIM.

The BCBS (2006**a**:3-4) also states that interest rate movements may adversely change a bank's profitability both in the short-term and long-term given the mismatch of its assets' and liabilities' repricing profiles. According to the OCC (1998:8) the IRR may arise from a variety of sources and the measurement system must thoroughly capture the sources of the bank's IRR exposure.

The sources of IRR are described consistently, amongst others, by supervisory authorities like the BCBS (2004:5), the OCC (1998:8) and the APRA (2008:8). In addition Lopez (2004:1) also confirms that the sources of IRR comprise of the repricing risk, basis risk, option risk and yield curve risk elements. The sources of IRR are as follows:

- Repricing or mismatch risk arises from differences in the timing of rate changes and the timing of cash flows that occur in the pricing and maturity of a bank's assets and liabilities. The repricing component refers to floating rate instruments and the maturity component refers to all fixed rate instruments (BCBS, 2004:5). According to the CEBS (2006:7-8) reprice or mismatch risk relates to the mismatch of repricing assets and liabilities.

  The APRA (2008:5) states that reprice risk is the risk of loss to the earnings or economic value of a bank due to the existence of mismatches in the reprice dates of the banking book items at a time when interest rates changes. According to the OCC (1998:8) repricing risk is often the most apparent source of IRR and is often gauged by comparing the volume of assets and liabilities that mature or reprice within a given time period. Van Greuning and Bratanovic (2000:178) endorses the observation that repricing risk is the most common source of IRR and that it arises from timing differences in the maturity of fixed rates and the repricing of floating rates, as applied to the assets and liabilities of the bank's balance sheet. Some banks will intentionally take repricing risk in the structure of the balance sheet in an attempt to improve earnings. The repricing risk is often but not always reflected in a bank's earnings performance.

The (OCC, 1998:8) states that by creating repricing imbalances a bank can create long term effects that will only manifest in the future earnings. If the bank only focuses on the short term, repricing imbalances may be induced to take on increased IRR by extending maturities to ultimately improve yield or profit. It is therefore imperative that when evaluating repricing risk the bank not only consider near term imbalances but also long term ones. Ford (1999**a**:418) argues that banks may typically create long-term positions in either rate-sensitive assets or liabilities which results in repricing imbalances in order to benefit from anticipated interest rate movements. The results of these imbalances may however only manifest in the long term.

When a bank's balance sheet repricing assets are longer than the repricing liabilities it is referred to that the bank is liability sensitive because the liabilities reprice more quickly than the assets. In such a case the bank will benefit from a decrease in interest rates given that the earnings will increase as the shorter repricing liabilities reprices against the lower interest rates before the repricing assets. Conversely an asset-sensitive balance sheet will benefit from an increase in interest rates as a result of the increased earnings due to the situation that repricing assets will reprice at higher interest rates faster than the repricing liabilities (OCC, 1998:8).

Koch and Macdonald (2000:309) state that depending on the volume and timing differential (between rate-sensitive assets and rate-sensitive liabilities) the IRR effect of the bank being asset-sensitive or liability-sensitive can be determined. If the bank is asset-sensitive then interest-income is likely to change more than interest-expense when interest rates change. The contrary also applies. The BCBS (2004:5) also acknowledges that whilst repricing mismatches are fundamental to the business of banking, they can expose the bank's income and underlying economic value to unanticipated fluctuations as interest rates vary.

- Basis risk is another important source of IRR according to the BCBS (2004:5). Basis risk originates from the imperfect correlation in the adjustment of the interest rates earned and paid on different assets and liabilities with otherwise similar repricing characteristics. Basis risk arises from the shift in the relationship between different financial market rates or on different financial instruments. According to the CEBS

(2006:7) the risk arising from interest rate exposures to one interest rate with an exposure to a rate that reprice under different conditions is termed basis risk.

According to the OCC (1998:8) basis risk occurs when market rates for different financial instruments (or index rates used to price assets and liabilities) change at different times and/or by different amounts. For example, basis risk occurs when the spread between the Prime rate and the Call rate change at different times and/or by different amounts.

Ford (1999**a**:424) argues that basis risk represents the non-linear or non-parallel changes in interest rates. Interest rates applied in lending transactions may change by 100 basis points but the cash rate on deposits may only change by 50 basis points. Furthermore, the OCC (1998:8) states that basis risk can also occur when the relationship between managed or administered rates and external interest rates changes. For example, if the Prime rate and the rates the bank offers on some of its unique liability products, like savings accounts, changes by different percentages the bank is exposed to basis risk as a source of IRR.

- Yield curve risk refers to the changes in portfolio values caused by unanticipated shifts in the slope and shape of the yield curve (Lopez, 2004:1). The APRA (2008:5) states that yield curve risk may result in losses to earning or economic value due to a change in the relative levels of interest rates of various tenors. Yield curve risk arises from balance sheet repricing mismatches.

  The OCC (1998:9) states that yield curve risk arises from the variations in the movement of interest rates across the maturity spectrum. It involves changes in the relationship between interest rates of different maturities of the same index or market e.g. a three-month NCD rate versus a twelve-month NCD rate. The BCBS (2004:5) states that what is important to note is that the exposure to yield curve risk is a cause of repricing risk. The repricing mismatches expose the bank to changes in the slope and shape of the yield curve. For instance the adverse effect on the economic value of a long position in 10-year government bonds hedged by a short position in 5-year government notes could decline sharply if the yield curve steepens. Van Greuning & Bratanovic (2000:178) also states that yield curve risk is a source of IRR embedded in unexpected shifts or non-

linear changes in the various term-rates on the yield cure. The repricing or mismatch risk therefore also expose the bank to IRR derived from changes in the slope and shape of the yield curve.

- Option risk according to the OCC (1998:9) or optionality according to the BCBS (2004:6) and Van Greuning and Bratanovic (2000:178), refer to the situation when a bank's customer has the right (but not the obligation) to alter the level and timing of the cash flows of an asset or liability. Lopez (2004:1) concurs that the option risk is embedded in the bank's assets and liabilities. Such options can be explicitly purchased from interest rate derivative markets or it can be included as a condition within a loan contract, such as the prepayment option included in a residential mortgage loan.

  According to the BCBS (2004:6) there is an increasingly importance on option risk as a source of IRR. Options conventionally is stand-alone instruments that may be transacted over-the-counter (OTC) and also by way of exchange trading. Instruments with embedded options are generally more important in non-trading activities. The option gives the holder the right but not the obligation to alter the cash flows of the instrument or loan by means of partial and full prepayments. It is also embedded in non-maturity deposits like current accounts and savings accounts where the depositor has the right to withdraw funds at any time, often without any penalties. In addition, according to the CEBS (2006:7) option risks arise from consumer redeeming fixed rate deals when market interest rates changes. In other words, these embedded options within the balance sheet refer to the prepayment and settlement (or refinancing) of existing deals.

  According to the BCBS (2004:6) if option risk is not managed adequately the asymmetrical payoff characteristics of the instruments with explicit or embedded optionality features may have significant risk particularly to the seller. This is due to the fact that options are normally exercised to the advantage of the holder i.e. the depositor or the borrower as client of the bank, and to the disadvantage of the seller (normally the bank).

  According to the OCC (1998:10) the option holders' ability to choose whether to exercise the option creates the asymmetry in the option's performance. The result is that the option holder or buyer faces minimal downside risk but the seller faces unlimited

downside risk. The prepayment option on residential loans is often given by the bank with limited or no penalty against the client when exercised. A prepayment option can be seen as the equivalent of writing a call option to the customer. When interest rates decline the customer will exercise the calls by prepaying the loan. In this case the bank's asset maturities will shorten, exactly the opposite to what the bank would like to do in such a scenario of lengthening the asset profile. Conversely, when interest rates increases the bank would like to shorten the maturities of its assets but the client will keep the mortgage and not opt too partially or fully settle the outstanding loan value (OCC, 1998:10).

4.3.3 PERSPECTIVES OF INTEREST RATE RISK

In the dissection of the definition of IRR it is evident that there are various sources of IRR given that the adverse movements of interest rates are implicit to specific balance sheet preconditions. This was discussed as the sources of IRR presented in section 4.3.2 (p100). The effects of IRR relates to the adverse results contrived from the sources of IRR. The effects of IRR were highlighted as the second consistent focal area across all the definitions of IRR discussed.

According to Spahr and Gronewoller (1997:110) the effects of interest rate changes can be measured on both the net interest income and the value of portfolio equity. When interest rates change, depending on the timing and whether rates increase or decrease together with the structure of the balance sheet, the bank's NII will be impacted. The structure of the balance sheet will also determine whether the economic value of assets increase or decrease more than that of the liabilities. The OCC (1998:5) recommends that to evaluate the potential impact of IRR on a bank's operations, a well-managed bank will consider the effects of interest rate changes on both its earnings and economic value. This view is also recommended by the BCBS (2004:6) given that the earnings and economic value of the bank is affected by the adverse changes in interest rates. According to the CEBS (2006:7) institutions normally consider two perspectives to assess IRRBB. Although these two perspectives are different they are complementary in the process of managing IRRBB.

These two separate but complementary perspectives for assessing the impact or effect of IRR are as follows:

- The earnings perspective: According to the BCBS (2004:5) the earnings perspective focuses on the impact of changes in interest rates on the accrual or reported earnings of the bank. According to Van Greuning and Bratanovic (2000:179) the income statement is directly affected by changes in interest rates given that changes to interest rates will result in changes to the interest income and/or interest expense of the bank over a given time period. This is the traditional approach to the assessment of IRR by most banks according to the BCBS (2004:5).

This earnings perspective to the affects of IRR is also identified and reported by Lopez (2004:1) stating that the traditional approach to measuring IRR is based on the earnings perspective. The earnings approach measure how the bank's earnings, which is typically measured as NII, is affected by interest rate changes.

In addition, according to Ong (1998:2) traditionally the measurement of assets and liabilities and therefore the value change, is governed by the accounting standards e.g. Generally Accepted Accounting Principles (GAAP). The accounting standards defines the various elements in the balance sheet and forces the analysis in terms of accounting yields rather than expected economic returns. The accounting income is measured based on the accrual concept which in turn is determined by the accounting standards as to which cash flows are included, when and how the change in asset values are measured and which changes in assets are to be included in the income reporting (Ong, 1998:2).

Van Greuning and Bratanovic (2000:179) also states that the earnings perspectives is the traditional approach to measuring IRR given that the NII is a significant source of a bank's profitability. The earnings or more specific, the NII enjoys much attention in the financial statements and profitability reporting of the bank which are primarily driven from an accounting perspective. Koch and MacDonald (2000:303-304) explains that the NIM of a bank is a focal point when assessing the profitability and potential changes to profitability due to IRR. Rosen and Zenios (2006:18) state that measuring the affects of IRR requires an assessment of the impact on earnings as reported in the income statement of the bank which is derived from the pricing of the balance sheet.

Therefore, accrual based accounting as directed by accounting standards gives the predictive ability of the balance sheet by assigning cash inflows and outflows to

appropriate accounting periods (Ong, 1998:3). According to Uyemura and Van Deventer (1993:61) this indicates that any analysis of IRR should be able to assess the potential changes to NII compared to the predictions or anticipated results as indicated by the budget process. In such an assessment the quantification process has to be consistent and therefore the same accounting standards should be applied in order to establish a like-with-like comparison. The decrease in earnings caused due to IRR will not only affect the earnings but also liquidity and capital.

According to Uyemura and Van Deventer (1993:61) the focus is on the risk of near-term accounting or earnings reduction which is typically over the next one to two years as time horizon, and even shorter e.g. three to twelve months. Matz (2005) state that measuring the risk to earnings is conducted through earnings-at-risk (EAR) analysis that attempts to quantify the deviation of NII due to interest rate changes.

According to the OCC (1998:5) the earnings effect due to IRR is normally reported through the changes in the bank's NII. The NII will vary due to differences in the mismatch position of assets and liabilities (repricing risk), changing relationships in interest rates and yield curves (basis and yield curve risk) and changes to the exercising of option positions (option risk).

According to the CEBS (2006:7-8) the earnings perspective focuses on the sensitivity of earnings in the short term, normally over one or two years, to changes in interest rates. Volatility in earnings is an important focus point for IRR analysis given that significantly reduced earnings may have a severe effect on the capital adequacy of the bank. The earnings perspective is usually the perspective adopted by most institutions for two reasons:

- This is the variable through which the changes in interest rates will have an immediate effect on reported earnings, and
- The economic perspective of assessing the impact of IRR is difficult because of the impact that assumptions about the behaviour of long-term instruments such as demand deposits and prepayment options may have on the results.

It is argued by the BCBS (2004:6) that the variations in earnings is a focal point for IRR analysis because reduced earnings or outright losses can threaten the financial stability of bank by pressurising its capital adequacy and market confidence in the bank. This is typically because NII is traditionally a major source of a bank's profit. The OCC (1998:5) warns that evaluating IRR only from the earnings perspective may not be sufficient if the bank has significant longer-term positions for instance, in the intermediate term (between two and five years) and long-term (more than five years). According to the OCC (1998:5) the reason is that the earnings-at-risk (EAR) perspective is typically focused on the one to two year time frame. The result is that the potential impact of the longer-term positions is not fully captured. This precondition makes it necessary to also assess IRR from the economic value perspective.

According to the APRA (2003,3) longer term IRR exposures may not be fully captured by the earnings perspective to IRR, given that only the impact to NII is measured over the reporting time frame. This may result that in the assessment of IRR that significant earnings exposures are not captured.

- The economic value perspective: The second result or effect of IRR is from the economic value perspective. The economic value perspective as a measure of the effect of IRR on a bank reflects the sensitivity of the bank's net worth to fluctuations in interest rates (Van Greuning & Bratanovic, 2000:179). According to the CEBS (2006:8) the economic value perspective is used in assessing the impact of changes in interest rates on the market values of interest bearing instruments. The changes to these market values are a reflection on potential impact in the future net worth of the institution. Negative changes in market values of the interest sensitive instruments gives and indication of the potential deterioration on future NII or vice versa.

Smith and Benci (1999:439) also states that positive NII may be realised over the short-term measurement horizon given an interest rate change but it is quite possible that NII may deteriorate afterwards. Therefore, this requires that IRR analyses are supplemented with the information on the change to the net worth of the bank as measured by its market value/economic value.

Uyemura and Van Deventer (1993:61) state that the economic value perspective is also referred to as the market value of equity, which is based on the market capitalisation concept i.e. the stock price value. This approach measures the changes to the capital value due to unexpected changes in interest rates and is therefore a balance sheet orientated concept which uses the net present value of all future cash flows to determine the equity sensitivity. The long term economic earnings are therefore incorporated in measuring the effects of IRR (Uyemura & Van Deventer, 1993:61).

Payant (1997**a**:1) however questions the appropriateness of the term market value of equity given that most of the banking book assets and liabilities does not have readily available market prices for future cash flows against which to present value such cash flows. The term economic value of equity was adapted given a more economic assessment is made which indicates an estimated discount rate is applied in the present value process. The economic perspective provides a measure of the underlying value of the bank's current position and attempts to evaluate the sensitivity of that value to interest rate changes.

According to Matz (2005) the economic value of equity (EVE) is an assessment of the net economic effect of the impact of interest rate changes on a bank's assets and liabilities. The cash flows of the assets and liabilities are present valued and the net difference is established as the EVE, similar as the difference between the book values of assets and liabilities equates to the balance sheet's reported equity value. According to Payant (1997**a**:1) the economic value perspective is related to the economic change in equity value which is formally termed the economic value of equity (EVE), which is in principal similar to the market value of equity approach. EVE however does not necessarily represent the balance sheet's net market value nor is it an assessment of the market value of its capital base (equity) (Payant, 1997**a**:1).

The CEBS (2006:6) states that the measurement of the impact of IRR on the economic value of the bank provides a more comprehensive view of the overall long term exposures of the institution. In this context, the economic value as it relates to the institutions solvency should be one of the main variables monitored under the institutions ICAAP on IRR (CEBS, 2006:6).

According to IPS-Sendero (2006**a**:917) the EVE is simply the net difference between the total economic values of the assets less the total economic value of the liabilities (excluding shareholders' value/capital). According to IPS-Sendero (2006**a**:917) economic value is calculated as the present value of the future stream of interest payments on an account and its total principal runoffs balances, discounted at the rate or rates derived from the values of the accounts' key rates, yield curves, ratios and spreads. The APRA (2008:4) states that the economic value is calculated as the present value of all future interest and principal cash flows. Therefore, according to the argument of the BCBS (2004:7) the economic value of the instruments equals their present values of their future cash flows. By evaluating the changes in the present values (economic values) of the instruments resulting from changes in interest rates, estimations can be made of the sensitivity of a bank's net economic value or EVE.

The OCC (1998:5) explains that in contrast to EAR, the EVE perspective identifies the impact of IRR arising from the long-term maturity and repricing gaps. The economic perspective in assessing the impact of IRR provides a more comprehensive measurement of IRR than the earnings (EAR) perspective. According to the OCC (1998:5) the future cash flow projections of the banks balance sheet is used to estimate the economic exposure which is a pro forma estimation of the future income to be generated by the bank's current balance sheet position. Given that the changes in the bank's economic value is indicative of the anticipated changes in the values of the future cash flows, the EVE is a leading indicator of the bank's future earnings and capital values.

According to the OCC (1998:6) the EVE approach or economic perspective to measuring IRR sensitivity is also a better approach in quantifying the potential impact of option positions (option risk) such as prepayments, non-maturity deposits (NMD) and caps or floors on adjustable rate mortgages, on the value of the bank's capital than would be the case with the EAR approach. Lopez (2004:2) and Matz (2005) states that the problem is however in that the economic perspective relies more heavily on the assumptions applied in estimating the future cash flows of all the financial instruments. Therefore, most of the economic perspective measurement systems will focus more on the sensitivity or relative change in the EVE rather than the absolute value or absolute change in value (Lopez, 2004:2; Matz, 2005).

According to the OCC (1998:6) EVE analysis requires significant assumptions about the cash flows of products without stated repricing and/or maturity terms. Various interest rate scenarios should be assessed for the impact of these embedded options on the EVE sensitivity of the bank. The BCBS (2004:7) also states that the impact of embedded customer options and the repricing of variable rate products require thorough consideration given their impact on EVE calculations. The focus of EVE analysis is therefore on the sensitivity of the EVE to interest rate changes and not so much on the absolute value.

4.4 SUMMARY

The intermediation function that banks perform exposes both their earnings and net worth to various risks. The focus of ALM is on optimising the NIM of a bank. In order to achieve this it requires that the NIM must be maximised within a set level of risk that is acceptable the bank and its shareholders. Changes to interest rates in particular may have an adverse effect on a bank's profitability. Although ALM process also focuses on liquidity risk, capital risk and foreign exchange risk, the risk exposure changes in interest rates is a fundamental ALM focus area that requires effective measurement and management.

In measuring IRR various metrics are available. Gap analysis, Duration analysis and risk modelling are specific IRR measurement techniques. In specific, simulation models measure the impact of IRR under various scenarios by simulating the changes to the NIM or net worth of the bank. Simulations can be performed from both a static and dynamic perspective and requires forecast input from various endogenous and exogenous factors influencing the balance sheet and income statement of the bank.

The sources of IRR are identified as being the repricing risk, yield curve risk, basis risk and option risk must be measured by the applied IRR measurement metric. The effects of IRR are fundamental in assessing the impact of interest rate changes and require that these effects are effectively captured by the measurement techniques applied to IRR management. Therefore, IRR should be measured from both the earnings perspective and economic value perspective. The earnings approach to measuring IRR focus on short-term earnings measured by typical accounting based target variables such as NIM, or NII and net income. In order to measure the long-term impact of IRR, which is not captured by the earnings approach, the impact of interest

rate changes on the economic value of the bank must be assessed. EVE analyses are applied as a complimentary approach to the earnings perspective to measuring IRR.

The various methods of quantifying IRR require an assessment of the impact of interest rate changes on both the EVE and earnings of the bank. Chapter 5 further discuss the methods for quantifying IRR as part of the ALM process.

CHAPTER 5

INTEREST RATE RISK MEASUREMENT IN ASSET AND LIABILITY MANAGEMENT

5.1 INTRODUCTION

According to the BCBS (2004:5) the exposure to IRR is a normal part of banking and that taking on IRR can be an important source of profitability and shareholder value. According to the OCC (1998:1) the acceptance and management of financial risks is inherent to the business of banking and bank's role as financial intermediaries. The OCC (1998:1) states that in the process of meeting the demands of their customers and to execute its business strategies, banks make loans, purchase securities and take deposits with different maturities and interest rates and these activities leave the bank's earnings and capital exposed to interest rate changes.

Ford (1999**a**:416) states that the need for IRR management is cogent given that taking on IRR is part of what banks do due to the intermediation function performed in the financial system, and therefore a major source of profit is derived from this activity. Lopez (2004:1) argues that changes in interest rates affect a bank's earnings by changing its NII and also the level of other non-interest sensitive income an operating expenses. Interest rate changes also affects the underlying value of bank's assets and liabilities and off-balance sheet instruments because the present value of the cash flows – and in some instances the cash flows themselves – will change when interest rates change.

The APRA (2003:3) states that in practice, the larger more sophisticated banks generally find a balance between techniques that focus on earnings and economic value. The economic value approaches offer a longer-term perspective to IRR by taking into account all cash flows generated by the balance sheet of the bank. The earnings-based approaches focus only on short run variability in the NII, therefore linking directly to reported profitability. The BCBS (2004:5) also states that the earnings perspective to IRR focuses on near-term earnings whilst the economic value perspective focuses on the value of a bank's net cash flows. Ford (1999**a**:423) also states that changes to interest rates will impact the earnings but also the market value of assets and liabilities.

Lopez (2004:1) argues that given the importance of IRR to the profitability of the bank it is possible that too much IRR can be realised in an effort to increase the earnings propensity of the bank. It is therefore quite possible that excessive IRR could threaten a bank's earnings and its capital base and as such warrants a prudent management approach.

It was discussed in chapter 4 that a primary role of ALM is the identification, measurement, monitoring and control of IRR. The effects of IRR are experienced on both the earnings and economic value of a bank. The assessment of IRR must therefore be performed with the objective of determining how interest rate changes impact a bank's earnings and net worth. Chapter 5 is a continuation of the discussion relating to ALM in banks as presented in chapter 4, focusing on the specific techniques for measuring IRR.

The objectives of chapter 5 are the following:

- To assist in the identification and application of techniques and methods available in measuring IRR in the banking book.
- To present a brief discussion on the application of each technique in the measurement of IRR as applied in to the banking book of a bank.

Chapter 5 will explicate the importance of risk management in general, and IRR management in particular as presented in chapter 2 (section 2.3, p40) and chapter 4 (section 4.3, p101), through presenting the practical ALM techniques applied to manage IRR in the banking book. Traded market risk/IRR is not the focus of this dissertation. The various techniques and methodologies applied to effectively quantify, monitor and manage the ALM IRR will be explained.

The various IRR measurement techniques are identified in section 5.2, encompassing the basic methods to the more complex simulation modelling techniques. A brief overview of each IRR measurement technique is presented and it should be noted that more technical and advanced methodologies are underpinning each technique in its attempts to more accurately measure IRR effects. Repricing gap analyses are discussed as the most basic IRR assessment method in section 5.3. The IRR measurement method of Duration is briefly discussed in section 5.4 as a more advanced measurement technique than reprice gap. Any attempts to incorporate the complexities of embedded options and customer behaviour influences on the duration technique are not discussed. The problems experienced with typical money and capital market instruments such as bonds in respect IRR sensitivity as measured by convexity and effective convexity are

only briefly discussed. The assessment of IRR by using simulation models are discussed in section 5.5 which elucidates its effectiveness in quantifying the earnings and economic value perspectives of IRR in a superior manner superseding the attempts of repricing gap and duration.

Through the ALM risk analysis presented in section 5.5, the focus on future profitability, in specific the net interest income, is pivotal in assessing IRR. The various inputs required to formulate and produce future balance sheets and income statement projections require an assessment of the associated risk-reward trade-offs the bank faces. The formulation of these inputs must incorporate the RAPM information to produce consistent risk analysis from which strategies are formulated. The objective is to set a background for the importance of projecting the future profitability of the bank and associated risk exposures (in specific IRR) by incorporating information gathered from the RAPM techniques, in specific FTP, in the ALM risk management process. FTP is discussed in more detail in chapter 6.

5.2 METRICS FOR IRR MANAGEMENT

According to the BCBS (2004:14-15) the measurement of IRR is achieved by applying various techniques. Most of these techniques will be the result of the processes deployed by senior management in identifying, measuring, managing and reporting of the bank's IRR to the ALCO. Most of these techniques differ in sophistication and therefore accuracy in identifying and measuring the quantum of IRR. Smith and Benci (1999:439) argue that various IRR measurement techniques can be applied in quantifying IRR exposures. The various methods differ in their effectiveness of measuring IRR. Ford (1999**a**:423) agrees that various IRR measurement techniques differ in sophistication and therefore varies in their accurateness of assessing IRR exposures.

According to APRA (2003:3) the measurement technique used by a bank to determine the potential financial impact of IRR can take a number of forms. The method chosen by the bank is mostly determined by whether the bank focuses on the earnings or economic value as an indicator of its financial position. The OCC (1998:10) states that the choice of IRR measurement technique applied by a bank is influenced by the nature and mix of the bank's balance sheet and products. The interest rate characteristics of its activities will mostly dictate the measurement technique and system deployed. According to the BCBS (2004:14) the IRR measurement methods applied by a bank is primarily driven from the nature and mix of bank's activities and

products. More complex organisation generally requires more sophisticated techniques for measuring IRR than less complex institutions. In addition the OCC (1998:10) states that many well-managed banks will apply various measurement techniques and systems in the quantification of the bank's IRR exposures. The BCBS (2004:10) also states that the chosen IRR measurement techniques are dictated by how effective such measurement metrics capture the IRR exposure of the bank in relation to the nature and scope of the bank's business.

According to the APRA (2003:3) many banks will choose to analyse the impact of IRR on earnings an in particular the NII component. Some other will also measure the effect of IRR on the economic value, that is the cash flows expected to be generated from its balance sheet, all discounted at a rate which adequately reflects the riskiness of the cash flows. According to the BCBS (2004:14-15) the impact of IRR to the economic value or earnings potential as a result of the various sources from which such IRR originates are captured in various levels of accuracy by the various IRR measurement techniques. A number of measurement techniques are available to measure IRR exposure on the basis of earnings and economic value (APRA, 2003:3).

According to the BCBS (2004:14) the complexity of IRR measurement systems range from simplistic calculations based on current holdings i.e. gap analyses to sophisticated dynamic simulation modelling techniques. According to Hudson (1992:77) gap analysis is the simplest of methods which depends primarily on repricing schedules to determine IRR exposure. At the other end of the spectrum are detailed dynamic modelling techniques that incorporate, amongst other things, the assumptions the bank makes about customer behaviour and business strategy in response to changing interest rates.

According to the BCBS (2004:15) these dynamic modelling or simulation techniques can be performed from both a static and dynamic perspective. A static simulation is performed when only the current balance sheet's cash flows are assessed. Therefore, no future anticipated customer behaviour or business activity is incorporated in the analysis. The dynamic simulation analysis on the other hand, builds in more detailed assumptions about the future course of interest rates and the response of the bank's business activity over time. Dynamic simulation techniques allow for the dynamic interaction between payment streams and interest rates and also better capture the effect of embedded options. According to Smith and Benci (1999:423) there distinct measures of IRR are used by banks namely repricing gap, duration and income

simulation models. According to the BCBS (2004:15) three distinct IRR measurement techniques may be used to quantify IRR, namely:

- gap-analysis
- duration analysis
- simulation modelling (BCBS, 2004:15).

According to the CEBS (2006:7-8) various tools may be used by banks to measure and manage IRRBB. Generally the following is used:

- Systems which tracks the progress of new transactions based on the estimated likely take-up rate;
- Gap analysis showing the differences in repricing assets and liabilities at different dates, and the sensitivity of the present value of theses buckets to different interest rate scenarios;
- Simulation techniques that shows the impact from applying different scenarios representing changes in market conditions, e.g. different repricing instruments, simulation of interest rate paths, customer behaviours, and bank strategies.

These techniques are also confirmed and advocated by the OCC (1998:10) stating that gap analysis, duration analysis and simulation modelling are the primary IRR measurement methods applied by banks. Hudson (1992:77) also states that simplistic gap analysis and duration analysis are typically applied in measuring IRR but that more sophisticated simulation models are increasingly used by banks. The APRA (2003:4) also states that a number of IRR measurement techniques are available to banks to measure IRR from both the earnings and economic value perspectives namely, gap analysis and simulation models. Van Greuning and Bratanovic (2000:181-184) also states that gap analysis, duration analysis and simulation models are mostly applied as the primary IRR measurement metrics. According to Bitner (1992:96-104) the IRR measurement methods of gap analysis, duration analysis and dynamic simulation analysis are most commonly applied in banks as the primary measurement of the earnings and economic value effects of IRR. Each of these IRR measurement techniques are discussed in sections 5.3 to section 5.5.

5.3 GAP ANALYSIS

According to Bitner (1992:96) gap analysis is produced by dividing the balance sheet's assets and liabilities in time periods reflective of their future repricing dates to assess whether more assets or liabilities will reprice in each future period. According to the BCBS (2004:15) a maturity or repricing schedule is used to conduct gap analysis. The repricing schedule is used to formulate a repricing gap and the maturity schedule is applied to formulate a liquidity gap. As the schedules dictate the repricing gap is used to measure IRR exposure and the liquidity gap is used to quantify liquidity risk exposure.

Uyemura & Van Deventer (1993:129) states that repricing schedules reflects the repricing behaviour of a bank's assets and liabilities. A balance sheet item is said to reprice when the interest rate applicable to such an item is scheduled to change. Gap analysis is the simplest techniques used by banks to measure their IRR exposures. Repricing gap reports is most often a static analysis, which means that it is a snapshot of the bank's balance sheet at a particular point in time. Although being the crudest approach to measuring IRR, repricing gap reports have intuitive appeal and are widely used and understood. A gap report distributes the individual assets and liabilities positions into time bands based on either their next repricing date if the item is priced based on a variable or floating interest rate, or the maturity date or cash flow date if the item yields a fixed interest rate (Uyemura & Van Deventer, 1993:129).

According to the APRA (2003:5) the simple technique of gap analysis distributes assets and liabilities into time bands based their next reprice dates (variable rate products) and maturity dates (fixed rate products). The OCC (1998:48) also states that the gap report or gap analysis stratifies all assets and liabilities into future time buckets or maturity segments based on the instrument's next repricing date or maturity date. According to Koch and MacDonald (2000:304) gap analyses attempts to measure by how much earnings may change due to IRR by comparing the sensitivity of assets with the sensitivity of liabilities. Assets and liabilities are grouped in sequential time-bands reflecting their respective repricing chronology.

Hudson (1992:77) explains that measuring the exposure to interest rate changes is achieved by preparing the mismatch ladder or repricing gap which involves the separation of all the interest sensitive assets and liabilities in a table according to a time band, or time buckets, which reflects the items' repricing profile. According to the OCC (1998:50) the bank must decide the

appropriate time-bands when constructing a reprice gap report. The narrower the time-bands or the shorter the period in each time-bucket the more accurate the measurement of IRR from the repricing gap analysis.

In addition, Hudson (1992:77) states that the time bands must be reflective of the type and complexity of the bank for example a trading house will have a limited number of short-term time bands to reflect on its funding needs and a large number of time bands at the longer terms to distinguish between the different bonds it is holding. Conversely the retail type of bank would like to see in its gap report a finer bucket definition in the short end of the mismatch ladder where the bulk of its business with customers are concentrated, but will be willing to have less detail in the long end. The OCC (1998:50) agrees stating that in measuring the risk to earnings the gap report should have at least monthly buckets for the first year of the analysis, and quarterly time-buckets for the second year. Time bands for longer periods for example, beyond ten years may be set relatively wide given that most IRR sensitivity may be limited for periods beyond ten years. Therefore, according to Hudson (1992:77) the amount of detailed buckets must be reflective of the level of information needed to achieve a clear analysis of IRR based on the profile of the balance sheet and should not make the analysis cumbersome and difficult to interpret

According to the BCBS (2004:27) repricing schedules are used as simple IRR indicators for both economic value and earnings sensitivity. Assets and liabilities are distributed in predefined time bands based on their maturity (fixed rate accounts) or next reprice date (floating rate accounts). Assets and liabilities without contractual reprice intervals i.e. current accounts and savings accounts are assigned to repricing bands based on the judgement and past experience of the bank. According to the OCC (1998:50) non-maturity-deposits i.e. demand deposits which may contract a zero percent interest rate when the balances are below a minimum level and when the balance rise to above a threshold level may attract an interest rate higher than zero percent, are included because their maturity or behaviour from the customer may expose the bank to IRR. Such deposits may have to be replaced with other interest-bearing products when they are drawn down (OCC, 1998:50).

Hudson (1992:78) also states that the same concept applies for the detail required in the assets and liabilities of the balance sheet as constructed in the mismatch table or repricing schedule. If the bank has largely a homogenous balance sheet only a few lines of detail will suffice in the

gap report. On the other hand, typically for a retail bank a number of its products will differ vastly in the sense of the volumes that will reprice and whose rates may be administered in nature which means each product will reprice in a different way when the index rates changes. This situation implies that the interpretation of the gap analysis may be enhanced if the amount of detail is increased in the assets and liability categories of the repricing schedules. In addition, the BCBS (2004:27-28) customer options should also be captured in accounts' repricing attributes reflecting the customers anticipated prepayment or early settlement decisions.

Furthermore, according to the OCC (1998:50) in the construction of the repricing gap a couple of important consideration has to be made which will influence the completeness and accurateness of the analysis. As a general rule it is important that all assets and liabilities i.e. the total balance sheet is used in constructing the repricing schedule. Less complex banks should have at a minimum included all interest-earning assets and interest-paying liabilities in their gap reports. The bank should consider including the potential repricing or maturities of non interest-earning assets and non-interest-bearing liabilities in its gap report. Non-earning assets such as non-accrual loans, for example, may at a later stage be renegotiated and become rate sensitive which will contribute to IRR. Non-interest-bearing liabilities should also be included in the gap report although such deposits do not pay explicit interest rate.

According to the BCBS (2004:28) the earnings sensitivity to interest rate changes are derived by subtracting each time band's interest rate sensitive liabilities from the corresponding time band's interest rate sensitive assets. This calculation produces the 'gap' between repricing assets and repricing liabilities for each time bucket. The OCC (1998:49) explains that the gap report or analysis will stratify all the assets and liabilities of the balance sheet into the specified corresponding maturity or repricing segments based on the repricing profile of the item. The balances in each time band for assets and liabilities respectively are then summed (assets are reported as positive amounts or debits and liabilities are reported as negatives or credits) to produce the net gap position for each time band. Conversely the arithmetic is as simple as to deduct the sum of the liabilities from the sum of the assets in each time band in order to compute the period or time band net gap position. This net gap between the assets and liabilities are also referred to as the mismatch, in other words the differential between the repricing of assets and liabilities over specified periods of time.

Cade (1997:151) state that in assessing the IRR exposure the net gap position or mismatch position for each time band is analysed. The size of the gap within the time band is therefore of importance given that it indicates the quantum of the repricing volume differential between assets and liabilities. This quantum of the gap is the measure of potential change in the performance or profitability of the bank when interest rates change. The gap can assume one of three positions in each time band, namely:

- Positive gap
- Negative gap
- Zero or neutral gap

The BCBS (2004:28) also states that a negative or liability-sensitive gap is the result of liabilities exceeding assets in the specific time bucket. This means that an increase in market rates will result in liabilities repricing faster than assets at the higher rates and therefore will cause a decline in earnings. An asset-sensitive dictates that assets reprice faster than liabilities and that an increase in interest rate will result in an increase in earnings.

According to the OCC (1998:49) the IRR is measured by the size of the gap (the amount of imbalance in a time band) and the length of time that the gap exists or is open. By using properly prepared gap reports the bank can identify and measure short-term and long-term repricing imbalances. Gap analysis is therefore quite appropriate to measure mismatch or reprice risk as a source of IRR for the current structural position of the bank's balance sheet before assumptions are made about new business or how to most effectively reinvest maturing balances. This perspective of constructing a gap report is termed to be a static gap analysis. A dynamic gap report on the other hand will make assumptions about how the current balance sheet position will be in a particular future point in time. Dynamic gap analysis is achieved conventionally by means of a simulation model. With this gap information the bank can also estimate in the crudest manner possible the earnings and economic effects within certain constraints (OCC, 1998:49).

The OCC (1998:49) presents in Table 5.1 a very high level example of a gap report. By interpreting this gap report the identification and measurement of mismatch IRR can be achieved. The report typically depicts the basic minimum required for a gap analysis in that only interest rate sensitive asset and liabilities are applied in the repricing schedule. The repricing

balances of assets and liabilities are projected over defined periods or time-buckets indicating the term to repricing (OCC, 1998:50).

Table 5.1 The repricing gap report

	< 1 Mo.	1 -3 Mos.	3 - 6 Mos.	6 - 12 Mos.	1 - 2 Yrs.	2 - 3 Yrs.	> 3 Yrs.	Total
Loans	100	10	20	45	5	20	30	230
Investments		5	5	10	20	20	50	110
Other Assets	5						15	20
Total Assets	105	15	25	55	25	40	95	360
Non-maturity Deposits	-65				-30		-50	-145
CDs and Other Liabilities	-35	-35	-45	-30	-10	-10	-20	-185
Total Liabilities	-100	-35	-45	-30	-40	-10	-70	-330
Equity								-30
Net Periodic Gap	5	-20	-20	25	-15	30	25	0
Cumulative Gap	5	-15	-35	-10	-25	5	30	0

Source: (OCC, 1998:49)

Koch and MacDonald (2000:306) state that rate-sensitive assets outweighing rate-sensitive liabilities indicate a positive gap in the specific time-bucket. A negative gap in a time bucket reflects more rate-sensitive liabilities repricing than rate-sensitive assets. The sum of periodic gaps is termed the cumulative-gap and reflects the overall IRR sensitivity over a specified period. According to the OCC (1998:49) a bank has a negative gap and is liability sensitive when more liabilities reprice within a given time band than assets. Table 5.1 describes a liability sensitive bank given the negative gap and cumulative gap (the continuous compounding of all previous time bands' gap positions) in the 1-3 months and 3-6 months time buckets. Koch and Macdonald (2000:316-317) states the cumulative gap is and indication of the substantiality of the gap position and therefore the IRR sensitivity of the bank's earnings over the specified period.

In addition, the OCC (1998:49) states that the bank will benefit from falling interest rates given that more rate-sensitive-liabilities (RSL) will reprice than rate-sensitive-assets (RSA). The decrease interest expense will therefore be more than the decrease in interest income when interest rates decline and the bank's structural repricing profile is indicative of a negative gap. Contrary when the bank has more assets that reprice than liabilities a positive gap exists. The bank will under a positive gap benefit from rising interest rates. The neutral or zero gap exists when the repricing of assets equal the repricing of liabilities. The bank is therefore indifferent from a change in interest rates as far as mismatch risk is concerned. Although, in such a case the bank's reprice risk may be zero or very small, the bank is still exposed to basis risk, yield curve risk and option risk which is not measured by gap analysis (OCC, 1998:49).

Furthermore, according to Cade (1997:151) a bank is geared to benefit from interest rate increases when a positive gap exists in the early time-bands. The structural mismatch of the balance sheet dictates the exposure to interest rate changes. Negative gaps indicate the bank will benefit from interest rate decreases. Kelly (1993:322-325) also states that when RSA is more than RSL the bank will benefit from interest increases and will suffer NII decreases when interest rates decreases. The bank will be benefit from a decrease in interest rates when the balance sheet is has negative structural mismatch or negative gap.

According to the APRA (2003:5) the gap analysis can be used to measure both earnings and economic value sensitivity of the bank to interest changes. Earnings-based approaches measure the size of the gap in each time band, thus giving an indication of the bank's repricing risk exposure. The direction of the gap indicates whether the NII is positively or negatively impacted by interest rate changes. The magnitude of the gap approximates the change in NII for a given interest rate shift (APRA, 2003:5). According to the OCC (1998:52) the various gap exposures are an indication of a bank's exposure to IRR and the focus of gap analysis is to measure NII at risk. According to Smith and Benci (1999:439) the reprice gap is a rough and ready measure of IRR and focuses its efforts on the effects of interest rate changes on the bank's NII. The repricing gap analysis is therefore an indication of the bank's earnings exposures to IRR, in specific reprice risk, and can be summarised as follow in Table 5.2. This is an indication of the gap position and the sensitivity to movements in interest rates under each position.

Table 5.2 Reprice gap analyses exposure direction

Repricing Gap Position	Interest rate direction	NII Sensitivity
Positive Gap	Up	Increase
	Down	Decrese
Negative Gap	Up	Decrese
	Down	Increase
Zero/Neutral Gap	Up	No Change
	Down	No Change

Source: (Author, 2008)

The OCC (1998:52) and Uyemura and Van Deventer (1993:131) explains how gap analysis can be applied to translate the magnitude of the gap into the amount of NII at risk over several periods. The formula applied to measure the NII exposure is:

(periodic gap) x (change in interest rate) x (time over which the periodic gap is in effect) = change in NII (5.1)

In addition, according to Koch and MacDonald (2000:312) the gap position i.e. whether positive or negative and the size of the gap will dictate the direction of NII changes when interest rates rise and fall. In this framework the NII changes can be derived by means of calculating the gap exposure to changes in interest rate levels over a specific time period. Formula 5.2 indicates the calculation of NII sensitivity over a period to a specific interest rate change, as discussed by Koch and MacDonald (2000:312).

$$\Delta NII_{exp} = GAP \times \Delta i_{exp} \tag{5.2}$$

Where:

ΔNII_{exp} = the change in NII over a specific period of time

GAP = the cumulative gap over the interval to the end of the period of time

Δi_{exp} = the permanent change in interest rates as expected.

The OCC (1998:52) explains that this formula can be illustrated by applying it to the gap report as per Table 5.1 and calculating the change in the bank's NII for an immediate 200-basis-point increase in interest rates for the next twelve-months. The gap report indicates the bank has a negative gap of $20 million in the one-month to three-month time band. More liabilities will reprice at the higher interest rates than assets in the time band for the remaining ten-months of the bank's 12-month time horizon. As shown in Table 5.3, the bank will pay $333,000 more in interest expenses and therefore reduce the NII earnings for the 10-month period. This calculation is applied to each time band from which the cumulative reduction in NII over the 12-month time horizon is approximately $362,500.

Table 5.3 Applying repricing gap analyses to measure NII sensitivity

Time Band	Size of Gap (In Millions of Dollars)	Basis Point Change	Part of Year Gap Is in Effect*	Impact on Annualized NII (In Thousands of Dollars)
< 1 Month	$ 5	200	11.5/12	$95.8
1 - 3 Months	-$20	200	10/12	-$333.3
3 - 6 Months	-$20	200	7.5/12	-$250.0
6 - 12 Months	$25	200	3/12	$125.0
Total				-$362.5

Source: (OCC, 1998:52)

*Assumes all repricing occur at the midpoint of the time band

Smith and Benci (1999:439) states that using repricing gap analysis to measure NII sensitivity is a crude and imprecise measure to the magnitude of IRR exposures. The BCBS (2004:27) also states that although gap analysis provides a basic indication of IRR exposure it is a simplistic metric and requires significant scaling and refinement in order to provide a more accurate assessment to the quantum of IRR. According to the OCC (1998:52) it is however important to stress that the gap approach to measuring the earnings effect of IRR is a very crude approach which utilises numerous assumptions, including the following:

- Repricing and maturities within each time band occur simultaneously.
- All maturing assets and liabilities are reinvested at overnight rates.
- New business is not incorporated in the analysis.
- An instantaneous change to the overnight rate takes place to a new and constant level.
- All interest rates move by the same amount. Simulation models may be used to test the sensitivity of the results to these assumptions.

APRA (2003:5) explains that gap reports may also be used to measure the economic value impact due to interest rate changes. This is achieved through evaluating the effects of changing interest rates on the economic value of the bank by applying sensitivity weights to the gap in each time band. The sensitivity weights are based on the duration of the assets and liabilities. The sensitivity weight is therefore based on a price sensitivity factor that approximates for a given interest rate change, the percent change in the present value of an instrument with similar cash flow, repricing and maturity characteristics. According to the OCC (1998:52) economic value can be calculated from applying the repricing gap balances in each time band to a price sensitivity factor. The price sensitivity factor is an approximate, for a given change in interest rates, the percentage change to the present value of an instrument with a similar cash flow and maturity/repricing attributes. Sensitivity or duration-weighted gaps are multiplied by an assumed interest rate change and the results are aggregated across all the time bands to produce an estimated change in the economic value of the bank given the assumed interest rate change. The sum of the weighted balances will be the economic value sensitivity of the bank to IRR.
This approach forms the basis of the standardised interest rate risk measurement methodology as proposed by the BCBS (2004:38), although more sophisticated banks will use more sophisticated approaches in the measurement of IRR.

The BCBS (2004:38) states that the economic value sensitivity of a bank's balance sheet can be calculated from the reprice gap report. The methodology entails that a gap report or mismatch ladder be constructed for the bank's balance sheet according to the following principles:

- All asset, liabilities and off-balance sheet (OBS) transactions which are sensitive to interest rate changes and belonging to the banking book must be slotted into the mismatch ladder comprising of time bands large enough to capture the nature of the IRR. According to Smith and Benci (1999:442) all assets and liabilities and off-balance sheet items must be allocated to a time bucket indicating their contractual repricing period. The OCC (1998:50) also states that the total balance sheet should be incorporated in the repricing gap analysis.

- On balance sheet items are treated at book value. Koch and MacDonald (2000:316) also state that all asset and liabilities are reported at their respective book values.

- Fixed rate items should be treated according to its residual term to maturity and floating rate items according to the residual term to the next repricing date. Smith and Benci (1999:442) also states that specific consideration should be made to the repricing timing of variable rate items as repricing may occur at the discretion of the bank or due to exogenous influences. Koch and MacDonald (2000:316) also states that products linked to rates that are administered by the bank itself may change infrequently although it may change contractually on a daily basis for example a variable rate home loan. In addition, Marrison (2002:179) states that products linked to the Prime rate, which is the advertised rate for most lending products, is not directly linked to market rates and therefore only change under specific circumstance. This renders the term of repricing of accounts linked to the Prime rate indeterminate.

- Core deposit levels as per non-maturity deposit analysis or assumptions are reported within an assumed maturity of no longer than five years. The OCC (1998:50) explains that current accounts and savings accounts often attract low or zero interest rates that changes infrequently. The nature of repricing of these items should be applied in the repricing gap. Smith and Benci (1999:441) also states that specific assumptions have to be made about balance sheet items without contractual maturity or repricing information in order to assess their impact on IRR. According to Koch and MacDonald (2000:316)

assets and liabilities without contractual maturities and repricing dates requires that the bank must assess the behavioural aspect pertaining to the repricing and maturity frequency of such products for example current accounts and savings accounts.

- National supervisors should provide guidance to how items with behavioural maturity and repricing different to their contractual profiles should be reported. This relates to items with specific embedded options for example mortgage loans with prepayment options, caps and floor interest rate options and current- and savings accounts behavioural adjustments. The OCC (1998:51) states that the prepayment options embedded in loans should be assessed and applied accordingly in the repricing gap report. The APRA (2003:6) states that products with embedded customer options requires careful consideration and requires a good understanding of customer behaviour. The anticipated changes in repricing balances and timing of such embedded options should be included in the repricing gap.

- Derivatives assume the position of the relevant underlying. The OCC (1998:50) states that the derivative instrument should be reported on the effective maturity date of the assets or liability it hedges on the balance sheet.

- Futures and forward contracts are treated as a combination of long and short positions.

- Swaps are treated as two notional positions with relevant maturities for the fixed and floating legs. The OCC (1998:50) also states that the entries to the repricing gap relating to interest rate swaps should be offsetting representing the fixed and floating legs of the instrument.

- Options are considered to the delta equivalent of the underlying or of the notional underlying (BCBS, 2004:38). The OCC (1998:51) states that the value of the option can be varied to the change in the value of the underlying instrument, which is represented as the delta-equivalent of the option value in the gap report.

According to the BCBS (2004:39) the economic value calculation process based on a gap report consists of the following five basic steps:

- The first step entails offsetting the long and short positions or in other words the assets less liabilities and off-balance sheet positions in each time band of the repricing gap, resulting in a single net position in each time band. According to the OCC (1998:16) the gap balances per time bucket can be applied in calculating the specific time period's economic value as long as the sufficient detail is available regarding the timing of the repricing of the balances.

- The second step is to weight the positions in each time band by a factor reflecting the sensitivity of the position to the interest rate changes assumed. The weighting factors for each time band is shown in Table 5.4. The factors are based on an assumed parallel shift in interest rates of 200 basis points and on a proxy of modified duration of positions that are assumed to be in the middle of each time band and yielding 5% (BCBS, 2004:39).

Marrison (2002:193) explains that the repricing gap provides the cash flows required for calculating the duration (modified duration) of the assets and liabilities. The OCC (1998:16) states that applying the repricing balances against duration estimates of the balances the economic value can be calculated. The duration of the balances is an indication of the economic value sensitivity of the asset or liability it represents.

According to the APRA (2003:5) the repricing gap can be used to calculate economic value by assigning sensitivity weights to the gap balances in each time band. The sensitivity can typically be based on the sensitivity of a corresponding term cash flow's value to an interest rate change.

Table 5.4 The calculation of the weighting factors

Time band	Middle of time band	Proxy of modified duration	Assumed change in yield	Weighting factor
Up to 1 month	0.5 months	0.04 years	200 bp	0.08%
1 to 3 months	2 months	0.16 years	200 bp	0.32%
3 to 6 months	4.5 months	0.36 years	200 bp	0.72%
6 to 12 months	9 months	0.71 years	200 bp	1.43%
1 to 2 years	1.5 years	1.38 years	200 bp	2.77%
2 to 3 years	2.5 years	2.25 years	200 bp	4.49%
3 to 4 years	3.5 years	3.07 years	200 bp	6.14%
4 to 5 years	4.5 years	3.85 years	200 bp	7.71%
5 to 7 years	6 years	5.08 years	200 bp	10.15%
7 to 10 years	8.5 years	6.63 years	200 bp	13.26%
10 to 15 years	12.5 years	8.92 years	200 bp	17.84%
15 to 20 years	17.5 years	11.21 years	200 bp	22.43%
Over 20 years	22.5 years	13.01 years	200 bp	26.03%

Source: (BCBS, 2004:40)

- The third step sum the resulting weighted positions to establish the net long or short position for the banking book in the given currency.

- The fourth step is to calculate the weighted position for the bank by summing all the respective currencies' net long or short weighted positions. The APRA (2003:5) explains further that the sensitivity or duration-weighted gaps should be multiplied by an assumed interest rate change and aggregated across all time bands to produce the estimated economic value sensitivity.

- The fifth step is to reference the weighted position of the bank to its capital base in order to establish the sensitivity of its economic value for the assumed interest rate change (BCBS, 2004:39). According to the OCC (1998:16) the economic value sensitivity is calculated by referencing the distribution of economic value estimates under various interest rate scenarios compared against the expected interest rate scenario's economic value.

A traditional mismatch/gap analysis embraces a number of valid insights and appreciation for the intuitive make-up and quantum of the IRR in the balance sheet. Cade (1997:154) states that gap analysis has several limitations given its simplicity. The BCBS (2004:28) explains that although repricing gap analysis is a frequently applied IRR measurement technique, it has several weaknesses which render it unsuitable for use in isolation, especially in larger more complex banks. According to the OCC (1998:53) the fact that gap analyses are primarily focused on the current balance sheet dictates that a limited assessment of IRR is performed. Uyemura and Van Deventer (1993:132) also reports that gap analyses have limited ability as far as assessing IRR is concerned given the simplifying assumptions it employs. The shortcomings of gap analyses are:

- According to Cade (1997:154) the first shortcoming of gap analysis relates to the time bands in that it may be insensitive to hidden internal mismatches, no matter how well the time bands are formulated. The analysis does not take into account the variations in characteristics of different positions within the time band. All positions within a time band are assumed to mature and reprice simultaneously. Koch and MacDonald (2000:318) state that the time-buckets of the gap report does not differentiate between the cash flows at the various intermittent periods within the period.

Smith and Benci (1999:439) state that repricing gaps ignore essential information on the timing difference of repricing of balances within the various time-buckets. According to the BCBS (2004:28) this is a problem that will have greater implications on the precision of the analysis the greater the concentration within a time band. A well-balanced position in the 3-6 months time band for example, may at the extreme hide a substantial opposite gap than expected which is not corrected until day 90. The longer the time bands the more scope is afforded for the inaccurateness of the analysis.

The OCC (1998:53) refers to this shortcoming as the intra-period gap situation in that although the balances are stratified in broad time bands the analysis does not detect the imbalances within these time bands. An attempt to overcome this weakness is to report the weighted average repricing maturity within each time band or by reducing the width of the time bands.

Uyemura and Van Deventer (1993:131) explain this shortcoming of gap analysis by means of the following example. Case Study Bank presented in Table 5.5 has a balance sheet consisting of a $1000, 6 month fixed rate loan funded by an $800, 4.5 month NCD and $200 of capital. The typical gap report is constructed with time bands: overnight to 3 months, 3 months to 6 months, 6 months to 12 months, 1 year to 2 years, 2 years to 5 years and longer than 5 years. The gap analysis is presented in table 5.5 which depicts a positive gap in the 3 month to 6 month time bucket of $200, which implies that Case Study Bank is geared towards an increase in NII when interest rates increase.

Uyemura and Van Deventer (1993:132) explain that when the gap for Case Study Bank (as presented in table 5.5) is analysed given an increase in interest rates the contrary to the expected result of an increase in NII occurs as suggested by the positive gap position. Table 5.6 depicts the anticipated NII for the next 4 quarters or 12-month time horizon if interest rates do not change and when interest rates increase by 1%. During the second quarter earnings will actually decrease from $8 to $7 as a result of the 4.5 month NCD repricing before the 6 month fixed rate loan. The second quarter time band is actually liability sensitive, not asset sensitive. The intra-period mismatches that exist within the time bands are ignored and therefore not incorporated in the gap analysis. Even when modifications to the time bands are made or the inclusion of weighted average periods of

repricing, the threat of inaccuracy is a danger to the IRR quantification process (Uyemura & Van Deventer, 1993:132).

Table 5.5 Gap analyses for Case Study Bank

	O/N to 3 months	>3 to 6 months	>6 to 12 months	>1 to 2 years	>2 to 5 years	>5 years	Total
Earning Assets:							
Loan	$0.00	$1,000.00	$0.00	$0.00	$0.00	$0.00	$1,000.00
Funding Sources:							
NCD	$0.00	$800.00	$0.00	$0.00	$0.00	$0.00	$800.00
Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$200.00	$200.00
GAPS:							
Incremental	$0.00	$200.00	$0.00	$0.00	$0.00	($200.00)	$0.00
Cumulative	$0.00	$200.00	$200.00	$200.00	$200.00	$0.00	$0.00

Source: (Uyemura & Van Deventer, 1993:130)

Table 5.6 Case Study Bank NII by Quarter

No Rate Change	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Year
Loan Yield	8.00%	8.00%	8.00%	8.00%	8.00%
Average NCD Rate	6.00%	6.00%	6.00%	6.00%	6.00%
Net Interest Margin	3.20%	3.20%	3.20%	3.20%	3.20%
Interest Income	$20.0	$20.0	$20.0	$20.0	$80.0
Interest Expense	$12.0	$12.0	$12.0	$12.0	$48.0
NII	$8.0	$8.0	$8.0	$8.0	$32.0

Rate Rise 1%	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Year
Loan Yield	8.00%	8.00%	9.00%	9.00%	8.50%
Average NCD Rate	6.00%	6.50%	7.00%	7.00%	6.63%
Net Interest Margin	3.20%	2.80%	3.40%	3.40%	3.20%
Interest Income	$20.0	$20.0	$22.5	$22.5	$85.0
Interest Expense	$12.0	$13.0	$14.0	$14.0	$53.0
NII	$8.0	$7.0	$8.5	$8.5	$32.0

Source: (Uyemura & Van Deventer, 1993:132)

- Cade (1997:155) states that the second shortcoming of gap analysis is that it fails to account for differences in the timing of payments that may occur as result of changes in the interest rate environment. According to Heagy and Tannenbaum (1997:301) gap

reports do not handle explicit and embedded customer options very well. The OCC (1998:53) specifically refers to the difficulty in capturing option risk as a source of IRR with gap reports. The sensitivity of the earnings or economic value is potentially incorrect as a result of option-related positions being incorrectly analysed. According to the BCBS (2004:28) products with uncertain repricing and maturity characteristics or complex customer behaviour based pricing options like current accounts and savings accounts or NMD, poses difficulties in classifying such items within the time bands for the gap report. Current account balances may be seasonal in nature but also sensitive to interest rate changes. Volume changes or balance fluctuations due to interest rate movements are also a concern within gap analysis.

Embedded customer options relating to prepayments or settlements may be exercised when interest rates change that will influence repricing balances. Furthermore, Cade (1997:155) also states that banks need to assess the repricing timing of accounts that have indeterminate repricing dates and that have inherent customer options. This is not captured by gap analyses in an effective manner as these embedded options behave differently under various interest rate scenarios and are often also driven by other market related factors. Marrison (2002:192) states that the gap report is inefficient in capturing the IRR effects induced by changes in customer behaviour. By including the effective maturity of loans and deposits gap analyses attempt to incorporate option risk but have limited ability in capturing the non-linearity of the value of customer options.

- According to the OCC (1998:53) the impact of basis risk on the NII is often not quantified. This is a third shortcoming of gap analysis in that the differences in the spreads between interest rates that may arise as a result of the changes in the levels of market rates are ignored. Cade (1997:155) explains that typically deposit accounts may only reprice by 50 basis points when other lending related interest rates may move by 100 basis points. The gap analysis however will assume the deposits to also reprice by 100 basis points. Smith and Benci (1999:439) also states that gap analyses do not acknowledge that the interest rates on some assets and liabilities will change in different quantum or magnitude when market interest rates change.

Koch and MacDonald (2000:318) concurs that the rates on administered products and certain market indexed rates have infrequent and unknown changes in quantum and

timing. This imputes that floating rate loans and deposits' repricing cash flows are assumption driven that will render IRR sensitivities derived from gap analyses inaccurate when assumptions do not reflect reality.

- According to the OCC (1998:53) a fourth shortcoming relates to the fact that the gap report measures the cumulative repricing risk over various time bands by simply summing the various time bands' gap positions. Implicit in this act is the assumption that all interest rate movements are perfectly correlated across all time bands and that they will move in a parallel fashion. According to Cade (1997:155) this indicates that any form of yield curve risk is not captured by gap analysis. Any movement in the yield curve over different terms will not be captured by the gap analyses. For example, if long-term rates are increasing on the yield curve but the short-term rates stay constant (or changes marginally) the non-linear effect of the interest rate changes and its impact on the earnings sensitivity of the balance sheet is not captured comprehensively.

- According to Heagy and Tannenbaum (1997:301) repricing gap do not incorporate any long-term balance sheet dynamics and does not provide a good assessment of future strategies and their IRR impact. Gap is a static measure of IRR which only focuses on the current balance sheet mix and term structure. Smith and Benci (1999:440) state that a fifth shortcoming of gap analysis is that only a static position is normally assumed and the impact of new business is not assessed. This can be partially overcome by calculating dynamic gap reports that assume future snapshots of the static balance sheet constructed under various assumptions relating to balance sheet growth and term and mix of new business. The OCC (1998:53) also states that dynamic gap reports may be constructed and this will typically be produced from the bank's earnings simulation model in order to assess the gap position after new business assumptions are incorporated into the risk measure.

- The BCBS (2004:28) state that another (sixth) shortcoming of gap analysis relates to the fact that the analyses fail to capture the variability in non-interest revenue and expenses that may fluctuate given an assumed change in interest rates. Although this perspective relates to the net income of the bank it originates due to IRR exposures. For example, when interest rates change the commissions and fees received from originated home loans may deviate as a result of the volume changes inadvertently triggered by the

change in interest rates (BCBS, 2004:28). Koch and MacDonald (2000:319) concurs that gap analysis typically ignores non-interest income and non-interest expenses. Gap also ignores non-rate assets and liabilities that will impact funding requirements and therefore IRR sensitivity.

Following that gap-analysis is an unsophisticated and crude method of IRR measurement more advanced IRR measurement techniques are required. More sophisticated banks are also required by regulators to deploy sophisticated IRR measures that are commensurate of their activities' complexities. Such attempts are made by duration analysis.

5.4 DURATION ANALYSIS

According to Smith and Benci (1999:440) the information on NII changes over the short-term should be supplemented with information on the change in net worth or economic/market value. Duration analysis is a more appropriate technique to measure the long-term economic value effects of IRR instead of short-term earnings variability. According to Koch and MacDonald (2000:340) to overcome the shortcomings of gap analysis duration measures can be applied to measure the sensitivity of bank's assets and liabilities in order to assess the net change in the banks economic/market value due to interest rate changes. Geske and Shearer (1997:24) explain that duration provides a better assessment of the long-term effects of IRR to the market value of an instrument. The price-sensitivity of for example, a bond can be computed as the weighted-average time to the receipt of it cash flows.

According to Cade (1997:155) a more sophisticated approach to measuring IRR is duration analysis, a technique borrowed from the bond market. Duration as a measure of IRR takes into account the interest cash flows and the time value of money. There are various versions of duration but the basic duration method aggregates the present values of all future cash flows (both principal and interest) within a portfolio, weighing them against their respective terms to maturity. Marrison (2002:57) states that duration is a measure of interest rate sensitivity of the value of a bond or loan. Various methods of calculating duration exist differentiated based on its accurateness in quantifying IRR sensitivity in terms of market values. Smith and Benci (1999:441) also state that the maturity of each asset and liability cash flow are weighted by the ratio of its present value to the total present value of all assets and liabilities The total of the

time-weighted present values divided by the present values calculates a single number indicating the duration of the portfolio, normally expressed in years (Cade, 1997:155).

According to Schraudenbach (1992:87) this form of duration was derived from the calculus by Frederick Macaulay in 1938 as means of comparing the maturities of instruments with differing payments structures i.e. amortising bonds versus non-amortising bonds. This became known as Macaulay duration. Geske and Shearer (1997:24) also states that Frederick Macaulay developed Macaulay duration in 1938 as a measure to assess the relative sensitivities of a portfolio of bonds' values given that longer term bonds are more sensitive to rate changes than short-term bonds. Schraudenbach (1992:87) warns that the term is used very casually in the financial world and caution should behold on using the term duration without specification on the exact method of the calculation. Macaulay duration measures the life of an instrument thereby accounting for the fact that an instrument with a principal repayment at maturity in ten years time must have a different measure of lifetime than a bond that is fully amortised over the ten years. The unit of measure for Macaulay duration is time, and the duration of an instrument i.e. a bond can never be greater than its maturity. Instruments with payment/s prior to maturity the duration will decrease as the payments prior to maturity grow.

According to Marrison (2002:57) Macaulay duration is simply the average time of cash flows weighted by their present values. IPS-Sendero (2006**a**:925) states that Macaulay duration is a measure of an instrument's relative term-to-maturity calculated by time-weighting the present value of expected cash flows. Stated in terms of time, Macaulay duration provides a gauge of length used to compare the relative maturity of instruments when the payment schedules and/or coupon rates of the instruments vary significantly. Various components exist in the calculation of Macaulay duration such the present value and market value. The market value is purely the sum of the present values of all the cash flows of an instrument.

According to Koch and MacDonald (2000:340) Macaulay duration is calculated as the weighted average time of receiving expected cash flows. The present values of the cash flows are weighted against the future time period in which they are destined to be received and calculated as a fraction of the instruments current price. Alternatively, Cade (1997:156) explains that Macaulay duration is the time-weighted average life or maturity of the individual cash flows where the weighting factors are the present values of the cash flows. Therefore the longer the duration of the instrument, the greater is the IRR. In addition, according to Bitner (1992:100) the

longer the duration of an instrument the more sensitive the instrument's economic/market value will be to interest rate changes.

The formal equation for Macaulay duration is presented by Uyemura and Van Deventer (1993:160) and confirmed by Schraudenbach (1992:87), as follows:

$$\text{Macaulay Duration} = D = \frac{\sum_{t=1}^{N} \frac{t \times CFt}{(1+r_t)^t}}{MV} \tag{5.3}$$

$$\text{Present Value} = \text{PV} = \frac{CF_t}{(1+r_t)^t} \tag{5.4}$$

$$\text{Market Value} = \text{MV} = \sum_{t=1}^{N} \frac{CF_t}{(1+r_t)^t} \tag{5.5}$$

where CFt = Cash Flow for Year t; r_t = Yield for Year t

Source: (Uyemura & Van Deventer, 1993:160; Schraudenbach, 1992:87)

According to Uyemura and Van Deventer (1993:157-159) the Macaulay duration of a zero coupon bond is the simplest transaction to analyse given that there is only one future cash flow which will occur at maturity. Consider a five-year zero-coupon bond with interest and principal paid at maturity with a current market value of $2000. The Macaulay duration for any zero-coupon or bullet transaction is equal to the remaining time until its maturity. Therefore, the duration of a new $2000 five-year zero-coupon bond is simply five years.

In addition, Bitner (1992:101) explains the Macaulay duration calculation of a five-year fixed rate loan of $10000 which requires annual interest payments. In deriving the present values the cash flows are discounted against the current market rate for five-year fixed rate loans. The present values are multiplied by the corresponding time periods to obtain the weighting-factor. By dividing the sum of the time-weighted factors by the sum of the present values of the cash flows produces the loan's Macaulay duration. The calculation is presented in Table 5.7.

Bitner (1992:101) further explains that if the fixed rate loan presented in table 5.7 had only one cash flow at maturity, similar to the case with a zero-coupon bond, the Macaulay duration would be equal to the five years. However, coupon payments are received in the form of annual interest

payments and given this receipt of payments prior to maturity, the Macaulay duration declines reflecting that cash is received before maturity. Therefore, by applying the PV and MV formulae, the Macaulay duration equals 4.16 years. This example intuitively elevates the fact that the repricing cash flows are used in the Macaulay calculation and that the previous examples used indicate cash flows only in the sense of a bond market instrument which has fixed coupon rates from which the cash flows originates (Bitner, 1992:101).

Table 5.7 Macaulay duration of a five-year fixed rate 10%-$10,000 loan

Period in Years	Cash Flows	Present value of the Cash Flow at 10%	Weighted Present Value
1	$ 1,000	909.09	909.09
2	$ 1,000	826.45	1,652.89
3	$ 1,000	751.31	2,253.94
4	$ 1,000	683.01	2,732.05
5	$ 11,000	6,830.13	34,150.67
Total		10,000.00	41,698.65
Macualay duration = 41,698.65 ÷ 10,000 = 4.169865 Years			

Source: (Bitner, 1992:101)

Uyemura and Van Deventer (1993:158) also explains that by applying a time-weighted assessment of the present values of an instruments cash flows as a fraction of its market value an assessment of it market value sensitivity can be made. This dictates that both cash flow and repricing information is required to establish principal and interest payments which in turn are applied in the duration calculation. The BCBS (2004:28) indicates that both the maturity and repricing schedule can be used to calculate the Macaulay duration of financial instruments. In essence, where the repricing balances as per the gap report differs from the maturity ladder balances for example, in a floating rate mortgage bond the reprice balance is applied as the cash flow value in the calculation. On the contrary, for fixed rate deals the cash flow balance is consistent for the repricing and maturity schedules. Generally, the longer to maturity or the next repricing date of the instrument and the smaller the payments that occur before maturity, the higher the duration.

Cade (1997:156) states that Macaulay duration has a number of distinct advantages. These advantages are:

- Cade (1997:156) explains that it provides a simple and fairly accurate method for hedging or immunising the net balance sheet position to IRR, by taking a new equal and opposite position in a security with the same net Macaulay duration. In addition, Koch

and MacDonald (2000:340) state that a bank can immunise its open IRR position by transacting in a hedging-instrument with a comparative or similar duration. Thus, any change in interest rates will cause a change in value of the instrument which will be offset by the change in value of the hedging instrument.

Geske and Shearer (1997:24) explains that a bond with a duration of five years have more IRR than a bond of two years to maturity. The OCC (1998:58) states that in general the higher the duration the greater the rice or value sensitivity of the instrument to interest rate changes. By comparing the duration of various positions the overall risk position can be established. According to Bitner (1992:103) the net duration position is achieved by calculating the Macaulay duration for the assets and for the liabilities of the balance sheet and then comparing their respective durations as an alternative to a gap report. If the asset Macaulay duration is shorter than the liability Macaulay duration (e.g. 1.5 years versus 2 years) the balance sheet is asset sensitive and therefore net duration is negative (e.g. 1.5 years - 2 years = -0.5 years).

According to Koch and MacDonald (2000:343) the difference between the net duration i.e. the duration of assets less the duration of liabilities, provides an indication of the earnings and economic value sensitivity of the bank. By comparing the duration of assets and liabilities the overall position towards interest rate changes can be established. The OCC (1998:59) also states that duration may be positive or negative that will indicate the positioning of the bank in terms of benefiting or being disadvantaged by changes in interest rates.

According to Cade (1997:156) a bank's NII will generally benefit or increase when interest rates rise and decline when interest rates decrease when a negative net duration persist in the balance sheet. When the net Macaulay duration is positive in that the asset duration is longer than the liability duration (e.g. 2 years versus 1.5 years), the balance sheet is liability sensitive. This indicates in general a benefit in NII of the bank when interest rates decrease. If the net Macaulay duration of the bank is neutral given that the duration of assets equals the duration of liabilities, the bank is immunised against IRR and the net value of the bank will stay constant when interest rates changes. It must be noted however that this supposition is based on a simplistic relationship between two or

more securities with differing cash flow and/or repricing profiles, ignoring pricing or spread differentials.

- Cade (1997:156) states that Macaulay duration may be used as a prudential standard of comparison for alternative business strategies and funding sources. The OCC (1998:59) also advocates that duration in general can be applied as a measure for IRR limit setting.

- According to Bitner (1992:102) the Macaulay duration and yield-to-maturity provides the two basic but essential elements for the calculation of price elasticity or interest rate elasticity. This directs that a quantum on IRR can be established through adapting Macaulay duration.

- Heagy and Tannenbaum (1997:300) also states that a single risk number may be produced for the IRR position of the bank which simplistic risk management processes and management may find appealing.

Schraudenbach (1992:88) states that whilst the concept of simple duration or Macaulay duration is a helpful tool in understanding the inherent riskiness of two comparative bonds or loans with differing cash flows, the practical application of duration should attempt to measure the price risk/sensitivity or IRR. The price or value change of an instrument for a change in interest rates is the measure that is the most relevant for risk management purposes and the measurement used to measure the price sensitivity must answer the question of how much is the value of the price sensitivity. Schraudenbach (1992:88) explains that modified duration can be used as a measure of price sensitivity for bonds and is therefore a method to quantify interest rate sensitivity. This establishes a method to quantify the direct relationship between the price of the bond and the changes in the underlying interest rate.

According to the BCBS (2004:28), in its simplest form Macaulay duration measures changes in market value or economic value resulting from a percentage interest rate change under the simplifying assumptions that the changes in value is proportional to the changes in the level of interest rates and that the timing of payments is fixed. The relaxation of the assumption in Macaulay or simple duration, that the change in value is proportional to the change in price of the instrument, establishes the method of modified duration. The modified duration is therefore

the Macaulay duration divided by 1 + r, where r is the level market interest rates, and is therefore an elasticity calculation.

According to Koch and MacDonald (2000:235) modified duration characterise the elasticity relationship between the price of a bond or instrument and interest rates. Therefore, the price change or value of the bond is approximately equal to the modified duration times the change in the market interest rates. According to Geske and Shearer (1997:25) the value change in a bond for a given change in interest rates can be estimated by multiplying the change in rates by the modified duration value. The modified duration is therefore simply Macaulay duration divided by the market rate. Modified duration is therefore a simple estimation of the sensitivity of an instrument's value or price to changes in interest rates. As such it is a reflection on the percentage change of the economic value of the instrument for a given percentage change in 1 + r. The modified duration methodology is consistent with measuring or quantifying the effect of IRR from an economic perspective.

The OCC (1998:57) states that most economic sensitivity models will compute the modified duration of a bank's financial instruments in its assessment of IRR. Therefore, sensitivity of market values to small changes in interest rates is measured by modified duration. According to IPS-Sendero (2006**a**:926) the modified duration is a measure of economic/fair value sensitivity by dividing the Macaulay duration by the instruments yield-to-maturity. Stated in terms of a percentage change, modified duration provides a rough estimate of the value sensitivity of an instrument as interest rates change. Higher modified duration implies greater value sensitivity and can be either a positive or negative number. Given that the economic/fair value is inversely related to interest rate changes, the modified duration sign indicates the direction of the value movement for the given interest rate change. For example, if interest rates increase the market value of the instrument will decrease. Modified duration is the measure of by how much the value will decline. According Smith and Benci (1999:441) a positive modified duration dictates that net worth will decrease when interest rates increase and vice versa. Koch and MacDonald (2000:232) also state that the greater the modified duration the greater the price/value sensitivity. A lower modified duration value will indicate less value or price sensitivity to the bond, instrument or portfolio of assets and liabilities.

In addition, the OCC (1998:57) explains that the modified duration of an instrument with no optionality, represents the percentage change in the market value from a given change in market

rates, for example 1 percent. For instance, the market value of a bond with a modified duration of five will decline approximately by 0.5 percent if the market interest increases by 10 basis points. Modified duration therefore expresses the price sensitivity or elasticity of an instrument to a given percentage change in interest rates. Higher modified duration implies greater value sensitivity and vice versa, of which the value can be either positive or negative given the direction of value movement as a result of the inverse relationship of value changes to interest rate movements.

According to the OCC (1998:57) and confirmed by Koch and MacDonald (2000:235) modified duration is calculated by the following formula:

$$\text{Modified Duration} = D` = \frac{D}{(1+r)} \qquad (5.6)$$

where D = Macaulay duration and r = market rate

Source: (OCC, 1998:57; Koch and MacDonald, 2000:235; Marrison, 2002:58)

If the coupon payments are other than annual payments then the modified duration's denominator is adjusted to allow for 1 + r ÷ the number of coupon payments per annum (OCC, 1998:57). This approach is also agreed by IPS-Sendero (2006**a**:813) stating modified duration formula can be formularised as:

$$\text{Modified Duration} = D` = \frac{D}{\left(1+r\right)f} \qquad (5.7)$$

Where: r = discount rate/100; D`= Macaulay duration and f = interest payment frequency

Source: (IPS-Sendero, 2006**a**:813)

Table 5.8 illustrates the calculation of the Macaulay and modified durations of a two-year $100,000 bond that pays interest semi-annually. The bond has a 7.5% coupon interest rate and was purchased at a par-to-yield price of 7.5%. The bond therefore has a modified duration of 1.82 which implies that if rates increased by 100 basis points the value of the note will decline by approximately 1.82 percent (OCC, 1998:58).

Table 5.8 Macaulay duration and modified duration calculations

Period (t)	Cash Flow (CF)	PV of $1 at 3.75%*	PV of CF	t x PV of CF
1	$3,750	0.96386	$3,614	$3,614
2	$3,750	0.92902	$3,484	$6,968
3	$3,750	0.89544	$3,358	$10,074
4	$103,750	0.86307	$89,544	$358,176
Total			$100,000	$378,832
Macaulay Duration: $ 378,832 / $ 100,000 = 3.79 semiannual periods or 1.89 years				
Modified Duration: 1.89/(1+(7.50%/2) = 1.89/(1+0.0375) = 1.82 * A 3.75% coupon and discount rate is used, because of the semiannual payment of interest.				

Source: (OCC, 1998:58)

According to Marrison (2002:58) the change in the value of an instrument can be calculated if the duration and potential movement in interest rates are known. By multiplying the modified duration value by the value of the bond and the change in interest rates the sensitivity of the bond's value to the specific change in interest rates are estimated. This is known as dollar duration in that a specific quantum of risk sensitivity is derived. IPS-Sendero (2006**a**:813) explains that although modified duration indicates the price sensitivity in terms of percentage value change for a change in yield, it does not indicate the monetary change. Dollar duration is a measure of economic value/fair value change given a change in interest rates, stated in dollar or monetary value. Dollar duration is calculated for both Macaulay and modified duration by multiplying the duration estimate by the value of the instrument as interest rates change.

Therefore, Macaulay Dollar Duration is calculated as:

- Macaulay Duration × economic value

Modified Dollar Duration is calculated as:

- Modified Duration × economic value (IPS-Sendero, 2006**a**:813).

Furthermore, Koch and MacDonald (2000:233) explain that assessing the change in the value of a bond for a given interest rate change can be calculated by the following formula:

$$\Delta Value = -1 \times ModifiedDuration \times Value \times \Delta r \qquad (5.8)$$

This is also reported by Marrison (2002:58) stating that multiplying by negative 1 makes modified duration compatible with Macaulay duration. The change in value is calculated as the negative modified duration multiplied by the change in interest rates multiplied by the value of the bond.

According to Koch and MacDonald (2000:233) modified duration is also comparable with price elasticity but instead of comparing the quantity demanded and price modified duration provides information about the change in market value based on changes to interest rates. Therefore, modified duration depicts elasticity and given this perspective, Uyemura and Van Deventer (1993:157) adopted the term interest rate elasticity (IRE) as the alternative to the term modified duration. IRE is defined as the percent change in the market value of an asset or liability (or equity) for a 1% increase in interest rates. The adapted IRE formula is:

$$\text{IRE} = \frac{-D}{(1+r)} \tag{5.9}$$

Source: (Uyemura & Van Deventer, 1993:161)

Following from the IRE equation 5.9, Uyemura and Van Deventer (1993:161-162) explains that if a loan with a Macaulay duration of 2.78 years and a yield of 8.78% is analysed, then the IRE calculates to be -2.56% (-2.78/1.0878). This indicates that for a 100 basis point rise in interest rates the market value will decline by 2.56%. However, when reflection is given to the market values of a bond for a wide range of interest rate changes, it becomes evident that the market values are a non-linear function of the yield curve changes. In Table 5.9 the average change in market value of 2.56% is confirmed (25.0/977.3), however the individual percentage changes in market values differs somewhat from the IRE of 2.56% due to this non-linear market value relationship to price changes. This situation is known as convexity and indicates one of the limitations of Macaulay duration and modified duration or IRE in that each of these methods assumes the linear relationship between the percentage change in value and the percentage change in market rates (Uyemura & Van Deventer, 1993:162).

Table 5.9 Market values for different market rates

		Original		1% Higher Rates		1% Lower Rates	
	Cash	Yield	Present	Yield	Present	Yield	Present
Year	Flow	Curve	Values	Curve	Values	Curve	Values
1	80	7.00%	74.8	8%	74.1	6%	75.5
2	80	8.00%	68.6	9%	67.3	7%	69.9
3	1080	9.00%	834.0	10%	811.4	8%	857.3
		8.89%	977.3	9.89%	952.8	7.90%	1,002.7
Changes in Market Value (from 977.3):					(24.5)		25.4
Percentage Change in Value:					-2.51%		2.60%

Source: (Uyemura & Van Deventer, 1993:162)

According to Heagy and Tannenbaum (1997:302) the duration of instruments can shift over various interest rate scenarios. The duration of core deposits without maturity are difficult to

predict and invariably changes under various interest rate environments. Mortgage loan prepayments also impact the duration of these loans and are highly influenced by in particular interest rate levels. This muddies the translation of interest rate changes to the changes in economic value. Similar to the convexity experienced in bonds the banking book products also experience the effects of convexity.

According to Marrison (2002:59) convexity is experienced as a result of changes to the cash flows directed by specific interest rate movements, but in a non-structured or non-linear fashion. Thus, convexity is the non-linear relationship of the price or value of a bond or for that matter a home loan or deposit, and its yield or interest rate.
Tannenbaum (1999:450) explains that for example, a home loan's performance will retract in low interest rate environments because the benefits of increased discounting are offset by the need to reinvest heavy prepayments at lower interest rates. This translates into that the home loan's life becomes shorter limiting its ability to increase in value. At the extreme further rate decreases may lead to even an implied zero duration given that its value exerts no reaction to further rate decreases. The manifestation of the impact of optionality through convexity therefore makes duration a moving target that changes across various interest rate environments.

Koch and MacDonald (2000:341) also states that duration as a measure of IRR assumes a linear price/value and interest rate relationship. The effects of optionality translate into changes to the cash flows of the instrument in an unstructured fashion. Therefore, convexity impacts the estimation of duration. When a customer exercise its embedded option the cash flow stream changes directly impacting the product's value assessment and sensitivity to any movement in interest rates.

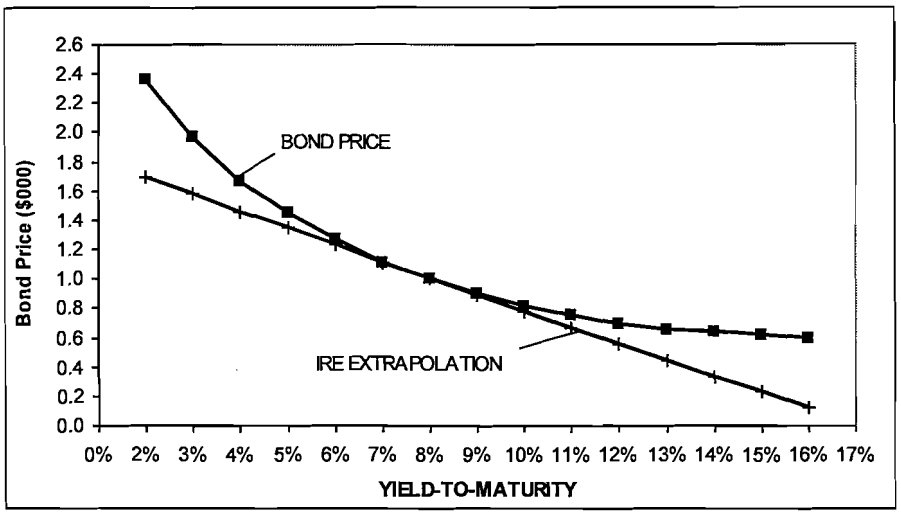
Convexity is presented in figure 5.1 which portrays the market values for a 30-year, 8% annual coupon bond for various yields-to-maturity. The IRE or modified duration is also plotted as the tangent to the price curve, reflecting the slope of the curve at the point where it was calculated which in this case at 8 percent (Uyemura & Van Deventer, 1993:162).

IPS-Sendero (2006**a**:914) explains that convexity measures the non-linearity of the value/yield curvilinear relationship, whilst duration is a measurement of the linear relationship of the value and yield curvilinear function. Convexity as a function is stated in percentage terms and indicates the rate of change in effective duration for a given interest rate change. The interest

rate change is normally expressed as a 100 basis point rate movement. Accordingly IPS-Sendero (2006**a**:918) explains that when positive convexity exists it implies that the instrument's value increases proportionally greater when rates fall than when rates rise. This is an attribute applicable to non-optioned fixed income positions. Negative convexity indicates that the value increases proportionally less when interest rates fall than when rates rise and this is indicative of optioned positions.

According to Koch and MacDonald (2000:342) negative convexity (or for that matter negative effective duration) indicates that when rates decrease the value of the instrument fall below its value derived under a rising interest rate environment. Convexity's calculation is based on effective duration which is a more robust measurement of IRR due to its inclusion of the effects of embedded options in the instrument's IRR sensitivity (IPS-Sendero, 2006**a**:918).

Figure 5.1 Convexity



Source: (Uyemura & Van Deventer, 1993:163)

The OCC (1998:58) explains that although modified duration alleviates the limitation of Macaulay duration which assumes changes in market value are proportional to the changes in interest rates, it does not alleviate the limitation that it assumes the timing of payments or the repricing of balances are constant. Therefore, modified duration is not valid for callable bonds or mortgage-backed securities, whose embedded options will result in changes to their cash flows and repricing balances when interest rates change.

Tannenbaum (1999:450) also argues that the effects of embedded options are a significant source of IRR. The duration of core deposits can change for even the slightest interest rate

movements and prepayment effects the duration due to cash flow changes triggered by interest rate movements. Duration calculation can attempt to incorporate the effects of embedded options and customer behaviour. According to the OCC (1998:58) the effects of convexity also further impacts the IRR sensitivity of both fixed and floating rate instrument with embedded options. To correct for this problem the method of effective duration was derived which uses simulation techniques to calculate the instrument's price change for a specific interest rate change.

According to Koch and MacDonald (2000:342) the use of effective duration attempts to incorporate the changes in the expected cash flows of the instrument when interest rates change. This dictates that cash flow forecasts must be linked to interest rate forecasts to derive the value changes under various movements of interest rates.

According to IPS-Sendero (2006**a**:918) effective duration have the capability to incorporate the changes in the cash flows of instruments with embedded options. Effective duration better captures the non-linearity of price or value movements by changes to market interest rates but it must be noted that it is useful only for the specific interest rate movements measured. Effective duration is a measure of modified duration implied/derived from observing actual price changes or even simulated price/value changes as interest rates changes.

The OCC (1998:60) states that similar to modified duration, effective duration is expressed in percentage change of value but its main advantage is that it incorporates the effects of optionality on duration measures. This method of duration is helpful in assessing the value sensitivity for embedded option instruments and is for this matter sometimes referred to as option-adjusted duration. Tannenbaum (1999:450) also states that effective duration are also known as option-adjusted duration given its attempts to incorporate the changes in cash flows driven by embedded customer options in the form of prepayments and core deposits (non-maturity deposits).

The BCBS (2004:29) advises that the specific interest rate movements or scenarios applied to the market valuation should allow for optimal incremental rate changes, often a single basis point. With advances in computing technology, effective duration can potentially be measured as the percentage change in the market value of the instrument for a basis point change in yield.

The effective duration is calculated as the percent change in value reflecting two different market yields.

According to IPS-Sendero (2006**a**:813-814) three related results needs to be analysed in order to compute the effective duration for example, a base result, and two results based on parallel rate shocks of equal magnitude up and down. A shift of a 100 basis points is measured in fractional units for example the change in the yield (Δr) is 0.01. Divide the absolute difference between the two present values by the bonds current market value (PV) times the assumed change in yield times two. The formula for effective duration can be defined as follows:

$$\text{Effective duration} = (EV_{down} - EV_{up}) \div (EV_{base} \times \Delta r \times 2) \quad (5.10)$$

Where: EV_{down} = Economic value for downward shift in rates of size Δr
and EV_{up} = Economic value for upward shift in rates of size Δr
and EV_{base} = Economic value with no shift in rates.
Therefore effective duration = $(PV_{-1bp} - PV_{+1bp}) / (2 \times PV \times 0.0001)$ (IPS-Sendero, 2006**a**:814).

According to Koch and MacDonald (2000:341) effective duration or option-adjusted duration is calculated by the following formula:

$$\text{Effective Duration} = \frac{P_{i-} - P_{1+}}{P_0(i_+ - i_-)} \quad (5.11)$$

Where: P is the economic value or market value; P_{+-} is depicted as the market rate plus/minus the increase/decrease in rate; and P_0 is the initial market/economic value of the instrument.

The OCC (1998:60) explains that the effective duration can be calculated for a security after a 100 basis point interest rate increase. It assumed the security trades at par-to-yield of 7 percent. The present value ($94) is calculated at 8 percent incorporating the assumption that cash flows will increase because prepayments will slow. The present value ($104) is also calculated at 6 percent interest rates with cash flows decreasing based on the assumed increase in the prepayment propensity in a lower interest rate environment. The effective duration is 5 [($104-$94/2(100)(0.01)] which indicates that the bond value will decline by approximately 5 percent when interest rates rise by 100 basis points (OCC, 1998:60).

According to Marrison (2002:193) duration as measures of IRR can indicate the earnings and economic value sensitivity of a bank to interest rate changes. This can be achieved through netting the duration positions of all assets and liabilities. A positive net duration will indicate that value or earnings will decline when rates increase and vice versa.

According to the OCC (1998:59) duration analysis as a tool to measure IRR sensitivity can be applied from both the earnings and economic value perspective. Similar to establishing the effect on the NII given the duration of the balance sheet for a specific interest rate movement, the economic value of equity (EVE) may also be viewed from a net balance sheet position. This is achieved by subtracting the value weighted liability durations from asset durations to establish the duration of equity. The net duration will indicate whether the EVE of the balance sheet will increase or decrease for a given change in interest rates. A bank with long-term assets funded by short-term liabilities will have a net positive duration of equity. Positive net duration of equity indicates that for an increase in interest rates the EVE will decrease. When the short-term assets of the bank are funded by long-term liabilities it indicates negative equity duration and therefore the EVE will generally increase when interest rates increase (OCC, 1998:59).

Smith and Benci (1999:441) also state that the net duration of the balance sheet or the duration of the net worth (equity) is indicative of the balance sheet's exposure to IRR. A positive duration of net worth indicates that economic value will increase when interest rates decrease and vice versa. By multiplying the duration of equity by the said interest rate change ratio an approximation of the value change can be established.

Koch and MacDonald (2000:343) also state that duration is additive across securities in a portfolio. Thus, by comparing the weighted-average duration of assets against the weighted-average duration of liabilities an indication of IRR can be established. A duration gap (DGAP) can therefore be constructed comparable to the methodology as applied to repricing gap. The duration gap compares the value sensitivity of assets and liabilities to assess whether the net position will be better or worse when interest rates changes. Ford (1999**a**:424) also states that duration gap are computed in similar fashion to repricing gap but by weighting the duration of instruments against their respective values in constructing the net position.

Although the duration analyses can be useful when applied correctly it also has limitations. According to Cade (1997:157) the main weakness of duration analyses lies possibly in its

simplicity which is also its main benefit in that it is a single number. This single number may however not explain the true sensitivity of the balance sheet to changes in interest rates. It may be masking extreme mismatches in narrower time bands which may offset one another in the aggregate. According to Smith and Benci (1999:440) although duration's attraction lies in its single number the risk to value its very simplicity is its downfall. Duration suffers of the same imperfections as repricing gap. Duration is highly exposed to the assumptions surrounding the timing of cash flows. If the duration of an asset and a liability is five years it does not necessarily mean that the earnings and economic value sensitivity is equal and therefore no IRR exists within the net position of asset and liability.

According to Ford (1999**a**:424) duration, similar like reprice gap, does not effectively capture significant option risk and yield curve risk. Static cash flow is assumed based on once-off discrete interest rate changes. The focus is therefore also on current business and any new business strategies are ignored in the assessment of IRR. The OCC (1998:60) also states that Macaulay and modified duration assumes that cash flows are constant over time over various interest rate movements. Thus, duration's effectiveness in capturing the effects of embedded options is limited and relies on effective duration calculations which in itself are troublesome. Cade (1997:157) concludes that the duration information is to crude to derive any comfort regarding its application in IRR under all circumstances.

The OCC (1998:60) further explains that all the duration methods measure fairly accurately the sensitivity to small and generally parallel interest rate changes but even effective duration's accurateness decreases when non-parallel interest rate changes are measured. According to Marrison (2002:58-59) duration is only effective for small parallel interest rate movements. Complex shifts in the yield curve and the resultant effects on the value of an instrument are not captured. Exposures to various twists, shifts and flexes to the curve over various terms will render duration as a measure of IRR highly inaccurate. The effects of convexity require that effective duration make numerous incremental assessments of the changes to interest rates and the resultant value changes. Smith and Benci (1999:441) also state that duration is not invariant to non-parallel interest rate movements given the relationship between cash flows and their timings and interest rates as incorporated in the discount factors.

The OCC (1998:60) also states that duration for different instruments will change over time at different rates, an observation called duration drift, which indicates that duration hedges will

become less effective over time. Macaulay and modified duration does not include the changing cash flows of instruments with embedded options although effective duration together with better computing technology attempts to overcome this limitation.

Van Vuuren (2005:6) argues that duration as a measure of IRR must be adapted to include the effects of optionality (prepayments, defaults and in perpetual maturity deposits) to address its limitations invoked by assuming linear value and interest rate relationships. According to Koch and MacDonald (2000:353) in order for duration to be meaningful it requires accurate forecast of the timing and the quantum of embedded options to be exercised by customers. Van Vuuren (2005:142) states that although the Macaulay duration and its enhanced or patched-up derivation in the form of effective duration can be adjusted to reasonably incorporate embedded option and default effects, the effort compared to benefit of re-patching the methodology remains questionable.

Heagy and Tannenbaum (1997:303) agree stating that with the significant advances in systems and access to full yield curve and scenario-driven cash flow projections, any attempts to incorporate these in the assessment of value changes as part of the duration assessment seems illogical. Given that the value assessments are already achieved through such advanced techniques, risk managers do not need to retreat to duration measures. In addition, Van Vuuren (2005:142) states that stochastic descriptions of yield curve movements can prove to be a better assessment of value changes. Heagy and Tannenbaum (1997:304) also states that best practise IRR management are no longer expressed in duration terms but in full-spectrum yield curve and cash flow generation models that best capture the information that duration may omit.

Therefore the need is established for better and more accurate projections of current and future IRR sensitivities from both the economic and earnings perspective, something which simulation modelling techniques attempts to provide (OCC, 1998:60).

5.5 SIMULATION MODELLING

According to the BCBS (2004:30) simulation techniques applied in the assessment of IRR can be seen as an extension and refinement of the more simplistic IRR analysis options such as gap and duration analysis. Gap and duration analysis are based on the maturity and repricing schedules of the bank's balance sheet. The difficulties experienced in quantifying the affect of

IRR on earnings with the associated maturity matching measures are solved by a more direct approach by ALM managers. Uyemura and Van Deventer (1993:135) describes that the best approach to the assessment of IRR through simulation models is to clearly understand the current balance sheet data. Payant (1992:17) argues that the existing balance sheet and its attributes pertaining to its cash flows and pricing behaviour form the basis of the simulation modelling process and the derivation of IRR. The OCC (1998:54) also states that the simulation model is driven from the current or existing balance sheet structure and pricing as embedded in the bank's products and activities reported which in turn directs the projection and analyses on earnings and economic value.

Uyemura and Van Deventer (1993:135) states that the computer simulation model starts with the current balance sheet, including detailed maturity and repricing schedules and associated rates and yields of those balances. Gavin (2001:61) explains that by building a model of the balance sheet and incorporating the numerous variables influencing profits, a more detailed picture could be developed of how earnings would act if interest rates changed. According to the BCBS (2004:30) simulation approaches involve more detailed breakdown and investigation of various categories of on- and off-balance-sheet positions. This allows to make specific assumptions about the principal and interest payments and also the non-interest income and –expense arising from each type of position and to incorporate these assumptions in the IRR analysis. Simulation techniques assess the potential effects of changes in interest rates on earnings and economic value by simulating the future path of interest rates and their impact on cash flows.

According to the OCC (1998:54) simulation models evaluate risk exposures over a period of time taking into account projected changes in balance sheet structures, pricing, maturity relationships and new business assumptions. Payant (1992:17) states that IRR assessment and profit planning modelling should be a dynamic process and that no proverbial crystal ball exists. Changes to interest rates and economic conditions will have an impact on growth and customer behaviour and also management's ability to manage or alter the impact from these exogenous factors. The simulation model therefore should take cognisance of the changing internal and external variables that may impact the future earnings and economic value of the bank.

Uyemura and Van Deventer (1993:135) explain that the forecast of future income statements, balance sheets and cash flow statements for a series of future time periods is established by literally simulating the future repricing, maturities, rollovers, and new business for all balance

sheet activities of the bank. To generate a plausible set of financial statements, assumptions are made about a number of important issues such as target balances, maturity schedules, interest rates and pricing assumptions for new business. The APRA (2003:6) concurs explaining that specific assumptions about product behaviour and varied changes to interest rate environment such as changes to the slope and shape of the yield curve are applied. Although mostly deterministic in nature the assumptions especially about future interest rate scenarios may be derived through a stochastic process typically by means of Monte Carlo simulations.

According to the BCBS (2004:30) the assessment of IRR is done from two perspectives namely the economic perspective and the earnings perspective. The APRA (2003:6) agrees stating that IRR assessment requires that both the earnings and economic value impact of interest rate changes are being assessed. In order to establish the quantum of IRR through simulation models two perspectives to simulations may be applied in the analysis of IRR, namely:

- Static simulations assess the cash flows arising from the bank's current on- and off-balance sheet positions. The exposure to earnings are assessed by simulating the estimated cash flows and resulting earnings over a specific period, based on one or more assumed interest rate scenarios (BCBS, 2004:30). The APRA (2003:6) states that all existing balance sheet assets and liabilities and off-balance sheet items' cash flows are simulated. This is also reported by Boulier (1998:25) stating that static simulation focuses on the existing business of the balance sheet and the resultant cash flows thereof.

- Dynamic simulations on the other hand builds in more detailed assumptions about the future course of interest rates and the anticipated changes in a bank's business activities in terms of new loans and deposits, pricing, loan prepayments and changes to interest rates over that period of time. (BCBS, 2004:30). The APRA (2003:6) explains that future business strategies may also impact the IRR exposure of the bank and requires assessment which may be performed through dynamic simulations. In addition, Cade (1997:158) states that to incorporate the impact of future business strategies on IRR dynamic simulations will include future anticipated business to the current (static) balance sheet positions of the simulation model..

According to the APRA (2003:7) the dynamic analysis supplied by dynamic simulations is generally regarded as a more realistic measure of changes to the anticipated NII over the

modelling time-frame. Bowers (2004:4) concurs with that ALM simulation models by design are simplifications of the real world and therefore attempts to emulate the future, incorporating as best possible, behaviour and financial and accounting frameworks and standards. The challenge of conforming an intricate balance sheet to corporate targets for risk tolerance, has led managers to increasingly implement more sophisticated computer based simulation software. According to Bowers (2004:4) this allows risk managers and bank management to investigate the causal environmental variables that influence a bank's financial performance.

The usefulness of simulation-based IRR measurement techniques depends highly on the validity of the assumptions employed within the model and the accuracy of the basic methodology (Bowers, 2004:4). Meyers (1988:13) concurs in that the function of simulation models is to transform assumptions and decisions into future financial analyses, something which is both an art and science. This requires serious consideration and frequent review and consensus.

The BCBS (2004:30) advises that the validity of the simulation assumptions about future interest rates and balance sheet variables such as bank strategy and customer behaviour must be assessed frequently. For the risk measurement system to be reliable the assumptions applied to the simulation model must be sound. It is crucial that the process underpinning the formulation of the assumptions for the simulation model is robust, credible and transparent. Independent reviews, back testing and reasonableness checks performed by appropriate role players on the results produced from the simulation model's inputs are some of the main considerations for ensuring trustworthy simulation results for the assessment of IRR.

The APRA (2003:7) agrees stating that all assumptions should be regularly validated and that formal reviews should be conducted. In addition, the OCC (1998:12) states that a bank should ensure that all simulation model inputs and assumptions are reliable, current and credible and that senior management must ensure that the integrity of the system is maintained.

The IPS-Sendero Asset/Liability Management System software (IPS-Sendero, 2006**a**:193) facilitates the following internal and external variables for which forecast assumptions must be made:

- Interest rate scenario.
- Loan prepayments and early settlements.

- Rate spreads.
- Capital requirements.
- Balance sheet target balances and new business volumes.
- New business volume term strategies.
- Foreign exchange rates.
- Purchase and sale strategies of investments.
- Overrides on economic value and duration.
- Other income and expense forecast information.
- Other input data: Other external variables, income tax rates, dividends and loan origination fees etc. may be input to facilitate better financial planning and simulation results (IPS-Sendero, 2006**a**:193).

According to Bowers (2001:6) computer simulation modelling is a risk measurement technique that has the ability to effectively capture the various sources of risk and in particular IRR. Therefore simulation models can estimate the effects of IRR on earnings and capital. It has the capability to estimate the effects of IRR from both the earnings and economic value perspectives (Bowers, 2001:6). According to the BCBS (2004:15) simulation models has the capability of projecting cash flows and effectively simulate future balance sheets and income statements from which both the earnings and economic value sensitivities may be derived. Van Greuning and Bratanovic (2000:184) also states that simulation models construct dynamic balance sheets over future periods, integrating various variables from which the effects of IRR to earnings and economic value can be assessed.

According to the OCC (1998:2) the earning perspective should assess the impact of IRR on NII as well as net income in order to fully assess the contribution of non-interest income and operating expenses to the IRR exposure of the bank. According to the BCBS (2004:7) the earnings perspective is relatively short-term based analysis of IRR effects. Smith and Benci (1999:440) state that interest income simulation quantifies the earnings variability of the NII over one to two years under various interest rate scenarios. The earnings perspective to IRR is forward looking and precisely measures the changes to NII or net income for based on anticipated balance sheet dynamics and interest rate environments. Income simulation is a critical process in estimating the earnings variability due to IRR. Bitner (1992:103) also states that simulation models are applied to project the NII of the bank under various interest rate scenarios giving an estimate of the bank's earnings sensitivity. The bank can therefore assess the

impact of IRR under various future earnings predictions based on various balance sheet and interest rate scenarios.

According to Koch and MacDonald (2000:349) banks can assess the sensitivity to their market value of equity or economic value by constructing the different cash flows of the balance sheet under various interest rate scenarios. This is achieved through a simulation model. Such economic value sensitivity analyses incorporate the long term effects of IRR as the variability in cash flows (for example due to embedded options) under various interest rate scenarios are assessed. According to the OCC (1998:2) the assessment of IRR from the economic value or capital perspective should consider how intermediate (two to five years) and long-tem (more than five years) positions could affect the bank's future financial performance. The reason is that the value of instruments with intermediate and long-term maturities can be highly sensitive to changes in interest rate. Therefore it is important for the bank to measure, monitor and control the level of these exposures (OCC, 1998:2).

According to Smith and Benci (1999:440) the earnings analysis based on income simulation lacks complete information on the impact of IRR on the net worth or economic value of the bank. The economic value measures the long-term effects on value in that all future cash flows of the balance sheet is assessed for value sensitivity due to changing interest rates. It is possible that a bank's earnings may be positively positioned to an interest rate increase but it economic value will decline. Therefore, information on earnings sensitivity should be supplemented with information on economic value variability. The BCBS (2004:7) states that the economic value perspective provides a comprehensive view of the long-term effects of IRR on the net worth of the bank. As such the earnings perspective simulates all interest and non-interest impacts on the earnings of the bank.

The OCC (1998:55) explains that the forecast of interest rates involves projecting the direction and shape of the yield curve. The bank's potential exposure to IRR is estimated by calculating how much the value, income, and expense of the bank's current and forecasted financial positions will potentially change as a result of interest rate changes. The BCBS (2004:15) also states that the assessment of IRR involves the forecast of the course of future interest rates.

According to the BCBS (2004:16) a bank's IRR exposure is mainly a function of the sensitivity of the bank's balance sheet to a given change in market interest rates but also the magnitude and

direction of this change in market interest rates. This requires that the simulation model applied in the assessment of the IRR exposure must calculate the results on the balance sheet and income statement for various interest rate scenarios. The OCC (1998:13) explains further that the forecast of these interest rates scenarios are typically driven by this perspective of the magnitude and direction of the change in interest rates.

According to Bitner (1992:103) banks usually focus on realistic and likely interest rate scenarios typically formulating scenarios based on management's best estimate of the expected future path of interest rates and then the potential highest and lowest levels of future interest rates as three standard scenarios. These scenarios of expected, high and low interest rate levels are often linked to a probability of occurrence. The APRA (2003:7) explains that banks assess the impact of IRR under various rate scenarios. Specific shifts and tilts in interest rates are often used and also rate forecasts based on the historical behaviour of the interest rates are often applied. The BCBS (2004:15) advises that multiple interest rate scenarios should be applied in the assessment of IRR. Statistical analysis may also be applied in the derivation of probable interest rate changes and the evaluation of correlation assumptions in respect to basis risk and yield curve risk.

According to Bowers (2001:6) stress however that the formulation of interest rates scenarios should also provide meaningful estimates of risk and include sufficiently wide ranges of interest rate movements to allow management to understand the risk inherent in the bank's products and activities. The rate simulations should present rigorous and stressful scenarios and the effort of the simulation must be focused on identifying those environments that may pose a serious threat. According to the BCBS (2004:15) the changes to interest rates must be sufficiently large to encompass the risk attendant to the bank's holdings. Multiple scenarios are advocated capturing the changes in relationships between interest rates indicative of yield curve and basis risk as well as changes in the general level of interest rates. Typically steep rate ramp interest rate paths of 100 basis point movements up and down over a one year period may be simulated to reveal behavioural factors that give rise to earnings and capital value at risk.

IPS-Sendero (2006**a**:930) explains that rate ramps are interest rate scenarios which are defined by the time period for realising a specified interest rate movement. The changes in interest rate over the time period is linear adjusted to the maximum specified value of change. The APRA states that interest rate scenarios can include changes to the short and/or long ends of the yield

curve. Changes may also be based on achieving a directional change in the shape of the yield curve such as yield curve tilts (steepening/flattening of the curve), inversions and/or other non-linear adjustments.

Smith and Benci (1999:445) also state that the IRR sensitivity can be derived by changing interest rates by a constant percentage i.e. one percent or 100 basis points. This is referred to as a parallel interest rate shift. The APRA (2003:4) also state that banks measure IRR sensitivities under various parallel movements of interest rates. The current or expected rate view is changed by a unitary percentage or basis points i.e. 100 basis points. According to IPS-Sendero (2006**a**:930) yield curve twists are rate scenarios which entail specified quantum and directional adjustments to the yield curve. Rate shocks on the other hand are interest rate scenarios based on instantaneous and sustained shifts in interest rates and tend to be more severe since the full weight of change in interest rates are immediately applied to all assets and liabilities at their earliest repricing dates. Typically parallel rate shocks could be applied which will instantaneously move the interest rate scenario by for example 100 basis points in an upward and downward direction (IPS-Sendero, 2006**a**:930).

According to the OCC (1998:13) banks will generally apply one of two methods to develop interest rate scenarios forecasts. These methods are:

- The deterministic approach: This is a common method used where the bank will specify the amount and timing of the rate changes. This approach typically uses standard scenarios for risk analyses based on the likelihood of adverse interest rate movements. The most likely scenario is often defined for comparative purposes. The number of scenarios is institution specific but mostly range from flat or expect, up and down to multiple parallel rate shocks, rate ramps, yield curve twists, shifts and inversions. According to the OCC (1998:13) deterministic rate scenarios generate an indicator of IRR exposure for each rate scenario by highlighting the difference in NII or net income between the base case and other scenarios

- The stochastic approach: This method deploys a model to randomly generate interest rate scenarios. A distribution of outcomes or exposures is produced from which probability estimations are made of a certain range of outcomes. For example, the bank may want a 95 percent confidence level that the bank's NII will not decline over the next 12 months

by more than a certain amount. Monte Carlo and Linear Path Space analysis are typical stochastic interest rate scenario generation models (OCC, 1998:13).

The BCBS (2004:15) states that the selection of interest rates scenarios will differ amongst institutions based on the complexity of the embedded risks within the balance sheet and the sophistication and resource availability of the particular organisation. The OCC (1998:13) concurs and also advise that the fundamental requirement is however that the risk measurement technique and methodology effectively captures the bank's exposure to IRR.

Simulation techniques are therefore a more sophisticated measure of IRR and applied by more complex banks to measure IRR (BCBS, 2004:30). According to Matz (2005) the simulation technique can be applied to measure IRR from both earnings and economic value perspectives. According to the OCC (1998:5) simulation models are best applied in capturing both the earnings and economic value effects of IRR. The BCBS (2004:6) agrees stating that simulation techniques best capture the IRR impact on projected earnings and economic value. According to Matz (2005) simulation analysis applied to quantify IRR effects from the earnings perspective is typically referred to as earnings-at-risk (EAR) analysis. IRR analysis applied by the simulation model to quantify IRR effects from the economic value perspective is referred to economic value of equity (EVE) analysis. Matz (2005) also states that each perspective entails different methodologies and processes that are facilitated by the simulation model.

5.5.1 EARNINGS-AT-RISK ANALYSIS

According to Matz (2005) the goal of income simulation modelling is to forecast how NII and net income varies in response to changes in prevailing interest rates. The fundamental principle of EAR analysis is its focus on the sensitivity of the amount of NII/net income to changes in interest rates and very limited focus on the projected absolute amount of NII/net income. In other words the EAR analysis is concerned with the potential earnings value at risk of being lost for a specified interest rate movement over a given period of time. According to Koch and MacDonald (2000:328) EAR measures the percentage variation in the NII or NIM based on associated changes in interest rates.

Smith and Benci (1999:440) states that income simulation (or EAR) incorporates future changes to the balance sheet and interest rate structures and by doing so overcome the shortcomings of gap and duration analyses. Matz (2005) further states that the most distinguishing factor of EAR

analysis as an ALM tool for IRR management is that it is forward looking. EAR analysis as a method applied to income simulation modelling looks at alternative future positions and the earnings effects of those future positions by analysing the IRR arising from both the bank's current position and forecast positions. Gap, duration and economic value analysis approaches concentrate on measuring IRR exposure of the current balance sheet position and market interest rates. Dynamic analysis may however position the gap, duration and economic value analysis to a snapshot of a future position incorporating only the reformation of the balance sheet up to that future point in time (Matz, 2005).

According to Matz (2005) the selection of interest rate scenarios used, especially deterministic scenarios must filter into the formulation of the balance sheet forecast. This ensures a dynamic balance sheet and income statement forecast result across all rate scenarios used. This will further ensure the ability to integrate the scenarios with liquidity risk management scenarios. According to Bitner (1992:104) typical EAR analysis entails the formulation of three interest rate scenarios and three business scenarios. This is confirmed by Matz (2005). The OCC (1998:55) also states that banks can analyse their IRR through the impact of three interest rate scenarios. Smith and Benci (1999:445) also states that three scenarios depicting expected interest rates, upward interest rates and downward interest rates can be applied to determine the earnings sensitivity (NII) due to IRR.

Bitner (1992:104) further explains that the three interest rate scenarios are deterministically formulated and typically entail a base or expect interest rate scenario and an upward or high and downward or low interest rate scenario. The three business scenarios are formulated in the same fashion representing the anticipated or planned business scenario or strategy and the worse than anticipated or low growth business scenario and better than anticipated or high growth scenario. The results of the EAR analysis may be reported in many different formats including graphical and numerical reports. To help management to understand the impact that IRR can have on the institutions earnings it is useful to summarise the results of the dynamic simulation analysis in a graphical format.

Table 5.10 illustrates the projected earnings under nine different scenarios. The NI for three business strategies/scenarios are each calculated against three interest rate forecast scenarios The resultant EAR-analysis for the nine scenarios is indicated in Table 5.11 in Dollar value and in

Table 5.12 as a percentage point variance form the base/expected business scenario and expected (flat) interest rate scenario NI result (Matz, 2005; OCC, 1998:55; Bitner, 1992:104).

Table 5.10 Projected earnings under nine scenarios

Projected Net Income for the Bank			
	Rising interest rate scenario Up 200 bp	Flat interest rate scenario no change	Decling interest rate scenario down 200 bp
Business stratgey 1	$2 550	$2 450	$2 400
Base case strategy	$2 400	$2 500	$2 650
Business stratgey 2	$2 300	$2 600	$2 850

Source: (Matz, 2005)

Table 5.11 Dollar EAR dispersion under nine scenarios

Earnings at Risk			
	Rising interest rate scenario Up 200 bp	Flat interest rate scenario no change	Decling interest rate scenario down 200 bp
Business stratgey 1	$50	-$50	-$100
Base case strategy	-$100	$0	$150
Business stratgey 2	-$200	$100	$350

Source: (Matz, 2005)

Table 5.12 Percentage point EAR variance under nine scenarios

Earnings at Risk			
	Rising interest rate scenario Up 200 bp	Flat interest rate scenario no change	Decling interest rate scenario down 200 bp
Business stratgey 1	2%	-2%	-4%
Base case strategy	-4%	0%	6%
Business stratgey 2	-8%	4%	14%

Source: (Matz, 2005)

The EAR analysis can also be reported as a dispersion of earnings over time for each scenario. The EAR report illustrated in Table 5.13 shows the variation in NII under alternative interest rate scenarios using a flat scenario as base. This may also be reported in graphical format as per Figure 5.2 in order to assist management better understand the impact of IRR (Bitner, 1992:104).

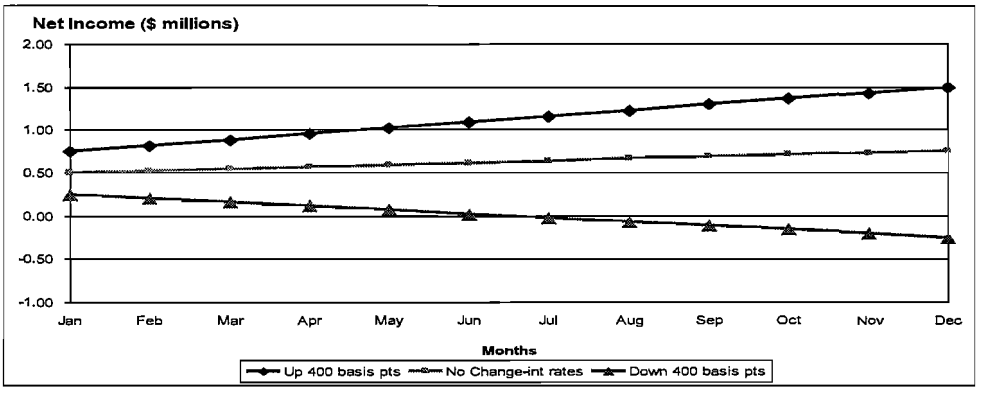
Table 5.13 Net Interest Income sensitivity

Net Interest Income Sensitivity
(In millions of dollars)

	NII Flat	Change in NII	
		Up 200 BP	Down 200 BP
Qtr 1	100	-5	5
Qtr 2	90	-5	5
Qtr 3	95	-10	15
Qtr 4	110	-10	15
Total	395	-30	40

Source: (OCC, 1998:55)

Figure 5.2 Dynamic simulation analysis results - EAR



Source: (Bitner 1992:104)

Principle 14 of the BCBS (2004:24) indicates that supervisory authorities must ensure that the internal measurement systems of banks adequately capture IRRBB. To facilitate the supervisor's monitoring of IRR banks must provide the results of their IRR measurement system's results i.e. from their simulation models expressed in terms of the threat to their economic value, using a standardised interest rate shock. Lopez (2004:3) also states that banks should use a standardised interest rate shock in the internal measurement system to assess the IRR of the bank.

The BCBS (2004:24) indicates however that the economic value perspective may be varied to banks outside the G10 internationally active population for example, by applying a standardised interest rate shock to the EAR analysis approach. The performing of a standardised interest rate shock however remains pivotal in ensuring that internal systems meet supervisory advised requirements in the measurement of IRR.

According to the CEBS (2006:11) banks should be able to assess their IRR under a standardised approach instilled by the supervisors. The standard methodology applied to the IRR measurement system should depict an interest rate shock deemed severe enough and appropriate for the currency in which the bank operates in order to effectively capture the extent of its IRR. Furthermore, the BCBS (2004:24) states it is essential to the success and acceptance of the internal measurement system i.e. the simulation model that generally accepted financial concepts and risk measurement techniques are employed. The system must also be able to measure IRR exposure from both the earnings and economic value perspectives

The BCBS (2004:36) states that banks should use these principles and determine the proposed rate shock for banks operating in G10 and non-G10 countries respectively. For G10 IRR exposures the rate shock should consider an upward and downward 200 basis point rate movement. According to the CEBS (2006:11) the standardised rate shock should consider a 200 basis point parallel rate shock. Lopez (2004:3) also states the standardised rate shock in G10 countries operating banks should consider a ± 200 basis point parallel rate shock.

Lopez (2004:3) also advocates that banks operating in non-G10 countries must consider interest rate changes consistent to the 1st and 99th percentile of observed interest rate changes over a historic period of at least five years. According to the BCBS (2004:36) exposures in non-G10 countries must be assessed under derived parallel interest rate shocks based on the 1st and 99th percentile of observed interest rate movements with a one-year holding period and a minimum of five years of observations. IRR exposures in G10 countries may also depict interest rate sensitivities based on the statistically derived observations as advocated applicable for non-G10 exposures.

The BCBS (2004:37) states that although the simplicity of a 200 basis point parallel rate shock makes it easy to implement it has the disadvantage of ignoring exposures that might be revealed through scenarios that include yield curve twists, inversions and other relevant scenarios. These

scenarios may be a necessary component in the overall management of interest rate risk exposures. Ong (1998:11) also states that various interest rate scenarios consisting of yield curve shifts, twists and butterfly rate movements may be applied in measuring IRR. While more intricate rate scenarios may expose certain underlying risk characteristics such as yield curve risk and basis risk, the BCBS (2004:37) deem that the standardised parallel interest rate shock are more than adequate for the modest objectives of supervisors in detecting banks with significant interest rate risk exposures.

According to Matz (2005) EAR analysis poses several advantages and disadvantages when compared to other IRR measures. The EAR advantages include:

- Repricing Gap and duration analysis is a proxy of IRR at a point in time. EAR is a specific measure of IRR impact on NII or net income.

- EAR reflects more accurately on reality. Rosen and Zenios (2006:19) also state that EAR analysis captures the impact of explicit ALM strategies and the variables of the market and economic environment.

- EAR focus on balance sheet changes that incorporates customer behaviour. Koch and MacDonald (2000:333) state that EAR analysis allows management to assess the sensitivity to IRR to changes in the balance sheet products' volume and composition, changes in the relationship between yields and shifts in the levels of interest rates. Changes in the balance sheet due to optionality and specific the pricing behaviour of non-maturity deposit account can be assessed. Marrison (2002:194) also states that the earnings sensitivity can be quantified incorporating the effects of prepayments and rate resets on non-maturity deposit accounts thus incorporating embedded options and how it may impact repricing.

- Management decisions, made as result of anticipated balance sheet and pricing realities are reflected. According to Koch and MacDonald (2000:333) earnings sensitivity analyses such as EAR assist the bank with information how it should position the balance sheet in respect to risk and how it might hedge if it wants to reduce IRR.

- Flexible method to reflect interest rate shifts for different maturities. Smith and Benci (1999:445) state that EAR analyses through simulation modelling allows to estimate the earnings sensitivity based on various interest rate scenarios reflecting non-parallel rate movements. Various balance sheet maturity strategies can be assessed against these interest arte scenarios.

- EAR can incorporate basis changes in different instruments. Various leads and lags to rate changes and the responsiveness of products' pricing to changes in market rates can be tested (Smith and Benci, 1999:444). The BCBS (2004:68) also states that the simulation model for EAR analyses can adjust for the interrelationships of volume levels and prices/interest rates in quantifying IRR.

- Can be integrated with other MIS i.e. budgeting and capital planning.

The EAR analysis as an IRR measure has the following disadvantages according to Matz (2005) which include:

- The simulation model's assumptions to quantify future customer, pricing and balance sheet behaviour require careful consideration, development, testing and monitoring. The BCBS (2004:67) agrees stating that the effects of market rates on deposit rates, product balances and customer behaviour requires significant analysis and consideration. Van Greuning and Bratanovic (2000:184) also state that simulations are highly dependent on input assumptions and may require significant time and continuous adjustments before any meaningful or accurate results are produced.

- Assumptions can be manipulated to over/understate IRR exposures.

- Accurateness of the IRR quantification may be impaired by inaccurate interrelations between internal and external variables.

- EAR does not capture long-term IRR exposure. Marrison (2002:194) states that EAR analyses may fail to capture the long term effects of complex interest rate changes i.e. rates going up at one time and falling in the longer term. Smith and Benci (1999:440) also state that income simulations may provide misleading information about IRR in that

long-term impacts of rate movements are not captured due to EAR analyses only focusing on the short-term i.e. next 12 months. In addition, Ford (1999**a**:424) states that income simulations and EAR analyses emphasise IRR over the short-term but ignore the fact that long-term economic performance may not be well correlated to short-term earnings.

- Deterministic and stochastic models to derive future interest rate scenarios may be applied. Too many scenarios can get confusing and unrealistic and too few may not capture the full extent of the IRR exposure (Matz, 2005).

5.5.2 ECONOMIC VALUE OF EQUITY ANALYSIS

According to Bowers (2001:6) a drawback of the EAR measurement technique is that it does not capture the capital value impact of IRR arising from mismatches and embedded options that exists in the balance sheet beyond the simulation time frame. The simulation time frame is normally measured over 12- or 24-months accounting periods. Gavin (2001:61) concurs that the impact of changes in interest rates on the earnings beyond the simulation time frame is not always considered by the earnings perspective and thus by the EAR analysis.

The OCC (1998:15) proclaims that a bank with significant long term mismatches or a high proportion of assets with complex customer options may be particular vulnerable to future IRR. Therefore the bank with significant medium- and long-term positions should assess the long-term impact of interest rate changes on its earnings and capital. To address the problem of capturing mismatches in periods beyond the EAR time frame and their IRR impact, especially from the economic perspective, the OCC (1998:15) suggests that economic value of equity (EVE) analysis be performed.

Bowers (2004:5) states that regulatory agencies recommend EVE analysis as a complimentary tool to EAR analysis due to its capability to extend the risk horizon to the entire life of the balance sheet in an attempt to estimate long-term NII sensitivity. The BCBS (2004:7) explains further that the EVE perspective to measuring IRR provides a more comprehensive view of the potential long-term effects of changes to interest rates than is offered by the EAR perspective. This comprehensive view is important since near-term earnings changes may not provide an

accurate indication of the impact of interest rate movements on the bank's overall position or its economic value.

According to Bowers (2001:7) when compared across hypothetical rate shock scenarios, the Eve sensitivity serves as an index on how the balance sheet's capacity to generate NII may change if rates move abruptly and remain at those levels indefinitely. Book value accounting, as applied in EAR analysis, may obscure real world, economic effects that impact an institution's long-term earnings potential. Under a fair value approach, the assets and liabilities bearing coupon rates that compare unfavourably to current market levels of interest rates will experience a decline in value. Bowers (2001:7) concludes that the change in the fair value therefore reflects the instruments relatively poorer future earnings prospects when measured against the bank's current lending, investing and deposit opportunities.

EVE is defined by Payant (1997**b**:3) as the present value of expected future cash flows on assets minus the present values of expected future cash flows on liabilities, plus or minus the present values of the expected future cash flows on off-balance sheet instruments. The EVE is therefore the net value of the balance sheet's future principal and interest cash flows, discounted at prevailing market interest rates. According to the OCC (1998:36) the difference between the present value of all assets and liabilities' cash flows represents a bank's economic value of equity.

IPS-Sendero (2006**a:**917) provides a more technical definition of economic value in that it is the present value of the future stream of interest payments on an account and its total principal runoff balances, discounted at a rate or rates derived from the values of the account's key rate, yield curve, ratio and spread. EVE is thus the net value between the economic value of assets, liabilities and OBS transactions.

The linkage between EVE and future earnings is conceptually straightforward according to Payant (1997**a:**1). This linkage can easily be understood by the progression of the following formula:

"EVE = Economic value of assets – Economic value of liabilities
= Present Value (Asset Cash Flows) – Present Value (Liability Cash Flows)
= Present Value (Asset Cash Flows – Liability Cash Flows)
= Present Value (Asset Principal Cash Flows – Liability Principal Cash Flows)

+ Present Value (Asset Interest Cash Flows – Liability Interest Cash Flows)
= Present Value of Book Equity + Present Value of Net Interest Income." (Payant (1997**a**:1.)

The OCC (1998:15-16) observed that the application of the discounting methods and the capabilities supplied by the simulation model regarding the projection of future cash flows renders the capability of calculating the balance sheet's EVE. This is achieved by calculating the net EV of all balance sheet assets and liabilities. This allows bank management the capability of understanding long term IRR effects (OCC, 1998:15-16).

EVE may therefore be seen as the difference between the economic value of assets and liabilities which is the residual value of future cash flows ultimately due to shareholders. Although EVE does not directly translate itself to earnings, Payant (1997**a**:2) creates the analogy that it can be thought of as being a reservoir from which future earnings flow. EVE is initially created when new transactions are created at positive interest spreads. A portion of the earnings reservoir makes its way into the income statement each accounting period. Smith and Benci (1999:440) state that EVE indicates the potential flow of future discounted income. Thus, a fall in EVE assumes a fall in future net income given an unchanged discount factor applies.

Cerny *et al.* (1997:331) explains that although income may be unchanged over the short-term based on earnings sensitivity analyses (i.e. EAR) the long term value exposure may imply the negative income earnings capacity due to adverse movements in interest rates. However, Payant (1997**a**:2) states that not all of the total earnings are reported in the income statement for various reasons for example due to accounting rules and methodologies. Ultimately, the larger the EVE reservoir, the greater the bank's contracted net interest earnings capacity from which future earnings will flow. Over time the reservoir of EVE is converted into earnings and therefore it must be replenished with new earnings opportunities.

Matz (2005) explains that the calculation of the economic value renders consideration about three important variables. The three variables are:

- The first variable is the amount of cash flow. According to the BCBS (2008:55) the accuracy of the EVE is strongly dependent on the cash flows used in the calculation. Matz (2005) argue that for a discount security such as a Treasury bill the cash flow

amount is the principal received at maturity. Loans may have multiple cash flows over the life of the deal. The more cash, the more valuable the deal than compared with less cash. The OCC (1998:56) also states that the level of cash flows is highly influential on the calculation of EVE.

- The timing of the cash flows is the second variable. A five-year, zero-coupon government bond with one cash flow after five years is less valuable than a 30-year mortgage loan with monthly incremental cash flows. Cash received sooner is more valuable than cash received later (Matz, 2005). The BCBS (2008:55) states that the timing of cash flows are highly influential on the calculation of the EVE. According to the OCC (1998:56) the timing of cash flows are important in the present valuing of cash flows when computing the EVE in that the timing of cash flows directly influence the discount factor and thus the present value.

- The third variable is the discount rate applied to measure the value between cash received at various points in time. Value is sensitive to the choice of discount rate (Matz, 2005).

Payant (1997**a**:2) explains that the question is often raised if the EVE as an approximation of future earnings can be reconciled with the future income statement reports. According to Payant (1997**a**:2) the point-in-time EVE as a proxy of earnings capacity can not be reconciled with subsequent earnings reports for several reasons:

- Firstly, the balance sheet's cumulative future cash flows are included in the EVE and not just the interest cash flows that will be paid, realised, and recorded during the next accounting period. A portion of the cash flow will also relate to the repayment of principal value of the loan which will not be included in the income statement's reporting of earnings.

- Secondly, earnings are measured over time whereas EVE is calculated based on a static balance sheet position. Over time new transactions will be added which provides new earnings and existing transactions may have their cash flows altered. The BCBS (2008:55) states that EVE calculations are mostly static assessments of value changes which focus mainly on the current balance sheet composition. Furthermore, market rates

will change over time as will the discount rates used in present valuing the cash flows. Customer options may also be exercised and the bank may change its strategy, all in their own best interest respectively. In addition, Payant (1997**b**:3) explains that although EVE measures the potential earnings capability of the current balance sheet, EVE can dispel prior to realising the future potential income. The major reason for this is the combined impact of changing interest rate levels and the overall repricing mismatch in the balance sheet's future cash flows.

IPS-Sendero (2006**a**:806) explains that the Sendero A/L simulation software have the capability of calculating the future principal and interest cash flows based on selected interest rate scenarios and the modifications to these cash flows as a result of prepayments triggered by the respective interest rate projections. Cerny *et al.* (1997:333) explains that all principal and interest cash flows are incorporated in EVE analyses. Any changes to both principal and interest payments incorporate the effects of embedded customer options such as prepayments of loans or the variability in the changes of interest rates and the cash flows of NMD-accounts.

According to Koch and MacDonald (2000:350) simulation models that calculate EVE sensitivities better captures the effects of embedded options such as loan prepayments, early deposit withdrawals and the rate change frequency/repricing propensity of variable rate and administered rate products. Therefore, the timings and volumes of the cash flows are important due to their impact on EVE. According to IPS-Sendero (2006**a**:806) a schedule of the timing of the cash flows is established indicating the weighted average day of each time bucket period within which the cash flows will occur. The calculation of the discount rate applied in the present valuing of the cash flows requires a selection of methodology.

According to IPS-Sendero (2006**a**:806) the following methods exist for the calculation of the discount rate namely Current Rate, Path Dependent, and Hybrid Discounting methods. The choice of method will affect both the discount rates and the cash flows used to calculate the Economic Value or EV IPS-Sendero (2006**a**:806). These methods are specifically embedded in the IPS-Sendero simulation software which is used for practical simulation examples performed and discussed in chapter 7. The three methods for calculating discount rates are discussed as follows:

- Current Rate and Hybrid Discounting method: IPS-Sendero (2006**a**:806) explains that under both the Current Rate and Hybrid Discounting methods the discount rates used are based on the spot rates derived from the yield curve at the EV time point. The discount rate is further adjusted for ratios and spreads. According to Matz (2005) the EVE can be calculated by using current prevailing interest rate levels. This is most commonly the current market yield curve. This establishes the EV for the current or static position of the bank's balance sheet and typically represents the base case scenario.
  According to the OCC (1998:41) computing the EVE relies on standard present value calculations. This dictates that future anticipated cash flows are present valued against interest rates reflective of the term of the cash flows. In addition, the OCC (1998:56) explains that the cash flows of all assets and liabilities are present valued by discounting the cash flows by an appropriate discount factor. According to Bessis (1998:192) the EVE can be calculated by present valuing all future principal and interest cash flows by using market rates. The Present value calculation is similar to presented in formula 5.4 (p140).

  According to IPS-Sendero (2006**a**:806) the difference between the Current Rate and Hybrid Discounting methods is based on how the cash flows for adjustable and floating rate instruments are calculated for the purpose of the present value calculation. The cash flows for the full life of the account are used under the Hybrid Discounting method. The Current Rate Discounting method on the other hand will only use the cash flows up to the first repricing period only.

  It is argued by Marrison (2002:60) that floating rate products' economic value will immediately move back to par through the adjustment of the interest/coupon payments to compensate for the change in value. Koch and MacDonald (2000:349) however explains that the impact of embedded options contribute to economic value changes. According to IPS-Sendero (2006**a**:807) a repricing balance cash flow is applied at this first repricing period to substitute all remaining cash flows. Cash flows for fixed rate and floating or adjustable rate products are therefore based on their respective repricing (gap) characteristics under the Current Rate Discounting method. The calculation method of the discount rate is therefore the same in both the Current Rate and Hybrid Discounting methods.

Table 5.14 presents examples of how the discount rates are calculated in the Sendero A/L software under these two methods. The various input variables are combined to establish a discount rate reflective and appropriate to the valuation and pricing of the account. The discount rate for each future month is derived from the key rate and/or yield curve and the global ratio and/or global spread or EV override spread that are current in the month corresponding to a defined economic value point. Rate scenario projections are ignored when calculating the discount rate for the static EV position. Dynamic EV, that is future forecast snapshot positions of the balance sheet incorporating the forecast data input of the simulation model, will use the forecast interest rates at the EV point to calculate the discount rate (IPS-Sendero, 2006**a**:807).

Table 5.14 Discount rate calculations under Current Rate Discount method

Example Number	Key Rate?	Spread?	Yield Curve?	Global Ratio & Spread?	Resulting Discount Rate Formula
1	Yes	Value is 0.0	Not checked	Yes	(Key Rate * Global Ratio) +Global Spread
2	Yes	Value is entered	Not checked	No	Key Rate + EV/Duration Spread
3	Yes	Value is 0.0	Checked	Yes	((Key Rate * Global Ratio) +Global Spread) - Rate on Yield Curve at the term of the + Rate on Spot Curve for each month
4	Yes	Value is entered	Checked	No	Key Rate - Rate on Yield Curve at the term of the Key Rate + EV/DurationSpread + Rate on Spot Curve for each month
5	None	Value is 0.0	Checked	No	Rate on Spot Curve for Each Month
6	None	Value is entered	Checked	No	Rate on Spot Curve for Each Month + EV/Duration Spread

Source: (IPS-Sendero, 2006**a**:808).

- Path Dependent Discounting method: According to IPS-Sendero (2006**a**:809) the Path Dependent Discounting method takes its name from the fact that the cash flows and discount rates for an account's future cash flows depends on the path of projected future - subsequent periods to the economic value point - interest rates for the account. This method uses discount rates that are based on the series of forecasted one-month rates for the selected yield curve, where the series starts at the EV time point. The discount rate is further adjusted for ratios and spreads.

According to Ong (1998:10) interest rate paths estimating the movements of future interest rates can be applied to calculate the economic value of an account. These interest

rate paths will also give direction to the changes in cash flows as influenced by the path of future interest rates.

According to the BCBS (2008:56) the cash flows applied in EVE calculations are influenced by embedded options of repricing (variable rate accounts) and prepayments. Such cash flow variance is best projected and incorporated through the application of path-dependent projections which allows for cash flows to be adjusted for customer behaviour and the level of interest rates.

According to Geske and Shearer (1997:36) a floating rate loan has embedded optionality in that changes to interest rates will impact the future interest cash flows. Changes in interest rates may however also impact the principal cash flows due to the effects of prepayments. Thus the present value is sensitive to interest rate changes given the changes in cash flows and the subsequent discount rates. Customers are also sensitive to rate changes in respect of executing their options relating to loan prepayment, deposit withdrawal and refinancing. By calculating the EV for all balance sheet products the EVE can be calculated for any combination of input variables.

According to Matz (2005) the input variables require specific consideration. Specifically the calculation of the cash flows, which is both principal and interest components, requires attention to the interest rate forecast. Future interest rates may affect interest payments but is also a significant influence on customer behaviour. Embedded options in terms of prepayments, either full or partial, will have a significant influence on cash flow projections.

The OCC (1998:36) confirms this observation of Matz (2005) explaining that changes to interest rates under various interest rate shocks or scenarios will affect the underlying EV of the balance sheet. This change in EV is due to the resultant changes in the present value of the cash flows and in some instances because the cash flows themselves may change due to the changes in interest rates. Therefore, EVE analysis requires significant more attention to the cash flow assumptions and embedded options than would be the case for the EAR perspective of IRR measurement.

Payant (1997**b**:3) argues that EVE analysis requires cash flow simulations under various rate scenarios considering the various rate-dependent characteristics of the balance sheet transactions. The most often rate-dependent characteristics considered are the effects of options, reflecting on option risk, and varying rate-spread relationships which reflect on basis risk. Lag effects of interest rate changes on administered and market rates may also be included. By reflecting on the changes in the net cash inflows and outflows under varying alternative interest rate scenarios, the residual cash flows are deemed as the net earnings value or EV of the balance sheet. Measuring potential changes to the EVE under alternative interest rate and resultant balance sheet scenarios therefore provides a gauge of the potential risk to future earnings.

In addition, Marrison (2002:195) also argues that changes to interest rates may impact the EVE of the balance sheet given that prepayments and deposit withdrawals can be rate sensitive. Administered interest rate may change at different times and quantum than market rates impacting cash flows and prepayment propensity. Various interest rate paths or scenarios can therefore be applied to calculate the EVE sensitivity. Lopez (2004:2) also state that various interest rate paths can be formulated in order to better assess the EVE impact of IRR specifically harnessing the effects of embedded customer options.

According to Payant (1997**b**:3) the EVE is highly sensitive to the ever changing projections of the balance sheet's future projected cash flows. Cash flows for many typical balance sheet instruments are dynamic, ever changing due to external economic and interest rate conditions. These dynamics requires that cash flows are simulated under various alternative interest rate scenarios, thus making Path Dependent Discounting a popular method to determine the risk to EVE.

According to IPS-Sendero (2006**a**:809) the cash flows for the full life of the instrument are used to calculate the EV similar to the Hybrid Discounting method. The repricing balances for floating or adjustable rate products' cash flows are therefore ignored and only the contractual cash flows adjusted for embedded options in the form of prepayments are applied in the EV calculation. Table 5.15 presents the combination of input variables in the calculation of the discount rates under Path Dependent

Discounting. The use of ratios and spreads are only applicable for the first month of forecast after the economic value time point (IPS-Sendero, 2006**a**:809).

Table 5.15 Discount rate calculations under Path Dependent Discounting method

Example Number	Key Rate?	Spread?	Yield Curve?	Global Ratio & Spread?	Resulting Discount Rate Formula
1	Yes	Value is 0.0	Either checked or not checked	Yes	((Key Rate * Global Ratio) +Global Spread) - Rate on Yield Curve at the term of the Key Rate + Series of one-month Rates from Yield Curve
2	Yes	Has a value	Either checked or not checked	No	Key Rate - Rate on Yield Curve at the term of the Key Rate + EV/DurationSpread + Series of one-month Rates from Yield Curve
3	None	No value (0.0)	Either checked or not checked	No	Series of one-month Rates from Yield Curve
4	None	Has a value	Either checked or not checked	No	EV/DurationSpread + Series of one-month Rates from Yield Curve

Source: (IPS-Sendero, 2006**a**:809).

IPS-Sendero (2006**a**:810) indicates that the discount rate for a future period cash flow depends on all of the one-month rates from the economic value point through to the one-month rate in the month of the cash flow. The discount rates in percent, before spread and ratio adjustments, are calculated as follows:

Month 1:

$$100\times\left(1+\frac{R_1}{100}\right)^{1/1}-100$$

Month 2:

$$100\times\left(1+\frac{R_1}{100}\right)^{1/2}\times\left(1+\frac{R_2}{100}\right)^{1/2}-100$$

Month n:

$$100\times\left(1+\frac{R_1}{100}\right)^{1/n}\times\left(1+\frac{R_2}{100}\right)^{1/n}\times\ldots\times\left(1+\frac{R_n}{100}\right)^{1/n}-100 \qquad (5.12)$$

Where:

R_i = The 1-month maturity interest rate during forecast month *i*.

N = Number of months until final maturity (IPS-Sendero, 2006**a**:810).

According to IPS-Sendero (2006**a**:811) the present value of the cash flows are calculated based on standard present value arithmetic but the discount rates applied in the calculation depends on the selection of economic value discounting method. The product principal and interest cash flows are all treated as separate zero coupon instruments. The discount factor for a period applied in the present value calculation is based on the discount rate, the payment frequency of the cash flow and the period number. The discount factor is calculated by the following formula based on the calculation performed by the IPS-Sendero (2006**a**:811) software.

$$\text{Discount Factor} = [1/ (1+ (r / (100\times f)))^{[(n-1)+t]}] / (12/f) \quad (5.13)$$

Where: r = current rate, n = cash flow period, t = maturity timing in cash flow period, f = payment frequency of yield curve, if no yield curve then f =12 (IPS-Sendero, 2006**a**:811).

The following two examples are used by IPS-Sendero (2006**a**:811) to explain the calculation of the discount factor for the present value calculation. The difference between the discount rate calculations and resultant discount factors applied in the EV calculation using the Current Rate- and Path Dependent Discounting methods are highlighted. Table 5.16 depicts a product with a cash flow in three month's time and the maturity timings of the cash flow are at mid-month and month-end respectively, to the value of R1000, and pricing to the yield curve.

Table 5.16 EV discounting method differences in discount rates

Month	**1**	**2**	**3**
Current Rate Discounting			
Cash Flow			1,000.00
Spot rates (derived from the current yield curve)	5.00	5.25	5.50
Path Dependent Discounting			
Cash Flow			1,000.00
1-month rates entered for forecast yield curves	5.00	6.00	7.00

Source: (IPS-Sendero, 2006**a**:811)

According to IPS-Sendero (2006**a**:811) the discount factor as calculated under the Current Rate Discounting method for this example is as follows:

Discount factor = $[1/ (1+ (5.5 / (100\times12)))^{[(3-1)+0.5]}] / (12/12)$

Discount factor = 0.988633

Present value of the cash flow = R1000 × 0.988633

Present value of the cash flow = R988.63 (IPS-Sendero, 2006**a**:811).

According to IPS-Sendero (2006**a**:812) the discount factor as calculated under the Path Dependent Discounting method for this example is as follows:

Discount Rate for period 3 = $100 \times ((1.05 \times 1.06 \times 1.07)^{(1/3)} - 1)$

Discount Rate for period 3 = 5.996855

Discount factor for period 3 = $[1/ (1+ (5.998655 / (100*12)))^{[(3-1)+0.999]}] / (12/12)$

Discount factor for period 3 = 0.98516

Present value of the cash flow = R985.16 (IPS-Sendero, 2006**a**:812).

IPS-Sendero (2006**a**:807) state that all cash flows are calculated consistently for all discounting methods but the Current Rate Discounting method will use repricing balance cash flows instead of contractual cash flows as used under the Hybrid and Path Dependent Discounting methods. The selection of discounting method influence both the discount rates and cash flows used in calculating EV.

The preceding discussions highlight the important considerations highlighted by Matz (2005) in calculating EVE (p171). The size of cash flows is influenced by interest rate scenarios given the existence of embedded customer options. The timing of the cash flows will influence the EV calculation and the timing of cash flows especially for NMD accounts which has an ambiguous maturity attribute requires significant consideration. The EAR perspective will pay specific attention too the repricing of these transactions but the EVE analysis requires cash flow information. When the Hybrid or Path Dependent Discounting methods are applied this becomes even more important. The discounting method is also a significant consideration as this will influence the required variable used and therefore determine the information need. This is evident from the differences in discount rate calculations and the usage of cash flow information under the various discounting methods.

According to Matz (2005) the quantum of EVE does not explain much of about IRR. In order to quantify the EV exposure to IRR, alternative interest rate scenarios need to be applied for which the respective EVE is calculated. Each of the alternative interest rate scenarios should reflect all

input variables such as the changes in the amount and timing of cash flows. This will reflect the changes in the economic activity associated with interest rate levels of the various scenarios. According to the BCBS (2008:55) the EVE sensitivity defines the IRR by comparing the changes in EVE under various interest rate scenarios to the EVE under a base scenario. According to the OCC (1998:56) the economic value exposure to IRR is derived by comparing the EVE for a current or base case to the EVE derived under various alternative interest rate scenarios.

According to Payant (1997**b**:3) the risk to EVE is often measured by stressing or shocking the balance sheet under a standardised set of interest rate scenarios. The base scenario of the term structure of interest rates is shocked up and down in a sustained and immediate parallel approach. The balance sheet instruments' cash flows are simulated under each interest rate scenario and then for each scenario the discount rates are used consistent to the cash flow driven interest rates to determine their present values (Payant, 1997**b**:3). This approach is also advocated by the BCBS (2004:24) as discussed under the selection of interest rate scenarios for the EAR analysis (p165). The standardised rate shock according to the BCBS (2004:25) comprises a 200 basis point parallel rate shock. Alternatively the BCBS (2004:25) advises that the 1st and 99th percentile of observed interest rate changes using a one-year holding period and a minimum of five years of observations may also be used.

According to Matz (2005) the best practise regarding the calculation of EVE sensitivity is to value each single asset and liability cash flow separately at an appropriate discount rate reflective of its tenor. The final procedure to calculate the EVE sensitivity is to subtract the alternative EVE values from the current EVE. This value is the quantity of EVE sensitivity. The sensitivity may be expressed in terms of a monetary value or percentage change from the base case EVE. In addition, Gavin (2001:61) concurs that the IRR impact measured from the economic value perspective should focus on the value change for a given change in interest rates and not the value itself for each scenario analysed. As interest rates change, both the cash flows and discount rates change. These changes evidently will change the net value of the balance sheet.

Payant, (1997**b**:3) continues by stating that there are many similarities between EAR rate shock analysis and EVE shock or sensitivity analysis. However, EVE interest rate shocks have some major conceptual difference that must be kept in mind when interpreting the EVE sensitivity

results and ultimately when applied in management decisions over IRR strategy and the general viability of a transaction and the bank as a whole. The BCBS (2008:57) states that a bank should apply careful consideration to the type of interest rate shocks it applies in measuring EVE sensitivity. It is important to consider whether it is assumed that rates should change gradually and how the bank can manage the IRR and whether interest rates will change suddenly. Payant (1997**b**:3) argues that rate shock analysis is unrealistic for the following reasons:

- Market rates do not move instantaneously in the magnitude of typical rate-shock scenarios. Ong (1998:11) also states that parallel rate shocks rate shocks for IRR analyses are unrealistic.
- It highly unlikely that the term structure of interest rates will move in a parallel fashion.
- Most interest rates do not remain stable and at the same level after a significant initial change. Interest rates have the tendency to remain rather volatile after drastic changes.

Payant (1997**b**:3) further explains that EAR rate-shock analysis uses a standard approach to measure the risk to annualised accrual-based earnings. The effects of balance sheet mismatches beyond the simulation time-frame are not considered. Potential earnings decreases under rate-shock analysis inhibit book capital growth slowly over time. EVE rate-shock analyses on the other hand extrapolates all mismatches and measure their cumulative effect into a single risk measure to today's economic value. This amplifies the magnitude of the overall balance sheet risk. This is due to the assumption that all cash flow mismatches, once simulated will not change over the remaining life of the balance sheet. This assumption might be valid for short-term risk analysis purpose but are dubious over longer time horizons.

The BCBS (2008:57) also states that the pace and magnitude of interest rate shocks impact interest income but also customer behaviour. When applying rate-shocks to EVE analysis, Payant (1997**b**:3) therefore cautions about interpreting EVE analysis that indicate a potential decline in EVE, as a measure on the short-term viability of the financial institution.

In order to determine the future earnings prospects it is relevant to compare the book value of an instrument with its EV. According to Payant (1997**a**:3) financial contracts with earnings rates lower than existing market rates are valued less than their book values. Assets with interest rates higher than comparative market rates are valued in excess of their book values. Assets with EV exceeding book value indicate an enhanced earnings potential. The inverse applies for liabilities.

According to the APRA (2008:8) by comparing the book value of capital to the EVE the embedded gains or losses within the balance sheet can be derived. The book value equity less the economic value of equity is the embedded loss if positive and the embedded gain if negative. In addition, Payant (1997**a**:3) states that by reflecting on the static EVE compared to the book value of equity of the bank an indication of the future prospective earnings potential is achieved. The difference between the book value of equity and the EVE should be viewed as the best estimate of the balance sheet's existing earnings capacity

Cerny *et al.* (1997:331) states that EVE can be seen as the liquidation value of a firm. The EVE is therefore the value of the firma after selling al its assets and repurchasing all liabilities at prevailing market prices. However, Bowers (2004:5) indicates this is a misconceptions relating to the use and interpretation of EVE. According to Bowers (2004:5) EVE does not indicate the liquidation value of bank. Some agencies proclaim that EVE is a gauge on solvency risk should the institution need liquidity from depreciated assets under an adverse interest rate scenario. Most bank instruments do not have trading markets available, and market appraisals for non-financial assets, liabilities and goodwill are excluded from the computation rendering these statements untrue. This is confirmed by the BCBS (2008:56) stating that most banking book products are not readily traded and therefore difficult to value at market prices.

The BCBS (2008:55) states that the EVE is not a measure of book capital but the market value of assets less liabilities. According to Bowers (2004:5) it is entirely incorrect to use EVE sensitivity as a measure of the percentage capital a bank stands to lose under adverse interest rate conditions Payant (1997**c**:3) agrees stating that the risk to EVE as indicated by typical interest rate shock analysis is not the same as the risk to its book capital. The reason for this is that EVE sensitivity established from rate-shocks is a single point-in-time risk calculation. Any factors that could influence future earnings outside the capital losses on existing transactions due to hypothesised instantaneous rate movements are totally disregarded (Payant, 1997**c**:3)

According to the BCBS (2008:55) EVE analysis has the ability to measure the long term effects of risk to future earnings. It therefore provides a single standardised measurement approach to assist bank management to better understand and analyse long term IRR exposure. The BCBS (2008:55) also states that EVE overcomes the shortcoming of EAR analysis of measuring earnings over the short-term by measuring long-term IRR effects. According to Matz (2005) EVE analysis bridges the shortcomings of EAR analysis. Matz (2005) states that the assessment

of IRR must deploy both EAR and EVE analyses. However, the primary risk limits as set by the IRR policy must use either one of the approaches as the primary IRR management tool. It is stressed that both measurement tools must be used in the assessment of the IRR for apparent reasons as discussed (Matz, 2005).

However, Matz (2005) cautions that care should be taken in trying to use both measures as primary IRR management tool for which primary or hard limits are set for in the IRR management policy. The reason is that applying both EAR and EVE as primary IRR measurement technique is counter productive. Bowers (2001:7) explains that the reason for not applying both measures as the primary limit setting is dictated by the need for a clear indication of the objectives of IRR management as contained in the IRR policy. Typically the time frame of IRR exposure management can be either short-term or long-term which dictates the use of an earnings or economic perspective to manage IRR by means of limits setting.

Koch and MacDonald (2000:355) also states that attempts to manage both short-term earnings and long-term economic value are impractical given that strategies that attempt to increase earnings may invoke higher economic value declines, and vice versa. According to Payant (1997**a**:3) any strategies to manage EVE into earnings by changing principal or interest cash flows either through active management i.e. hedging, pricing or outright liquidation strategies, should consider that management's desire to increase short-term earnings may possibly have a detrimental effect on long-term earnings potential. The problem is that business strategies that may be implemented to maximise near-term future earnings may assume significant balance sheet mismatch and options risk. According to Bowers (2001:7) these risk elements will undoubtedly expose the bank to significant earnings risk over the long term.

According to Payant (1997**a**:3) any predication that favourable market conditions may turn unfavourable and vice versa may cause the dissipation or enhancement of EVE. Such views or beliefs might be wrong or inaccurate. Therefore Bowers (2001:7) states that bank management must make definitive decisions on the tolerance levels for variations in earnings and capital due to interest rate changes. The determination of the deemed appropriate risk controls and limits is based on a candid assessment of the bank's ability to manage risk and its capacity to assume risk.

Matz (2005) therefore recommends the selection of a primary risk measurement tool with specific hard limits approved by the Board. The secondary measurement tool, whether being EAR or EVE analysis, must be used as a complimentary tool in the assessment of IRR in order to understand both short-term and long-term IRR exposures to the balance sheet. Matz (2005) also recommends that secondary limits, often referred to as soft limits or guidance limits, based on the secondary risk measurement tool may be set to ensure a prudent IRR assessment covering the full extent of IRR exposures. On the contrary, the use of a single risk measurement tool is dangerous as no one single risk measure is perfect (Matz, 2005).

According to Matz (2005) EVE sensitivity analysis has the following advantages:

- EVE analysis captures IRR arising from all time periods. According to Cerny *et al.* (1997:331) all cash flows and income are analysed and not only income over the short-term. According to Payant (1997**c**:4) gap and EAR analysis may show over the accounting time-frame that limited to zero IRR risk exposure may exist in the balance sheet, but EVE sensitivity analysis may show the contrary given that the all future cash flows are analysed.

- A specific and standardised measure of IRR exposure is provided through EVE sensitivities. Payant (1997**c**:4) states that EVE analysis is the only standardised IRR measurement technique indicating the potential decline of earnings opportunities caused by all cash flow mismatches within the bank's balance sheet, and not only the mismatches within the simulated accounting time-frame. Thus, EVE shocks provide a standardised measure of the effect that overall balance sheet mismatches may have on future earnings.

- The IRR in the current position of the bank is assessed. According to the BCBS (2008:55) the current risk of the balance sheet is assessed by EVE analysis. Cerny *et al.* (1997:333) also state that risk of the current balance sheet is measured at current market rates and not at historic rates or amortised cost such as is done by EAR analysis.

- EVE analysis can be used to analyse the IRR exposure in individual products.

- Option risk is captured with EVE sensitivity analysis. Cerny *et al.* (1997:333) states that EVE captures the effects of embedded options. According to the OCC (1998:56) EVE analysis can incorporate the IRR effects induced by customer options under various interest rate scenarios.

- Yield curve risk is captured.

- Basis risk is captured.

- EVE analysis supplies the flexibility to measure IRR sensitivity over a wide range of interest rate scenarios. According to the OCC (1998:56) EVE measures IRR over various interest rate scenarios. The BCBS (2008:56) also states that multiple rate scenarios are applied in deriving the EVE sensitivity.

- Can capture IRR obscured by accrual accounting measures for example reinvestment risk.

- Regulatory expectations are met by the usage of EVE analysis. Measuring IRR from the economic value perspective is advocated by the APRA (2003:3). The BCBS (2004:14; 2008:55) also states that banks should assess their IRR exposure from the economic value perspective. The OCC (1998:5) states that banks should measure IRR on the economic value of equity of their balance sheet.

- EVE analysis can be integrated with other management information systems such as hedge analysis and fair value disclosures (Matz, 2005).

According to Matz (2005) no single risk measure is perfect for the complete assessment of IRR. Matz (2005) states that for this very reason EVE analysis poses some disadvantages, for example:

- Managing EVE sensitivity can increase earnings volatility. Typically this may occur when rate risk managers implement strategies or take actions to reduce risk in one accounting period that will actually be incurred in future accounting periods.

- EVE ignores the impact of new business. According to Payant (1997**c**:3) balance sheet projected cash flows do not stay static but changes constantly. According to the BCBS (2008:56) the static or liquidation approach is taken on EVE calculations ignoring the impact of future business strategies. Payant (1997**c**:3) also states that management has the ability to influence when and if economic losses are realised through the income statement. The bank is a going concern and renders the ability to transform its balance sheet as time progress which leaves static assessments of IRR questionable.

- EVE sensitivity analysis may indicate the size and volatility of IRR exposure in all time periods but does not assist in gaining any insight into the timing of exposures in order to better understand specific periods of increased exposure.

- The assumptions deployed in EVE analysis require careful development, analysis, increased controls and testing. Assumptions can be modified easily but requires considerable input and consideration given the significant impact it has on the EVE computation. Heagy and Tannenbaum (1997:301) also states that establishing the parameters relating to cash flows and their timing requires continuous validation and refinement. According to Bowers (2001:8) the reasonableness of cash flow assumptions should be reviewed frequently given its impact on the EVE calculation.

- Discount rates used will influence the EVE results. This may introduce additional measurement errors. Typically, if retail term deposits are discounted by applying the Treasury note curve, the rate sensitivity of the product will be overstated. This creates the problem that it is not always clear whether the interest rate sensitivity is driven from the cash flows, the discount rate selection or both. According to Koch and MacDonald (2000:354) EVE analyses requires that each cash flow are discounted by a discount rate reflective of the future rate at the term when the cash flow arises. Assessing future rates pose complexities of their own.

- EVE analysis requires significant and accurate assumptions about the impact on volumes or cash flows due to embedded options. Koch and MacDonald (2000:353) agree stating that the changes to cash flows due to optionality instil a complex data requirement on effective and accurate EVE calculations. The timing of when embedded options will be exercised also requires significant analyses.

- EVE may fail to capture a material amount of IRR exposure (Matz, 2005).

According to Bessis (1998:16) the formulation of balance sheet strategies and pricing decisions and the overall IRR management process of the ALM function must therefore focus on enhancing the risk-reward trade-off. Haubenstock and Aggarwal (1997:175) ads that risk optimisation should be applied in ensuring the optimisation of shareholders' value. This requires that conventional risk measures and control should incorporate risk-adjusted analysis in formulation of strategies. The risk-reward trade-off is quantified which in turn will establish what types and combinations of risk should be taken and at what price. This indicates a requirement to formulate input assumptions for the simulation model based on RAPM information from which the IRR is derived.

Weiner (2000**b**:15) also states that in order to incorporate performance measurement results in IRR management and strategy formulation of the bank requires the utilisation of a funds transfer pricing (FTP) system to quantify the risk-adjusted NIM and to transfer the IRR contribution of the NIM to the ALM unit. The OCC (1998:69) also states that a FTP system allows a bank to transfer the impact of IRR on the NIM from business units to the ALM department. The FTP system is used to centralise the management of IRR and to better evaluate and enhance the performance of business units. In addition, Weiner (1999:56) proclaims that FTP provides the linkage between the profitability measurement of units, products and customers and the overall ALM policy of the bank. Therefore, the integration of ALM IRR management is an integral part and focus of a successful FTP system.

5.6 SUMMARY

The effective identification, measurement, management and monitoring of IRR and liquidity risk is of paramount importance to the ALM function of a bank. In order to optimally manage the NIM and/or net income of the bank clear and effective IRR management strategies must to be formulated. These strategies must take cognisance of the associated risks from an enterprise perspective. Although individual risks are managed and mitigated on a stand-alone basis the overall integration and measurement of the risk/reward profile of the bank necessitates successful convergence of risk effects in strategy formulation. Financial risk management and in particular ALM were discussed as being a critical component of successful risk management.

This chapter presented the IRR measurement techniques in quantifying the IRR exposures of a bank. Basic approaches i.e. gap analysis and duration analysis may be applied to measure IRR. Both gap and duration analyses have specific disadvantages that may provoke an inaccurate assessment of IRR exposures. This may lead the ALM or ALCO of the bank to formulate potential unprofitable and suboptimal IRR mitigating strategies. Simulation modelling approaches however was established as the most accurate and comprehensive approach to measure IRR. Simulation analysis has the capability of measuring both the earnings and economic value perspectives of IRR. The EAR and EVE analyses performed to quantify IRR exposures proof to be best suited for IRR management. It was established that both EAR and EVE analyses should be applied in assessing IRR but that a preferred method should be applied to setting risk limits in accordance to the IRR policy objectives of the bank.

The ALM process is predominantly focussed on the future positioning of the balance sheet in order to optimise the risk/reward trade-off of the bank. Associated credit risk, liquidity risk and IRR are typically considered in the formulation of assumptions underpinning the simulation models' dynamic analyses performed. An aggregated ALM system supplies useful insight to the overall risk exposure of a bank in particular IRR and liquidity risk. Although the information is of critical importance it is not enough because the executive management of a bank also needs to know the financial risk exposures, the efficiency and the profitability performance of its units. The profit of a bank is largely contributed by the management of the financial risks flowing from its financial intermediation activities, by which the bank bridges the gap between the needs and preferences of surplus and deficit units in the economy. The profit performance of each bank unit therefore relates to the specific risks it manages and controls.

The formulation of strategies to optimise future anticipated earnings within acceptable levels of associated risk necessitates that the historic contribution of risk to profitability must be quantified, analysed and understood. Therefore a process needs to be established that comprehends the bank's margin and overall profitability given the risks endeavoured. This process can play a pivotal role in positioning the future balance sheet to effectively optimise profitability against the backdrop of forecast internal and external factors. The ALM IRR quantification process therefore can benefit to integrate the profitability or performance measurement results in its strategic planning processes. A Funds Transfer Pricing process can be deployed for such purposes.

CHAPTER 6

FUNDS TRANSFER PRICING AND THE ROLE OF FUNDS TRANSFER PRICING IN ASSET/LIABILITY MANAGEMENT IN BANKS

6.1 INTRODUCTION

In the previous chapters it was discussed that the intermediation function banks perform manifest into a risk-reward trade-off. This risk-reward trade-off requires that the bank's management and shareholders must apply a process of prudent risk management in order for the banks and its shareholders to meet their required returns. Bank supervisors and regulators also recognise the importance of banks managing their risk exposures to ultimately ensure the health of the bank and financial system overall. Such risk management systems and processes must focus on effectively identifying, measuring, monitoring and management of risk. In chapter 5 the asset/liability management (ALM) risk management and risk measurement processes as pertaining to interest rate risk was discussed. Chapter 4 highlighted the importance of a risk-adjusted performance measurement (RAPM) process in order to measure the risk-reward trade-off for products, customers, business units and business lines on a comparable basis. According to Weiner (2000**b**:15) the matched-term funds-transfer pricing is an important mechanism to the implementation of a customer or relationship profitability measurement process. Fundamental to the ALM process is the mechanism relating to funds transfer pricing (FTP).

According to Ong (1998:14) in measuring the risk-reward of a bank it is important that profitability measurement incorporate the risk-adjusted returns as part of the profitability equation. From a NIM perspective the FTP system which calculates the treasury transfer prices which allocates the associated income and expenses associated with the risk-taking activities of the bank i.e. credit risk and IRR, are an integral part of the RAPM process. According to Weiner (1999:56) the integration of ALM IRR management is an integral part and focus of a successful FTP system. FTP provides the linkage between the profitability measurement of units, products and customers and the overall ALM policy of the bank. The FTP and performance measurement process also provides the ALCO with the necessary feedback on the results of specific ALM-pricing decisions or strategies relating to structural balance sheet changes. The linkage between profitability measurement and ALM interest rate risk (IRR) management is established through the implementation of an effective FTP system. Payant (1994:1) states that a FTP system is an integral part a financial institution's profitability measurement and in specific a RAPM system.

Matten (1996:145) argues that the FTP system plays an important part in establishing the contribution of IRR to the profitability of the bank and how risk taking is rewarded and risk-based capital allocated to business units. Hodnett (2000:38) agrees stating the FTP system is integral to a successful RAPM process which focuses on the risk-adjusted profitability contribution of products, business units and the organisation. The FTP system also allocates the IRR to an area dedicated to manage the effects of IRR. Haubenstock and Aggarwal (1997:179) also states that to ensure that all costs and revenues are allocated to products, customers and business units on a risk-adjusted basis (i.e. credit, IRR etc.) a FTP system is required. The FTP system assists with isolating the IRR component of the NIM.

For the purpose of this dissertation the mechanisms relating to the allocation of expected losses (impairments/provision assigned to credit risk), non-interest income and expense and risk-based capital components in the performance measurement process will not be discussed, although of critical importance in the broader concept of RAPM's.

The objectives of this chapter are to:

- Discuss the FTP rationale and identify the FTP methodologies.
- Explore the Matched-Term FTP method as a RAPM component and in managing IRR in ALM.

Section 6.2 discusses the background pertaining to the concept underpinning funds transfer pricing. This is endeavoured in section 6.2.1 which discusses the measurement problem faced by banks pertaining to balancing the measured unit's balance sheet in order to achieve a NIM component for the RAPM model. The central funding unit concept is presented in section 6.2.2 as an important element in integrating the FTP and the ALM IRR management processes. The various available FTP methods are briefly presented in section 6.2.3 whilst section 6.3 will discuss the matched-term FTP method in more detail given its effectiveness in most accurately measuring the risk-adjusted return (NIM) from both the RAPM and ALM IRR management perspectives.

6.2 FUNDS TRANSFER PRICING (FTP)

According to Weiner (1999:45) FTP is the process by which a bank attempts to allocate the NIM to the users and providers of funds. FTP can be used to improve the understanding of the

various sources and uses of funds, their relevant value and the risks inherent in those transactions. A significant profit portion of any division, product or client is generated through the NIM and therefore the methodologies used in the allocation process are critically important to the measurement process.

According to Bessis (1998:332) FTP is the process by which prices are set determining the respective cost or worth of the funds when allocated between business units. Law and Reyniers (1988:35) explain that FTP determines the cost or worth of funds pertaining to the assets and liabilities of the various business units, products and customers of a bank. In addition, Marrison (2002:210) states that FTP is a framework of internal transactions between business units and the resultant prices of these internal transactions. The internal transactions represent the funds flow between the units and the respective costs associated to these funds. The FTP process captures the movement of funds between the accounting entities and measures the profit and risk embedded in the units. Proquest (2001:1) states that the FTP system is an internal measurement and allocation process that compute and assign the profit contribution to the NIM of the funds gathered and lent by the business units of a bank.

Smith (1999:6) explains that a FTP systems allocate the net interest income (NII) or net interest margin (NIM) to business units and segregate the inherent risks in financial contracts that the bank have with its customers. This indicates that the NII or NIM is segregated based on the contribution of various risks to the balance sheet and the associated interest income and expenses as accounted for in the income statement. Therefore, FTP is a RAPM component as it quantifies the impact of risk on the profitability of the bank where the NIM is concerned.

According to Weiner (1999:45) the NII of a bank can be segregated based on the risk taking attributes of transactions from which profit is derived. The profitability of the bank is therefore assessed based on the risks associated in generating the profits. In particular, the interest income and expense contributing risks taken by the bank can be identified and measured by a FTP system. According to Payant (1994:1) customer and product profitability as far as the NIM is concerned is determined by the FTP-mechanism which allocates the expenses to assets and income to liabilities. FTP is therefore the framework of the allocation method used to assign the value of funds used and provided between business units and product lines. Neither product or customer profitability measurement can be achieved optimally without the metrication of the value of funds used and provided by means of a FTP system. According to Payant (1994:1) the

specific methodology chosen need to ensure that the overall objectives are met as set out by the bank.

According to Bessis (1998:344) several FTP methods can be used to measure the risk-adjusted NIM. The importance of setting the measurement process parameters are dictated by that the FTP process must give direction to the setting of prices by the business units and subsequently effectively measure the profitability of these transactions engaged at set prices. According to Uyemura and Van Deventer (1993:321) the bank can apply various methods to allocate internal prices to the assets and liabilities within its balance sheet through an internal FTP process. The selection of methodology must ensure that business units are effectively measured on a risk-adjusted basis and that only controllable variances (originated from controllable risks) are retained in the profitability reports.

Smith (1999:6) states that several methods of FTP exist and it is of critical importance to fully comprehend the biases associated with the various methods. The reason for this is that the various methods will impact the results and may give false signals as to the true profitability contribution of risk to the business units. This is of particular importance when the FTP process is used as a measurement for incentive-based compensation. A well thought-out FTP system that provides performance information towards the organisation's goals and objectives, will add value through better pricing decisions for loans and deposits.

In addition, Smith (1999:6) states that the accountability for all risks inherent to the customer contracts can be assigned to the individual/s best equipped with the expertise in managing the risks. The focus of the individuals responsible for the profit and loss spreads is on the maintenance of the transactions, new business production and pricing in accordance with the overall objectives of the bank. According to Mark (1997:158) the FTP system should be able to decentralise decision making in that only controllable risk decisions should be made by business units and any considerations to IRR and funding should be left to ALM. In measuring the business units' contributions to the NIM/NII it should be based on the factors that are within their control and against a single standard. The FTP system should guide business behaviour which is consistent to the overall objectives of the bank regarding the risk-reward trade-off.
The OCC (1998:69) states that all IRR can be removed from the business units and transferred to the treasury or ALM unit tasked with managing IRR. Business units are therefore isolated from the impact of changing interest rates on their profitability measurement results. The

profitability results attributable directly to business units' management actions are more easily measured by application of a FTP system. Bessis (1998:344) also states that the FTP system must send consistent signals to the business units regarding pricing and profitability objectives that are driven by the risks and activities that are within the business units' control. Thus, concerns regarding IRR and NIM variability due to interest rate changes are transferred to the ALM function.

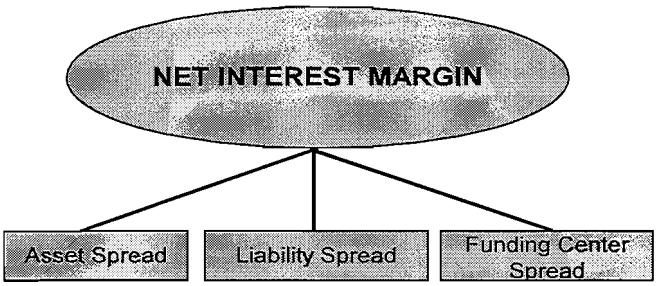
According to Koch and MacDonald (2000:178) a comprehensive cost-accounting system are often applied to generate income statements that incorporate the allocation of all overheads and direct expenses and income (interest and non-interest income and expenses). This was also discussed in chapter 3, section 3.2 (p58). Weiner (1994**b**:1-3) states that measuring performance requiring that all costs and income are assigned effectively to the area allocated the management responsibility for controlling such income and expense. According to IPS-Sendero (2006**c**:22) cost-accounting measures are used by banks to determine the profitability of products, units and customers. FTP compliments the performance measurement process by assigning a cost for funds used and a credit to funds provided. This allows the institution to segment the NIM into logical components. This is illustrated in figure 6.1.

The difference between the cost for the funds used and the yield on the customer loan (asset) is presented by the asset spread and the difference between the credit applied to funds (deposit) raised is presented by the liability spread. The net difference between the accounting NIM and the asset/liability spreads are presented by the funding center spread. Once the logical components of the NIM are identified the accountability for managing the level and direction of these components can be assigned to line managers (IPS-Sendero, 2006**c**:22).

Weiner (1999:45) states that the ultimate goal of FTP is to create a process by which the management of the NIM's contributing sources and uses of funds could be altered in order to improve the bank's overall NIM. Bessis (1998:331) also states that FTP is a strategic management tool that assists in isolating IRR to the ALM function, assists business units to make better pricing decisions and effectively allows measuring the risk-adjusted profitability of the organisation its business units and products. According to Marrison (2002:210) FTP influences the measurement of profitability of business units in that the NIM is isolated from uncontrollable risks elements. By allocating the transfer rates/prices (cost of funds) the business unit's NIM is risk-adjusted. The risk-adjusted profitability can directly impact the incentives and

compensation paid to management. FTP also assist in setting better strategies relating to prices charged to customers.

Figure 6.1 Components of the NIM



Source: (IPS-Sendero, 2006**c**:22)

Uyemura and Van Deventer (1993:320-321) also states that FTP has the ability to transfer all IRR from the business units and assist better pricing decision through the setting of transfer prices. Better performance measurement of the organisational units is also facilitated through a FTP system. In addition, Ford (1999**b**:179) explains that a FTP system provides a bank with the ability to remove IRR from its business units and isolate its profitability impact to the ALM unit. The units can be measured on a risk-adjusted basis which renders more accurate performance measurement given that unit managers are responsible for only the income variances that are within their control. Furthermore, accurate risk-based pricing can be established and business units can receive information through the FTP process that will induce behaviour consistent to the risk and profitability objectives of the bank.

6.2.1 THE MEASUREMENT PROBLEM

Payant (1994:1) states that proper decision making about the value of funds used and provided are the most critical variables in determining business unit, product line and customer profitability. But too often interest income is only associated with assets and interest expense associated with liabilities. Proquest (2001:1) argues that business units contribute different quantities of loans and deposits. The units also rarely supply as much funds as they use or vice versa. The NIM and value contribution is therefore not equal by all units of the bank. Koch and MacDonald (2000:178) also states that measuring the performance of business units renders a problem assigning the interest and expenses to units with only income or expense driven balance

sheet items. This creates a measurement problem which requires a FTP system to allocate both interest income and expense to all units.

Weiner (1994**a**:8) explains that different business areas or divisions across a bank have been defined and the measured entities have unbalanced balance sheets. This is due to the definition being based on generic product groupings, client profiles or other business logic. The different levels in the profitability measurement hierarchy further necessitate different levels of measurement. The measurement of the contribution of risk to the NII must be done at the individual transaction or account level. Most units, products and customers are either fund users or fund providers and therefore create an imbalance at the NIM at the lowest level. The resultant problem for unbalanced balance sheets is the question of which specific funding or deposit and related costs must be allocated to which specific lending or loan activities in the measurement process.

Bessis (1998:330) also states that business units in a bank are often focussed on specific customers and/or products which renders that they are either loan originators or deposit gatherers. This requires that any deficit on the balance sheet of the unit has to be funded and any surplus must be invested internally. According to Marrison (2002:211) the amount of deposits taken in by a specific business unit may exceed the amount of loans made. The additional funds are normally provided by another business unit i.e. the treasury funding operation. The interest rate charged for the additional funding is determined by the transfer pricing process in that the actual funds may be determined by a pool of funds which may be at different interest rates and some of which may have no interest rate at all.

Proquest (2001:1) also state that pooled approaches determine the values of funds under specific predefined criteria. The derivation of funds value or cost of funds is therefore often subjective and often can not effectively capture the true value of a loan or deposit through its contribution to the NIM. According to Bessis (1998:332) the problem occurs in that the central pool of funds requires a methodology to determine the allocation and price of funds transferred to the business units but also surpluses received from business units. This requires a methodology for setting the interest rates on funds exchanged. Ford (1999**b**:178) also states that the setting the interest rates to determine the value of funds used or provided may pose to be a challenge for a bank.
According to Weiner (1999:45) table 6.1 indicates the fact that each asset and invested fund contributes to interest income and interest expense. Each earning asset or investable fund should

have an interest income and interest expense component which dictates that all assets are funded and liabilities are invested. Interest is earned directly from the customer for each earning asset. An associated interest expense should be charged based on a calculated charge for the cost of carrying the loan or asset as the bank need the funds, and pays for it, to on lend to the customer. Therefore the bank receives interest directly from the client and intrinsically pays an interest expense as a charge for the cost of holding the asset.

Table 6.1 NIM at the transaction level

Earning Assets	Investable Fund
Direct Interest Income	Credit for Funds Provided
Charge for Funds Used	Direct Interest Expense
Net Interest Income	Net Interest Income

Source: (Weiner, 1999:45)

According to Bessis (1998:333) all loans should be allocated a cost of funds to determine the profitability of lending the funds to a customer at a set interest rate. Marrison (2002:211) also explains that in determining the profitability of a loan the associated cost for each loan has to be established. The determination of the cost of funds which were lent to the customer determines the profitability of the loan. Uyemura and Van Deventer (1993:320) also state that in determining the profitability of a loan it requires that the associated funding cost needs to be determined. This renders the question as to which specific deposit or source of fund's cost are allocated to fund the specific deal in order to determine its profitability. Ford (1999**b**:179) also states that to effectively determine the profitability of a transaction all loans must be refinanced to determine the associated funding cost.

Weiner (1999:45) states that the same principle applies to a source of funds or deposit. Investable funds or deposit placement from clients with the bank result in a direct interest expense payment to the customer. Interest income should be derived for acquiring the funds based on an internally derived implicit credit to the funds' acquirer/s. Therefore the Bank must derive an acceptable method for calculating the charge for funds used and the credit for funds supplied, keeping in mind that it has to incorporate the underlying risk profile for each account (Weiner, 1999:45). Ford (1999**b**:179) also states that deposits are reinvested to determine the worth of the funds in order to determine the profitability of the transaction or product.

According to Weiner (1999:45) the measurement problem is even more clearly illustrated when referring to the first level of profitability measurement, i.e. the organisational units. Table 6.2 illustrates the concept of surplus and deficit units in the Bank, with Unit 1 being a deficit unit or net user of funds whose balance sheet consists only of loans, and Unit 2 being a net source of funds or a surplus unit whose balance sheet consists only of deposits. What can be derived from table 6.2 is that if Unit 1 is not charged for the funds it uses to support its earning assets, then no matter how much operating expenses are allocated to Unit 1 it will probably always appears to be profitable. The same situation applies for Unit 2. It will always appear to be unprofitable if it is not credited for the funds it provides. When operating expenses are added the profitability situation of Unit 2 will appear to deteriorate even further. Although the overall situation of the bank looks acceptable, it must allocate the 400 basis points NIM to the individual units, products and customers in the context of measuring the NIM profitability at the transaction level (Weiner, 1999:47).

Table 6.2 The measurement problem

	Unit 1		Unit 2		Total Bank	
Balance Sheet	**Amount**	**Rate**	**Amount**	**Rate**	**Amount**	**Rate**
Loan						
Consumer installment	350,000	11.77%			350,000	11.77%
Mortgage	400,000	9.70%			400,000	9.70%
Commercial	250,000	8.00%			250,000	8.00%
Total Loans	1,000,000	10.00%			1,000,000	10.00%
Deposit						
Now accounts			200,000	3.50%	200,000	3.50%
Savings accounts			275,000	4.50%	275,000	4.50%
CDs			525,000	7.74%	525,000	7.74%
Total deposits			1,000,000	6.00%	1,000,000	6.00%
Net Funds Used/Provided	**1,000,000**	**10.00%**	**-1,000,000**	**6.00%**	**0**	**4.00%**
Income Statement	**Interest Income**		**Interest Expense**		**Net Interest Income**	
Unit 1						
Consumer installment	41,200	11.771%			41,200	11.77%
Mortgage	38,800	9.700%			38,800	9.70%
Commercial	20,000	8.000%			20,000	8.00%
Total Loans	100,000	10.000%			100,000	10.00%
Unit 2						
Now accounts			7,000	3.50%	-7,000	-3.50%
Savings accounts			12,375	4.50%	-12,375	-4.50%
CDs			40,625	7.74%	-40,625	-7.74%
Total deposits			60,000	6.00%	-60,000	-6.00%
Net Interest Income (Expense)	**100,000**	**10.00%**	**-60,000**	**6.00%**	**40,000**	**4.00%**

Source: (Weiner, 1999:45)

Marrison (2002:211) concurs stating that business units with unbalanced balance sheets render an unclear line between the profitability origination of the bank. It is often unclear whether the profitability is driven b raising cheap funds from deposits or by pricing optimally on any loans made. Assessing the profitability of individual products and customers are even more of a challenge.

According to Weiner (1999:47) one of the primary reasons for measuring NII at the transaction level is to identify and assign responsibility for the risks associated to any transaction. The RAPM principle requires that the NIM must be quantified according to the risk/reward trade-off. Ford (1999**b**:180) concurs that all transactions must be assigned individual transfer rates to effectively capture the risk-adjusted profit/loss. The FTP method used must therefore identify the risk, assign the responsibility for the risk and quantify its contribution to the NIM per customer account according to the various levels of the profitability measurement hierarchy as presented in figure 3.1 in chapter 3 (p60). According to Weiner (1999:47) several risk classifications must be addressed by the bank implementing FTP. The main risk classifications are:

- Interest rate risk: Ford (1999**b**:179) states that business units have little control over changes to interest rates and how it affects their NIM. As such when interest rates change the resultant change in their NIM should not impact the measurement of their performance. Marrison (2002:210) argues that when a fixed-rate loan is funded with floating rate deposit, the NIM of the transaction will change when interest rates change. The change in the NIM due to IRR should not be allocated to the transaction's owners as they are not responsible to manage the IRR. As such the ALM of the bank should be receiving the NIM's IRR component.

  Uyemura and Van Deventer (1993:320) also states that product owners/divisions have control over the pricing of products and customer accounts but have no control over changing market yield curves and unusual index rate movements such as the Prime rate. Thus, FTP must remove IRR variances from the profitability results of the division and products.

Mark (1997:159) states that the FTP system should endeavour to remove all IRR from a business unit as the unit has does not have the allocated responsibility of managing the IRR effects; this is assigned to the ALM area of a bank.

Weiner (1999:47) states that IRR is a natural part of a bank's financial intermediation function and must be managed to avoid the deterioration of the economic value of the institution as a result of changes in interest rates over time. Figure 6.2 depicts the impact of interest rate risk or mismatch from a profitability analysis point of view, where a fixed rate loan was made with a spread of 290 basis points above the market based funding curve. However, 2 years later when compared to changed market rates, it seems that the lending officer made a poor pricing decision. For instance, if refinancing this deal it would appear that the deal is totally unprofitable. Neither the loan officer nor the division should be held responsible for the interest rate risk effect when measuring the profitability of the customer, product or organisational unit as long as the loan was originated within the ALM guidelines (Weiner, 1999:47).

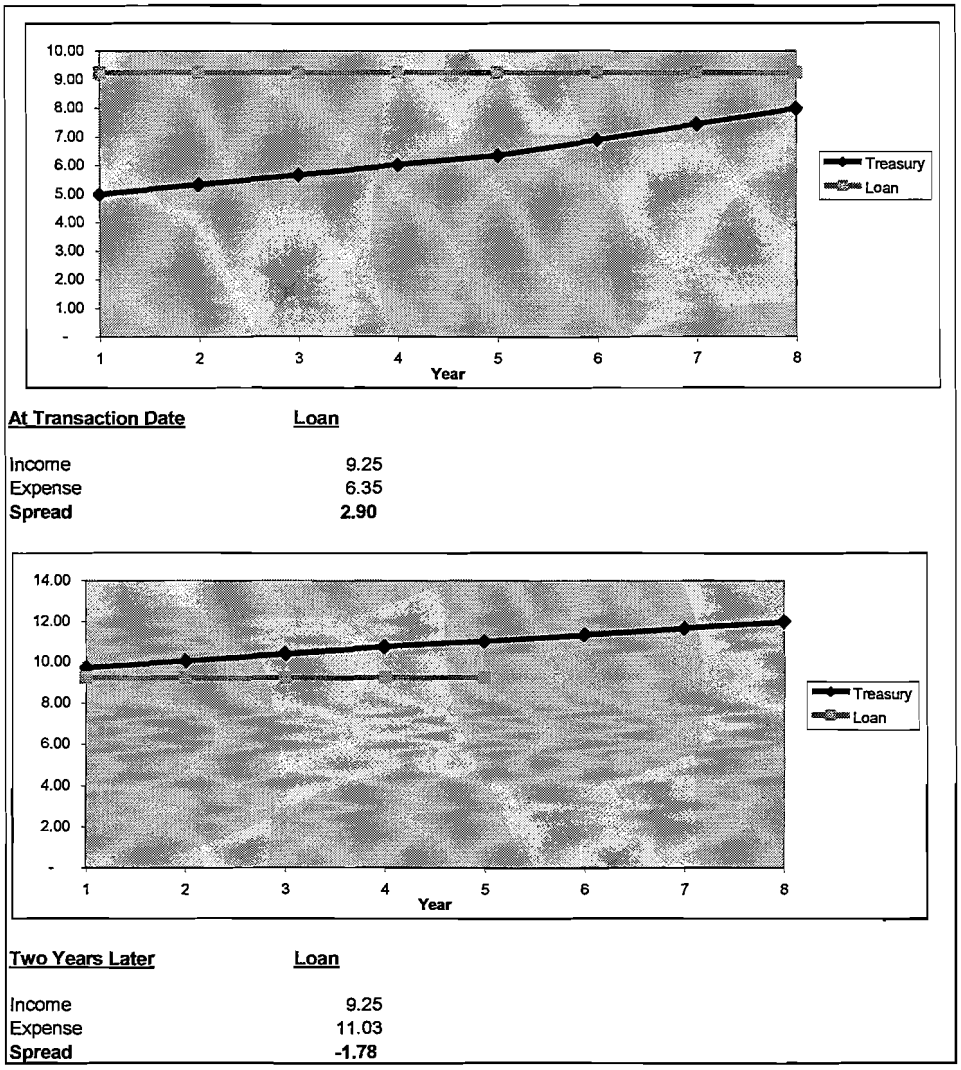
This is also reported by Haubenstock and Aggarwal (1997:178) stating that any changes to the profitability of a product or business unit due to IRR should be transferred to the ALM unit responsible for managing the affects of IRR. Thus, IRR from the profitability assessment of business units and products should be cleared of IRR profit or loss.

- Prepayment risk: According to Weiner (1999:47) the potential that loans will be repaid prior to the scheduled maturity date. This has serious implications when assessing the contribution of such accounts to the risk-adjusted NIM from a profitability point of view, as the repayment profile has been altered and therefore the resulting margin and mismatch will change. Prepayment penalties are often added to products displaying high levels of prepayment risk. This practise induced another dimension to pricing (Weiner, 1999:47).

  According to Ong (1998:10) prepayments will impact the cash flows and timing which are assigned transfer prices or costs. This may impact the effectiveness of the IRR calculated component of the NIM through the FTP system. According to the Kamakura Corporation (2008) the changes to cash flows and the timings of the cash flows directly impacts IRR and thus requires consideration in assessing the NIM under a FTP process.

The expected profitability and associated cost of funds charged will therefore be impacted by prepayments to the loan.

Figure 6.2 Interest rate risk (IRR)



Source: (Weiner, 1999:46)

- Credit risk: According to Haubenstock and Aggarwal (1997:178) business streams should be analysed on an equal footing which renders in the calculation of risk-adjusted returns through a FTP system the credit risk profitability contribution must be allocated to the business units which manages the exposure. Thus the risk that a loss may be incurred due to the default of counterparty in a transaction is allocated to the business unit held responsible for the management of the risk. The potential that assets will not be repaid as scheduled due to client default is the result of credit risk.

According to Mark (1997:158) the bank takes on credit risk for which it receives a fee as part of its NIM profitability. The FTP process therefore needs to consider/measure the profitability attributable to credit risk exposures.

Weiner (1999:47) states that although credit risk is one of the oldest forms of banking risks, it still represents a major financial impact. The account officer needs to ensure that today's good credit doesn't change into the future charge-off. Through a solid credit review process and effective pricing which result in charging for the associated credit risk the risk can be mitigated. The credit risk should stay with the transaction for its entire life and the institution should assign a cost that it can be measure as part of the overall account profitability. Ong (1998:14) also states that in computing the risk-adjusted returns a bank should assess the profitability impact of credit risk.

- Other risks: According to Weiner (1999:48) other risks like translation risk or currency risk should be clearly defined due to the potential impact on the organisation's overall profitability. Inflation, market and operating risks may also, if deemed material to the profitability of the bank, be quantified and incorporated in the FTP mechanism (Weiner, 1999:48). Haubenstock and Aggarwal (1997:178) also states that market risk, foreign exchange and operational risks may impact profitability of a bank and should render consideration when designing a FTP framework.

In the preceding sections (p192-194) it was discussed that part of the objectives of FTP is to assign responsibility for the management of various risks' contribution to the NIM at the individual customer level. The bank must therefore implement a mechanism that will provide quantifiable measures that produce results that are acceptable by all role players. According to Ford (1999**b**:180) the unit that sweeps all IRR from the divisions are responsible for managing the flow of funds the resultant prices/interest rates of theses funds. This unit is embedded as part of the functioning of the FTP process.

Bessis (1998:332) also states that ALM is primarily responsible for the FTP system and transfer prices and therefore is the central unit for establishing the risk-adjusted measurement process of the NIM. According to Weiner (1999:48), the central funding unit (CFU) concept is a typical mechanism deployed by institutions to facilitate the solution to the measurement problem and therefore effectively allocate risk responsibility as contributed to the NIM.

6.2.2 THE CENTRAL FUNDING UNIT (CFU) CONCEPT

According to Weiner (1999:48) the CFU essentially buys all investable or deposit funds from units, products and customers. Conversely the CFU will sell funds to the units, product and customers that support all earning assets. In simplistic terms all areas of the bank will enter into a transaction with the CFU to supply the other half of the NIM equation for all transaction performed. The CFU does not deal in net amounts. Each and every transaction is measured in isolation as to its profitability contribution through the NIM (Weiner, 1999:48).

Bessis (1998:334) states that the ALM or funding unit will notionally transact in buying and selling back all funds from business units. All assets are sold the required funding they require and all liabilities are bought from business units at specific prices derived from the FTP system.

IPS-Sendero (2006**c**:24) explains that the Funding Center (FC) or CFU is often referred to as the bank's banker given its activity of buying and selling the institutions internal funds. The CFU or FC main objectives are:

- To accurately value the funds used and provided in order to establish a valid allocation of the NIM through an effective FTP system.
- Isolate units from IRR (IPS-Sendero, 2006**c**:24).

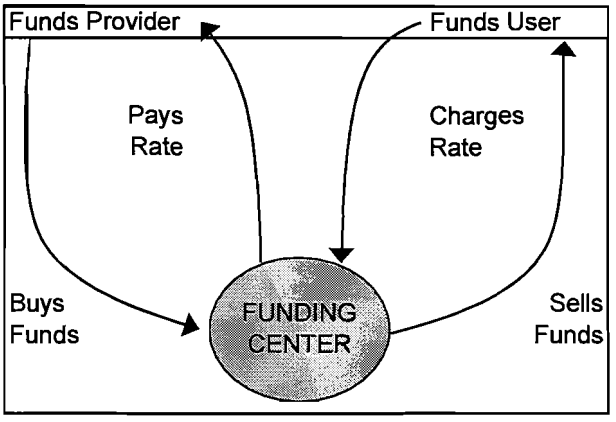
According to Marrison (2002:214) an internal ALM desk or FC can be established to transact all assets and liabilities within the bank. All loans that require funding will transact with the FC to receive an internal funding cost and all deposits will invest with the FC and receive an internal worth of funds. Thus, the various units i.e. the funding unit, loans unit and ALM desk or FC give fictitious/notional loans to each other which represents the alternative funding and investments they could have achieved in the external markets.

Ford (1999**b**:180) also explains that all assets are funded by the treasury funding center and all deposits are purchased by the treasury FC. The corresponding transfer prices or interest rates at which the loan and deposit are either sold or bought determine the contribution of each transaction to the profitability of the organisation. The net difference compared to the accounting NIM is retained in the FC.

According to Stott (1992:51) the role of the treasury FC is pivotal to an effective FTP system in that all assets and liabilities are transacted through the FC to attract a transfer rate. In the process the FC or ALM has the ability to more effectively manage and control structural risk positions within the balance sheet. This is achieved by applying unique transfer rates to all assets and liabilities by selling funds to loans and purchasing the deposits.

According to IPS-Sendero (2006**c**:24) figure 6.3 explains the functioning of the CFU or FC. The FC will credit fund providers for making funds available and charge the users of funds for employing the available funds. The business unit which are providers of funds therefore receives a credit of funds, or transfer income, from the FC which enhances the unit's profitability. The charges to a unit that uses funds are known as a cost of funds or transfer expense, which will reduce the unit's profitability. The FC therefore reflects the institutions net transfer pricing activity. The credits and charges for funds are based on internal transfer rates, usually derived from a market-based yield curve, and other key rates. The application of the internal transfer rates allows for the identification of the NIM components (IPS-Sendero, 2006**c**:24).

Figure 6.3 Funds bought and sold from the Funding Center or Central Funding Unit



Source: (IPS-Sendero, 2006**c**:24)

Weiner (1999:47) explains that institutions that deploy simplistic FTP processes typically apply the netting of assets and liabilities. The netting process implies that all units, products and customers are self-funding to the extent that their deposits offset their loans. Bessis (1998:333) states that 'netting' relates to the transfer of excesses and deficits to a central pool. The central pool of funds simply purchases the excess of surplus units and sell/lend funds to the deficit units. A unique price is applied for the net transferred balances. Koch and MacDonald (2000:178) argue that by applying the netting of funds as part of a FTP process to determine the transfer prices the unit retains all risks. The interest income and expense is thus allocated based

on the pool of funds assigned as either assets or liabilities to balance the balance sheet of the unit.

Marrison (2002:211) states that surplus funds of one unit are often loaned to units short of funds through the treasury unit which is the interface to the wholesale markets. The surplus unit receives a return on the surplus funds. The problem is however that the profitability of the units are indeterminable based on their inherent riskiness. The fee paid and received for the funds loaned or required by the unit impacts the overall NIM of the unit and is often less or more than the prevailing market rates. Thus it falsely increases or decreases the measured units' profitability. If interest rates changes the overall IRR impact are reflected in the subsequent changes in the NIM due to IRR which are retained by the business unit.

According to Weiner (1999:47) all funds are therefore treated as if they had the same underlying characteristics. Any mismatches are therefore disregarded in the sources and uses of funds. The netting approach will leave the unit, product or customer with a portion of the mismatch risk or IRR and is therefore in direct conflict with the objective of removing IRR to the CFU. The resultant spreads representing other risks controllable by the unit is therefore also distorted. In addition, Bessis (1998:333) states that only the net balances are transferred between units and no assets or liabilities generated by the units, transit through the system. The FTP system based on 'netting' is therefore simplistic and its impact is limited on the operations of the business units. This approach fits with a passive management of funds.

Smith (1999:6) explains that the main objective of the CFU in buying and selling funds is that the IRR is absorbed in the CFU, but the credit and other risks remain in the business unit. The CFU is responsible for the management of IRR. The CFU should therefore be held accountable for its ability to manage the IRR within the broader objectives of the institution. The FTP mechanism is a method to quantify the inherent risk contribution to the NIM and also measuring the CFU's performance.

Weiner (1999:48) agrees stating that FTP can be applied as a mechanism to measure the profitability impact of IRR. The transferred IRR to the FC should also be measured to ensure that all IRR strategies are achieving the specific objectives. Bessis (1998:333-334) explains that ALM should therefore apply a FTP system whereby all assets and liabilities are exchanged with ALM or the CFU in a full internal capital market with internal prices. Every asset and liability is

therefore transfer priced (bought and sold) between the CFU and the business units. Any global net excess or deficit is then invested or funded in the money or capital market.

Bessis (1998:334) states that through the FTP process which set transfer rates, the ALM of a bank has a powerful leverage on business units. All pricing decision and commercial policy are dependent on the FTP process and as such the ALM can direct important strategic objectives.

The OCC (1998:69) states that FTP allows the ALM of a bank to influence the business units in making decisions that are consistent with the IRR management objectives of the ALCO. FTP can also drive the enhancement of the performance of business units through its risk-adjusted profitability reporting. According to Weiner (1999:49) the linkage between FTP and IRR management provides the bank with an excellent tool to assist with the implementation of its ALM strategies and policies. Through the FTP process and the CFU concept the ALCO can translate IRR management decisions into the subsequent pricing decisions for loans and deposits in the market. Weiner (1999:49) states that the linkage between FTP and IRR management also supplies valuable information of the overall IRR exposure of the consolidated position of the institution. Several methodologies relating to FTP exist in order to establish the CFU concept

6.2.3 FTP METHODS

According to Uyemura and Van Deventer (1993:320) various methods and conceptual designs are available to FTP, leaving a choice of methods in solving the measurement problem. The following FTP methods are described by Weiner (1999:49) as being available to banks which want to make use of the CFU concept. These methods are also advocated by Hodnett (2000:38) and Smith (1999:6). Smith (1999:6) warns that banks must ensure they understand the biases of each method and how it impacts towards its quantification of the risk/reward trade-off embedded within its NIM. The FTP methods according to Weiner (1999:49) are:

- Single Pool Method: The single pool method is the simplest of all FTP methods. The same rate is used to charge for funds used and to assign credit for funds provided. The same rate is therefore used to do the NIM calculation at the different levels of profitability measurement hierarchy. This method is illustrated in table 6.3. The single pool method usually derives the rate from the current month's marginal cost-of-funds but could also be based on the average asset yield or a blend of both (Weiner, 1999:49).

Proquest (2001:1) explains that the single pool method assigns a single interest rate or transfer rate to all transactions. Hodnett (2000:38) explains that although this method is simple to use it is practically considered to be unfair given that it has the tendency of benefiting one side of the balance sheet, typically the side from which the transfer rate (the rate at which funds are charged or credited) is predominantly derived. In table 6.3 the single pool method is presented. From the balance sheet information it is presented that Unit 1 is a deficit unit having assets only of R 1 million, and Unit 2 is a surplus unit with only deposits of R 1 million. The various yields associated with the unit's respective assets and liabilities results in their respective income statements calculating each unit's respective NIM. The single pool FTP method uses the same rate of 7.00% to charge fund users and credit fund providers in order to complete the NIM equation for all earning assets and liabilities. The cost for the funds used to create the earning assets in Unit 1 is charged at 7.00%. Similarly, the provider of funds or Unit 2 is credited at a rate of 7.00% for the funds it sourced from depositors typifying the transaction with CFU buying the funds from the unit. The NIM for Unit is therefore 3% and the NIM for Unit 2 is 1%. The FTP effect on the CFU is zero (Weiner, 1999:48).

According to Law and Reyniers (1988:37) the single pool method will simply allocate a weighted average cost of funds to all assets. Hodnett (2000:38) states that single pool FTP method will place all funds in a single pool from which the average cost is assigned to all lending and investment activities.

According to Weiner (1999:49) the primary advantages of the single pool method are:

- It is the simplest FTP method to implement as the calculation of the transfer rate is simplistic with easy mathematics. According to Payant (1994:2) single-pool FTP is the simplest method of determining the volume mismatch value to the NIM of products and business units.

- The database needed to do the calculation for the NIM allocation is small and easy to access and maintain. Hodnett (2000:38) also states that the single pool method is easy to use and simple to compute lacking a need for complex databases and significant amounts of data.

- Reports are easy to read and understand (Weiner, 1999:49).

Table 6.3 Single Pool Method

	Unit 1		Unit 2		Total Bank	
Balance Sheet	**Amount**	**Rate**	**Amount**	**Rate**	**Amount**	**Rate**
Loan						
Consumer installment	350,000	11.77%			350,000	11.77%
Mortgage	400,000	9.70%			400,000	9.70%
Commercial	250,000	8.00%			250,000	8.00%
Total Loans	1,000,000	10.00%			1,000,000	10.00%
Deposit						
Now accounts			200,000	3.50%	200,000	3.50%
Savings accounts			275,000	4.50%	275,000	4.50%
CDs			525,000	7.74%	525,000	7.74%
Total deposits			1,000,000	6.00%	1,000,000	6.00%
Net Funds Used/Provided	**1,000,000**	**10.00%**	**-1,000,000**	**6.00%**	**0**	**4.00%**
Income Statement	**Interest Income**		**Interest Expense**		**Net Interest Income**	
Unit 1						
Consumer installment	41,200	11.77%	24,500	7.00%	16,700	4.77%
Mortgage	38,800	9.70%	28,000	7.00%	10,800	2.70%
Commercial	20,000	8.00%	17,500	7.00%	2,500	1.00%
Total Loans	100,000	10.00%	70,000	7.00%	30,000	3.00%
Unit 2						
Now accounts	14,000	7.00%	7,000	3.50%	7,000	3.50%
Savings accounts	19,250	7.00%	12,375	4.50%	6,875	2.50%
CDs	36,750	7.00%	40,625	7.74%	-3,875	-0.74%
Total deposits	70,000	7.00%	60,000	6.00%	10,000	1.00%
Net Interest Income (Expense)	**170,000**	**8.50%**	**130,000**	**6.50%**	**40,000**	**4.00%**
Actual Net Interest Income					40,000	
Central funding unit effect					-	

Source: (Weiner, 1999:48)

Although the single pool method is probably suitable for an organisation in the infant phases of profitability measurement, the shortcomings and lack of value-add of this method are soon realised. Weiner (1999:49) state the following disadvantages associated with the single pool FTP method:

- The single pool method tends to be biased towards fund users or fund providers, depending on the derivation of the transfer rate. If the transfer rate is based on the short-term cost of funds, the asset acquirers tend to look exceedingly profitable as a result. The inverse will apply when an asset yield transfer rate is used. In this case the most profitable products appear to be funding related and therefore asset acquirers seem least profitable.

  According to Hodnett (2000:38) the single pool method is considered as an unfair measurement as it tends to favour either one side of the balance sheet or the other.

The rate is either determined by the deposit rates or adjusted for loan rates. Payant (1994:2) also states that setting the transfer rate based on the cost of funds make fund users look more profitable than fund providers. The transfer rate derived from assets yields will achieve the opposite.

Marrison (2002:211) explains that using the average rate as impact by the netting of funds to balance the balance sheets of business units, renders the measurement of profitability inaccurate. This is because the assessment of products profitability is unclear as to where the profits originate from i.e. whether good loan pricing drives profitability or funding strategies attracting cheap deposits.

- Marrison (2002:211) states that IRR will impact the NIM of the business unit as the single pool method retains all IRR within the NIM. Changes to interest rates will change the single transfer rate derived from average funding/investment rates and this will continuously change the perceived profitability.

  Hodnett (2000:38) states that all IRR is retained in the business unit through the application of the single pool FTP method. Weiner (1999:49) states that probably the biggest disadvantage is the fact that this method leaves most or all of the interest rate risk with the unit, product or client. The reason for this is that longer-term instruments are subject to interest rate fluctuations. If the certificate of deposit (CD) in table 6.3 of for example, three-year tenor, were sold when long term interest rates were at 6.00% it may look particularly disadvantageous if rates decline by 200 basis-points. All funds are therefore treated the same irrespective of maturity and repricing characteristics. Hodnett (2000:38) further states that this method ignores the time-value of money and also ignores any economic characteristics of the balance sheet.

- The single pool may not solve the measurement problem as is evident in the CD at a spread of negative 74 basis-points in table 6.3 (Weiner, 1999:50).

- Double Pool Method or Split-Single Pool Method: According to Hodnett (2000:38) an enhancement of the single pool method is to apply two pools to derive the transfer rate. A different rate is used for borrowers of funds (loan-units) and a different rate for suppliers of funds (deposit-units). According to Weiner (1999:50) the double pool

method, also known as the split-single pool method, was developed to alleviate the biased measurement methodology problem of the single pool method. The transfer rate is derived for both earning assets and paying liabilities of the balance sheet. Typically the average cost paid for funds sourced is applied as the transfer rate allocated towards fund users or asset acquirers. Likewise the average yield on earning assets would be derived and allocated to fund providers or deposit generating units. Each side of the balance sheet's interest earning and paying contracts are measured against the opposite sides average yield (Weiner, 1999:50).

According to Payant (1994:2) two pools can be created to derive a transfer rate for assets and liabilities respectively. The funds user's pool is set at the average cost of funds and the funds provider's pool could be established at the average earnings asset yield.

According to Weiner (1999:49) table 6.4 presents the same balance sheet, yields and resultant income statement results as per the single pool method explanation presented in table 6.3. However, in table 6.4 the double pool FTP method is applied indicating that fund providers (Unit 2) are credited at a rate of 10% which is the average yield derived from actual earning assets (as per unit 1). The fund users or loans (Unit 1) are charged for the funds used at a rate derived from the average paying liabilities (as per units 2) which is 6%. Therefore, both Unit 1 and Unit 2 have a 4% NIM. Consequently, the CFU has an R -40000.00 FTP effect, double that of the actual bank total NII.

Weiner (1999:50) and Hodnett (2000:38) explain the following advantages of the double pool method:

- Similarly to the single pool method it is easy to understand and calculate.
- This method usually results in positive margins and therefore solves the measurement problem, although in its simplest form.
- The rates for lenders and borrowers of funds are not the same. Therefore this method attempts to overcome the weakness of the single pool method that favours one party i.e. the fund providers or users. According to Hodnett (2000:38) the double pool method attempts to solve the weakness of the single pool method that usually favour on unit over the other unit/s (i.e. the funds users over the funds providers, or vice versa).

Table 6.4 Double Pool Method

	Unit 1		Unit 2		Total Bank	
Balance Sheet	**Amount**	**Rate**	**Amount**	**Rate**	**Amount**	**Rate**
Loan						
Consumer installment	350,000	11.77%			350,000	11.77%
Mortgage	400,000	9.70%			400,000	9.70%
Commercial	250,000	8.00%			250,000	8.00%
Total Loans	1,000,000	10.00%			1,000,000	10.00%
Deposit						
Now accounts			200,000	3.50%	200,000	3.50%
Savings accounts			275,000	4.50%	275,000	4.50%
CDs			525,000	7.74%	525,000	7.74%
Total deposits			1,000,000	6.00%	1,000,000	6.00%
Net Funds Used/Provided	**1,000,000**	**10.00%**	**-1,000,000**	**6.00%**	**0**	**4.00%**
Income Statement	**Interest Income**		**Interest Expense**		**Net Interest Income**	
Unit 1						
Consumer installment	41,200	11.77%	21,000	6.00%	20,200	5.77%
Mortgage	38,800	9.70%	24,000	6.00%	14,800	3.70%
Commercial	20,000	8.00%	15,000	6.00%	5,000	2.00%
Total Loans	100,000	10.00%	60,000	6.00%	40,000	4.00%
Unit 2						
Now accounts	20,000	10.00%	7,000	3.50%	13,000	6.50%
Savings accounts	27,500	10.00%	12,375	4.50%	15,125	5.50%
CDs	52,500	10.00%	40,625	7.74%	11,875	2.26%
Total deposits	100,000	10.00%	60,000	6.00%	40,000	4.00%
Net Interest Income (Expense)	**200,000**	**10.00%**	**120,000**	**6.00%**	**80,000**	
Actual Net Interest Income					40,000	
Central funding unit effect					-40,000	

Source: (Weiner, 1999:49)

According to Weiner (1999:50) the following disadvantages of the double pool method may be derived:

- The contribution of IRR to margin as a result of mismatch is still retained in the division, product or measured customer. No differentiation is made on the transfer rate based maturity and/or repricing characteristics. Payant (1994:2) states that all funds are equal regardless of how, when, why, for what and for how long they were acquired. The varying maturities, spreads, repricing, withdrawal options, and contractual characteristics make some funds more valuable than others. This is ignored by both the single pool and double pool FTP methods.

- There is limited scope to objectively derive between profitable and less profitable units. Therefore derived strategic decisions are still questionable. Payant (1994:2) also states that the full organisational spread is earned by all units. Thus, the consequential sum of all units' NII contributions can be double that of actual NII of the bank. This is clearly seen in table 6.4 (p209). Law and Reyniers (1988:38) also

states that no single transfer rate (whether single pool or double pool derived) are feasible for measuring the value of loans and deposits. The profitability of a unit will be overstated or understated as interest rates move as most IRR is retained in the units being measured.

- Multiple Pool Method: Hodnett (2000:38) states that when assessing the usefulness of single- and double pool methods in a RAPM process it becomes quite obvious that these methods are not suitable. The reason for this is that the balance sheets' underlying maturity and repricing characteristics of its interest earning assets and interest paying liabilities, are not taken into account when deriving transfer rates for a FTP system.

  Law and Reyniers (1988:40-41) also explains that transfer rates must incorporate the attributes of the accounts they measure. Fixed and floating rate loans of various maturities should be assigned different FTP rates. When interest rates change the allocation of the NIM should not be affected by the FTP rates applied. The multiple pool method eliminates distortion created by single pool and double pool methods that treat products as being homogeneous. Hodnett (2000:38) states the multiple pool method acknowledges the mismatch created as a result of the individual accounts' maturity and repricing characteristics by incorporating a method of deriving pools of transfer rates, based on the instruments' maturity and repricing attributes.

  Weiner (1999:50) explains that under the multiple pool method the term structure of market-based interest rates are separated into logical segments to create various term pools. At a minimum it is required that short-term, intermediate and long-term pools of rates are derived. The term structure of the balance sheet is also separated into logical segments. A pool of balances is created for each one of these segments from the various assets and liabilities in that segment. By assigning a representative market-based rate for each term, the transfer rate for each pool is derived. A different transfer rate is therefore assigned to accounts with similar maturity and repricing terms as the associated pool rates.

  In addition, Uyemura and Van Deventer (1993:32) also states that each asset and liability is classified to one of several pools of funds which represents the maturity or repricing

term of the product. The transfer rate is therefore the products' pool rate of similar maturity range.

Payant (1994:2) states that the multiple pool method acknowledges that assets and liabilities have different maturing and repricing characteristics. This is achieved by establishing multiple pools of funds of differing maturity time frames. Each pool has a pool transfer rate based on the current market yield curve representing the value of funds of similar maturity. The multiple pools are then used to assign rates to value all funds based on their repricing characteristics.

According to Proquest (2001:2) the multiple pool method includes the attributes such as maturity or repricing term of the funds when assigning a transfer rate or a contribution value to funds. Numerous pools are created over the entire maturity spectrum of funds on the balance sheet. Each pools transfer rate is also representative of the representative market rates for its term. The balance sheets funds are then matched to the pool representing the term of the funds in assigning the transfer rate.

According to Uyemura and Van Deventer (1993:323) fairly acceptable results can be achieved from applying the multiple pool FTP method to allocate the NIM to business units. Weiner (1999:50) also states that the multiple pool method can go far towards improving the measurement of the NIM, depending on how many segments are created, the accuracy of the pools and how the transfer rate for these pools is derived. The same balance sheet, yields and resultant income statement results are applied as per the single pool method explanation presented in table 6.3. The result of using the multiple pool FTP method is illustrated in table 6.5 indicating the CFU is allocated with the IRR originated NIM contribution. The NIM contribution of Unit 1 is 3.52% given that the weighted-average transfer rate assigned to its R 1 million assets is 6.48%. Unit 2 has a NIM contribution of 0.83% based on the value of its deposits credited with a weighted-average transfer rate of 6.83%. The CFU effect is R- 3563.00.

According to Payant (1994:2) the pool rates for multiple repricing/maturity terms can be derived from the current market rates of similar maturity. According to Weiner (1999:51) the simplest way of deriving the various pool rates is to use the current month's treasury or other logically derived yield curve. The FTP rates for each pool are

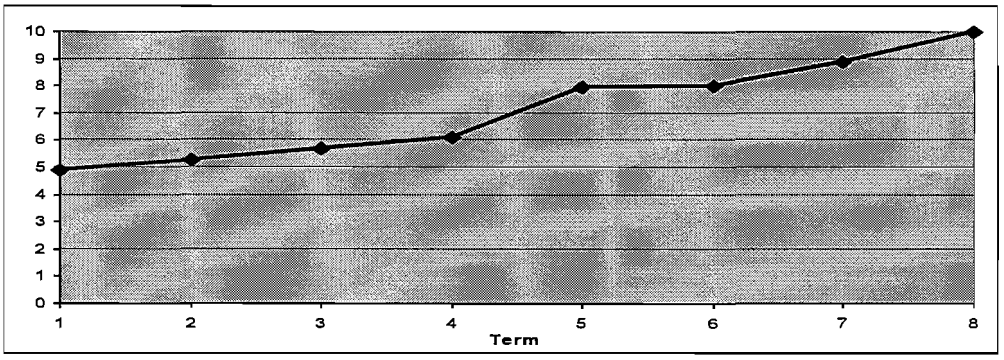
then simply derived from the various rates in the yield curve, based on their term representation. Figure 6.4 illustrates the yield curve and term segments used to derive the pool rates. Using this approach still creates a situation where changes in the yield curve affect the NIM measurement calculation. Setting the transfer rate in this manner is also known as using the current-month marginal rate. Unfortunately this approach in deriving the pool rates leaves most of the IRR with longer-term instruments and may therefore reduce the overall credibility of the FTP process.

Table 6.5 Multiple Pool Method

	Unit 1		Unit 2		Total Bank	
Balance Sheet	**Amount**	**Rate**	**Amount**	**Rate**	**Amount**	**Rate**
Loan						
Consumer installment	350,000	11.77%			350,000	11.77%
Mortgage	400,000	9.70%			400,000	9.70%
Commercial	250,000	8.00%			250,000	8.00%
Total Loans	1,000,000	10.00%			1,000,000	10.00%
Deposit						
Now accounts			200,000	3.50%	200,000	3.50%
Savings accounts			275,000	4.50%	275,000	4.50%
CDs			525,000	7.74%	525,000	7.74%
Total deposits			1,000,000	6.00%	1,000,000	6.00%
Net Funds Used/Provided	**1,000,000**	**10.00%**	**-1,000,000**	**6.00%**	**0**	**4.00%**
Income Statement	**Interest Income**		**Interest Expense**		**Net Interest Income**	
Unit 1						
Consumer installment	41,200	11.77%	21,875	6.25%	19,325	5.52%
Mortgage	38,800	9.70%	31,000	7.75%	7,800	1.95%
Commercial	20,000	8.00%	11,875	4.75%	8,125	3.25%
Total Loans	100,000	10.00%	64,750	6.48%	35,250	3.52%
Unit 2						
Now accounts	10,500	5.25%	7,000	3.50%	3,500	1.75%
Savings accounts	15,813	5.75%	12,375	4.50%	3,438	1.25%
CDs	42,000	8.00%	40,625	7.74%	1,375	0.26%
Total deposits	68,313	6.83%	60,000	6.00%	8,312	0.83%
Net Interest Income (Expense)	**168,312**	**8.42%**	**124,750**	**6.24%**	**43,562**	
Actual Net Interest Income					40,000	
Central funding unit effect					-3,563	

Source: (Weiner, 1999:50)

Figure 6.4 Multiple Pool Method – marginal rates based on the Treasury Yield Curve



Source: (Weiner, 1999:51)

Proquest (2001: 2) also states that contemporary market rates reflects the current interest rates prevailing in the market to set transfer rates. Funds with corresponding terms are assigned the pool rate derived from a similar term. Payant (1994:2) also state that by using current interest rates the remaining term of the funds are matched to the matching pool transfer rate.

Payant (1994:3) states that the weighted average life, duration or repricing term of a deal can also be applied to determine the pool rate assigned to value the transaction. According to Weiner (1999:51) a less simplistic approach for deriving the transfer rate per pool is to establish a weighted-average cost of funds for each portfolio's associated term. The beginning weighted-average portfolio rate is developed using the same maturity and repricing data used in interest rate risk calculations such as gap, duration and economic value. The portfolio is updated by excluding matured deals at the rates at which they were originally included in the portfolio. New deals are added to the portfolio at rates which are derived from the current month's market-based yield curve. Therefore the various pool rates are updated with an estimate of the weighted-average maturity of the portfolio, and the result from a database of projected monthly interest rates based on the portfolio's average maturities.

Payant (1994:2) states that the historical or original term of funds are incorporated in the transfer rate derived from the pool, reflecting the impact on profitability of deals at their origination. Proquest (2001:2) also states that that a historical pool variation approach captures the value of funds at their origination and is not impacted by pool rates updated with current rates. The transfer rates can be set at origination but this requires a continuous updating of the pools' respective interest rates to reflect both historic rates and current rates. Table 6.6 shows the derivation of the FTP rate for a product using the historical weighted-average approach.

Table 6.6 Multiple Pool Method – historical weighted-average rates

		Interest Income		Interest Income		Margin	
Installment Loans	Amount	Yield	Amount	Rate	Amount	Spread	Amount
Beginning balance	105,000,000	7.94	694,750	5.00	437,500	2.94	257,250
Maturities	-15,000,000	7.10	-88,750	4.75	-59,375	2.35	-29,375
Additions	10,000,000	8.57	71,417	5.50	45,833	3.07	25,583
Ending balance	100,000,000	8.13	677,417	5.09	423,958	3.04	253,458

Source: (Weiner, 1999:52)

Weiner (1999:51) presents the following advantages of the multiple pool method:

- It reflects maturity and repricing rates of funds used or provided, by segregating funds into pools. Payant (1994:3) also state that the repricing and maturity term of funds can be incorporated in setting transfer rates based on the multiple pool approach.

- Funding and lending activities have transfer rates based on the yield curve for each segment. Payant (1994:3) also states that the multiple pools incorporates the term structure of interest rates and provides a better assessment of the maturity-adjusted value of funds.

- It is the first methodology to incorporate the impact of mismatch- or interest rate risk on the NIM in a simplistic manner. According to Hodnett (2000:38) the multiple pool method of FTP start to provide an indication of the levels of IRR assumed by the various areas of a bank. According to Payant (1994:3) mismatches within the balance sheet is better assessed with the multiple pool method and as such provides a segregation of IRR within the NIM of the business units.

Weiner (1999:51) presents the following disadvantages of the multiple pool method:

- Changes to the yield curve affect the measurement results. According to Proquest (2001:2) a shortcoming of multiple pool method is when current rates are applied to derive the pools' rates. This dictates that when rates change the pool rate will change that renders the inability to accurately measure the value of funds and the quality of management decisions when the deal was originated.

  Payant (1994:3) also states that the interest rate conditions that applied when the funds was originated are lost and bears no impact on the value assessment of the funds/NIM going forward. This dictates that subsequent interest rate changes cause variability to the allocation of the NIM. Hodnett (2000:38) also states that the transfer rate may not be fixed from origination up to maturity of the funds which means the business unit may be exposed to IRR.

- Using the current-month marginal rate approach leaves most of the interest rate risk with longer-term instruments, while the historical-weighted average gives better readings but requires monthly adjustments to prevent the rate becoming materially inaccurate. Proquest (2001:2) states that when interest rates are derived from current pool rates the IRR of long term products may be retained in the business unit. Hodnett (2000:38) also explains that under the multiple pool method the assigned transfer rate is not fixed until maturity and therefore the unit will still be exposed to some element of IRR.

In summary, the multiple pool method clearly incorporates, albeit in a simplistic way, the underlying maturity and repricing characteristics of the products and is therefore a more accurate reflection of the mismatch contribution to the NIM. This is a more acceptable method in assigning the responsibility for managing interest rate risk to the CFU.

- Matched Rate Method: According to Payant (1994:3) the matched-funded FTP approach establish the transfer rate of funds at their origination date. The transfer rate remains allocated to the funds until their maturity date. Thus the net interest contributions of the funds are locked in and any subsequent changes to interest rates will not affect the value of the funds.

According to Weiner (1999:51) the matched rate method measures the NIM of each individual account in the balance sheet. The individual cash flow and repricing attributes of all accounts are incorporated when deriving the transfer rate used in analysing the NIM. Each account is transfer priced at a rate derived from the origination date of deal against the selected yield curve on that transaction date. This dictates that each transfer rate is based on each account's own unique repricing and maturity characteristics. This transfer rate is then used for the full life of the deal or until the deal reprice.

Hodnett (2000:38) further explains that the benchmark rate is equivalent to the rate available in the market for loans and deposits of a similar maturity and repricing term. Each asset and liability is matched with a rate based on its individual interest rate characteristics. Thus, the matched rate method is based on the assumption that each asset and liability has a unique effect on a bank's overall profitability.

According to Payant (1994:3) banks that intend to centralise IRR management deploys the matched rate FTP method. This is achieved by setting transfer rates at the origination date of a deal. Bessis (1998:335) also explains that by segregating the NIM between the various margin contributions based on risk and product attribute the IRR can be effectively allocated to the ALM (CFU) function of a bank.

Weiner (1999:54) states that the matched rate method is particularly successful in assigning responsibility to the CFU for IRR management. This method bases the NIM of each account on the specific rate-environment that existed when the account originated or last repriced. Therefore, the NIM calculation is not influenced by changes to the yield curve and effectively quantifies the interest rate risk contribution to the NIM This method also solves the measurement problem with the highest level of accuracy

Table 6.7 presents the basic derivation of the transfer rates and NIM equations under the matched rate method for individual accounts with differing terms. It is important to notice the rates selected from the yield curve must match or consider the account's repricing- and maturity term. Three distinct loan products of varying terms are transfer priced or 'funded' based on the matched-rate FTP method. The income statement effect of the three products present an interest income of R6222 based on a weighted-average yield of 10.28%. The transfer rates are based on the individual product's characteristics and present a weighted-average transfer rate of 7.38%. The net result of the products' yields (10.28%) and transfer rates or funds charge (7.38%) translates into a NIM contribution of 2.90% (Weiner, 1999:53).

Table 6.7 Matched Rate FTP calculations

Origination Date	Loans	Amount	Rate				
6/12/1997	5-year auto loan	25,000	10.75				
3/20/1999	3-year home improve	17,500	9.65				
1/11/1998	4 year auto loan	18,000	10.25				
		60,500	10.28				
		Interest Income		Funds Charge		Total	
		Amount	Rate	Amount	Rate	Amount	Rate
6/12/1997	5-year auto loan	2,688	10.75	1,950	7.80	738	2.95
3/20/1999	3-year home improve	1,689	9.65	1,208	6.90	481	2.75
1/11/1998	4 year auto loan	1,845	10.25	1,305	7.25	540	3.00
	Total	6,222	10.28	4,463	7.38	1,759	2.90

Source: (Weiner, 1999:53)

Hodnett (2000:39) explains that the matched rate method is very data intensive and also requires serious consideration towards IT-related issues such as processing power, storage and warehousing capabilities. The derivation of the methodologies applied in setting transfer rates also requires considerations that may become very complex and difficult to get well-accepted within the bank. Weiner (1999:54) agrees and states in addition, that although a simplistic measurement process may be established initially by using this method, it can inevitably become more complex given the required considerations required with regards to the economic characteristics of the balance sheet's assets and liabilities.

Stott (1992:47) also states that matched rate FTP bets captures the IRR impact of all assets and liabilities but requires considerations regarding methodology and implementation. Given this FTP method being the best suitable towards identifying, measuring and allocating the NIM's risk contribution to the CFU and other responsible entities, it deserves further explanation on the detailed aspects towards its functioning.

6.3 FUNDS TRANSFER PRICING – THE MATCHED-TERM APPROACH

The matched approach to FTP goes under various descriptions. Weiner (1994**a**:8) refers to Matched Maturity FTP and also Matched Rate FTP (Weiner, 1999:51). Hodnett (2000:38) also use the term of Matched Funds Transfer Pricing in reference to the Matched Maturity FTP. Payant (1998:1) also makes reference to the Matched Maturity FTP method as Match-Funded Transfer Pricing (Payant, 1994:3). All these terms are synonymous with the Matched Term FTP method. For the purpose of further discussion in this dissertation the term Matched-Term FTP will be used as synonymous to the Matched-Rate FTP, Matched Maturity FTP and Matched Funds FTP approaches.

IPS-Sendero (2006**c**:27) states that Matched-Term FTP (MTFTP) represents the process of assigning a transfer rate i.e. cost for funds used or credit for funds provided, to an account based on the assumption the accounts were fully funded or invested at inception. The inherent factor amongst all these terms refers to the single common objective of setting transfer rates based on a market-based matched repricing term for each balance sheet transaction at the origination date of the transactions repricing term.

According to Proquest (2001:2) MTFTP all assets and liabilities are matched according to the cash flow and repricing characteristics to the market-based yield curve in deriving the transfer rate to value the funds. Marrison (2002:215) explains that the MTFTP concept derive transfer rates for all assets and liabilities based on the interest-rate characteristics of the transaction. This devise that the funds' transfer rate and the interest rates to the clients are mirrored. These transfer rates are set at origination for the life of the deals.

According to the OCC (1998:69) the MTFTP assigns a transfer rate to assets and liabilities based on their respective maturity and repricing characteristics. Ford (1999**b**:179) also states that MTFTP match the repricing and cash flow attributes of funds in setting the transfer rates. The transfer rates are also derived from the market rates comparative of the alternative investment/borrowing opportunities to the bank. Stott (1992:52) states that the transfer rate is derived from the cash flow and repricing maturities of the asset or liability. The repricing attribute is driving the sensitivity to interest rate changes and is therefore applied in the MTFTP process.

According to Payant (1998:1) the FTP rates will vary in accordance to the repricing term and other attributes of the deposits and loans and should reflect the alternative opportunity rate of return for the bank's sources and uses of funds. In other words, the value added from intermediation activities is measured against alternative market opportunities that would not include the selling and acceptance of financial intermediation contracts.

According to Uyemura and Van Deventer (1993:323) the MTFTP transfer rates assigned to the asset or liability should mirror the cash flow pattern of the transactions. However, Payant (1998:1) forewarns that the matched FTP concept should not be mistaken as process by which the transactions are actually match funded or pared off against each other in order to derive the transfer rates.

According to Marrison (2002:214) the MTFTP approach only makes notional or fictitious internal purchases and sales of funds and does not physically match funds as if real transactions were made to the external markets. Only the net surplus or deficit position of the bank overall will be settled to the external market by the CFU. Payant (1998:1) also states that most banks do not have the capability or desire to eliminate all mismatches and in most cases most banks' boards will encourage mismatches in order to encourage potential profitability improvements.

According to Payant (1994:3) under the matched FTP approach a transfer-rate curve is published everyday to the business units. The FTP-rate curve, often referred to as the alternative pricing curve, is set according to the term structure of interest rates. It should reflect the alternative wholesale prices for sources and uses of funds. According to Ford (1999**b**:181) the optimal transfer rates is derived by the opportunity cost of the transaction which is the value foregone by not using the funds in its next best alternative use i.e. by a low-risk bond or raising wholesale funds. This opportunity cost is usually derived as the marginal costs or market prices.

Uyemura and Van Deventer (1993:323) also states that the yield curve should represent the marginal cost of funds for the bank, thus depicting the alternative investment or borrowing opportunities in the wholesale markets. According to Proquest (2001:3) the transfer rates are representative of the market-based alternative. As such the FTP yield curve from which like-term transfer rates are derived is based on treasury yield curves, interbank lending curves, interest rate swaps curves, government bond curves or by various combinations. According to Payant (1994:3) the FTP-rate curve may be derived internally or from external market rates. Using external market rates provides more integrity to the FTP system. The transfer curve is the basis for the valuation of the value added by transactions based on their underlying repricing maturity.

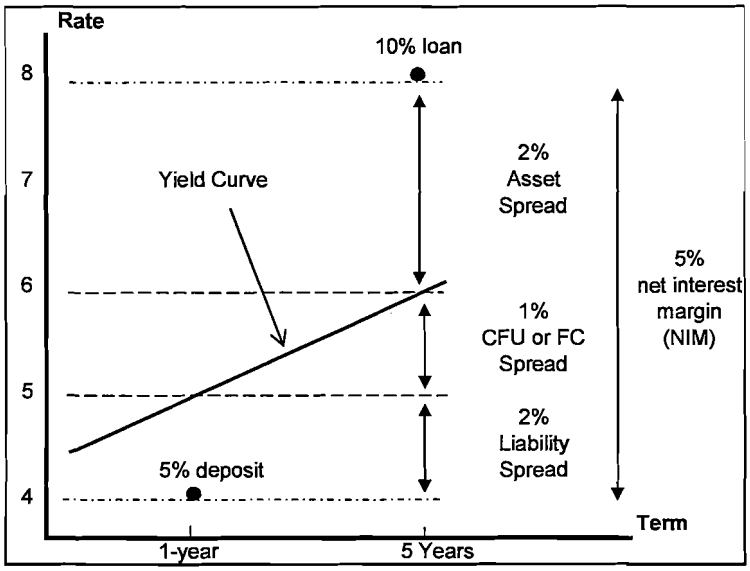
IPS-Sendero (2006**c**:25) explains the basic concept behind Matched-Term FTP by means of a simplistic example. The subtle nuances which ultimately may create complexities associated to the matched-term concept can be better explained once a basic conceptual foundation to this FTP method is established. Figure 6.5 presents the matched-term FTP results for a balance sheet consisting of:

- A 3-year amortising loan that is generated by the fund user, earning 10% interest.
- A 1-year certificate of deposit generated by the fund providers of the balance sheet, paying an interest rate of 5%.

Marrison (2002:213) states that based on the term characteristics of the transactions, transfer rates may be derived at the deals' origination dates from the market-based or internally derived transfer pricing yield curve. The transfer rates represent the alternative transactions created by the CFU in buying the deposit and selling funds to the loan. According to IPS-Sendero (2006**c**:25) the result is that the CFU or funding center will pay 7% for the funds provided by

the 1-year certificate of deposit. The charge by the CFU or funding center to the generator of the 3-year amortising loan for using funds is 8%.

Figure 6.5 Graphical presentation of the Matched-Term FTP Method



Source: (IPS-Sendero, 2006**c**:26)

Koch and MacDonald (2000:180) explain that since the bank is earning a NIM of 5% from its activities, the risk-reward trade-off requires quantification. Therefore the NIM can be segmented into its various components by applying the matched-term FTP methodology. Ford (1999**b**:180) also states that by deploying MTFTP the NIM can be segregated in three independent sources of profit (or loss). According to IPS-Sendero (2006**c**:25) three distinct components of the NIM are segmented by applying MTFTP to the balance sheet example used in figure 6.5. The three components are:

- The funds provider earns a spread of 2% for generating funding for the bank. The funds provider paid 5% to its customer and was credited with 7% for the funds bought from the CFU or funding center. Hodnett (2000:39) states that this spread is known as the Liability Spread, also often referred to as the funding spread. The funding done through the deposit-taking activity has contributed 2% as a liability or funding spread to the NIM. Marrison (2002:213) explains that the bank sourced funding in the form of a 1-year certificate of deposit at an expense for 1-year. This compares favourably to what 1-year funding, with a similar profile, would have cost to acquire in the wholesale market.

However, IPS-Sendero (2006**c**:25) states that the bank elected to source the funds from an individual client, which is priced lower than funds obtained from corporate clients in the wholesale market. Thus, the 2% funding or liability spread is the value contributed to the NIM for sourcing deposits cheaper than the alternative funding opportunities of the bank. Uyemura and Van Deventer (1993:324) notes that the 2% liability spread is not guaranteed beyond the 1-year period as the rate will change after each maturity or rollover (reprice date).

- The fund user is earning 10% from the loan to its customer but is charged 8% by the CFU for making use of the bank's funds. This leaves the fund user also with a spread of 2%. This 2% spread is known as the asset spread or credit/lending spread. According to Ford (1999**b**:180) the investment margin, lending spread or asset spread is calculated as the difference between the interest rate earned on the 3-year instalment loan and the corresponding term interest rate on the market related yield curve. The rationale behind this is that the organisation could have invested the funds at a wholesale rate in the capital market for a corresponding period of time.

  According to Mark (1997:158) the bank/business unit opted to lend the funds through an asset-based transaction to a client at a margin above the comparative wholesale market rates, and be compensated for the credit risk it is exposed to due to the client's credit risk profile. The spread earned as the difference between the rate charged to the loan and the transfer rate is also referred to as the credit spread in reference for the profit derived from credit exposures. Therefore, IPS-Sendero (2006**c**:25) concludes that the bank, through its lending activity and the credit risk involved, has contributed a 2% lending or asset or credit spread to the NIM. Proquest (2001:3) also states that the business units can measure the profit contribution of individual customer transactions through their funding spreads and lending spreads.

- According to IPS-Sendero (2006**c**:25) the difference between what the CFU or funding center is paying and charging for funds is a 1% spread. The 1% spread is known as the funding center spread or Mismatch Spread. Law and Reyniers (1988:46) states that difference between the funding and lending spreads are the result of IRR or mismatches within the balance sheet.

> According to Ford (1999**b**:180) the residual 1% is attributable to the mismatch created by the bank's activities. This mismatch spread can also be termed the IRR margin. The interest rate risk embedded in the balance sheet is therefore isolated from the value contributed by its banking activities. According to Uyemura and Van Deventer (1993:324) the mismatch spread represents the NIM contribution due to IRR within the balance sheet. The mismatch spread or IRR margin is transferred to the ALM (CFU) responsible for managing IRR. According to Payant (1994:3) by isolating the mismatch spread from the business units the CFU or ALM becomes the depository of the rewards associated with the management of IRR.

According to IPS-Sendero (2006**c**:27) the derivation of the transfer rate on the matched-term basis requires clarification with regards to as what are the rules in establishing the matched-term. The purpose of transfer pricing each individual loan, deposit, borrowing or investment at the customer level is to solve the measurement problem and to transfer the IRR or mismatch spread to the CFU or funding center. However, both cash flow and maturity and repricing characteristics are important when deriving the transfer rate of an account. According to Marrison (2002:212) the MTFTP approach effectively captures the IRR or mismatch spread within the NIM and isolates IRR from the business units. This is achieved by incorporating the repricing frequency, amortisation of cash flows and time of final re/payment.

Ford (1999**b**:179) also states that in order to centralise the IRR component of the NIM the transfer rates need to match the terms of the transactions to which they are assigned. The requirement is therefore that the differences in transaction date, term, cash flow, and pricing characteristics need to be incorporated in the transfer rate derivation. According to Proquest (2001:3) the account term must be established from its amortisation schedule and rate reset information. These account attributes need to be included in the matched-term concept for FTP.

According to IPS-Sendero (2006**c**:31) the term can be incorporated in the transfer rate calculation of an account by assigning a rate from the transfer pricing yield curve for a term corresponding to the term to maturity of the account. Single cash flow or bullet maturity accounts with a fixed rate typically use a term to maturity approach to derive the transfer rate. Single cash flow instruments i.e., bullet maturity accounts, has a single scheduled cash flow at a specific future maturity date which makes assigning the matched-term transfer rate at the origination date very easy.

Uyemura and Van Deventer (1993:323) also state that the transfer rate derivation must mirror the cash flows of an account i.e. the amortisation profile of principal repayments. In order to incorporate the repricing and cash flow attributes of an account IPS-Sendero (2006**c**:430) states that each principal cash flow of an account is weighted against a corresponding term rate from the transfer pricing curve. A time-and-principal weighted-average rate is calculated from the yield curve which represents the transfer rate of the loan or deposit.

Stott (1992:52) reported that repricing attributes are important when deriving the transfer rates for transaction. The considerations towards repricing characteristics are based on the accounts rate change attribute i.e. floating, fixed or adjustable in nature. Typically adjustable and fixed rate products are similar in that the rate effectively remains unchanged for a stated period of time. According to Crandon and McCarthy (1991:10) the repricing term effectively dictates the term characteristic of the funds in derivation of the corresponding term rate from the transfer pricing yield curve. Uyemura and Van Deventer (1993:337) also states that for MTFTP to work effectively in transferring IRR from business units to the ALM area, the repricing nature of funds must be incorporated in deriving transfer rates.

IPS-Sendero (2006**c**:31) states that the repricing term and cash flow maturities are different for example in adjustable rate instruments variable rate amortising products. The transfer rate is derived as a rate from the yield curve as at the date of the last repricing corresponding to the repricing term of the account. The repricing term driven approach to derive the transfer rate implies that the funds used or provided are matched based on the pricing term of the instrument. With the next scheduled repricing, the curve applied to the transfer rate derivation will change to the current date of repricing.

Ford (1999**b**:180) also states that the repricing term attribute of the funds should be applied in setting the transfer rate to ensure that the transfer rate will reset when the funds rate to the customer resets. This ensures that IRR is effectively removed from the business unit and transferred to the ALM function o CFU.

In deriving the term of a loan to determine the transfer rate, Uyemura and Van Deventer (1993:336) explains that the effects of prepayments should be considered. Mortgage loans and instalment loans have the embedded customer option to settle the outstanding balances prior to

the maturity date. This will create a misstated MTFTP transfer rate as the contractual cash flows were altered by the prepayment/s and thus the transfer rate incorrectly assigned to the deal. According to Weiner (1999:52) this method involves maturity definition issues. For example it is illogic to assign a 25-year home loan a 25-year rate if the mortgage generally matures within 12-years. Weiner (1999:52) also states that embedded customer options also pose problematic for the FTP process as it does for the ALM simulation modelling process. The risk of prepayment simplistically means that future anticipated cash flows will change. Therefore the derivation of the transfer rate has to incorporate anticipated cash flow changes resulting from prepayments.

Marrison (2002:217) also states that the transfer rates are based on original fund values and subsequent cash flows. The value of the funds may change however due to prepayments in that cash flows may increase which renders the term of the outstanding funds to shorten. This impacts the effective transfer rate of the funds.

IPS-Sendero (2004:16) explains that in the realm of FTP the occurrence of any form of prepayment, early settlement or withdrawal will result in a cost or benefit to the CFU. This results from the fact that the CFU had provided a notional or theoretical matched-term transfer price for all accounts at origination date. Prepayments will create the situation that the CFU have over funded (over bought or sold) the account. The CFU therefore essentially have to break the funding and may result in a loss or gain to the CFU.

According to Uyemura and Van Deventer (1993:325-326) the bank can either charge a spread to the transfer rate or retrospectively recoup a prepayment penalty from the business unit in the form of a break-cost. The break-cost is based on either the contractually agreed customer penalty or as the mark-to-market gain/loss between the original and final transfer rates (based on original amortisation cash flows compared against prepayment adjusted cash flows).

The Kamakura Corporation (2008) also explains that break charges or transfer rate adjustments can be applied to incorporate the effects of prepayments on the setting of transfer rates. This dictates that the organisation need to incorporate the impact of embedded options in the management of IRR.

According to IPS-Sendero (2004:16) the bank can apply a break-charge to the transfer rate equal to the mark-to-market value of the difference between the derived transfer rates before and after the prepayment effects. Alternatively, an option cost can be added or subtracted as an adjustment to the transfer rate, based on the option value derived from the anticipated early prepayment or withdrawal. This enables the bank to promote proper pricing by considering prepayment options when setting customer rates on accounts that do not have explicit prepayment penalties as part of the contract.

Weiner (1999:55) further explains that other adjustments to the market-based transfer rates may also be made to create the correct behaviour, both pricing and activity based, by fund users and providers. For example, if the ALM strategy is to increase core deposit funding it may adjust the transfer pricing mechanism to increase the credit for these funds provided. Alternatively to reduce certain lending activities the charge for funds provided may be increased.

Ford (1999**b**:185) states that the transfer rate is often difficult to derive for terms in which the bank don't actively participate, issue debt frequently or restrict the issuance altogether. Thus, a liquidity premium may be raised to negate the transfer rate being set in an artificial manner which ultimately does not reflect the bank's marginal cost/worth of funds.

According to IPS-Sendero (2004:14) liquidity premiums or adjustments may also be made to the transfer rates through adjustments to the yield curve. Liquidity premiums are specifically considered for ambiguous maturity deposits or accounts without any stated maturity, which generally speaking portray longer-term cash flow and repricing characteristics than is inferred by the demand nature of the product. The reduced risk associated with such accounts could be recognised through a liquidity adjustment to the FTP transfer rates.

Weiner (1999:54) explains that the objective is to classify account balances in its stable and volatile components often referred to as the core- and non-core deposit level. The core-deposit level refers to the component of funds expected to remain with the bank for longer-term and is therefore deemed to be a stable source of funding. The volatile component or non-core deposit level refers to the transactional nature of the account which reflects the demand nature of the product. It is likely that this portion of the account's balance may be withdrawn immediately.

According to IPS-Sendero (2004:14) various derivation methods of the liquidity premium exist. Methods relating to observing the spread between various yield curves are beset with error. For example, comparing the AAA-rated corporate debt yield curve against the interest rate swap curve is flawed as the spread is driven by credit risk. Ford (1999**b**:185) also state that the debt-rating of a yield curve should be considered when setting the market-based yield curve for FTP. The use of an AAA-rated yield curve may encourage business units to make profitable loans to high quality customers which may be passed on when applying a BBB-rated yield curve. The impact on deposit gatherers should also be considered.

According to IPS-Sendero (2004:14) some other approaches to setting transfer pricing curves refer to swap spreads as an indicator of liquidity. The swap spreads however is for example a measure of the perceived credit risk between typical LIBOR bank rates and the relative risk free Treasury securities market. Ford (1999**b**:185) agrees stating that by using the interest rate swap curve to determine the marginal cost of funds may be considered but imposes a disparate measurement due to the impending credit risk between the swap curve and the wholesale debt markets. It may be futile trying to quantify the swap spread components. Furthermore, the benchmark may be incorrect altogether given that it gauges market liquidity and not funding liquidity. Given the complexities associated with the quantification and introduction of liquidity premium adjustments in the FTP process care should be taken by institutions (IPS-Sendero, 2004:14).

According to Marrison (2002:217) Prime-linked accounts and accounts without contractual maturities, for example Prime-linked loans and NMD-accounts, are difficult to transfer price as they do not have a reprice term or a term to maturity. Such products lack information about the expected cash flows or principal maturity. Also, the repricing behaviour of the account dictates that its interest rate changes infrequently. Although an amortising loan may have an expected cash flow profile the interest rate resets may be unknown.

According to IPS-Sendero (2004:11) the interest rate of a variable rate asset or liability will only change or reprice whenever the rate index to which the instrument's pricing is linked changes, such as the Prime rate. On the other hand, some accounts i.e. non-maturity deposit accounts with administered rates may further display delayed pricing responsiveness versus market rates. There may also be a lag in the timing and quantum of the pricing adjustment. Statistical

regression analysis may be applied to determine the index rate or combination of term rates that best represents the variable rate accounts repricing behaviour.

Marrison (2002:218) explains that the variable rate product's transfer rate should reflect the combination of term rates that best reflects its interest rate in such a manner that causes the minimal variation in value. Uyemura and Van Deventer (1993:337) state that Prime-linked loans or variable rate deposits have to be assigned a transfer rate representing the expected repricing profile of the product. As such various terms of interest rates are combined to most effectively reflect the interest rate of the product.

IPS-Sendero (2006**c**:32) explains that the lack of maturity and repricing terms poses possibly the biggest challenge to both the FTP and ALM simulation modelling processes. The reason for this is that ambiguous maturity and variable rate accounts need to be allocated a transfer rate based on its economic characteristics. This requires the institution to develop a mechanical representation of the account's interest rate sensitivity and liquidity attributes.

Uyemura and Van Deventer (1993:342) also explain that NMD-accounts need to be allocated a term to derive transfer rates. Prime indexed products are mostly variable rate products and does not have a contractual repricing term. Thus, instruments without contractual maturities and variable rate instruments require consideration in the matched-term concept. According to IPS-Sendero (2004:15) instruments without contractual maturities refer to products such as non-maturity deposit accounts like current- and savings accounts, working capital lines of credit, credit cards, overdrafts etc.

Ford (1999**b**:189) states that balance can be separated based on their stable (core) and volatile (non-core) components. The core balances are deemed to have a longer term profile and the volatile components are deemed short-term in nature. Marrison (2002:217) states that the stable (core) component of NMD-accounts may be invested for a longer term and therefore should attract a transfer rate based on the comparative term. According to IPS-Sendero (2004:15) the core-deposit level may be assigned a short term rate considering the balance to be of transactional nature and therefore volatile. A long term rate is assigned to the core-deposit portion of the account considered to be of investment nature and most stable of all. Therefore, the core-deposits may attract 70% of a 3-year tenor rate and the non-core deposits a 30% of the overnight funds rate.

According to IPS-Sendero (2004:15) option-adjusted spread (OAS) and econometric techniques are complex approaches to transfer pricing core and volatile balance components of accounts. The grouping of historical account data into sub-portfolios based on age or geography may be used to isolate typical accounts with similar characteristics. The sub-portfolios' historical rate sensitivity behaviour may be used in a multi-path interest rate simulation model to determine the value of the customers option to withdraw deposit funds. This option cost may be used as an adjustment to the transfer rate over the projected life of the deposit category.

Ford (1999**b**:90) states that the OAS reflects the liquidity and IRR associated with deposit balances being withdrawn and as such being repriced. Uyemura and Van Deventer (1993:341) states that the impact of NMD accounts and prepayment options can be quantified through OAS-analyses. Multiple interest rate scenarios' impact is assessed on the propensity of the individual products to reprice or withdraw which will facilitate an exposure to interest rate changes or a change in setting a price on the value of the funds.

In the preceding sections it was discussed that the MTFTP method is the most accurate in setting transfer rates that are indicative of the economic characteristics of a balance sheet asset or liability. The ability to isolate and allocate the NIM based on risk contribution to responsible parties makes this method superior to other FTP methods. According to IPS-Sendero (2006**c**:28) the implementation of Matched-Term FTP may provide the following advantages to the bank:

- Accountability is established for managing the NIM. Transfer rates are used to isolate the components of the margin attributable to liability spread, asset spread and funding center spread. Fund providers are responsible for the liability spread. Fund users are responsible for the asset spread. The CFU, funding center, ALM or ALCO is responsible for the IRR or mismatch spread. Hodnett (2000:38) also states that MTFTP captures the effects of IRR on the NIM and transfer such IRR to the ALM. Marrison (2002:215) also states that MTFTP transfer all mismatch or IRR to the ALM area which decides how to manage the position i.e. to hedge the IRR or to run a mismatch position. Koch and MacDonald (2000:180) state that MTFTP transfer IRR to the ALM which are responsible for managing the IRR position of the bank.

- Freed of uncontrollable IRR the line managers can focus on controllable and manageable tasks. Fund providers may focus on sourcing adequate amounts of funds and lowering

possible finding interest rates. Fund users can focus on making quality asset underwriting decisions at the best possible yield reflective of the credit risk endeavoured. ALM/ALCO or the CFU may focus on managing the IRR exposure and ensuring optimal and adequate liquidity.

In addition, Koch and MacDonald (2000:180) state that business units are immunised from IRR in that their allocated NIM are relatively free of variances induced by changes to interest rates. Thus business units are not impacted by IRR and thus do not need to make decisions about the effects of mismatch and how it should be managed. Mark (1997:158) also states that business units should not be concerned about managing IRR as it has no impact on their risk-adjusted profitability under a MTFTP approach. Business units can focus on managing the controllable elements and risks within their business.

- Rational pricing decisions can be performed by knowing the internal value of funds by term and product characteristic. Pricing decisions can be decentralised in a coherent fashion throughout the organisation. According to Payant (1994:4) the MTFTP system directly assist with better pricing decisions in that the transfer rates are known in advance. This assists business units to make informed decisions on the derivation of customer rates in order to meet profitability objectives.

  Hodnett (2000:38) also states the MTFTP process is a progressive approach that enables management to determine the prospective profitability of a deal in advance by identifying the matched transfer rate. This allows management to identify the profitability contribution from a risk-adjusted basis for each account at the unit, product and customer level. Uyemura and Van Deventer (1993:321) also states that MTFTP effectively capture the risk-adjusted spreads of business units which removes IRR induced volatility from their NIM.

- Senior management may allocate scarce resources to the most profitable activities, products, units and customers (IPS-Sendero, 2006**c**:28).

- According to Hodnett (2000:38) the value added by each account's NIM is effectively isolated. This means that the performance of an area is not influenced by the behaviour

of other areas and effectively eliminates any cross-subsidisations between units, products and customers. Uyemura and Van Deventer (1993:325) also states that each individual product's spread or profitability is independent from other products' profits or losses which means that on transaction does not subsidises another in order to appear more profitable.

According to Uyemura and Van Deventer (1993:321) the centralisation of the mismatch to the ALM area is a primary objective of MTFTP. The OCC (1998:69) also states that the MTFTP system centralise the management of IRR. The net result of funds bought and sold by the FC therefore need to isolated and managed. The ALM therefore has the option to assume the mismatch or hedge it into the market.

According to Chittenden (2000:1) the costs and credits for funds are posted to the mismatch unit which is typically within the ALM or treasury ambit of the bank. The mismatch unit or typically referred to as the CFU or FC holds the result of the FTP mechanism pulling all IRR from business units, making the mismatch unit the true holder of the IRR position. The mismatch unit's profit and loss is therefore solely based on market rates absent of credit risk and funding spreads from external customers.

According to Chittenden (2000:2) the mismatch unit's main objectives and functions are:

- Management of the mismatch unit or CFU/FC
  - Keep the bank and the mismatch unit's margin within the ALCO policy limits.
  - Keep the mismatch unit or CFU/FC earnings at an acceptable level.
- Conduct margin analysis on the consolidated bank NIM
  - Explain the bank's NIM dynamics through the analysis of the mismatch unit's performance.
  - Monitor and analyse the bank's NIM (Chittenden, 2000:2).

According to Ford (1999**b**:180) MTFTP provides a thorough understanding of the components of the NIM that drive changes in the bank's margin. According to Young (2000:1) various financial risks originates from providing products and services to customers. These risks can not be avoided and a bank must therefore have a strategy for profitable risk taking, to price risks appropriately and monitor, manage and report on these risks to shareholders. Matched-Term

FTP assigns the costs and credits associated with these risks while simultaneously isolating and assigning the responsibility for managing these risks at the enterprise level.

According to Kawano (2000:1) a FTP system is a major tool available to banks to enhance profits. Profitability rather than growth is a focal point and the key to success and survival of a financial institution. The application of FTP is primary to the ability to perform profitability analysis and performance measurement. The FTP system directly facilitates the performance measurement process from a risk-adjusted NIM perspective. A properly utilised FTP system promotes profitable pricing decisions, facilitates a comparable performance measurement of funds users and providers and supports the ALM strategies and objectives.

According to Ong (1998:14) the FTP system assist with the establishment of risk-comparable profitability information. Such information is necessary to make informed decisions on the performance of business units and products which directly influence the strategic objectives defined by the bank.

Koch and MacDonald (2000:178) state that the MTFTP process gives the ALM of the bank the ability to remove IRR from business units. The ALM strategies are formulated to mitigate the IRR exposures of the bank and as such the business units are not being impacted in their profitability assessment. The business units may however be directed by the FTP process in their pricing and funds sourcing/using activities towards the objectives of the ALCO/ALM.

According to Chittenden (2000:2) the ALM function or process of a bank is charged with the responsibility of managing the IRR of the bank. In the ALM process of managing the IRR the profile of the bank's asset/liability mix or mismatch are altered. The volatility of the margin is changed by ALM strategies and therefore changes to the bank's profitability may be incurred due to the ALM policy and strategies. This will evidently filter into the CFU or FC results as quantified by the Matched-Term FTP process. It is therefore important that the ALM function be coherent and integrated with the FTP system to ensure an integrated, precise and goal-orientated focus towards the performance measurement process.

According to Weiner (1999:56) the integration of ALM IRR management is an integral part and focus of a successful FTP system. FTP provides the linkage between the profitability measurement of units, products and customers and the overall ALM policy of the bank. The

CFU or FC buys and sells all funds within the institution creating a risk-adjusted allocation of the NIM in the process. The CFU is the vehicle for the ALM process or ALCO to sensitise the institution to its IRR management policy and strategic balance sheet and NIM objectives. FTP through the CFU or FC also provides a communication medium to the institution in presenting its ALM priorities to line managers dealing with customers on a daily basis.

Bessis (1998:334) also argues that the FTP process is a key tool for the ALM of the bank to communicate it IRR management strategies. The ALM and FTP mechanisms have powerful leverage capabilities on the business and commercial strategies of the bank and how it is executed by business units.

Payant (1994:4) also states that the FTP process and ALM IRR management objectives can provide information on the highest risk-adjusted profitability products. Such information is valuable in directing where the bank should invest its resources and how to leverage its franchise value. The FTP and RAPM process also provides the ALCO with the necessary feedback on the results of specific ALM-pricing decisions or strategies relating to structural balance sheet changes. The linkage between profitability measurement and ALM IRR management is established through the implementation of an effective FTP system.

6.4 SUMMARY

Measuring the profitability of customers, products or business units requires the solving of the measurement problem. The measurement problem originates from the unbalanced balance sheets of measured entities which translate in an incomplete NIM calculation for profitability measurement purposes. The CFU or FC which is typically associated with the ALM or treasury functions buys all funds from fund providers and sell funding to all fund users. In this process all measured unit's balance sheets are fully funded. The costs associated to the buying and selling of funds by the CFU or FC is set by the FTP methodology it applies. Various FTP methodologies exist and are differentiated based on each method's ability to isolate the various risk components' contribution to the NIM. The Matched-Term FTP most accurately assigns transfer rates derived from a market based yield curve and in the process best quantifies the resultant mismatch or FC spread representing the IRR contribution to the NIM. The Lending Spread (credit risk) and Funding Spread (funding/liquidity) are quantified and assigned to the appropriate management responsible for managing the associated risks.

The MTFTP method considers the transfer rate from both a maturity and repricing term perspective in order to establish economic transfer prices. The effects of prepayments can be incorporated in the derivation of transfer rates as well as adjustments based on credit quality, assumed liquidity enhancing initiatives and variable rate accounts with no stated maturity date or repricing term. In relation to the adjustments made on transfer prices and the overall effectiveness of deriving transfer rates from a market-based yield curve, the MTFTP method can be applied to drive organisational behaviour and pricing focused on achieving ALM and profitability strategies. Therefore, the MTFTP method exudes the ability to calculate transfer prices on all assets and liabilities based on the economic characteristic of the products. The risk/reward trade-off for the NIM is therefore calculated in the most efficient manner of all the FTP methods and is therefore an integral part of the RAPM process. Managing IRR is a primary focus of ALM and through the MTFTP process the linkage between ALM IRR management/policy and the broader RAPM objectives is established. The RAPM information is also used by business units in order to formulate business strategies. These plans are filtered into the ALM simulation models by means of the forecast variables in order to assess the consequential IRR exposures based on balance sheet and pricing forecasts driven by the RAPM results. The resultant measurement of IRR by ALM and the management of the mismatch spread by the CFU (ALM) are therefore intertwined with the RAPM process through the FTP mechanism.

CHAPTER 7

THE APPLICATION OF ASSET AND LIABILITY MANAGEMENT, FUNDS TRANSFER PRICING AND BANK PERFORMANCE

7.1 INTRODUCTION

According to Bessis (1998:32-33) a bank needs organisational devices in order to facilitate the information flow between the strategic objectives and its operational conduct. This is to ensure that the objective of risk management to optimise the risk-reward trade-off for the bank is facilitated. The funds transfer pricing (FTP) system is one of these devices. Weiner (1999:56) explained that the FTP system's success is linked to its effective integration with interest rate risk (IRR) management. The BCBS (2004:3) states that it is critical for a bank to manage its IRR exposures. A bank's risk measurement systems must adequately assess the impact of IRR on both its earnings and economic value. The OCC (1998:10) also states that a bank must ensure it IRR management systems is adequate to effectively capture the effects of IRR.

The OCC (1998:69) further states that a bank can centralise the mismatch exposure of its NIM which originates from IRR through the application of a FTP system. All IRR are centralised to the ALM area of the bank which effectively isolates business units from the effects of IRR. Weiner (1999:56) states that the link between profitability measurement and the ALM function relating to IRR management is facilitated through the FTP system. The central funding unit (CFU) is the vehicle to sensitise the various units and products of the bank to the goals and objectives of the ALM (ALCO) IRR management policy, strategic balance sheet and net interest income (NII) objectives.

Chittenden (2000:2) also states that through the transfer of IRR component of the NIM to the ALM of a bank the overall objectives regarding risk and profitability can be directed by the ALM process. This is achieved through the setting of the transfer rates to measure the risk-adjusted profitability of the business units and products. In addition, Kawano (2000:1) states that the FTP system facilitates the performance (profitability) measurement process from a risk-adjusted NII perspective, through which it supports pricing decisions, provide comparable information of profitability of measured units and products and support the ALM strategies and objectives. Haubenstock and Aggarwal (1997:175) explain that in order to move from conventional risk measurement and control processes, which do not incorporate performance

measurement information, the bank must measure its risks by incorporating risk-adjusted analysis.

Chapter 7 presents the results of an empirical study relating to the IRR measures discussed in chapter 5 and the matched-term FTP (MTFTP) as discussed in chapter 6. The empirical study applied a practical simulation model pertaining to a sample balance sheet from which the IRR measures and MTFTP results were calculated. The results are presented in this chapter.

The objectives of chapter 7 are:

- To present a practical simulation model in order to provide insight into the application of an ALM simulation model in quantifying IRR.
- To provide a practical sample balance sheet's IRR measurement results in the form of gap analysis, duration analysis, earning-at-risk (EAR) analysis and economic value of equity (EVE) analysis.
- To present the MTFTP results of the balance sheet which facilitates the risk-adjusted information applied in the risk-adjusted performance measurement (RAPM) process. The mismatch/IRR component of the NII as centralised in the CFU is also presented to illustrate the role of FTP in IRR management.
- To highlight the ability of applying FTP results in formulating input assumptions for the ALM simulation model from which IRR management strategies are developed.

Section 7.2 will briefly discuss the ALM simulation model as it is applied in the formulation of the empirical study's results. The various configuration components that facilitate the input assumptions are presented. The balance sheet of Typical Bank is also presented on which the empirical study's results are based. The purpose of the simulation model/software applied in the empirical study is to highlight the ability of the ALM simulation model to integrate the analyses produced by the FTP process in the IRR measurement process in ALM. The specific model input components pertaining to pricing, new business volumes and the terms of such new business can be derived through balance sheet and pricing strategy formulation based on the FTP analyses. The dynamic data (new business) inputs for the simulation model is assumed to be based on and derived by using the FTP results to develop strategies that will optimise the profitability of the bank with consideration for the risks involved.

The results of the IRR measurement techniques (as discussed in chapter 5, sections 5.3 – 5.5) of Typical Bank's balance sheet are presented in section 7.3. Section 7.4 presents Typical Bank's MTFTP results which are incorporated in a RAPM process. MTFTP as part of a RAPM process was discussed in chapter 6 (section 6.3, p219) and chapter 3 (section 3.3, p67) respectively.

7.2 THE ALM SIMULATION MODEL

The foundation of ALM is in the management of interest rate risk (IRR) and liquidity risk. This was also reported by Mark (chapter 4, section 4.2.1, p82), Kelly (chapter 4, section 4.2.1, p89), Bessis (chapter 4, section 4.2.1, p89), (chapter 4, section 4.2.1, p88), and the CEBS (chapter 4, section 4.2.1, p84). It was discussed in chapter 4, section 4.2.2 (p91) and chapter 5, section 5.5 (p154) that simulation models are required for quantifying, monitoring and managing ALM risks due to the complexities experienced in anticipating the uncertainty surrounding future mismatch positions for the bank. It is therefore prudent to discuss a typical ALM simulation model before the risk quantification techniques applied to IRR is presented. This will give a basic understanding of the practical setup and workings of a current industry applied ALM simulation model.

An attempt will be made to present a representative example of a South African bank's balance sheet as the basis for the simulation model which will also be applied to the subsequent IRR analyses. It must be understood that there is in practise a magnitude of additional conventions and technical details underpinning such a simulation model and that it is beyond the scope of this dissertation to cover all of these in detail. Therefore a high level setup of a simulation model will be performed by using the IPS-Sendero (2008) SVAL balance sheet simulation software.

However, in the experience of the author this high level setup is consistent to the setup any bank need to perform to configure its ALM simulation model and therefore represents a practical and working solution banks will typically deploy. The technical details embedded within the simulation software are granted as being of high quality and following best market practise. This is based on experience of the author and according to IPS-Sendero (2008) stating that their products are highly rated worldwide serving more than 3400 organisations in 70 countries across the globe, with the software being used in some form or another in the ALM process by the most highly respected institutions locally and abroad.

Dattatreya (1991:54) explains that an ALM simulation model is conceptually based on three major components namely the Portfolio Manager, the Cash Flow Generator and the Portfolio Analyser. The IPS-Sendero (IPS-Sendero, 2008) software follows in some sense this approach as described by Dattatreya (1991:55). The basic architecture of the software consists of the Data Management System (DMS), the Asset/Liability Management (SVAL) and the Funds Transfer Pricing (FTP) applications.

According to Dattatreya (1991:54) the Portfolio Manager is basically a data program that facilitates the collection and management of customer account data or portfolio data. This program is usually user friendly and includes details of the accounts like amount values and other information of the assets and liabilities held in the portfolio. It is able to produce a number of relevant reports to the portfolio management process. It also produces the information required by the Cash Flow Generator. The Cash Flow Generator obtains information from the Portfolio Manager and generates the cash flows for the assets and liabilities. The cash flow is simply the date and amount of the cash flow and also the nature of the cash i.e. if it is principal or interest.

According to IPS-Sendero (2006**b**:17) the DMS channels data into a central data warehouse. These robust features make it possible to easily examine, catalogue, and manage data at detail customer account and summary portfolio levels. The purpose of the DMS is to provide data from its data warehouse that can be used by the SVAL application. DMS calculates all cash flows and repricing information for individual accounts and then align them according to the groupings associated with the SVAL and FTP applications' analytical levels. DMS therefore facilitates the function of a Portfolio Manager and Cash Flow Generator.

Dattatreya (1991:54) states that the basic customer based calculations are performed within the Cash Flow Generator which is needed in the Portfolio Analyser. The Portfolio Analyser is the main analytical part of ALM system. It produces a number of analytical reports, conducts scenario analysis and recommends the actions to be taken for risk control. It must be noted that the recommendations is only a result of the analyses it facilitates and are by no means automatically produced. It is an essential tool for managing both IRR and liquidity risk (Dattatreya, 1991:55).

According to IPS-Sendero (2006**b**:17) this data can be sliced-and-diced in which ever way is needed for both the SVAL and FTP systems and other third party software or management information systems (MIS). The SVAL and FTP systems perform the primary risk analytics and produce various risk related reports. These reports analyse associated ALM risks and also produce financial analyses on the NIM and the balance sheet. IPS-Sendero (2006**a**:31) states that the SVAL system helps banks to manage their balance sheets to improve and protect performance. The system offers tools for identifying the nature and source of interest rate risk, planning and testing the strategies developed, for performance and risk management and complying with supervisory authorities' regulations.

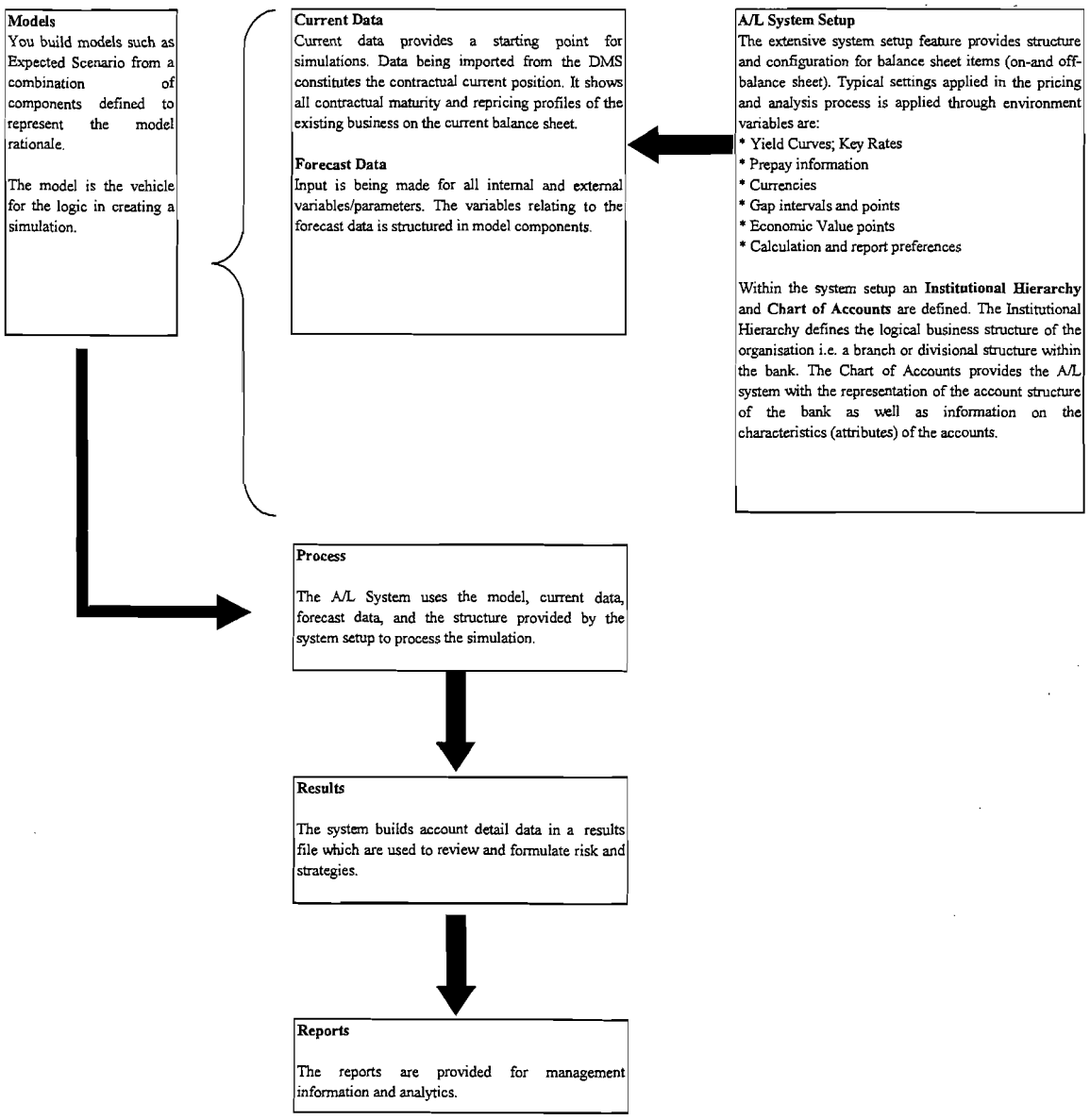
The SVAL application supports the ALM purpose of improving performance and controlling risks to performance, by providing the tools for gap analysis, income simulation, economic value analysis and decision support. Predominantly the same functions of the Portfolio Analyser, as explained by Dattatreya (1991:54) are performed by the SVAL system.

The following section discusses the simulation model applied in the empirical study. The SVAL software used is reviewed briefly to describe its basic functioning and to supply the reader with a reference of how the simulation model incorporates the components required to measure IRR and profitability. It highlights that the inputs required for simulating NII requires inputs that can be derived from RAPM and MTFTP information, in order to formulate strategies consistent for risk and profitability management purposes.

According to IPS-Sendero (2006**a**:35) the SVAL system provides a financial institution with a sophisticated balance sheet management modelling tool. Various financial models can be created which generate simulations from known and forecast balance sheet data. By analysing the impact of various simulated financial conditions, ALM can achieve its objectives of better managing the bank's assets and liabilities and associated levels of risk. The SVAL system's setup is a logical order of inputs and selections given a defined balance sheet modelling framework. The flow of data through the major input structures of the SVAL system is presented in figure 7.1. It explains the basic setup considerations of the system which facilitates the input data and forecast assumptions. This facilitates the data behind the model's scenarios which are processed to produce the various sets of financial and risk analyses results. These results are then reported through a management information system (IPS-Sendero, 2006**a**:35).

According to IPS-Sendero (2006**a**:191) the details of the individual parts of the framework are fairly self explanatory and simply represent all the considerations in the balance sheet modelling process, which are basically internal parameters and exogenous or external influences. Therefore it is important that the pragmatic workings or accounting methodology applied within financial statements are applied in a technically sound manner in the model which means that the reports generated from the calculations performed in the simulation model is replicating actual accounting practices and real-life scenarios. It was reported by the BCBS (chapter 5, section 5.5 p156), Cade (chapter 5, section 5.5, p156) and Van Greuning and Bratanovic (chapter 5, section 5.5, p158) that dynamic simulations models incorporate projections about endogenous and exogenous factors in simulating the future balance sheet and income statement.

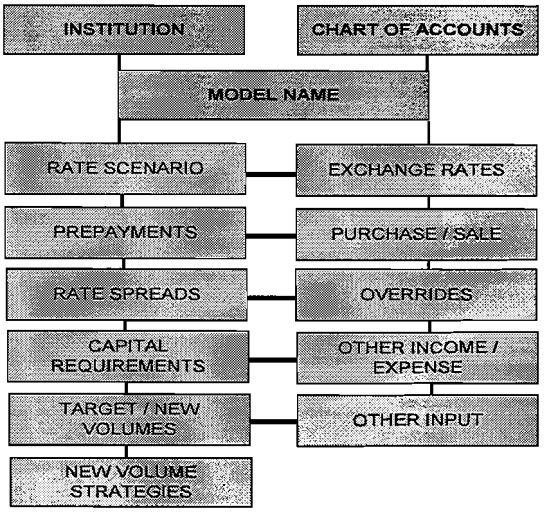
Figure 7.1 The SVAL Model Framework



Source: (IPS-Sendero, 2006**a**:36)

According to IPS-Sendero (2006**a**:191) both the internal structures and reporting capabilities and accounting standards together with bank controlled variables i.e. business strategy, growth volumes, pricing methodology is capable of being input in the simulation model. Exogenous factors i.e. customer prepayments and market interest rates should also be capable of being input into the model and integrated with the other simulation parameters or variables, in the generation of financial results and risk analysis (IPS-Sendero, 2006**a**:191). Chapter 5, section 5.5 (p154) discussed the perspectives to simulation modelling as a method of facilitating risk assessment techniques in a more realistic, dynamic and accurate manner. The ALM model components framework which relies on inputs for forecast data are set out in figure 7.2.

Figure 7.2 Model component structure



Source: (adapted from IPS-Sendero, 2006**a**:193)

The balance sheet which will be simulated and analysed within the IRR and MTFTP quantification in section 7.3 and section 7.4 respectively, is presented in table 7.1. A balance sheet is simulated representing a typical South African bank which comprises of both retail and wholesale business. The products within the balance sheet's assets and liabilities are typical banking products applied by banks in their financial intermediation process. The balances are rounded to the nearest R billion for simplicity. Furthermore, for simplicity the more complex types of products i.e. subordinated debts, securitization deals, collateralised mortgage obligations (CMOs), collateralised debt obligations (CDOs) and syndicated loan deals, - however standard they are in modern banking - are excluded from this simulation model. Given the much needed focus they deserve in order to fully understand and analyse them are beyond the scope of this dissertation.

The balance sheet of Typical Bank as at the end of 28 February 2007 comprises of lending activities (assets) through products such as Overdrafts, Instalments Sales (vehicles), Home Loans, Personal Loans, Structured Loans and a Debtors book. The liabilities of the balance sheet consist of products such as Current Accounts, Savings Accounts, Call Deposits, Fixed Deposits, Negotiable Certificates of Deposits, Creditors and Share Capital.

Table 7.1 Balance sheet of Typical Bank

Balance Sheet for TYPICAL BANK as at the end of 28 February 2007.

	R '000 000
FINANCIAL ASSETS	
Overdrafts	R 35,000
Treasury Bills	R 10,000
Installment Sales	R 40,000
Home Loans & Commercial Property Finance	R 52,837
Personal Loans	R 25,000
Structured Loans	R 35,000
TOTAL FINANCIAL ASSETS	**R 197,837**
NON-FINANCIAL ASSETS	
Debtors	R 5,000
TOTAL ASSETS	**R 202,837**
FINANCIAL LIABILITIES	
Current Accounts	R 45,000
Savings Accounts	R 30,000
Call Deposits	R 27,837
Fixed Deposits	R 30,000
Negotiable Certificates of Deposit	R 25,000
TOTAL FINANCIAL LIABILITIES	**R 157,837**
NON FINANCIAL LIABILITIES	
Creditors	R 15,000
LIABILITIES before CAPITAL	**R 172,837**
EQUITY	
Share capital	R 20,000
Retained Earnings	R 10,000
TOTAL EQUITY	**R 30,000**
TOTAL LIABILITIES	**R 202,837**

(Source: Author, 2008)

7.3 ALM – INTEREST RATE RISK MEASUREMENT

Payant (1998:2) explains that the results of the MTFTP process can be applied as input in the ALM simulation model. By applying either the transfer rates or the MTFTP-spreads to its existing business, a business unit can forecast its risk-adjusted contribution to its preordained net interest margin (NIM). The same methodology may be applied to future new business to forecast the business unit's performance from a risk-adjusted basis. The ALM simulation models can provide a forecast of the business unit's preordained NIM of its existing and new business.

This is also reported by Eastburn (2000:2-3) stating that by using the FTP results relating to profitability spreads and derived strategies which are based on performance objectives (i.e. balance sheet strategies that will generate the highest returns based on the risks taken), the ALM model can generate performance forecasts and derive associated risk exposures. In addition, Eastburn (2000:3) state that the application of MTFTP results in the ALM simulation model to formulate strategies may also assist with continuous financial planning and the bank's budget process. This approach will assist the finance department and ALM to converge its performance measurement, financial planning and IRR management efforts. This is also reported in the risk optimisation concept by Haubenstock and Aggarwal (chapter 3, section 3.3, p70).

Payant (1998:3) explains that the difference between the asset transfer rate (transfer income) and liability transfer rate (transfer expense) represents the mismatch spread allocated to the central funding unit (CFU). Alternatively, the mismatch contribution may also be calculated as the difference between the customer rates based NII and the FTP-spread based allocation of the NII.

Payant (2002:2) states that this mismatch spread is for the cumulative profitability impact of both prior matched and unmatched balance sheet positions. The MTFTP results can therefore be applied to the formulation of ALM and business unit financial plans and integrated with the ALM simulation model to measure prospective IRR exposures. Eastburn (2000:3) also states that various interest rate and business scenarios may be formulated and applied in order to formulate the strategies that will optimise available resources and capital in order to meet profitability targets.

The IRR measurement results presented in the following sections assumes that the optimal input assumptions were supplied by the business units of Typical Bank, derived from the MTFTP information and the RAPM process. The results present the preordained profitability (NII and net income) results and associated IRR exposures, based on customer coupon rates. The application of transfer rates or spreads in the simulation model and measuring IRR sensitivities presents challenges which are beyond the scope of this dissertation. Measuring mismatch management effectiveness and the concept of remaining-term FTP are important to measure the existing mismatch profitability and the effectiveness of deployed IRR management strategies. This may be the topic for further research. The subsequent focus on IRR measurement is therefore as far as EAR and EVE analysis is concerned, focused on forecasting the accounting and economic income statement perspective of Typical Bank's NII.

7.3.1 GAP ANALYSIS

The application of gap analysis as an IRR measurement method was discussed in chapter 5, section 5.3, on p121. The following discussion presents a practical application of gap analysis to measure IRR. The practical example ALM model for Typical Bank reflects the structural IRR or mismatch profile in table 7.2 and table 7.3 respectively.

In chapter 5, section 5.3, p135-p136, Cade, Heagy and Tannenbaum, the OCC and the BCBS explained the problems associated with applying repricing assumptions to NMD accounts in repricing gap analyses. Variable rate accounts and accounts without a maturity data demand consideration as to the repricing of the balances for IRR measurement purposes. Table 7.2 represents the static gap analysis of the balance sheet without consideration to any non-maturity deposit (NMD) maturity or repricing profile. Table 7.3 represents the static gap analysis inclusive of the assumptions surrounding NMD products, in specific current- and savings accounts. Therefore the balance sheet of Typical Bank can be analysed from a contractual perspective (table 7.2) and also in terms of specific important behavioural assumptions and how they impact the gap analysis. The following NMD assumptions are applied:

- Firstly, the assumption on non-maturity-deposit accounts i.e. current accounts and savings accounts are assumed to be 25% repricing in 1 month, 50% repricing in 3 month and 25% in 2 years. This applies to rateable accounts which attract a positive interest rate. Various analytical techniques can be applied to facilitate customer behaviour analysis but this type of analyses is beyond the scope of this dissertation. Current Account and savings accounts that attracts a zero percent interest rate is deemed to be priced at zero percent interest rate and should not to be seen a non-rate account. These accounts are classified as administered prices in nature with the assumption of repricing occurring in the longer than 3years time-bucket.

- Secondly, for simplicity pre-payment analyses or optionality are ignored for this analysis.

The size and position/direction of the gap per time bucket indicates the bank's exposure towards interest rate changes. This was discussed by the OCC (chapter 5, section 5.3, p125), the BCBS OCC (chapter 5, section 5.3, p125), Koch and MacDonald OCC (chapter 5, section 5.3, p126)

and Kelly OCC (chapter 5, section 5.3, p126). In table 7.2 the gap for Typical Bank indicates that the bank will benefit from falling interest rates given that a negative gap persists in the overnight time bucket, which indicates that liabilities reprice faster than assets and therefore the bank will benefit if interest rates decline.

Table 7.2 Static Gap of Typical Bank – no behavioural assumptions

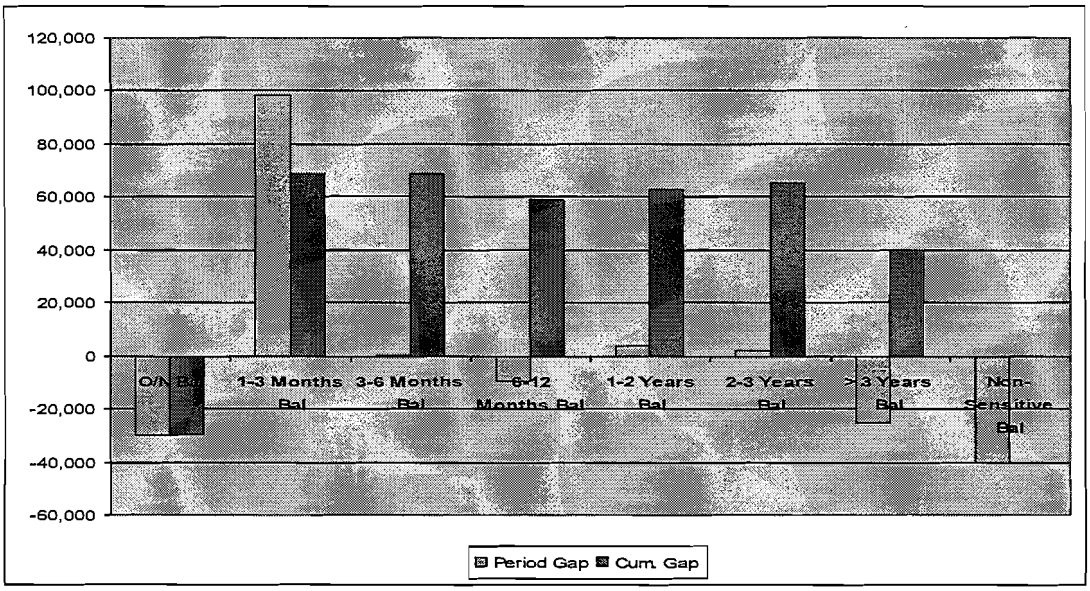
Repricing Gap Report	O/N Bal	O/N Rate	1-3 Months Bal	1-3 Months Rate	3-6 Months Bal	3-6 Months Rate	6-12 Months Bal	6-12 Months Rate	1-2 Years Bal	1-2 Years Rate	2-3 Years Bal	2-3 Years Rate	> 3 Years Bal	> 3 Years Rate	Non-Sensitive Bal	Total Bal	Total Rate
Typical Bank																	
Base Case																	
Base																	
Static																	
Assets:																	
Overdrafts	35,000.00	16.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35,000.00	16.05
Treasury Bills & Bills of Exchange	0.00	0.00	8,679.79	9.36	952.50	9.42	368.38	9.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10,000.00	8.97
Instalment Sales	0.00	0.00	39,232.95	11.57	82.37	12.95	104.27	12.68	96.62	11.55	79.97	11.58	412.02	11.38	0.00	40,000.00	11.58
Home Loans & Comm Property Finance	0.00	0.00	49,475.76	11.07	322.02	10.64	705.83	11.50	1,100.87	11.81	245.34	16.62	956.75	15.51	0.00	52,806.58	11.20
Personal Loans	0.00	0.00	19,229.34	18.00	987.12	53.71	1,944.12	52.36	2,874.11	50.85	908.16	47.98	56.56	47.69	0.00	25,000.00	27.05
Structured Loans	0.00	0.00	19,405.77	10.30	1,906.75	11.02	1,091.06	11.86	1,245.90	12.43	1,022.39	11.95	11,236.12	10.56	0.00	35,000.00	10.60
Interdivisional Loans	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Surplus Funds Investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Financial Assets	35,000.00	16.05	134,052.79	11.88	4,273.16	20.31	4,153.62	30.71	5,409.71	32.70	2,255.84	26.83	12,691.46	11.15	0.00	197,806.58	13.68
Debtors 19007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5,000.00	5,000.00	0.00
Non-Financial Assets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5,000.00	5,000.00	0.00
Unalloc Assets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Assets	35,000.00	16.05	134,052.79	11.88	4,273.16	20.31	4,153.62	30.71	5,409.71	32.70	2,255.84	26.83	12,691.46	11.15	5,000.00	202,806.58	13.66
Liabilities:																	
Current Accounts	7,284.53	4.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37,715.47	0.00	0.00	45,000.00	0.79
Savings Accounts	29,973.52	3.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.48	0.00	0.00	30,000.00	3.63
Call Deposits	27,836.58	7.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27,836.58	7.51
Fixed Deposits	0.00	0.00	25,026.91	8.67	1,466.70	9.19	1,566.35	9.49	720.04	10.79	105.65	11.55	122.36	16.41	0.00	30,000.00	9.01
Negotiable Certificates of Deposit	0.00	0.00	9,279.47	8.89	2,590.40	9.02	12,200.99	9.56	919.02	8.32	0.00	0.00	10.22	16.03	0.00	25,000.00	9.26
Interdivisional Funding	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Call Funding Requirement	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Financial Liabilities	65,094.63	5.52	35,306.38	8.66	4,047.09	9.09	13,767.24	9.64	1,639.06	9.40	105.65	11.55	37,874.52	0.06	0.00	157,836.58	5.46
Creditors 20006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15,000.00	15,000.00	0.00
Non-Financial Liabilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15,000.00	15,000.00	0.00
Total Liabilities	65,094.63	5.52	35,306.38	8.66	4,047.09	9.09	13,767.24	9.64	1,639.06	9.40	105.65	11.55	37,874.52	0.06	15,000.00	172,836.58	4.99
Equity:																	
Share Capital 20007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20,000.00	20,000.00	0.00
Retained Earnings 20008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10,000.00	10,000.00	0.00
Total Equity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30,000.00	30,000.00	0.00
Total Liab/Equity	65,094.63	5.52	35,306.38	8.66	4,047.09	9.09	13,767.24	9.64	1,639.06	9.40	105.65	11.55	37,874.52	0.06	45,000.00	202,836.58	4.25
Period Gap	-30,094.63		99,746.41		226.07		-9,615.63		3,770.65		2,150.19		-25,183.06		-40,000.00		
Cum. Gap	-30,094.63		69,651.78		69,877.85		59,262.22		63,032.87		65,183.06		40,000.00		0.00		
RSA/RSL	0.54		3.80		1.06		0.30		3.30		21.35		0.34		0.11		
Off Balance-Sheet:																	
Total Off Balance Sheet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Period Gap	-30,094.63		99,746.41		226.07		-9,615.63		3,770.65		2,150.19		-25,183.06		-40,000.00		
Cum. Gap	-30,094.63		69,651.78		69,877.85		59,262.22		63,032.87		65,183.06		40,000.00		0.00		
RSA/RSL	0.54		3.80		1.06		0.30		3.30		21.35		0.34		0.11		

Source: (Author, 2008)

Hudson (1992:80) explains that the mismatch between assets and liabilities can be easily illustrated in a chart. It enables the ALM analyst to see how the book is positioned. Accordingly the graph for Typical Bank's gap analysis is presented in figure 7.3. Although the gap illustrates a negative gap in the overnight time-bucket the cumulative gap indicates that a positive gap persists in the 1-3month time-bucket. In the short term Typical Bank will benefit from falling interest rates but is the overall effect positive or negative? By analysing the gap chart it is not easily ascertained whether the repricing of liabilities in the short-term will outweigh the repricing of the assets in the medium-term, and therefore although the gap analysis gives a simple overview of interest rate exposure, it does not always produce a readily quantifiable IRR estimate.

Cade (1997:152-155) assess that the size of the gap can indicate that the change in earnings may be temporary until such time that the slacker assets catch up with repricing. The negative gap in the early time band in figure 7.3 indicates a liability sensitive position, in which it suggests that the NII temporarily stands to increase in a downward interest rate scenario and to shrink when interest rates rise. The basic limitations of static gap analysis for instance, the time bands selected and the assumption that all interest rates will move simultaneously by the same amount in the same direction, may hide the true vulnerability of Typical Bank to IRR. This is because the exact reverse of what is depicted by the snapshot of today's gap report may be the reality (Cade, 1997:155). This specific scenario will be reflected on in the section dealing with earnings-at-risk simulation analysis.

Figure 7.3 Chart static gap of Typical Bank – no behavioural assumptions



Source: (Author, 2008)

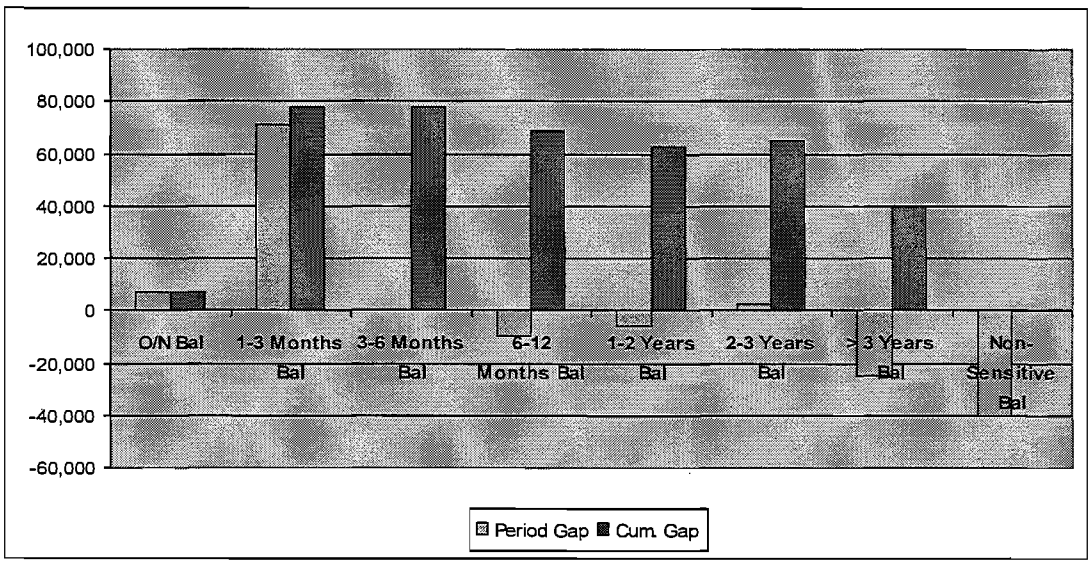
If the behavioural analysis or assumptions surrounding NMD accounts like current accounts and savings accounts are incorporated, then the positive period gap profile as per table 7.3 and figure 7.4 respectively is fairly undoubtedly positioned to benefit from interest rate increases. The stability in the interest rates associated with NMD accounts renders that the current- and savings accounts' repricing nature is in nature of a longer term rather than the overnight profile which positions the gap positive in the short term. The remaining periods up to 6-months also pose a positive repricing gap which indicates that changes in the income generated from assets will be greater than the sensitivity of expenses generated from liabilities.

Table 7.3 Static Gap Typical Bank – NMD assumptions

Repricing Gap Report	O/N Bal	O/N Rate	1-3 Months Bal	1-3 Months Rate	3-6 Months Bal	3-6 Months Rate	6-12 Months Bal	6-12 Months Rate	1-2 Years Bal	1-2 Years Rate	2-3 Years Bal	2-3 Years Rate	> 3 Years Bal	> 3 Years Rate	Non-Sensitive Bal	Total Bal	Total Rate
Typical Bank																	
Base NMD																	
Base NMD																	
Static																	
Assets:																	
Overdrafts	35,000.00	16.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35,000.00	16.05
Treasury Bills & Bills of Exchange	0.00	0.00	8,678.78	9.36	952.90	8.42	368.33	8.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10,000.00	8.57
Instalment Sales	0.00	0.00	39,232.55	11.57	82.37	12.95	104.27	12.66	88.82	11.56	79.97	11.56	412.02	11.86	0.00	40,000.00	11.58
Home Loans & Comm Property Finance	0.00	0.00	49,475.76	11.07	322.02	10.64	785.63	11.50	1,100.67	11.81	245.34	16.02	966.76	16.50	0.00	52,896.58	11.20
Personal Loans	0.00	0.00	18,229.94	18.00	967.12	53.71	1,544.12	52.86	2,574.11	50.86	906.16	47.66	56.56	47.69	0.00	25,000.00	27.05
Structured Loans	0.00	0.00	18,436.77	10.30	1,808.75	11.02	1,031.09	11.86	1,345.90	12.43	1,022.39	11.93	11,236.12	10.55	0.00	35,000.00	10.80
Interdivisional Loans	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Surplus Funds Investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Financial Assets	35,000.00	16.05	134,052.79	11.88	4,273.16	20.31	4,153.62	30.71	5,409.71	32.70	2,255.84	26.63	12,691.45	11.15	0.00	197,896.58	13.89
Debtors 19807	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5,000.00	5,000.00	0.00
Non-Financial Assets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5,000.00	5,000.00	0.00
Unalloc Assets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Assets	35,000.00	16.05	134,052.79	11.88	4,273.16	20.31	4,153.62	30.71	5,409.71	32.70	2,255.84	26.63	12,691.45	11.15	5,000.00	202,896.58	13.65
Liabilities:																	
Current Accounts	0.00	0.00	5,463.40	4.86	0.00	0.00	0.00	0.00	1,621.13	4.86	0.00	0.00	37,715.47	0.00	0.00	45,000.00	0.79
Savings Accounts	0.00	0.00	22,480.14	3.83	0.00	0.00	0.00	0.00	7,499.39	3.83	0.00	0.00	20.46	0.00	0.00	30,000.00	3.83
Call Deposits	27,896.59	7.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27,896.58	7.51
Fixed Deposits	0.00	0.00	26,108.91	9.97	1,466.70	9.18	1,559.36	9.49	720.04	10.78	905.65	11.56	122.35	16.41	0.00	30,000.00	9.91
Negotiable Certificates of Deposit	0.00	0.00	9,279.47	8.99	2,590.40	9.12	12,200.65	9.66	919.02	9.52	0.00	0.00	10.22	15.03	0.00	25,000.00	9.26
Interdivisional Funding	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Call Funding Requirement	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Financial Liabilities	27,896.59	7.51	63,249.92	6.74	4,047.09	9.06	13,769.24	9.64	10,953.57	4.84	105.65	11.56	37,874.52	0.06	0.00	157,896.58	5.45
Creditors 20806	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15,000.00	15,000.00	0.00
Non-Financial Liabilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15,000.00	15,000.00	0.00
Total Liabilities	27,896.59	7.51	63,249.92	6.74	4,047.09	9.06	13,769.24	9.64	10,953.57	4.84	105.65	11.56	37,874.52	0.06	15,000.00	172,896.58	4.98
Equity:																	
Share Capital 20807	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20,000.00	20,000.00	0.00
Retained Earnings 20808	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10,000.00	10,000.00	0.00
Total Equity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30,000.00	30,000.00	0.00
Total Liab/Equity	27,896.59	7.51	63,249.92	6.74	4,047.09	9.06	13,769.24	9.64	10,953.57	4.84	105.65	11.56	37,874.52	0.06	45,000.00	202,896.58	4.25
Period Gap	7,103.42		70,802.87		226.07		-9,615.63		-5,543.86		2,150.19		-25,183.06		-40,000.00		
Cum. Gap	7,103.42		77,906.29		78,132.36		68,516.73		63,032.87		65,183.06		40,000.00		0.00		
RSA/RSL	1.26		2.12		1.06		0.30		0.49		21.35		0.34		0.11		
Off Balance Sheet:																	
Buy Swaps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Off Balance Sheet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Period Gap	7,103.42		70,802.87		226.07		-9,615.63		-5,543.86		2,150.19		-25,183.06		-40,000.00		
Cum. Gap	7,103.42		77,906.29		78,132.36		68,516.73		63,032.87		65,183.06		40,000.00		0.00		
RSA/RSL	1.26		2.12		1.06		0.30		0.49		21.35		0.34		0.11		

Source: (Author, 2008)

Figure 7.4 Chart static gap of Typical Bank – NMD behavioural assumptions



Source: (Author, 2008)

However, the argument posed by Cade, Smith and Benci and Heagy and Tannenbaum (chapter 5, section 5.3, p136-p138) should be considered given that the analyses are based on a liquidated

concern and not as a going concern. It does not incorporate future business developments and is therefore a static analysis. Static analyses are mathematically naïve and simply do not tell the ALCO enough of what it needs to know regarding effectively managing the IRR. A more sophisticated method are needed to assess the impact of IRR (Cade, 1997:155).

7.3.2 DURATION ANALYSIS

The following section discusses a practical application of duration analysis in support of the research presented in the foregoing discussion of chapter 5, section 5.4, on p137. In specific, Macaulay duration was discussed in chapter 5, section 5.4, p139-p143. Modified duration was discussed in chapter 5, section 5.4, p144-p147. The duration analysis for the sample simulation model, Typical Bank, is reviewed in table 7.4 which reflects the cash flow and repricing behaviour inclusive of the NMD adjustments relating to current accounts and savings accounts. Therefore the cash flows and repricing balances depicted in table 7.3 and figure 7.4 applies which represents the static position of Typical Bank inclusive of NMD assumptions.

For illustration purposes the duration reports are expanded to show the interest rate attribute of the products, for example, the fixed- variable- and adjustable interest rate repricing behaviour of the contracts. This will indicate the difference between the various duration values for fixed rate contracts where the cash flows are priced at the incremental dates at which they occur, and the floating/variable rate contracts where the timing of the cash flows are different to the timing of the repricing balances.

As explained by Cade and Bitner in chapter 5, section 5.4, p140, the length or size of a product's duration value indicates its sensitivity to changes in interest rates. The duration analysis for Typical Bank indicates a net positive duration of equity in that the duration of interest sensitive assets is longer than the duration of interest sensitive liabilities and therefore indicating a liability sensitive balance sheet, positioned to benefit from a decrease in interest rates. Therefore the EVE of Typical Bank will increase when interest rates decrease and the EVE will decrease when interest rates increase.

The Macaulay duration indicates the average time of repricing of capital being 1.31 years and the modified duration depicts that the value of the balance sheet will change by 1.10 percent for a 100 basis point change in interest rates. The effective duration for a 100 basis point movement

confirms the positioning of the balance sheet to benefit from a decrease in interest rates, at least from the economic value perspective.

Table 7.4 Macaulay and modified duration – Typical Bank

ECONOMIC VALUE DURATION Static	Economic Value	Book Value	Gain/Loss	Macaulay Duration	Modified Duration	Macaulay Dollar Duration	Modified Dollar Duration
Typical Bank Base NMD Base NMD							
Assets:							
Overdrafts	R35,000.00	R35,000.00	R0.00	0.00	0.00	-105.00	-105.00
Treasury Bills & Bills of Exchange	R9,995.78	R10,000.00	-R4.22	0.16	0.14	-1,562.75	-1,438.16
Instalment Sales Fixed 10003	R952.03	R859.30	R92.73	2.79	2.59	-2,659.85	-2,465.25
Instalment Sales Variable 10003	R39,155.39	R39,140.70	R14.69	0.01	0.01	-434.00	-401.65
Instalment Sales	R40,107.42	R40,000.00	R107.42	0.08	0.07	-3,093.86	-2,866.90
Home Loans Fixed 10004	R69.92	R51.70	R18.22	7.39	6.89	-516.77	-481.74
Home Loans Variable 10004	R48,106.30	R48,106.30	R0.00	0.00	0.00	-0.01	-0.01
Home Loans Adjustable 12m 10004	R924.73	R921.09	R3.64	0.55	0.51	-510.23	-469.38
Home Loans Adjustable 24m 10004	R929.91	R920.91	R9.00	1.39	1.27	-1,291.14	-1,184.90
Home Loans 10004	R50,030.86	R50,000.00	R30.86	0.05	0.04	-2,318.15	-2,136.03
Commercial Property Fin Fixed 10004	R1,742.69	R1,547.89	R194.80	2.87	2.58	-5,001.12	-4,494.41
Commercial Property Fin Var 10004	R1,254.42	R1,253.28	R1.14	0.02	0.02	-30.70	-28.61
Commercial Prop Fin 3m Adj 10004	R35.42	R35.42	-R0.00	0.09	0.08	-3.09	-2.79
Commercial Property Finance 10004	R3,032.52	R2,836.58	R195.94	1.66	1.49	-5,034.91	-4,525.81
Home Loans & Comm Property Finance	R53,063.38	R52,836.58	R226.80	0.14	0.13	-7,353.06	-6,661.84
Personal Loans Fixed 10005	R7,806.76	R7,704.12	R102.64	0.76	0.51	-5,963.49	-4,003.04
Personal Loans Variable 10005	R17,295.88	R17,295.88	R0.00	0.00	0.00	0.00	0.00
Personal Loans	R25,102.64	R25,000.00	R102.64	0.24	0.16	-5,963.49	-4,003.04
Structured Loans Fixed 10006	R21,863.05	R21,847.48	R15.57	2.85	2.59	-62,267.12	-56,576.80
Structured Loans Variable 10006	R2,446.59	R2,442.86	R3.73	0.04	0.04	-108.09	-101.68
Structured Loans Adjustable 3m10006	R5,841.07	R5,814.10	R26.98	0.14	0.13	-808.57	-760.28
Structured Loans Adjustable 6m10006	R4,930.73	R4,895.56	R35.17	0.20	0.19	-1,006.95	-941.99
Structured Loans	R35,081.44	R35,000.00	R81.44	1.83	1.66	-64,190.74	-58,380.76
Interdivisional Loans	R0.00	R0.00	R0.00	0.00	0.00	0.00	0.00
Surplus Funds Investment	R0.00	R0.00	R0.00	0.00	0.00	0.00	0.00
Total Financial Assets	R198,350.66	R197,836.58	R514.07	0.41	0.37	-82,268.90	-73,455.69
Debtors 10007	R5,000.00	R5,000.00	R0.00	0.00	0.00	0.00	0.00
Non-Financial Assets	R5,000.00	R5,000.00	R0.00	0.00	0.00	0.00	0.00
Accrued Interest Receivable	R0.00	R0.00	R0.00	0.00	0.00	0.00	0.00
Unalloc Assets	R0.00	R0.00	R0.00	0.00	0.00	0.00	0.00
Total Assets	R203,350.66	R202,836.58	R514.07	0.40	0.36	-82,268.90	-73,455.69
Liabilities:							
Current Accounts 20001	R7,284.53	R7,284.53	R0.00	0.61	0.58	-4,414.79	-4,209.31
Current Accounts Zero-Rate 20001	R37,715.47	R37,715.47	R0.00	0.00	0.00	0.00	0.00
Current Accounts	R45,000.00	R45,000.00	R0.00	0.10	0.09	-4,414.79	-4,209.31
Savings Accounts 20002	R29,973.52	R29,973.52	R0.00	0.61	0.58	-18,165.46	-17,495.11
Savings Accounts Zero-Rate 20002	R26.48	R26.48	R0.00	0.00	0.00	0.00	0.00
Savings Accounts	R30,000.00	R30,000.00	R0.00	0.61	0.58	-18,165.46	-17,495.11
Call Deposits	R27,836.58	R27,836.58	R0.00	0.00	0.00	-83.51	-83.51
Fixed Deposits Jibar 20004	R244.13	R244.09	R0.03	0.11	0.10	-26.26	-24.00
Fixed Deposits 20004	R29,823.62	R29,755.91	R67.72	0.21	0.20	-6,395.03	-5,871.22
Fixed Deposits	R30,067.75	R30,000.00	R67.75	0.21	0.20	-6,421.29	-5,895.22
NCDs Jibar Linked 20005	R3,439.11	R3,437.29	R1.82	0.13	0.11	-430.33	-394.25
NCDs Issued 20005	R21,634.20	R21,562.71	R71.49	0.60	0.55	-13,076.77	-11,976.66
Negotiable Certificates of Deposit	R25,073.31	R25,000.00	R73.31	0.54	0.49	-13,507.10	-12,370.91
Interdivisional Funding	R0.00	R0.00	R0.00	0.00	0.00	0.00	0.00
Call Funding Requirement	R0.00	R0.00	R0.00	0.00	0.00	0.00	0.00
Total Financial Liabilities	R157,977.65	R157,836.58	R141.06	0.27	0.25	-42,592.15	-40,054.06
Creditors 20006	R15,000.00	R15,000.00	R0.00	0.00	0.00	0.00	0.00
Non-Financial Liabilities	R15,000.00	R15,000.00	R0.00	0.00	0.00	0.00	0.00
Accrued Interest Payable	R0.00	R0.00	R0.00	0.00	0.00	0.00	0.00
Total Liabilities	R172,977.65	R172,836.58	R141.06	0.25	0.23	-42,592.15	-40,054.06
Equity:							
Total Equity	R30,373.01	R30,000.00	R373.01	1.31	1.10	-39,676.75	-33,401.63

Source: (Author, 2008)

Effective duration and convexity was discussed in chapter 5, section 5.4, p148-p151. As explained by IPS-Sendero (chapter5, section 5.4 and p150) and Koch and MacDonald (chapter5, section 5.4 and p150) the effects of optionality and non-linear rate movements are better captured through effective duration and effective convexity measures. Table 7.5 indicates the changes in economic value of Typical Bank for incremental 25 and 50 basis points upward and downward movements based on the effective duration and effective convexity calculations for a 100 basis point change in interest rates. The changes to the EVE are shown as the Projected EV for each basis points change. The effective duration of 2 percent indicates that for a 100 basis

point change in interest rates the EVE of Typical Bank will change by 2 percent. The EVE analysis confirms that when interest rates increase by 100 basis points the EVE will decrease by R583.95 million or 1.92 percent. A decrease of 100 basis points will result in an EVE increase of R631.55 million or 2.08 percent. The effective duration of 2 percent is confirmed as the average of the basis point movements' EVE results.

Table 7.5 Effective duration and effective convexity – Typical Bank

	Base	Base +100bp	Base -100bp	Effective Duration	Effective Convexity	Projected EV 1	Projected EV 2	Projected EV 3	Projected EV 4
Effective Duration Report									
Economic Value									
Institution: Typical Bank									
Chart: Financial Accounts									
Model: Base NMD									
Base Result File: Base NMD									
Upward Shift Result File: Base NMD UP 100									
Downward Shift Result File: Base NMD DN 100									
Rate Shift		100.00	-100.00	%	%	25.00	50.00	-25.00	-50.00
Assets:									
Overdrafts	R35,000.00	R35,000.00	R35,000.00	-	-	R35,000.00	R35,000.00	R35,000.00	R35,000.00
Treasury Bills & Bills of Exchange	R9,995.78	R9,980.32	R10,011.36	0.16	0.13	R9,991.90	R9,988.03	R9,999.66	R10,003.55
Instalment Sales Fixed 10003	R952.03	R926.55	R979.01	2.76	15.72	R945.52	R939.10	R958.64	R965.33
Instalment Sales Variable 10003	R39,155.39	R39,151.08	R39,159.70	0.01	0.00	R39,154.31	R39,153.24	R39,156.47	R39,157.55
Instalment Sales	R40,107.42	R40,077.63	R40,138.71	0.08	0.37	R40,099.83	R40,092.34	R40,115.10	R40,122.88
Home Loans 10004	R50,030.86	R50,008.37	R50,054.12	0.05	0.15	R50,025.16	R50,019.52	R50,036.60	R50,042.39
Commercial Property Finance 10004	R3,032.52	R2,984.21	R3,083.30	1.63	8.15	R3,020.21	R3,008.06	R3,044.99	R3,057.60
Home Loans & Comm Property Finance	R53,063.38	R52,992.58	R53,137.42	0.14	0.61	R53,045.38	R53,027.57	R53,081.59	R53,100.00
Personal Loans Fixed 10005	R7,806.76	R7,749.88	R7,864.38	0.73	0.95	R7,792.47	R7,778.23	R7,821.10	R7,835.48
Personal Loans Variable 10005	R17,295.88	R17,295.88	R17,295.88	-	-	R17,295.88	R17,295.88	R17,295.88	R17,295.88
Personal Loans	R25,102.64	R25,045.76	R25,160.26	0.23	0.29	R25,088.35	R25,074.10	R25,116.97	R25,131.36
Structured Loans Fixed 10006	R21,863.05	R21,274.33	R22,495.61	2.79	20.05	R21,711.76	R21,563.21	R22,017.08	R22,173.85
Structured Loans Variable 10006	R2,446.59	R2,445.52	R2,447.66	0.04	0.01	R2,446.32	R2,446.05	R2,446.86	R2,447.13
Structured Loans Adjustable 3m10006	R5,841.07	R5,833.07	R5,849.15	0.14	0.13	R5,839.07	R5,837.06	R5,843.09	R5,845.10
Structured Loans Adjustable 6m10006	R4,930.73	R4,920.78	R4,940.80	0.20	0.24	R4,928.23	R4,925.74	R4,933.24	R4,935.75
Structured Loans	R35,081.44	R34,473.71	R35,733.22	1.80	12.55	R34,925.38	R34,772.07	R35,240.26	R35,401.83
Interdivisional Loans	R0.00	R0.00	R0.00	-	-	R0.00	R0.00	R0.00	R0.00
Surplus Funds Investment	R0.00	R0.00	R0.00	-	-	R0.00	R0.00	R0.00	R0.00
Total Financial Assets	R198,350.66	R197,570.00	R199,160.98	0.41	2.50	R198,150.84	R197,954.12	R198,553.58	R198,759.61
Debtors 10007	R5,000.00	R5,000.00	R5,000.00	-	-	R5,000.00	R5,000.00	R5,000.00	R5,000.00
Non-Financial Assets	R5,000.00	R5,000.00	R5,000.00	-	-	R5,000.00	R5,000.00	R5,000.00	R5,000.00
Accrued Interest Receivable	R0.00	R0.00	R0.00	-	-	R0.00	R0.00	R0.00	R0.00
Unrealized Gain/Loss on Securities	R0.00	R0.00	R0.00	-	-	R0.00	R0.00	R0.00	R0.00
Unalloc Assets	R0.00	R0.00	R0.00	-	-	R0.00	R0.00	R0.00	R0.00
Total Assets	R203,350.66	R202,570.00	R204,160.98	0.40	2.44	R203,150.84	R202,954.12	R203,553.58	R203,759.61
Liabilities:									
Current Accounts 20001	R7,284.53	R7,284.53	R7,284.53	-	-	R7,284.53	R7,284.53	R7,284.53	R7,284.53
Current Accounts Zero-Rate 20001	R37,715.47	R37,715.47	R37,715.47	-	-	R37,715.47	R37,715.47	R37,715.47	R37,715.47
Current Accounts	R45,000.00	R45,000.00	R45,000.00	-	-	R45,000.00	R45,000.00	R45,000.00	R45,000.00
Savings Accounts 20002	R29,973.52	R29,973.52	R29,973.52	-	-	R29,973.52	R29,973.52	R29,973.52	R29,973.52
Savings Accounts Zero-Rate 20002	R26.48	R26.48	R26.48	-	-	R26.48	R26.48	R26.48	R26.48
Savings Accounts	R30,000.00	R30,000.00	R30,000.00	-	-	R30,000.00	R30,000.00	R30,000.00	R30,000.00
Call Deposits	R27,836.58	R27,836.58	R27,836.58	-	-	R27,836.58	R27,836.58	R27,836.58	R27,836.58
Fixed Deposits Jibar 20004	R244.13	R243.87	R244.39	0.11	0.09	R244.06	R244.00	R244.19	R244.26
Fixed Deposits 20004	R29,823.62	R29,760.77	R29,887.59	0.21	0.37	R29,807.81	R29,792.06	R29,839.51	R29,855.47
Fixed Deposits	R30,067.75	R30,004.64	R30,131.98	0.21	0.37	R30,051.87	R30,036.05	R30,083.70	R30,099.73
NCDs Jibar Linked 20005	R3,439.11	R3,434.86	R3,443.40	0.12	0.11	R3,436.05	R3,436.98	R3,440.18	R3,441.25
NCDs Issued 20005	R21,634.20	R21,504.85	R21,764.44	0.60	0.42	R21,601.78	R21,569.41	R21,666.68	R21,699.21
Negotiable Certificates of Deposit	R25,073.31	R24,939.71	R25,207.85	0.53	0.37	R25,039.82	R25,006.40	R25,106.86	R25,140.46
Interdivisional Funding	R0.00	R0.00	R0.00	-	-	R0.00	R0.00	R0.00	R0.00
Call Funding Requirement	R0.00	R0.00	R0.00	-	-	R0.00	R0.00	R0.00	R0.00
Total Financial Liabilities	R157,977.65	R157,780.94	R158,176.41	0.13	0.13	R157,928.28	R157,879.03	R158,027.15	R158,076.77
Creditors 20006	R15,000.00	R15,000.00	R15,000.00	-	-	R15,000.00	R15,000.00	R15,000.00	R15,000.00
Non-Financial Liabilities	R15,000.00	R15,000.00	R15,000.00	-	-	R15,000.00	R15,000.00	R15,000.00	R15,000.00
Accrued Interest Payable	R0.00	R0.00	R0.00	-	-	R0.00	R0.00	R0.00	R0.00
Total Liabilities	R172,977.65	R172,780.94	R173,176.41	0.11	0.12	R172,928.28	R172,879.03	R173,027.15	R173,076.77
Equity:									
Share Capital 20007	R20,000.00	R20,000.00	R20,000.00	-	-	R20,000.00	R20,000.00	R20,000.00	R20,000.00
Retained Earnings 20008	R0.00	R0.00	R0.00	-	-	R0.00	R0.00	R0.00	R0.00
Other Comprehensive Income	R0.00	R0.00	R0.00	-	-	R0.00	R0.00	R0.00	R0.00
Total Equity	R30,373.01	R29,789.06	R31,004.56	2.00	15.67	R30,222.56	R30,075.09	R30,526.44	R30,682.84
Change in EVE		-R583.95	R631.55			-R150.45	-R297.93	R153.43	R309.83
Percentage change in EVE		-1.92%	2.08%			-0.50%	-0.98%	0.51%	1.02%

Source: (Author, 2008)

The effective convexity of 15.67 shows a positive convexity in the balance sheet which indicates that the EVE will increase proportionally greater when interest rates fall than when interest rates rise, evident of the non-optioned fixed income positions in Instalment Sales and Structured Loans of Typical Bank. Therefore, for every 100 basis point change in interest rates the effective duration will change by 15.67 percent. When reflection is given on the repricing gap analysis of Typical Bank, keeping in mind that the NMD assumptions alter the repricing gap from being liability sensitive to asset sensitive in the overnight time bucket, it indicates that the NII will increase when interest rates increase, contrary to the duration analysis. Therefore, it is a possibility that the balance sheet mismatches in the short term may offset each other in such a way that it masks the true IRR sensitivity, something which may only be articulated by means of simulation analysis. This confirms the constraints of gap analyses as discussed by Koch and MacDonald and the OCC (chapter 5, section 5.3, p133-p134) and Uyemura and Van Deventer (chapter 5, section 5.3, p134-p135).

7.3.3 EARNINGS-AT-RISK ANALYSIS

In support of the discussion on EAR analysis supplied by the OCC (chapter 5, section 5.5.1, p163), Bitner (chapter 5, section 5.5.1, p163), the BCBS (chapter 5, section 5.5.1, p166) and Matz (chapter 5, section 5.5.1, p163-p167), the EAR analysis conducted on the sample simulation model using the IPS-Sendero software for Typical Bank, is presented in figure 7.5 in graphical format and in table 7.6 as a comparative income statement report for a 12-month forecast period. The analysis indicates the anticipated expected or most likely scenario compared to scenarios for upward and downward interest rates. The results are a quantification of the EAR sensitivity for the specified scenario's quantum over a 12 month period.

What can be clearly derived is that Typical Bank is positioned to benefit from an increase in interest rates and will be adversely affected by a decrease in interest rates. When the gap analysis is reflected upon as per table 7.3 and figure 7.4 which indicated a positive inclination towards an interest rate increase given the behaviour of NMD accounts, the EAR sensitivity confirms the position towards interest rate changes. The duration analysis on the other hand indicated a negative capital or economic value exposure to interest rate increases as per the discussions based on table 7.4 and table 7.5. The balance sheet therefore fostered a positive duration of equity which dictates that the long-term effects of IRR will have a negative impact

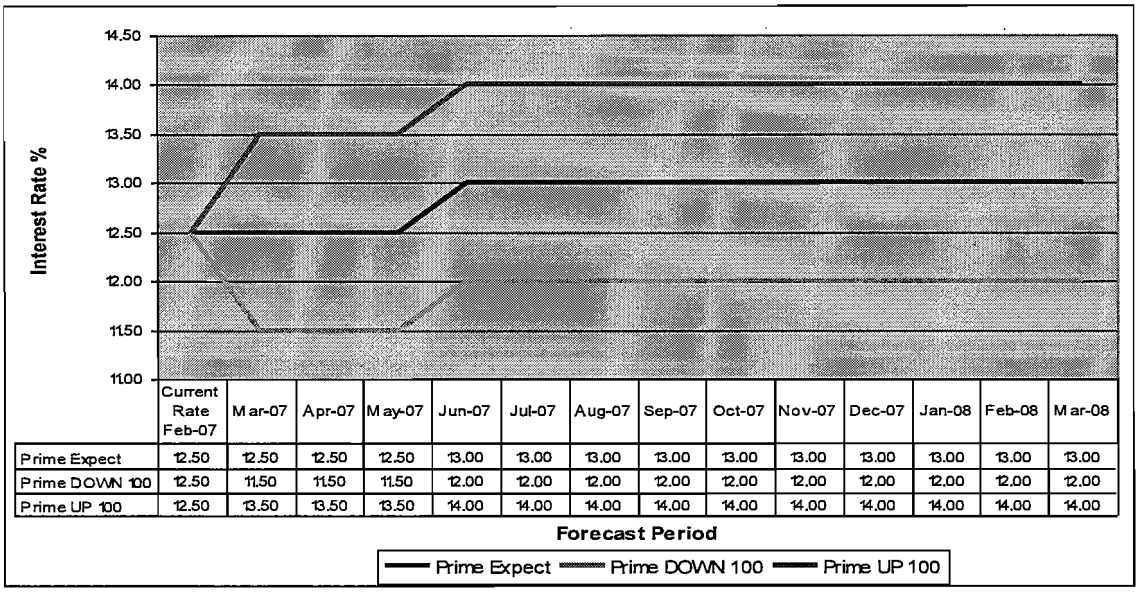
on the current balance sheet if interest rates increase. This contradicts the repricing gap and EAR-analyses.

What is highlighted is the argument by Ford, Smith and Benci and Cade (chapter 5, section 5.4, p153) that the duration analyses are highly dependent on the assumptions it deploys regarding the timing and repricing of cash flows. Closer inspection of the NMD-assumptions deployed in the repricing gap shows that the zero-rate current accounts and savings accounts attracted no duration estimate (zero duration) implying no IRR sensitivity which dictates that a shorter overall duration to liabilities are applied. The applied NMD-assumptions in the repricing gap however assigned a longer term to the rateable savings accounts (from overnight to the 1-3 month time-bucket and the 3 year time-bucket) thus changing the negative reprice gap (figure 7.3, p247) to a positive reprice gap (figure 7.4, p248).

The EAR analysis as far as the earnings perspective is concerned has the added benefit of a monetary value attached to the IRR as quantified for the specific scenario, something to which management much better respond and understand. It must be emphasised that a magnitude of varied scenarios for the balance sheet and interest rate projections may be applied within the simulation model. These scenarios may include expect, high and low interest rate scenarios with various growth assumptions for the balance sheet and non-interest income and operating expense items of the income statement. It is not feasible in the context of this dissertation to reflect on all the various deterministic and stochastic scenarios and strategies that may be applied. Only the basic concept and methodologies of the IRR measurement techniques available to banks and deployed within their simulation models are presented. The EAR simulation model core assumptions are summarised as follows:

- Target balances to grow at eight percent per annum;
- New volume term strategies indicative of historic data;
- The interest rate scenarios applied are indicative of an anticipated Prime interest rate change of 50 basis points in 4 months' time for the Expect scenario and a 100 basis points parallel interest rate shock. The forecast of interest rate scenarios used is illustrated in figure 7.5 showing the Prime index rate forecasts (Author, 2008).

Figure 7.5 Typical Bank interest rate scenarios

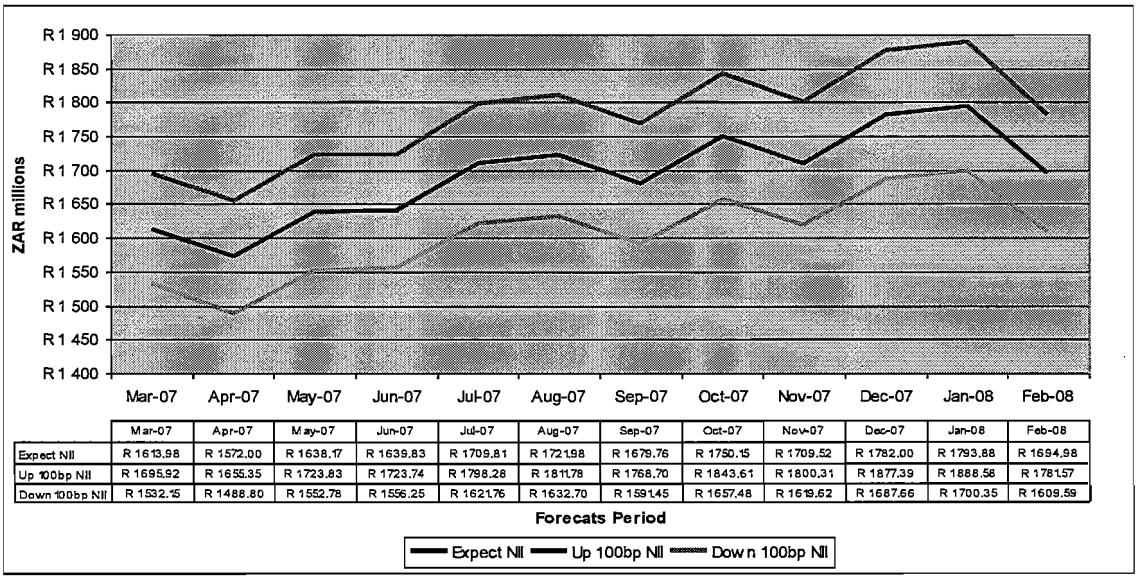


	Current Rate Feb-07	Mar-07	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08
Prime Expect	12.50	12.50	12.50	12.50	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
Prime DOWN 100	12.50	11.50	11.50	11.50	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Prime UP 100	12.50	13.50	13.50	13.50	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00

Source: (Author, 2008)

The EAR analysis conducted on Typical Bank's balance sheet as presented in figure 7.6 and table 7.6 indicates an IRR sensitivity of R1055.47 million for an instantaneous 100 basis-point rate decrease. Given the expected scenario of an increase in the Prime interest rate of 50 basis-points it indicates a balance sheet positively positioned towards interest rate anticipations. The EAR analysis therefore have the ability to supply the ALCO and the bank's management with information about a quantum of IRR exposure under varied and relevant strategies and interests rate scenarios.

Figure 7.6 Typical Bank projected 12-month NII based on 100bp EAR sensitivity



	Mar-07	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08
Expect NII	R 1613.98	R 1572.00	R 1638.17	R 1639.83	R 1709.81	R 1721.98	R 1679.76	R 1750.15	R 1709.52	R 1782.00	R 1793.88	R 1694.98
Up 100bp NII	R 1695.92	R 1655.35	R 1723.83	R 1723.74	R 1798.28	R 1811.78	R 1768.70	R 1843.61	R 1800.31	R 1877.39	R 1888.58	R 1781.57
Down 100bp NII	R 1532.15	R 1488.80	R 1552.78	R 1556.25	R 1621.76	R 1632.70	R 1591.45	R 1657.48	R 1619.62	R 1687.66	R 1700.35	R 1609.59

Source: (Author, 2008)

Table 7.6 Typical Bank 12-month NII and net income comparative report

Income Comparisons	Expect NII	Up 100bp #2	Diff. (2 - Ref.)	% Diff.	Down 100bp #3	Diff. (3 - Ref.)	% Diff.
Interest Income:							
Overdrafts	R 6 010.10	R 6 375.94	R 365.85	6.09	R 5 644.25	-R 365.85	-6.09
Treasury Bills & Bills of Exchange	R 946.06	R 1 035.49	R 89.44	9.45	R 856.69	-R 89.37	-9.45
Instalment Sales Fixed 10003	R 107.90	R 110.01	R 2.10	1.95	R 105.80	-R 2.10	-1.95
Instalment Sales Variable 10003	R 4 920.98	R 5 325.46	R 404.47	8.22	R 4 516.51	-R 404.47	-8.22
Instalment Sales	R 5 028.89	R 5 435.46	R 406.58	8.08	R 4 622.31	-R 406.58	-8.08
Home Loans Fixed 10004	R 6.53	R 6.56	R 0.03	0.41	R 6.51	-R 0.03	-0.41
Home Loans Variable 10004	R 5 855.62	R 6 358.61	R 502.99	8.59	R 5 352.63	-R 502.99	-8.59
Home Loans Adjustable 12m 10004	R 110.12	R 114.49	R 4.37	3.97	R 105.75	-R 4.37	-3.97
Home Loans Adjustable 24m 10004	R 106.71	R 107.25	R 0.54	0.51	R 106.16	-R 0.54	-0.51
Home Loans 10004	R 6 078.98	R 6 586.91	R 507.93	8.36	R 5 571.05	-R 507.93	-8.36
Commercial Property Fin Fixed 10004	R 247.71	R 249.27	R 1.56	0.63	R 246.15	-R 1.56	-0.63
Commercial Property Fin Var 10004	R 154.23	R 167.00	R 12.77	8.28	R 141.47	-R 12.77	-8.28
Commercial Prop Fin 3m Adj 10004	R 4.36	R 4.70	R 0.34	7.77	R 4.02	-R 0.34	-7.77
Commercial Property Finance 10004	R 406.30	R 420.97	R 14.66	3.61	R 391.64	-R 14.67	-3.61
Home Loans & Comm Property Finance	R 6 485.29	R 7 007.88	R 522.59	8.06	R 5 962.69	-R 522.59	-8.06
Personal Loans Fixed 10005	R 4 153.11	R 4 177.33	R 24.22	0.58	R 4 128.89	-R 24.22	-0.58
Personal Loans Variable 10005	R 2 970.96	R 3 151.80	R 180.84	6.09	R 2 790.11	-R 180.84	-6.09
Personal Loans	R 7 124.07	R 7 329.13	R 205.06	2.88	R 6 919.01	-R 205.06	-2.88
Structured Loans Fixed 10006	R 2 438.63	R 2 517.84	R 79.22	3.25	R 2 359.25	-R 79.37	-3.25
Structured Loans Variable 10006	R 269.11	R 293.46	R 24.35	9.05	R 244.76	-R 24.35	-9.05
Structured Loans Adjustable 3m10006	R 618.53	R 671.05	R 52.53	8.49	R 566.04	-R 52.49	-8.49
Structured Loans Adjustable 6m10006	R 563.31	R 604.11	R 40.80	7.24	R 522.42	-R 40.89	-7.26
Structured Loans	R 3 889.57	R 4 086.47	R 196.90	5.06	R 3 692.46	-R 197.11	-5.07
Interdivisional Loans	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Surplus Funds Investment	R 321.02	R 396.51	R 75.50	23.52	R 253.62	-R 67.39	-20.99
Total Financial Assets	R 29 804.98	R 31 666.89	R 1 861.91	6.25	R 27 951.04	-R 1 853.95	-6.22
Non-Financial Assets	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Unalloc Assets	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Total Interest Income	**R 29 804.98**	**R 31 666.89**	**R 1 861.91**	**6.25**	**R 27 951.04**	**-R 1 853.95**	**-6.22**
Interest Expense:							
Current Accounts 20001	R 293.31	R 316.09	R 22.78	7.77	R 270.54	-R 22.78	-7.77
Current Accounts Zero-Rate 20001	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Current Accounts	R 293.31	R 316.09	R 22.78	7.77	R 270.54	-R 22.78	-7.77
Savings Accounts 20002	R 1 206.90	R 1 300.62	R 93.72	7.77	R 1 113.18	-R 93.72	-7.77
Savings Accounts Zero-Rate 20002	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Savings Accounts	R 1 206.90	R 1 300.62	R 93.72	7.77	R 1 113.18	-R 93.72	-7.77
Call Deposits	R 2 469.09	R 2 759.19	R 290.10	11.75	R 2 178.94	-R 290.15	-11.75
Fixed Deposits Jibar 20004	R 24.71	R 26.99	R 2.28	9.23	R 22.43	-R 2.28	-9.23
Fixed Deposits 20004	R 2 986.25	R 3 250.85	R 264.59	8.86	R 2 722.15	-R 264.11	-8.84
Fixed Deposits	R 3 010.97	R 3 277.84	R 266.87	8.86	R 2 744.58	-R 266.39	-8.85
NCDs Jibar Linked 20005	R 343.36	R 374.83	R 31.47	9.17	R 311.89	-R 31.47	-9.16
NCDs Issued 20005	R 2 175.29	R 2 269.26	R 93.97	4.32	R 2 081.31	-R 93.98	-4.32
Negotiable Certificates of Deposit	R 2 518.65	R 2 644.09	R 125.44	4.98	R 2 393.20	-R 125.45	-4.98
Interdivisional Funding	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Call Funding Requirement	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Total Financial Liabilities	R 9 498.92	R 10 297.83	R 798.91	8.41	R 8 700.44	-R 798.48	-8.41
Non-Financial Liabilities	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Total Interest Expense	**R 9 498.92**	**R 10 297.83**	**R 798.91**	**8.41**	**R 8 700.44**	**-R 798.48**	**-8.41**
Off-Balance:							
Total Off Balance Sheet	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Net Interest Income	**R 20 306.06**	**R 21 369.06**	**R 1 063.00**	**5.23**	**R 19 250.60**	**-R 1 055.47**	**-5.20**
Provision for Loan Loss	R 1 981.53	R 1 981.53	R 0.00	0.00	R 1 981.53	R 0.00	0.00
Other Income:							
Commissions & Fees	R 6 540.00	R 6 540.00	R 0.00	0.00	R 6 540.00	R 0.00	0.00
P & L Accounts	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Total Other Income	R 6 540.00	R 6 540.00	R 0.00	0.00	R 6 540.00	R 0.00	0.00
Other Expense:							
Staff Costs	R 6 960.00	R 6 960.00	R 0.00	0.00	R 6 960.00	R 0.00	0.00
Operating Expenses	R 3 852.00	R 3 852.00	R 0.00	0.00	R 3 852.00	R 0.00	0.00
Total Other Expense	R 10 812.00	R 10 812.00	R 0.00	0.00	R 10 812.00	R 0.00	0.00
Income Before Adjustments & Taxes	R 14 052.53	R 15 115.53	R 1 063.00	7.56	R 12 997.06	-R 1 055.47	-7.51
Adj. To Income - Before Taxes	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Pretax Income	R 14 052.53	R 15 115.53	R 1 063.00	7.56	R 12 997.06	-R 1 055.47	-7.51
Local Tax #1	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Local Tax #2	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
Regional Tax	R 0.00	R 0.00	R 0.00	N/A	R 0.00	R 0.00	N/A
National Tax	R 4 075.23	R 4 383.50	R 308.27	7.56	R 3 769.15	-R 306.09	-7.51
Total Tax	R 4 075.23	R 4 383.50	R 308.27	7.56	R 3 769.15	-R 306.09	-7.51
Net Income	**R 9 977.30**	**R 10 732.03**	**R 754.73**	**7.56**	**R 9 227.92**	**-R 749.38**	**-7.51**

Source: (Author, 2008)

In the preceding sections it was discussed that the repricing gap excluding NMD-assumption (figure 7.3, p247) did not accurately quantify the IRR exposure although it gave a rudimentary indication of the balance sheets position towards changes in interest rates. The duration analyses also indicated the inclination towards interest rate movements from both an earnings and economic value perspective to be positively positioned to interest rate decreases. Given the employed assumptions the true IRR position was masked and therefore it lacks the accurateness and sophistication of dynamic analysis and varied interest rate movements. EVE simulation analysis attempts to accurately measure the economic perspective of IRR.

7.3.4 ECONOMIC VALUE OF EQUITY ANALYSIS

The EVE analysis as a measure of long-term IRR was discussed in chapter 5, section 5.5.2, p169. As discussed by Matz (chapter 5, section 5.5.2, p172), the OCC (chapter 5, section 5.5.2, p176) and Payant (chapter 5, section 5.5.2, p177) the selection of discounting method influence both the discount rates and cash flows used in calculating EV. The discount rate calculation was discussed based on the IPS-Sendero formulas and examples as referenced in the previous section. In order to gain a better understanding of how the discounting methods differs in terms of the cash flows used in the EV calculation, the IPS-Sendero SVAL simulation model can be used to generate examples to show the differences in the methods for a floating or variable rate and fixed rate product.

IPS-Sendero (2006**a**:807) states that all cash flows are calculated consistently for all discounting methods but the Current Rate Discounting method will use repricing balance cash flows instead of contractual cash flows as used under the Hybrid and Path Dependent Discounting methods.

As discussed by Geske and Shearer and the BCBS (chapter 5, section 5.5.2, p175-p176) by reflecting on the EV calculation for a variable and fixed rate amortising cash flow product such as a mortgage loan, a better understanding may be achieved on the cash flow impact of the various EV calculation methods. The cash flows used for the variable and adjustable products will be used similar to a fixed rate product when the Path Dependent and Hybrid Discounting methods are used. Conversely variable rate products' contractual cash flows will be applied under the Path Dependent and Hybrid Discounting methods reflecting a similar application of cash flow balances to a fixed rate product under the Current Rate Discounting method. The cash

flows will however be based on the repricing balances at the first repricing dates under the Current Rate Discounting method for variable and adjustable rate products.

Table 7.7 and table 7.8 indicates the EV calculation for a variable rate and fixed rate mortgage respectively under a combination of input variables such as ratios, spreads and maturity timing factors. These two reports illustrate the different cash flows utilised under the various EV calculation methods. This was discussed in chapter 5, section 5.5.2, p173–p178 by the methodologies for calculating EV by the IPS-Sendero software.

Table 7.7 Variable rate product using the Current Rate Discounting method

	Total	Nov-05	Dec-05	Jan-06
Home Loans Variable				
Current Curve				
Discount Method KR/YC - Prime / None				
EV Spread - None				
Global Ratio/Spread - 1.00 / 2.00				
Prepayment Type - (None)				
Rate KR/YC - Prime / (None)				
Repricing Term - 1				
Payment Frequency - Monthly				
Static				
Beginning Balance		R5,000.00	R4,990.89	R4,981.73
Ending Balance		R4,990.89	R4,981.73	R4,972.51
Interest Cashflow	R25.68	R25.68		
Overrides and Prepayments	R0.00	R0.00		
Contractual Runoff	R5,000.00	R9.11	R9.16	R9.22
Reprice Balance		R4,990.89		
Total Cashflow	R5,025.68	R5,025.68		
SMM		0.000		
Discount Rate		12.500		
Discount Factor		0.995		
W/A Timing Factor	0.500			
Economic Value	R4,999.71	R4,999.71		
Book Value	R5,000.00			
Gain/Loss	-R0.29			
Macaulay Duration	0.042			
Modified Duration	0.037			
Weighted Avg Life	12.384			

Source: (Author, 2008)

The top section of the report in table 7.7 explains the various variables of the product impacting on the discount factor calculation. The total cash flow to be PV is made up as follow:

Interest cash flow for the month * timing factor = R25.68 (R51.37 * 0.5)
Principal maturity (as per contractual cash flow) = R 9.11
Remaining cash flows to be repriced in month 1 = R4990.89
Total cash flow to PV = R5025.68

The discount factor is calculated as follows:

$[1 / (1+ (12.50 / (100*12)))^{[(1-1)+0.50]}] / (12/12) = 0.995$

Economic Value (R5025.68 * 0.995) = R4999.71

It is important to note that given the repricing of this variable rate mortgage loan occurs in month 1 all future cash flows are discounted at cash flow period n = 1.

The EV calculation for the fixed rate mortgage loan is presented in table 7.8. The report does not include all future cash flow periods due to space constraints but the summation of the EV and cash flows are based on all future periods' cash flows.

Table 7.8 Fixed rate product using the Current Rate Discounting method

	Total	Nov-05	Dec-05	Jan-06
Home Loans Fixed				
Current Curve				
Discount Method KR/YC - Prime / None				
EV Spread - None				
Global Ratio/Spread - 1.00 / 4.00				
Prepayment Type - (None)				
Rate KR/YC - Prime / (None)				
Payment Frequency - Monthly				
Static				
Beginning Balance		R1,500.00	R1,494.38	R1,488.70
Ending Balance		R1,494.38	R1,488.70	R1,482.94
Interest Cashflow	R1,344.99	R14.30	R17.81	R18.33
Overrides and Prepayments	R0.00	R0.00	R0.00	R0.00
Contractual Runoff	R1,500.00	R5.62	R5.69	R5.75
Total Cashflow	R2,844.99	R19.92	R23.50	R24.09
SMM		0.000	0.000	0.000
Discount Rate		14.500	14.500	14.500
Discount Factor		0.990	0.979	0.967
W/A Timing Factor	0.774			
Economic Value	R1,499.68	R19.73	R23.00	R23.30
Book Value	R1,500.00			
Gain/Loss	-R0.32			
Macaulay Duration	3.873			
Modified Duration	3.383			
Weighted Avg Life	6.185			

Source: (Author, 2008)

For explanation and example purposes the discount factor used in December 2005 which is the 2nd EV period, is calculated as follows:

$[1 / (1+ (14.50 / (100*12)))^{[(2-1)+0.774]}] / (12/12) = 0.979$

All other cash flow periods' discount factors are calculated based on the same formula. The weighted average timing factor of the cash flow is the result of the weighted average payment day of cash flows occurs on the 24th day of each month. Therefore the timing factor applied to the cash flows in the discount factor calculations is calculated in the following manner:

The maturity timing in days ÷ 31days = 24/31 = 0.774

The EV for this fixed rate mortgage loan is calculated by summing all the cash flow periods' economic values. The result is that a fixed rate mortgage loan of R1500 yields an EV of R1499.68 given the combination of input variables.

Considering the preceding discussion on EVE sensitivity analysis and how to perform the analysis by using simulation modelling techniques, the considerations are numerous. The selection of method, discount rates and cash flows should all be carefully considered. Embedded options and the cash flow timings of NMD accounts require significant analysis in order to formulate accurate assumptions. In reflecting on EVE sensitivity analysis of Typical Bank's balance sheet, prepayment assumptions are not included due to explanatory complexities which require discussion specifically around OAS analysis, which is beyond the scope of this dissertation. The NMD assumptions apply as previously indicated for the simulation model (chapter 7, section 7.3.1, p245).

The EVE analysis for Typical Bank therefore reflects on EVE under alternative interest rate scenarios. The EVE sensitivity derived from the analysis is an indication of the risk to potential future earnings. For illustration purposes scenarios indicating high, expected and low interest rate scenarios are used to imply the usage of alternative interest rate scenarios. The alternative interest rate scenarios may be deterministically or stochastically derived. As discussed by the OCC (chapter 5, section 5.5, p161) and Matz (chapter 5, section 5.5.2, p180) deterministic scenarios may be derived by using interest rate shocks or the implied forward interest rates. One or more realistic scenarios may also be forecasted typically using the budget rate forecast or from other sources such as the bank's economist, or a consensus from the bank's economic unit or the ALCO. Stochastic scenarios are typically forecast using a term structure model. The EVE analysis is also conducted on the balance sheet of Typical Bank based on a 200 basis point parallel interest rate shock typical to the recommendations of the BCBS (chapter 5, section 5.5.2, p181). The 200 basis point rate shock is also applicable to the discussions of Bowers

(chapter 5, section 5.5.2, p170) and Payant (chapter 5, section 5.5.2, p176) on using rate shock analysis to determine EVE sensitivity.

The EVE sensitivity analyses for Typical Bank are conducted showing both the Current Rate Discounting and Path Dependent Discounting methods as applied by IPS-Sendero (2006**a**:806). This highlights the difference in impact on the EVE due to the selection of discount rates and the usage of cash flow information.

The Base scenario EVE calculation is presented in table 7.9 (p261). The balance sheet products' EV is shown from which the net economic value or EVE is calculated for Typical Bank. The EVE of Typical Bank equates to R 30 373.01 using the Current Rate Discounting method. According to the recommendations of Matz, the BCBS, the OCC and Payant (chapter 5, section 5.5.2, p180-p181) the risk to EVE should therefore be the deviation from the base case EVE due to changes in interest rates.

Table 7.10 (p262) presents the condensed EVE results for 2 alternative scenarios depicting a deterministic derived high and low interest rate scenarios. It must be kept in mind that a full balance sheet EV calculation is performed for each instrument to calculate the EVE. This enables the capability to analyse EV change at the individual product level as noted by Matz (chapter 5, section 5.5.2, p185). The Current Rate Discounting method was applied. As discussed by Matz (chapter 5, section 5.5.2, p181) the focus is on the value change between scenarios which can be done either as monetary value change or percentage change from the base scenario. Table 7.11 (p262) presents the EVE results for the same base, high and low interest rate scenarios but using the Path Dependent Discounting method.

The selections of discounting method i.e. discount rates and cash flow values and cash flow timings clearly have a significant effect on the EVE sensitivity, as noted by Matz (chapter 5, section 5.5.2, p172) and IPS-Sendero (chapter 5, section 5.5.2, p173). The sensitivity for the High scenario changed from -1.27% (table 7.10) to -3.95% (table 7.11) between the two methods. The Low scenario changed from 1.34% to 14.97% due to discounting method selected. What the Path Dependent Discounting method highlights is that given the cash flow profile and the series of 1 month forecast rates under the Low scenario is that the long-term future earnings prospects are significantly more positive under the Low interest rate scenario. Contrary to what is shown in the EAR analysis in that the balance sheet is geared over the next accounting period

of 12 months to benefit from rising interest rates as proposed in table 7.6. This also confirms the duration estimates of IRR in that the long-term exposure to IRR indicates that Typical Bank is geared towards benefiting in decreases in interest rates. This highlights Matz's (chapter 5, section 5.5.2, p183-p184) recommendation that both the EAR and EVE analyses must be applied to measure and manage IRR.

Table 7.9 EVE base scenario analysis using Current Rate Discounting

ECONOMIC VALUE	Static
Typical Bank	
Base NMD	
Base NMD	
Assets:	
Overdrafts	R 35,000.00
Treasury Bills & Bills of Exchange	R 9,995.78
Instalment Sales Fixed 10003	R 952.03
Instalment Sales Variable 10003	R 39,155.39
Instalment Sales	R 40,107.42
Home Loans Fixed 10004	R 69.92
Home Loans Variable 10004	R 48,106.30
Home Loans Adjustable 12m 10004	R 924.73
Home Loans Adjustable 24m 10004	R 929.91
Home Loans 10004	R 50,030.86
Commercial Property Fin Fixed 10004	R 1,742.69
Commercial Property Fin Var 10004	R 1,254.42
Commercial Prop Fin 3m Adj 10004	R 35.42
Commercial Property Finance 10004	R 3,032.52
Home Loans & Comm Property Finance	R 53,063.38
Personal Loans Fixed 10005	R 7,806.76
Personal Loans Variable 10005	R 17,295.88
Personal Loans	R 25,102.64
Structured Loans Fixed 10006	R 21,863.05
Structured Loans Variable 10006	R 2,446.59
Structured Loans Adjustable 3m10006	R 5,841.07
Structured Loans Adjustable 6m10006	R 4,930.73
Structured Loans	R 35,081.44
Interdivisional Loans	R 0.00
Surplus Funds Investment	R 0.00
Total Financial Assets	R 198,350.66
Debtors 10007	R 5,000.00
Non-Financial Assets	R 5,000.00
Accrued Interest Receivable	R 0.00
Unalloc Assets	R 0.00
Total Assets	R 203,350.66
Liabilities:	
Current Accounts 20001	R 7,284.53
Current Accounts Zero-Rate 20001	R 37,715.47
Current Accounts	R 45,000.00
Savings Accounts 20002	R 29,973.52
Savings Accounts Zero-Rate 20002	R 26.48
Savings Accounts	R 30,000.00
Call Deposits	R 27,836.58
Fixed Deposits Jibar 20004	R 244.13
Fixed Deposits 20004	R 29,823.62
Fixed Deposits	R 30,067.75
NCDs Jibar Linked 20005	R 3,439.11
NCDs Issued 20005	R 21,634.20
Negotiable Certificates of Deposit	R 25,073.31
Interdivisional Funding	R 0.00
Call Funding Requirement	R 0.00
Total Financial Liabilities	R 157,977.65
Creditors 20006	R 15,000.00
Non-Financial Liabilities	R 15,000.00
Accrued Interest Payable	R 0.00
Total Liabilities	R 172,977.65
Equity:	
Total Equity	R 30,373.01
Off-Balance:	
Buy Swaps	R 0.00
Total Off Balance Sheet	R 0.00
Other Income:	
Total Servicing Income	R 0.00
P & L Accounts	R 0.00
Total Other Income	R 0.00

Source: (Author, 2008)

Table 7.10 EVE alternative scenario analysis using Current Rate Discounting

Typical Bank EVE Decision Matrix EV Point: Static			
Baseline Result: Base NMD	Economic Value of Equity	difference	% difference
Base NMD	R 30 373.01	R 0.00	0.00
ALT1 NMD High	R 29 987.84	R -385.18	-1.27
ALT2 NMD Low	R 30 779.68	R 406.67	1.34

Source: (Author, 2008)

When typical OAS analyses are deployed, where cash flows are further changed due to prepayments driven by interest rate levels, the changes may even be more dramatic. This dictates that the appropriate measurement method and discount rates derived from the correct yield curve or pricing rate must be applied to produce credible results.

Table 7.11 EVE alternative scenario analysis using Path Dependent Discounting

Typical Bank EVE Decision Matrix EV Point: Static			
Baseline Result: Base NMD PDD	Economic Value of Equity	difference	% difference
Base NMD PDD	R 44 195.77	R 0.00	0.00
ALT1 NMD High PDD	R 42 449.41	R -1 746.36	-3.95
ALT2 NMD Low PDD	R 50 812.81	R 6 617.04	14.97

Source: (Author, 2008)

EVE sensitivity analysis results, based on a 200 basis point parallel interest rate shock, are presented in table 7.12 and Table 7.13. The sensitivity analysis performed under a parallel rate shock provides the ability to standardise the measurement approach. This enables the bank's management to assess the risk to EVE consistently over subsequent measurement periods for example in 1 month's time, 2 month's time etc. The benefit is that it may be compared to previous risk numbers and ultimately against preset hard limits as set out in the IRR policy.

Table 7.12 presents the EVE sensitivity of Typical Bank to a 200 basis point rate shock using the Current Rate Discounting method. Table 7.13 applies the Path Dependent Discounting method which results in a higher EVE sensitivity towards a 200 basis point rate shock. The direction of risk however stays consistent which indicates that both methods of risk assessment capture the balance sheet's exposure in a credible manner.

Table 7.12 EVE sensitivity to a 200 basis point parallel rate shock using Current Rate Discounting

Typical Bank EVE Decision Matrix EV Point: Static			
Baseline Result: Base NMD	Economic Value of Equity	difference	% difference
Base NMD	R 30 373.01	R 0.00	0.00
Base NMD DN 200	R 31 682.84	R 1 309.83	4.31
Base NMD UP 200	R 29 243.96	R -1 129.06	-3.72

Source: (Author, 2008)

Table 7.13 EVE sensitivity to a 200 basis point parallel rate shock using Path Dependent Discounting

Typical Bank EVE Decision Matrix EV Point: Static			
Baseline Result: Base NMD PDD	Economic Value of Equity	difference	% difference
Base NMD PDD	R 44 195.77	R 0.00	0.00
Base NMD DN 200 PDD	R 46 667.18	R 2 471.41	5.59
Base NMD UP 200 PDD	R 42 066.69	R -2 129.09	-4.82

Source: (Author, 2008)

7.4 MATCHED-TERM FUNDS TRANSFER PRICING

A practical application of Matched-Term FTP has been performed on the sample balance sheet of Typical Bank. The MTFTP methodology was discussed in chapter 6, section 6.3, p219. In solving the measurement problem (which was discussed in chapter 6, section 6.2.1, p195) the FTP process applied to the Typical Bank balance sheet, identified and quantified the individual business units' profitability but also the client and organisational profitability. Typical Bank exists of 2 business units representing retail and corporate client focused institutional hierarchy. The two divisions are referred to as the Retail Division and the Corporate Division. The product profitability is therefore presented per business unit, derived from the individual customer transaction level. For explanation purposes table 7.14 presents the divisional balance sheets of Typical Bank. It must be noted that the consolidated balance sheet of Typical Bank presented in section 7.2, table 7.1 (p243) includes consolidation eliminations of the interdivisional funding lines used to establish divisional balanced balance sheets.

Table 7.14 Typical Bank divisional balance sheets – Retail Division and Corporate Division

Balance Sheet for RETAIL DIVISION as at the end of 28 February 2007.

	R '000 000
FINANCIAL ASSETS	
Overdrafts	R 25,000
Treasury Bills	R 0
Installment Sales	R 30,000
Home Loans & Commercial Property Finance	R 50,000
Personal Loans	R 25,000
Structured Loans	R 0
TOTAL FINANCIAL ASSETS	**R 130,000**
NON-FINANCIAL ASSETS	
Debtors	R 4,000
TOTAL ASSETS	**R 134,000**
FINANCIAL LIABILITIES	
Current Accounts	R 30,000
Savings Accounts	R 30,000
Interdivisional Funding (CORPORATE)	R 24,650
Fixed Deposits	R 20,000
Negotiable Certificates of Deposit	R 0
TOTAL FINANCIAL LIABILITIES	**R 104,650**
NON FINANCIAL LIABILITIES	
Creditors	R 10,000
LIABILITIES before CAPITAL	**R 114,650**
EQUITY	
Share capital	R 12,900
Retained Earnings	R 6,450
TOTAL EQUITY	**R 19,350**
TOTAL LIABILITIES	**R 134,000**

Balance Sheet for CORPORATE DIVISION as at the end of 28 February 2007.

	R '000 000
FINANCIAL ASSETS	
Overdrafts	R 10,000
Treasury Bills	R 10,000
Installment Sales	R 10,000
Home Loans & Commercial Property Finance	R 2,837
Interdivisional Loan (RETAIL)	R 24,650
Structured Loans	R 35,000
TOTAL FINANCIAL ASSETS	**R 92,487**
NON-FINANCIAL ASSETS	
Debtors	R 1,000
TOTAL ASSETS	**R 93,487**
FINANCIAL LIABILITIES	
Current Accounts	R 15,000
Savings Accounts	R 0
Call Deposits	R 27,837
Fixed Deposits	R 10,000
Negotiable Certificates of Deposit	R 25,000
TOTAL FINANCIAL LIABILITIES	**R 77,837**
NON FINANCIAL LIABILITIES	
Creditors	R 5,000
LIABILITIES before CAPITAL	**R 82,837**
EQUITY	
Share capital	R 7,100
Retained Earnings	R 3,550
TOTAL EQUITY	**R 10,650**
TOTAL LIABILITIES	**R 93,487**

Source: (Author, 2008)

The customer profitability measurement is presented in table 7.15 for an amortising cash flow home loan account priced at an annual adjustable rate. This represents the repricing term approach of MTFTP as described by IPS-Sendero (chapter 6, section 6.3, p223). The report in table 7.15 supply customer account information, transaction data and the various methodological options applied in the derivation of the transfer rate. The account generates interest income at a rate of 10.15% or R17007.33 for the period. The transfer rate of 9.1098% translates in a transfer expense of R15264.44. The NIM attributable to the asset spread or lending spread therefore equates to 1.0402% or R1742.89, representing the risk-adjusted value-add by the customer transaction through the lending activity of the bank.

Table 7.15 Retail Division amortising mortgage loan – annual adjustable rate

Table: Loans Home Loans
Effective Date: 2/28/2007
Restated Rates: Restated Transfer Rates

Report Date and Time: 1/3/2008 10:56:56AM

FTP Results Typical Bank
Account Detail Report

Break Charge Errors
Pricing Errors and Warnings

Account Information

Account Number	00000000000883020780010l	Chart Name	Home Loans Variable 10004	Bank	1
GL Account #	10004	Organizational Unit	Retail Division	Cost Center	2107

Account Data

Current Balance	2,184,262.70	Trade Date	11/16/2004	Original Term	242.00	Rate Type	A
Original Balance	2,184,000.00	Origination Date	11/16/2004	Balloon Term	0.00	Pmt Type	7
Average Balance	2,184,262.70	Maturity Date	1/1/2025	Remaining Term	214.03	Accrual Basis	ACT/ACT
Last Rep. Balance	2,184,262.70	Balloon Date		Rate Chg Freq	12	Pmt Freq	Monthly
PI Payment	22,086.55	Last Rep. Date	10/16/2006			Currency Code	
Percent Owned	100.00	Nxt Rep. Date	10/16/2007			GL Account Type	Asset
		Price Date	10/16/2006	Price Term	12.00	Coupon Rate	10.1500

Target Information

Transfer Method Mapped	Term to Maturity/Repricing Term	Prepay Table	None	Lag Name	None
Transfer Method Used	Term to Maturity/Repricing Term	Prepay Type		Lag Type	
Yield Curve Mapped	Valuation Curve	Prepay Value	0.00	Lag Value	
Yield Curve Used	Valuation Curve				

Effective Rate Details (Restated Transfer Rates)

Base EffectiveTransfer Rate		9.1098
Transfer Rate Adjustments		
(Weighting Factor - 1.0000)		
Adjustment 1	0.0000	
Adjustment 2	0.0000	
Adjustment 3	0.0000	
Adjustment 4	0.0000	
Adjustment 5	0.0000	
Total Adjustments		0.0000
Effective Transfer Rate		**9.1098**
Effective Interest Rate		10.1500
Effective Spread		**1.0402**

Ending Rate Details (not restated)

	Previous Period	Current Period
Ending Base Transfer Rate	9.1098	9.1098
Ending Interest Rate	10.1500	10.1500
Ending Base Spread	1.0402	1.0402

Break Funding Details

Prepay Amount	0.00
Prepay Speed (CPR)	0.00
Waived Break (Chg)/Cr	0.00
LTD Prepay Amount	0.00
LTD Break (Chg)/Cr	0.00
LTD Waived Break (Chg)/Cr	0.00
Prepay Criteria:	

Income / Expense

Average Balance	2,184,262.70
Effective Interest Rate	10.1500
Interest I/E	17,007.33
Average Balance	2,184,262.70
EffectiveTransfer Rate	9.1098
Transfer I/E	(15,264.44)
Net Interest Margin	**1,742.89**
Break (Charge)/Credit	0.00
Break Funding Margin	**1,742.89**

Page 1 of 1

Source: (Author, 2008)

The use of a replicating portfolio rate is presented in table 7.16. This represents the use of a key rate for a variable rate product with amortising cash flows. For Typical Bank's prime interest rate linked products, the Prime Replicating Portfolio rate is presented to illustrate the use of statistical analysis to establish a combination of term rates best reflecting the repricing term or characteristics of the account. This was explained earlier based on the information by IPS-Sendero (chapter 6, section 6.3, p228) for variable rate accounts.

The transfer expense and NIM component is analysed similar to that was done for the home loan presented in table 7.15. The prime-linked instalment sale loan has an asset spread of 3.67%. Table 7.17 presents a similar instalment sale loan at a fixed interest rate. This presents the use of

the cash flow approach in MTFTP for an instrument with contractual amortising cash flows at a fixed interest rate, as described by IPS-Sendero (chapter 6, section 6.3, p225). The asset spread for this transaction is 2.436%.

Table 7.16 Retail Division amortising instalment sale loan – variable rate account

Table: Loans Instalment Sales
Effective Date: 2/28/2007
Restated Rates: Restated Transfer Rates

Report Date and Time: 1/3/2008 10:54:18AM

FTP Results Typical Bank
Account Detail Report

Break Charge Errors
Pricing Errors and Warnings

Account Information

Account Number	00000000000002407400010312	Chart Name	Instalment Sales Variable 10003	Bank	1
GL Account #	10003	Organizational Unit	Retail Division	Cost Center	2107

Account Data

Current Balance	2,657,720.65	Trade Date		Original Term	72.00	Rate Type	V
Original Balance	6,585,854.88	Origination Date	4/1/2003	Balloon Term	0.00	Pmt Type	7
Average Balance	2,657,720.65	Maturity Date	4/1/2009	Remaining Term	25.03	Accrual Basis	30/365
Last Rep. Balance	0.00	Balloon Date		Rate Chg Freq	0	Pmt Freq	Monthly
PI Payment	117,214.64	Last Rep. Date				Currency Code	
Percent Owned	100.00	Nxt Rep. Date				GL Account Type	Asset
		Price Date	2/1/2007	Price Term	1.00	Coupon Rate	12.5000

Target Information

Transfer Method Mapped	Assign Rate	Prepay Table	None	Lag Name	None
Transfer Method Used	Assign Rate	Prepay Type		Lag Type	
Key Rate Mapped	Prime Replicating Portfolio Rate	Prepay Value	0.00	Lag Value	
Key Rate Used	Prime Replicating Portfolio Rate				

Effective Rate Details (Restated Transfer Rates)

Base EffectiveTransfer Rate		8.8334
Transfer Rate Adjustments		
(Weighting Factor - 1.0000)		
Adjustment 1	0.0000	
Adjustment 2	0.0000	
Adjustment 3	0.0000	
Adjustment 4	0.0000	
Adjustment 5	0.0000	
Total Adjustments		0.0000
Effective Transfer Rate		**8.8334**
Effective Interest Rate		12.5000
Effective Spread		**3.6666**

Ending Rate Details (not restated)

	Previous Period	Current Period
Ending Base Transfer Rate	8.8334	8.8334
Ending Interest Rate	12.5000	12.5000
Ending Base Spread	3.6666	3.6666

Break Funding Details

Prepay Amount	0.00
Prepay Speed (CPR)	0.00
Waived Break (Chg)/Cr	0.00
LTD Prepay Amount	0.00
LTD Break (Chg)/Cr	0.00
LTD Waived Break (Chg)/Cr	0.00
Prepay Criteria:	

Income / Expense

Average Balance	2,657,720.65
Effective Interest Rate	12.5000
Interest I/E	25,484.99
Average Balance	2,657,720.65
EffectiveTransfer Rate	8.8334
Transfer I/E	(18,009.55)
Net Interest Margin	**7,475.45**
Break (Charge)/Credit	0.00
Break Funding Margin	**7,475.45**

Page 1 of 1

Source: (Author, 2008)

The use of the term to maturity approach in MTFTP, as described by IPS-Sendero (chapter 6, section 6.3, p224), is presented in table 7.18. The fixed deposit has a single contractual future cash flow at a fixed interest rate. The liability or funding spread is 0.4811%. This indicates that the credit for funds provided is higher than the interest rate paid to the customer resulting into a positive value-add from this transaction. The CFU or FC therefore bought or valued the funds sourced by the Corporate Division at a higher price than what is paid externally to the customer.

Table 7.17 Retail Division amortising instalment sale loan – fixed rate account

Table: Loans Instalment Sales
Effective Date: 2/28/2007
Restated Rates: Restated Transfer Rates

Report Date and Time: 1/3/2008 10:54:18AM

FTP Results Typical Bank
Account Detail Report

Break Charge Errors
Pricing Errors and Warnings

Account Information

Account Number	00000000000007522100000005	**Chart Name**	Instalment Sales Variable 10003	**Bank**	1
GL Account #	10003	**Organizational Unit**	Retail Division	**Cost Center**	2107

Account Data

Current Balance	487,026,807.68	Trade Date	2/1/2004	Original Term	147.00	Rate Type	F
Original Balance	326,801,146.89	Origination Date	2/1/2004	Balloon Term	0.00	Pmt Type	7
Average Balance	487,026,807.68	Maturity Date	5/10/2016	Remaining Term	110.32	Accrual Basis	30/365
Last Rep. Balance	0.00	Balloon Date		Rate Chg Freq	0	Pmt Freq	Monthly
PI Payment	7,256,459.76	Last Rep. Date				Currency Code	
Percent Owned	100.00	Nxt Rep. Date				GL Account Type	Asset
		Price Date	2/1/2004	Price Term	147.00	Coupon Rate	11.9000

Target Information

Transfer Method Mapped	Cashflow	Prepay Table	None	Lag Name	None
Transfer Method Used	Cashflow	Prepay Type		Lag Type	
Yield Curve Mapped	Valuation Curve	Prepay Value	0.00	Lag Value	
Yield Curve Used	Valuation Curve				

Effective Rate Details (Restated Transfer Rates)

Base EffectiveTransfer Rate		9.4640
Transfer Rate Adjustments		
(Weighting Factor - 1.0000)		
Adjustment 1	0.0000	
Adjustment 2	0.0000	
Adjustment 3	0.0000	
Adjustment 4	0.0000	
Adjustment 5	0.0000	
Total Adjustments		0.0000
Effective Transfer Rate		**9.4640**
Effective Interest Rate		11.9000
Effective Spread		**2.4360**

Ending Rate Details (not restated)

	Previous Period	Current Period
Ending Base Transfer Rate	9.4640	9.4640
Ending Interest Rate	11.9000	11.9000
Ending Base Spread	2.4360	2.4360

Break Funding Details

Prepay Amount	0.00
Prepay Speed (CPR)	0.00
Waived Break (Chg)/Cr	0.00
LTD Prepay Amount	0.00
LTD Break (Chg)/Cr	0.00
LTD Waived Break (Chg)/Cr	0.00
Prepay Criteria:	

Income / Expense

Average Balance	487,026,807.68
Effective Interest Rate	11.9000
Interest I/E	4,445,954.31
Average Balance	487,026,807.68
EffectiveTransfer Rate	9.4640
Transfer I/E	(3,535,837.57)
Net Interest Margin	**910,116.74**
Break (Charge)/Credit	0.00
Break Funding Margin	**910,116.74**

* Cashflow schedules are not displayed when the Recalculate Transfer Rates Only when Necessary option is in effect.

Page 1 of 1

Source: (Author, 2008)

Table 7.18 Corporate Division fixed deposit – contractual maturity at fixed rate

Table: Term Deposits
Effective Date: 2/28/2007
Restated Rates: Restated Transfer Rates

Report Date and Time: 1/3/2008 10:51:45AM

FTP Results Typical Bank
Account Detail Report

Break Charge Errors
Pricing Errors and Warnings

Account Information

Account Number	00000000374975135590000104	Chart Name	Fixed Deposits 20004	Bank	1
GL Account #	20004	Organizational Unit	Corporate Division	Cost Center	2124

Account Data

Current Balance	181,500.93	Trade Date	12/19/2006	Original Term	3.00	Rate Type	F
Original Balance	181,500.93	Origination Date	12/19/2006	Balloon Term	0.00	Pmt Type	9
Average Balance	181,500.93	Maturity Date	3/20/2007	Remaining Term	0.65	Accrual Basis	ACT/ACT
Last Rep. Balance	0.00	Balloon Date		Rate Chg Freq	0	Pmt Freq	At Maturity
PI Payment	0.00	Last Rep. Date				Currency Code	
Percent Owned	100.00	Nxt Rep. Date				GL Account Type	Liability
		Price Date	12/19/2006	Price Term	3.00	Coupon Rate	8.6000

Target Information

Transfer Method Mapped	Term to Maturity/Repricing Term	Prepay Table	None	Lag Name	None
Transfer Method Used	Term to Maturity/Repricing Term	Prepay Type		Lag Type	
Yield Curve Mapped	Valuation Curve	Prepay Value	0.00	Lag Value	
Yield Curve Used	Valuation Curve				

Effective Rate Details (Restated Transfer Rates)

Base EffectiveTransfer Rate		9.0811
Transfer Rate Adjustments		
(Weighting Factor - 1.0000)		
Adjustment 1	0.0000	
Adjustment 2	0.0000	
Adjustment 3	0.0000	
Adjustment 4	0.0000	
Adjustment 5	0.0000	
Total Adjustments		0.0000
Effective Transfer Rate		**9.0811**
Effective Interest Rate		8.6000
Effective Spread		**0.4811**

Ending Rate Details (not restated)

	Previous Period	Current Period
Ending Base Transfer Rate	9.0811	9.0811
Ending Interest Rate	8.6000	8.6000
Ending Base Spread	0.4811	0.4811

Break Funding Details

Prepay Amount	0.00
Prepay Speed (CPR)	0.00
Waived Break (Chg)/Cr	0.00
LTD Prepay Amount	0.00
LTD Break (Chg)/Cr	0.00
LTD Waived Break (Chg)/Cr	0.00
Prepay Criteria:	

Income / Expense

Average Balance	181,500.93
Effective Interest Rate	8.6000
Interest I/E	(1,197.41)
Average Balance	181,500.93
EffectiveTransfer Rate	9.0811
Transfer I/E	1,264.39
Net Interest Margin	**66.99**
Break (Charge)/Credit	0.00
Break Funding Margin	**66.99**

Page 1 of 1

Source: (Author, 2008)

For simplicity sake the product and organisational profitability analysis is jointly presented in the following reports. The management information and reports that are available from a modern well-implemented FTP system is endless. Needles to say that all reports and analysis can not be presented in this dissertation. The allocation of the NIM to the various products and units of Typical Bank is presented in table 7.19. Both product and organisational unit profitability measurement information is available from the application of the Matched-Term FTP concept. Therefore the NIM components are isolated and identified and typical Bank has the capability of allocating the NIM to the various line managers. Accountability may now vest with the appropriate resources for managing the controllable risk elements' contribution to the NIM and overall profitability residing in the customers, products and business units.

It is also important to note that most capital is invested in typical Prime interest rate indexed products and therefore attracts a credit to the divisions at the prime replicating portfolio rate. This is typically assumption driven and highlights the importance of a well-defined capital allocation methodology in order to establish better capital pricing within the broader RAPM. As noted by Payant (chapter 3, section 3.3, p76) and Matten (chapter 6, section 6.1, p191) the development of a capital allocation methodology are important to the overall RAPM process. Capital, debtors and creditors balances are furthermore contributing to the net endowment effect on the NIM. Changes in interest rate environments will therefore significantly impact the risk-adjusted margin, or components of the NIM.

Table 7.19 Transfer margin report for Typical Bank

Project: Typical Bank FTP
Results Table: FTP Typical Bank Feb 2007
Effective Date: 2/28/2007
Balances and I/E: GL Balances

Report Date and Time: 1/3/2008 10:21AM

FTP Results Typical Bank
Static Reports:
Transfer Margin Report

Organizational View: Typical Bank Hierarchy
G/L View: GL Account View

Filter: None

Typical Bank	Balance	Income / (Expense)			Rates		
	Average Balance	Interest Inc./(Exp.)	Transfer Inc./(Exp.)	Margin	Interest Rate	Transfer Rate	Spread
Asset Accounts:							
GL Account Number and Description							
10001 - Overdrafts	35,000,000,000	430,930,361	(237,170,955)	193,759,406	16.050	8.833	7.217
10002 - Treasury Bills	10,000,000,000	64,212,863	(67,123,288)	(2,910,425)	8.371	8.750	(0.379)
10003 - Installment Sales	40,000,000,000	355,413,147	(272,311,032)	83,102,115	11.583	8.874	2.708
10004 - Home Loans & Com Property Finance	52,836,584,249	453,544,553	(359,943,825)	93,600,728	11.190	8.880	2.309
10005 - Personal Loans	25,000,000,000	518,798,574	(166,829,492)	351,969,082	27.052	8.699	18.353
10006 - Structured Loans	35,000,000,000	284,382,855	(243,611,735)	40,771,120	10.592	9.073	1.519
10007 - Debtors	5,000,000,000	0	(33,863,012)	(33,863,012)	0.000	8.829	(8.829)
10008 - Interdivisional Loan (RETAIL)	24,650,000,000	166,952,762	(166,944,649)	8,112	8.829	8.829	0.000
Totals for selected Asset Accounts	**227,486,584,249**	**2,274,235,114**	**(1,547,797,987)**	**726,437,127**	**13.032**	**8.869**	**4.163**
Liability Accounts:							
GL Account Number and Description							
20001 - Current Accounts	(45,000,000,000)	(27,279,395)	304,767,108	277,487,713	0.790	8.829	8.038
20002 - Savings Accounts	(30,000,000,000)	(87,783,642)	203,178,072	115,394,430	3.814	8.829	5.014
20003 - Call Deposits	(27,836,584,249)	(160,336,378)	184,026,511	23,690,133	7.508	8.618	1.109
20004 - Fixed Deposits	(30,000,000,000)	(207,250,920)	207,587,183	336,263	9.006	9.020	0.014
20005 - Negotiable Certificates of Deposit	(25,000,000,000)	(177,578,420)	176,331,142	(1,247,278)	9.259	8.936	(0.324)
20006 - Creditors	(15,000,000,000)	0	101,589,036	101,589,036	0.000	8.829	8.829
20009 - Interdivisional Funding (CORPORATE)	(24,650,000,000)	(166,952,762)	166,944,649	(8,112)	8.829	8.829	0.000
Totals for selected Liability Accounts	**(197,486,584,249)**	**(827,181,518)**	**1,344,423,703**	**517,242,186**	**5.460**	**8.842**	**3.381**

Page 1 of 3

Results Table: FTP Typical Bank Feb 2007 Filter: None

Typical Bank	Balance	Income / (Expense)			Rates		
	Average Balance	Interest Inc./(Exp.)	Transfer Inc./(Exp.)	Margin	Interest Rate	Transfer Rate	Spread
Equity Accounts:							
GL Account Number and Description							
20007 - Share capital	(20,000,000,000)	0	135,526,260	135,526,260	0.000	8.833	8.833
20008 - Retained Earnings	(10,000,000,000)	0	67,763,130	67,763,130	0.000	8.833	8.833
Totals for selected Equity Accounts	**(30,000,000,000)**	**0**	**203,289,390**	**203,289,390**	**0.000**	**8.833**	**8.833**
Typical Bank	**0**	**1,447,053,596**	**(84,894)**	**1,446,968,702**			

Static Reports:
Transfer Margin Report

Results Table: FTP Typical Bank Feb 2007 Filter: None

Net Total	Balance	Income / (Expense)			Rates
	Average Balance	Interest Inc./(Exp.)	Transfer Inc./(Exp.)	Margin	
Totals for selected Organizational Units	**0**	**1,447,053,596**	**(84,894)**	**1,446,968,702**	

Static Reports:
Transfer Margin Report

Source: (Author, 2008)

From the report presented in table 7.19 the various products' asset and liability spreads are displayed. The balance sheet's customer balances transfer priced, per product, and interest and transfer income and expense. The Typical Bank NIM for period February 2007 is 8.29%. Corporate Division's NIM is 4.89% and Retail Division's NIM is 10.67%. The breakdown of the divisional NIM's is presented in table 7.20. Cost center 2107 refers to the center number of Retail Division and cost center 2124 refers to the center number allocated to the Corporate Division.

On closer analysis of the Retail Division's NIM the following can be derived:

- The value added from its funding and lending activities translated into an increase in its risk-adjusted profitability or NII to R1100million from an accounting NII of R1096million. A net value-add originating from IRR or mismatch is reported of R-3.7million for which the unit is credited. The R3.7million attributable to IRR is transferred to the CFU or FC.

- The funding structure of the Retail Division contribute significantly to its liability spread and therefore to its overall profitability. The value of stable and low interest rate NMD-accounts are evident.

- Personal Loans and Overdraft products are the most profitable and it is therefore derived that significant credit risk is attached to these accounts.

On closer analysis of the Corporate Division's NIM the following can be derived:

- Corporate Division's FTP results indicate a NIM value-add attributable to IRR of positive R3.79million. Therefore the R3.79million is transferred from the Corporate Division to the CFU or FC.

- The Overdrafts and Current Account products shows healthy margins but the Structured Loans product, which represents a significant portion of the lending activity in the overall balance sheet, shows a thin margin (1.519%). This may be indicative of a competitive corporate market in which Corporate Division operates or sub-optimal pricing decisions.

- The endowment effect on profitability relating to creditors and equity is significant for the Corporate Division. The division is credited with approximately R106million under the current methodology and interest rate environment. Therefore approximately 30% of the risk-adjusted NII of R346.753million is attributable to the allocation of capital and endowment value. If interest rates are set to increase this value will increase even further.

It is important to keep in mind that although the report is based on an aggregated chart of account reporting view, the underlying transactions are transfer priced based on its individual cash flow, repricing and other economic characteristics. The reporting formats and level of detail is endless especially when specialised report writing tools are applied on the data.

Table 7.20 Transfer margin reports for Retail Division and Corporate Division

Project: Typical Bank FTP
Results Table: FTP Typical Bank Feb 2007
Effective Date: 2/28/2007
Balances and I/E: GL Balances

Report Date and Time: 1/3/2008 10:07AM

FTP Results Typical Bank
Static Reports:
Transfer Margin Report

Cost Center View: Typical Bank Bank/Cost Center
Chart View: Chart of Accounts
Filter: None

Bank 1 Cost Center 2107	Balance	Income / (Expense)			Rates		
	Average Balance	Interest Inc./(Exp.)	Transfer Inc./(Exp.)	Margin	Interest Rate	Transfer Rate	Spread
Asset Accounts:							
10001 - Overdrafts	25,000,000,000	301,751,552	(169,407,825)	132,343,727	15.734	8.833	6.901
10003 - Installment Sales	30,000,000,000	265,426,061	(203,515,793)	61,910,268	11.533	8.843	2.690
10004 - Home Loans & Com Property Finance	50,000,000,000	423,941,755	(338,841,254)	85,100,501	11.053	8.834	2.219
10005 - Personal Loans	25,000,000,000	518,798,574	(166,829,492)	351,969,082	27.052	8.699	18.353
10007 - Debtors	4,000,000,000	0	(27,090,410)	(27,090,410)	0.000	8.829	(8.829)
Totals for selected Asset Accounts	**134,000,000,000**	**1,509,917,942**	**(905,684,773)**	**604,233,168**	**14.689**	**8.811**	**5.878**
Liability Accounts:							
20001 - Current Accounts	(30,000,000,000)	(22,487,140)	203,178,072	180,690,933	0.977	8.829	7.851
20002 - Savings Accounts	(30,000,000,000)	(87,783,642)	203,178,072	115,394,430	3.814	8.829	5.014
20004 - Fixed Deposits	(20,000,000,000)	(136,184,711)	137,241,626	1,056,915	8.876	8.945	0.069
20009 - Interdivisional Funding	(24,650,000,000)	(166,952,762)	166,944,649	(8,112)	8.829	8.829	0.000
20006 - Creditors	(10,000,000,000)	0	67,726,024	67,726,024	0.000	8.829	8.829
Totals for selected Liability Accounts	**(114,650,000,000)**	**(413,408,255)**	**778,268,444**	**364,860,189**	**4.700**	**8.849**	**4.148**
Equity Accounts:							
20007 - Share capital	(12,900,000,000)	0	87,414,438	87,414,438	0.000	8.833	8.833
20008 - Retained Earnings	(6,450,000,000)	0	43,707,219	43,707,219	0.000	8.833	8.833
Totals for selected Equity Accounts	**(19,350,000,000)**	**0**	**131,121,656**	**131,121,656**	**0.000**	**8.833**	**8.833**

Page 1 of 4

Bank 1 / Cost Center 2107	**0**	**1,096,509,687**	**3,705,327**	**1,100,215,014**

Bank 1 / Cost Center 2124

	Balance	Income / (Expense)			Rates		
	Average Balance	Interest Inc./(Exp.)	Transfer Inc./(Exp.)	Margin	Interest Rate	Transfer Rate	Spread
Asset Accounts:							
10001 - Overdrafts	10,000,000,000	129,178,809	(67,763,130)	61,415,679	16.839	8.833	8.006
10002 - Treasury Bills	10,000,000,000	64,212,863	(67,123,288)	(2,910,425)	8.371	8.750	(0.379)
10003 - Installment Sales	10,000,000,000	89,987,086	(68,795,239)	21,191,847	11.730	8.968	2.763
10004 - Home Loans & Com Property Finance	2,836,584,249	29,602,798	(21,102,571)	8,500,227	13.604	9.698	3.906
10006 - Structured Loans	35,000,000,000	284,382,855	(243,611,735)	40,771,120	10.592	9.073	1.519
10008 - Interdivisional Loan (RETAIL)	24,650,000,000	166,952,762	(166,944,649)	8,112	8.829	8.829	0.000
10007 - Debtors	1,000,000,000	0	(6,772,602)	(6,772,602)	0.000	8.829	(8.829)
Totals for selected Asset Accounts	**93,486,584,249**	**764,317,172**	**(642,113,214)**	**122,203,958**	**10.658**	**8.954**	**1.704**
Liability Accounts:							
20001 - Current Accounts	(15,000,000,000)	(4,792,256)	101,589,036	96,796,780	0.416	8.829	8.412
20003 - Call Deposits	(27,836,584,249)	(160,336,378)	184,026,511	23,690,133	7.508	8.618	1.109
20004 - Fixed Deposits	(10,000,000,000)	(71,066,209)	70,345,557	(720,651)	9.264	9.169	(0.095)
20005 - Negotiable Certificates of Deposit	(25,000,000,000)	(177,578,420)	176,331,142	(1,247,278)	9.259	8.936	(0.324)
20006 - Creditors	(5,000,000,000)	0	33,863,012	33,863,012	0.000	8.829	8.829
Totals for selected Liability Accounts	**(82,836,584,249)**	**(413,773,263)**	**566,155,259**	**152,381,996**	**6.511**	**8.831**	**2.320**
Equity Accounts:							
20007 - Share capital	(7,100,000,000)	0	48,111,822	48,111,822	0.000	8.833	8.833
20008 - Retained Earnings	(3,550,000,000)	0	24,055,911	24,055,911	0.000	8.833	8.833
Totals for selected Equity Accounts	**(10,650,000,000)**	**0**	**72,167,733**	**72,167,733**	**0.000**	**8.833**	**8.833**
Bank 1 / Cost Center 2124	**0**	**350,543,910**	**(3,790,222)**	**346,753,688**			

Results Table: FTP Typical Bank Feb 2007 Filter: None

Net Total	Balance	Income / (Expense)			Rates
	Average Balance	Interest Inc./(Exp.)	Transfer Inc./(Exp.)	Margin	
Totals for selected Bank / Cost Centers	0	1,447,053,596	(84,894)	1,446,968,702	

Static Reports:
Transfer Margin Report

Page 4 of 4

Source: (Author, 2008)

In order to facilitate the management and analysis of the CFU/FC (the CFU was discussed in chapter 6, section 6.2.2, p202) or mismatch unit IRR contribution to the NIM, as noted by Chittenden (chapter 6, section 6.3, p229), the mismatch spread has to be quantified.

The FC summary report as shown in table 7.21 shows the net result of all funds bought and sold by the CFU or FC from the Retail Division and Corporate Division. Typical Bank's IRR contribution to the NIM as quantified by the Matched-Term FTP process indicates an IRR contribution to the NII of R0.084894million. This represents the net funding position of the CFU or FC. The FC spread report is presented in table 7.22 indicating a mismatch spread of 0.0289% of the NIM attributable to the mismatch or IRR in the balance sheet of Typical Bank. Typical Bank therefore has an asset spread of 4.1627% and a liability spread of 4.1004%.

Table 7.21 Typical Bank Funding Center summaries per division

Project: Typical Bank FTP
Results Table: FTP Typical Bank Feb 2007
Effective Date: 2/28/2007
Balances and I/E: GL Balances

Report Date and Time: 1/3/2008 10:07AM

FTP Results Typical Bank
Static Reports:
Funding Center Summary

Cost Center View: Typical Bank Bank/Cost Center
Chart View: Chart of Accounts

Filter: None

Bank 1 Cost Center 2107	Ending Balance	Average Balance	Transfer Rate	Transfer Inc / (Exp)	Weighted Avg Remain Term
Asset Accounts:					
Overdrafts	25,000,000,000	25,000,000,000	8.833	169,407,825	1
Instalment Sales Variable 10003	30,000,000,000	30,000,000,000	8.843	203,515,793	49
Home Loans Variable 10004	50,000,000,000	50,000,000,000	8.834	338,841,254	205
Personal Loans Variable 10005	25,000,000,000	25,000,000,000	8.699	166,829,492	40
Debtors 10007	4,000,000,000	4,000,000,000	8.829	27,090,410	0
Totals for selected Asset Accounts	**134,000,000,000**	**134,000,000,000**	**8.811**	**905,684,773**	**95**
Liabilities Accounts:					
Current Accounts 20001	(30,000,000,000)	(30,000,000,000)	8.829	(203,178,072)	0
Savings Accounts 20002	(30,000,000,000)	(30,000,000,000)	8.829	(203,178,072)	0
Fixed Deposits 20004	(20,000,000,000)	(20,000,000,000)	8.945	(137,241,626)	(1)
Interdivisional Funding	(24,650,000,000)	(24,650,000,000)	8.829	(166,944,649)	0
Creditors 20006	(10,000,000,000)	(10,000,000,000)	8.829	(67,726,024)	0
Totals for selected Liability Accounts	**(114,650,000,000)**	**(114,650,000,000)**	**8.849**	**(778,268,444)**	**0**
Equity Accounts:					
Share Capital 20007	(12,900,000,000)	(12,900,000,000)	8.833	(87,414,438)	0
Retained Earnings 20008	(6,450,000,000)	(6,450,000,000)	8.833	(43,707,219)	0
Totals for selected Equity Accounts	**(19,350,000,000)**	**(19,350,000,000)**	**8.833**	**(131,121,656)**	**0**

Results Table: FTP Typical Bank Feb 2007

Filter: None

Bank 1 / Cost Center 2107	**0**	**0**	**(3,705,327)**

Results Table: FTP Typical Bank Feb 2007 Filter: None

Bank 1 Cost Center 2124	Ending Balance	Average Balance	Transfer Rate	Transfer Inc / (Exp)	Weighted Avg Remain Term
Asset Accounts:					
Overdrafts	10,000,000,000	10,000,000,000	8.833	67,763,130	2
Treasury Bills & Bills of Exchange	10,000,000,000	10,000,000,000	8.750	67,123,288	2
Instalment Sales Variable 10003	10,000,000,000	10,000,000,000	8.968	68,795,239	41
Home Loans Variable 10004	2,836,584,249	2,836,584,249	9.698	21,102,571	74
Structured Loans Variable 10006	35,000,000,000	35,000,000,000	9.073	243,611,735	46
Interdivisional Loans	24,650,000,000	24,650,000,000	8.829	166,944,649	0
Debtors 10007	1,000,000,000	1,000,000,000	8.829	6,772,602	0
Totals for selected Asset Accounts	**93,486,584,249**	**93,486,584,249**	**8.954**	**642,113,214**	**24**
Liabilities Accounts:					
Current Accounts 20001	(15,000,000,000)	(15,000,000,000)	8.829	(101,589,036)	0
Call Deposits	(27,836,584,249)	(27,836,584,249)	8.618	(184,026,511)	0
Fixed Deposits 20004	(10,000,000,000)	(10,000,000,000)	9.169	(70,345,557)	(5)
NCDs Issued 20005	(25,000,000,000)	(25,000,000,000)	8.936	(176,331,142)	(7)
Creditors 20006	(5,000,000,000)	(5,000,000,000)	8.829	(33,863,012)	0
Totals for selected Liability Accounts	**(82,836,584,249)**	**(82,836,584,249)**	**8.831**	**(566,155,259)**	**(3)**
Equity Accounts:					
Share Capital 20007	(7,100,000,000)	(7,100,000,000)	8.833	(48,111,822)	0
Retained Earnings 20008	(3,550,000,000)	(3,550,000,000)	8.833	(24,055,911)	0
Totals for selected Equity Accounts	**(10,650,000,000)**	**(10,650,000,000)**	**8.833**	**(72,167,733)**	**0**
Bank 1 / Cost Center 2124	**0**	**0**		**3,790,222**	

Results Table: FTP Typical Bank Feb 2007 Filter: None

Net Total	Ending Balance	Average Balance	Transfer Rate	Transfer Inc / (Exp)	Weighted Avg Remain Term
Net Funding Position	**0**	**0**		**84,894**	

Source: (Author, 2008)

Table 7.22 Funding Center spread report for Typical Bank

Project:	Typical Bank FTP	Report Date and Time:	1/3/2008 10:21AM
Results Table:	FTP Typical Bank Feb 2007		
Effective Date:	2/28/2007		
Balances and I/E:	GL Balances		

FTP Results Typical Bank
Static Reports:
Funding Center Spread Analysis

Organizational View: Typical Bank Hierarchy
G/L View: GL Account View

Net Total	Ending Balance	Average Balance	Transfer Rate	Interest Rate
Totals for Selected Accounts				
Assets	227,486,584,249	227,486,584,249	8.8694	13.0321
Liabilities / Equity	(227,486,584,249)	(227,486,584,249)	8.8404	4.7400
Net Funding Position	**0**	**0**	**0.0289**	**8.2921**

Asset Spread		
Total Asset Interest Rate	13.0321	
Total Asset Transfer Rate	8.8694	
Asset Spread		**4.1627**

Liability/Equity Spread		
Total Liability / Equity Transfer Rate	8.8404	
Total Liability / Equity Interest Rate	4.7400	
Liability/Equity Spread		**4.1004**

Mismatch Spread		
Total Asset Transfer Rate	8.8694	
Total Liability / Equity Transfer Rate	8.8404	
Mismatch Spread		**0.0289**

Total Bank Spread		
Total Asset Interest Rate	13.0321	
Total Liability / Equity Interest Rate	4.7400	
Total Bank Spread		**8.2921**

Source: (Author, 2008)

7.5 SUMMARY

Various metrics are available to measure the effects of IRR. Repricing gap analyses can incorporate adjustments to the repricing and cash flow timings of variable rate products and NMD accounts but provide very limited comfort as to the quantum of IRR. Duration analyses are highly dependent on the applied assumptions pertaining to the cash flows of a product. This was highlighted in section 7.3.2 (p249). Duration analyses on Typical Bank's balance sheet explained that the earnings and economic value will decrease when interest rates increase, contradicting the repricing gap analyses.

The application of simulation models and analyses in ALM is the optimal method of measuring IRR and the formulation of MTFTP results. Given the limitations of gap and duration analysis, EAR and EVE analyses provides better solutions to measuring the effects of IRR on both the earnings and economic value perspectives. The influence of the assumptions applied to the repricing and maturity (cash flows) of products with embedded optionality requires careful consideration. This was highlighted by Typical Bank's EVE analyses indicating that for increases in interest rates the earnings propensity of the bank is negatively positioned. As such, the reprice gap and EAR analyses indicated a short-term earnings benefit to upward interest rates compared to the long-term decrease in EVE projected by both duration and EVE analyses. Both EAR and EVE analyses need to be applied in order to manage IRR. As such, both the short-term and long-term impact of IRR can be assessed. As such, a bank must ensure that the formulation of its IRR strategies are well defined and that its IRR measurement metrics are well understood given the underlying assumptions applied on the repricing term and cash flows of its balance sheet.

The FTP model is a critical link to integrate RAPM and ALM. This is particular true for quantifying the mismatch spread as a measure of IRR contribution to the NIM. The CFU has the ability through FTP to assess the effects of mismatch IRR on the NIM and to sensitise the bank's business units to the ALM policy of the bank.

The setting of transfer rates to the products of business units should consider the IRR management objectives of the bank. Business units should focus on managing their risk-adjusted NIM which are isolated from IRR effects and as such must formulate strategies that will optimise their risk-reward trade-off. The business units of Typical Bank are isolated from the

impact of IRR through the application of the MTFTP system. The profitability derived from their inherent balance sheet products can be analysed in order to enhance future profitability. This may be achieved through more effective pricing strategies or by enhanced focus on the type of loans and deposits transacted and even the type of customers.

Given the availability of the FTP information business units can formulate integrated performance measurement and financial planning/budget strategies in order to meet financial targets. Therefore, business units and line management can formulate the input assumptions for the ALM model to facilitate an integrated ALM/RAPM simulation model as far as the NIM is concerned. This allows the ALCO/ALM to measure the resultant IRR based on strategies formulated from the inclusion of RAPM information. The CFU can actively assess the effects of IRR through EAR and EVE analysis.

ALM has the ability to apply transfer rates or spreads in deriving the prospective risk-adjusted NIM and subsequent IRR from the simulation results. The risk measurement and control function can therefore evolve to the risk optimisation level.

CHAPTER 8

RESEARCH SUMMARY AND CONCLUSIONS

8.1 INTRODUCTION

This section presents a summary of the research conducted in this dissertation. The chapter proceeds as follows:

- Firstly, the research objectives and the main findings of the research are summarised.
- Secondly, the limitations of the research are examined and their impacts on the research assessed.
- Lastly, the areas of potential further research are identified.

8.2 THE RESEARCH OBJECTIVES AND SUMMARY OF MAIN FINDINGS

The study and research was motivated by the researcher's practical experience in the field of ALM. The implementation of various FTP and ALM simulation models to quantify, amongst others, the IRR for commercial banks posed to be problematic in converging the efforts and objectives of the respective areas of performance measurement and risk management and those of senior management concerned. The researcher's concern of incoherent and often opposing views and motivations between the treasury, finance and ALM functions of a bank, which may lead to suboptimal bank management actions and balance sheet strategies, enhanced the need for this study.

8.2.1 THE RESEARCH OBJECTIVES

The objective of this study was to research the possibility of integrating performance measurement and ALM in banks, by understanding the background and rationale of each field and investigating the methodologies and measures applied; that would be available to use as information in consistently integrating the objectives of each process, whilst making such analyses information available to the bank's management in formulating strategies.

Thus, the research question:

"What processes and/or methodologies can be applied to link and integrate performance measurement and interest rate risk management in ALM, in order to supply the information required to develop strategies that will optimise a bank's risk-reward trade-off?"

In order to take advantage of the researcher's experience in the banking industry the research is primarily focused on performance measurement and ALM activities of banks. The research question has been posed in specific relation to banks but it is acknowledged that other financial institutions and entities operating in the financial system may in some form or context apply the same methodologies and/or concepts. Furthermore, the research question is specifically posed in relation to IRR within the banking book of a bank.

8.2.2 THE INVESTIGATIVE QUESTIONS

The following investigative questions that needed to be answered in order to address the research question were:

- What is the risk-reward trade-off and why manage risks in banks?
- What is bank performance measurement?
- Why must risk be integrated in performance measurement?
- In order to manage IRR how is IRR measured in ALM?
- How can FTP be applied to measure the risk-adjusted NIM and transfer all mismatch spread to the CFU?
- How can the information from the FTP process be applied in the ALM risk measurement process?

In the following sections it is discussed how this dissertation addressed these research questions.

8.2.3 WHAT IS THE RISK-REWARD TRADE-OFF AND WHY MANAGE RISKS IN BANKS?

The dissertation background, as presented in section 1.2 (p2) of chapter 1, provided a basis to understanding the origin of risk in banking and why a bank's profit is related to the risks it endeavours. The focus of regulators exudes on ensuring that banks manage their risks was also presented as motivation towards risk management and therefore ALM. However, the literature

review in chapter 2 provides the answer to this question. Chapter 2 explained the risk-reward trade-off (p24) banks face resulting from its intermediation activities and the various banking risks endeavoured in the process was presented. The role of risk management (p40) was presented as an important requirement in order to manage a bank's risk exposures thus contributing to financial system stability through continued profitability and meeting supervisors' recommendations and supervisory objectives. The business case for performance measurement and ALM in banks are presented from these discussions.

Surplus and deficit units exist in the economic system due the interaction of the available funds between the various economic entities such as households, corporate businesses, the general government and foreign sector entities. Surplus economic units have surplus funds available for investment whilst the deficit economic units are in need of funds to satisfy their production, economic expansion/investment, expenditure or consumption needs.

The financial system comprises a framework of a complex set of arrangements and procedures, arising from diverse and innumerable acts of investment, disinvestment and monetary payments between the economic units throughout the economic system. Banks generally are entrusted with the safekeeping of the funds but also assist with the transfer of funds between the economic entities. Therefore banks are an integral part of the financial system. By providing the function of intermediation banks have the ability to transform the funds requirements of surplus units into acceptable terms meeting the requirements of deficit units.

In the financial intermediation process, banks create financial products which satisfy the requirements of surplus and deficit units. In the process banks are exposed to various risks given that the requirements of deficit units are transformed through the financial instruments created by the bank to meet the requirement of the surplus units. Embedded within these direct and indirect financial claims are various risks which the bank bears and for which the bank is paid by its clients.

The importance of banks and their role in the financial system is recognised by the financial/bank system supervisors and regulators. It is acknowledged that if a bank is unprofitable or manages its business risks inadequately, it will fail and in the process may have dire consequences to the effectiveness and health of the financial system and the economy of a country as a whole. Effective bank supervision and regulations is therefore important in

assisting to achieve financial system stability, ensuring institutional (bank) safety and soundness and promoting consumer protection. Various components and principles are established by supervisory authorities to achieve effective bank supervision. Most important to establish the focus on ALM and risk management of a bank are the supervisory principles relating to:

- The prudential regulations and requirements pertaining to the bank's ability and competence in managing its risks and the appropriateness of its risk management and control systems. Interest rate risk in the banking book is identified as one of the risks that should be identified, measured, monitored and controlled as part of the bank's risk management processes.

- The continuous and ongoing supervision of banks through an understanding of a bank's operations and regular contact and inspections by the supervisor to the bank. Banks must also furnish reports stating the condition of the banks from various perspectives to the supervisor.

Therefore, risk management and in particular IRR management are required by the bank supervisors in order to assist with ensuring that a bank is in good financial health and that failure due to imprudent risk management practises is unlikely. Financial system stability is therefore dependent on the fact that a bank's risks are managed; the bank is profitable and unlikely to fail. The BIS and the SARB are typical supervisory and regulatory bodies dedicated to ensure bank's management processes are optimal and contributing to ensure financial losses due to IRR does not contribute to a bank's failure.

The process of intermediation in the financial system therefore exposes the bank to various risks. This is acknowledged by the bank's management and the supervisors. Risk contribute the bank's profitability given that the bank's clients (surplus and deficit units) pay for the transformation and repackaging of their risk profiles through the bank's financial products they consume. A bank has therefore a trade-off between the risks it assumes through its intermediation activities and the reward or profit it makes from doing so.

The risk-reward trade-off requires that for higher risk a higher comparative reward should be achieved. Risk is the possibility of loss, an uncertain outcome or a dispersion from what is expected. The uncertainty or the fact that the outcome is unknown pertains to the existence of

risk. The extent or impact of the risk may be quantified by statistical means such as variance, volatility and standard deviation. All measures of risk must assess the dispersion of the risk manifestation results from the expected or anticipated outcome.

However, risk is not always bad and both an up-side and a down-side exist to risk. This means that depending on the particular risk exposure the beholder of risk may benefit from the manifestation of risk. The mere existence of risk therefore does not imply a loss. The reward associated to the risk is critical in assessing if the risk is worth taking. If more risk warrants higher reward then quantifying the reward is the balancing factor in the risk-reward trade-off.

The profitability impact is fundamental behind the assessment of any business activity. The reward or earnings can be measured from both an accounting and market-based perspective. Typical accrual accounting measures such as net income, net interest income, net interest margin, asset growth etc. are traditional accounting measures of reward. Market based measures are a measurement of the economic rewards. These measures include mark-to-market and net present value (NPV) methods which capture long term and market influences on the anticipated performance/profitability of an instrument, something which accrual accounting measures do not achieve. In assessing the risk-reward trade-off it is important that the reward measure must incorporate the risk associated to generating the reward. Therefore, it is critical to assess the adequacy of the reward in perspective of the extent of the risk involved.

Banks are exposed to various financial and non-financial risks. The principal banking risks are:

- Credit risk
- Liquidity risk
- Interest rate risk (IRR)
- Market risk
- Foreign exchange risk
- Solvency risk

The financial implications these risks may have on a bank's profitability, solvency and capital of shareholders requires prudent management. Risk management is a set of tools and techniques that enables the bank's management to optimise the bank's risk-reward trade-off. This is achieved through a process that identify, measure, monitor, control and oversee/realign the various risks at all levels of the bank's activities.

In order to ensure the correct management actions are taken the bank may deploy a funds transfer pricing and capital allocation methodologies to direct the behaviour of its internal management and business units. This allows that the correct strategies are implemented correctly and risks are priced optimally. This allows the establishment of a competitive advantage for the bank in that risk control is a key factor contributing to profitability. Therefore, measuring a bank's performance and managing its risks are critical contributions to its continuous success.

8.2.4 WHAT IS BANK PERFORMANCE MEASUREMENT?

Measuring the performance of a bank is a critical component to ensuring financial targets are met, and if not, why. This was discussed in chapter 3 (p58). The objective of a performance measurement system is to supply management with the information required to make profitable decisions. It also facilitates a comparative measurement framework to assess what is good performance and what is bad performance.

Performance measurement allows measuring the profitability at the organisational unit, product, customer and business line level. The responsible management at each level can therefore be held accountable for their efforts and actions as pertaining to their profitability contribution. However, shareholders expect above average returns on their investment in the bank and therefore frequent analysis and measurement of performance against defined financial targets must be conducted in order to supply performance information to shareholders. Bank management has as objective to optimise shareholder wealth and must therefore make decisions based on the risk-reward trade-off the bank faces.

Various cost accounting and budget comparison measures are applied to analyse and measure the performance of management. These measures are often ill-trusted and meaningless given that management's input are often discarded and that customer influences and external factors are often not effectively incorporated. Typical accounting measures of profitability i.e. ROA, ROE and ROC are misguided and inefficient measures of heterogeneous business activities and financial products. Revised capital standards from bank supervisors and regulators i.e. the 1988 Capital Accord and Basel II also require risk-based allocation of capital which further renders these methods inappropriate. These measures often supply misleading and inadequate

performance information and may lead to incorrect business decisions. Traditional accounting measures do not incorporate the impact of risk in the measurement of the return. Therefore, the performance of various customers, products and units can not be measured on a risk comparable basis reflecting risk attributes.

8.2.5 HOW CAN RISK BE INTEGRATED IN PERFORMANCE MEASUREMENT?

Chapter 3, section 3.3 (p67) discussed further that the measurement of the return should be adjusted to incorporate the risk associated to the return. This enables the measurement of the risk-reward trade-off on a comparable basis between customers, products, organisational units and business lines. Risk adjusted performance measurement (RAPM) enables bank management to assess its performance based on relevant risk and profitability information for both historic and prospective endeavours.

RAPM allows effective pricing for risk in order to ensure that the return is commensurate of the risks taken. Various RAPM metrics can be applied in measuring risk-adjusted profitability but risk-adjusted return on capital (RAROC) or often applied risk-adjusted return on risk-adjusted capital (RARORAC) are the most suitable given that both return and capital is adjusted for their risk attribution.

The formulation of RAROC or RARORAC requires that the net interest income (NII) is risk-adjusted. Impairments or provisions for expected losses are included as part of the risk-adjusted return calculation together with the allocation of non-interest income and expenses to the measured entity, typically through a cost-allocation system.

Capital is also risk-adjusted based on the capital required to cover unexpected losses associated to the various risks i.e. credit risk and market risk. In measuring the risk-adjusted returns of the NII a FTP system is applied to allocate the value of funds used (typically through loans and investments) and funds provided (through deposits) based on the economic characteristics of the measured unit or entity. A matched-term FTP system has the ability to isolate the IRR contribution to the NII, which is of particular importance to the ALM function.

8.2.6 IN ORDER TO MANAGE IRR HOW IS IRR MEASURED IN ALM?

The answer to this question is discussed in chapter 4 and chapter 5. ALM is tasked with the primary responsibility, amongst others, to measure, monitor and manage IRR in the banking book. Various quantitative indicators of risk exist such as sensitivity, volatility and downside measures in the form of worst case scenario outcomes. Simulation models supply a new dimension to measuring IRR in that the NII of the bank is simulated by incorporating various input assumptions driving the projected forecast of the balance sheet and resultant NII. The sources of IRR are found in mismatch risk, basis risk, yield curve risk and option risk. The impact of IRR on NII dictates that adverse changes to interest rates will have a negative effect on future NII. IRR is also the adverse effect on the financial condition of a bank due to adverse movements in interest rates. This dictates that the impact of IRR has both an earnings and economic value perspective.

Managing IRR requires that the effects of IRR must be measured. Measures of IRR must supply bank management with the appropriate information to assess and direct the management of IRR through the development of policies and procedures and risk management systems to assist in the strategic direction of managing IRR.

Techniques for measuring IRR are gap-analysis, duration analysis and simulation modelling. Simulation models supply the most accurate measure of IRR from both the earnings and economic value perspectives of IRR. The simulation model is populated with the contractual information of the existing business of the bank. This is typically referred to as static-analysis. Dynamic analysis is achieved by formulating and supplying the simulation model with specific input assumptions about internal and exogenous variable impacting future business. These inputs include interest rate scenarios, new business volumes, term of new business, pricing spreads, non-interest income and –expenses and future capital requirements.

Furthermore, simulation models can incorporate complex stochastic term-structure interest rate models and adapt the effects of pre-payments and embedded customer options. Simulation models therefore has the ability to simulate the future NII incorporating both existing and future new business in its analyses.

Earnings-at-risk (EAR) analysis focuses typically on the effects of IRR over the short-term time horizon for example, 12- to 24 months. It employs the earnings-perspective to measuring the effects of IRR in that the deviation/sensitivity from the expected NII is measured resulting various parallel interest rate shocks, yield curve twists, inversions and even stochastic interest rate scenarios.

The long-term effects of IRR is however ignored and significant IRR exposures manifesting outside the measured time frame may affect the effectiveness and appropriateness of developed IRR mitigating strategies based on the EAR analyses. Economic value of equity (EVE) analysis captures the long term effects of IRR on the future earnings capacity of the bank. It is important that both EAR and EVE measures are applied in measuring the effects of IRR on the bank's profitability.

In setting IRR limits which governs the management of IRR through the ALM IRR policy, a primary IRR measure limit should be set depending on the objectives of the bank's IRR strategy and policy. A secondary or soft limit can be applied to the secondary IRR measure, whether it is EAR- or EVE analysis. The measurement of IRR should therefore focus on the optimisation of the risk-reward trade-off. In specific, ALM is tasked with managing IRR and therefore requires the profitability contribution information pertaining to IRR management, but also requires a mechanism to assist in dictating and executing its IRR policy.

8.2.7 HOW CAN FTP BE APPLIED TO MEASURE THE RISK-ADJUSTED NIM AND TRANSFER ALL MISMATCH SPREAD TO THE CFU?

Chapter 6 discussed the mechanics of FTP and explained why FTP better captures the risk contribution to profitability that conventional accounting and cost allocation methods.
The FTP system allocates the NIM to business units on a risk-adjusted basis which provides information on profitability based on the inherent risk contributions embedded in the financial contracts.

The measurement problem of unbalanced business units which renders incomparable financial information from the financial system is solved by the FTP process, in which all funds bought and sold are settled with the central funding unit (CFU). The CFU therefore allocates a transfer rate for all the assets and liabilities of a business unit. Therefore, the funds used and provided by

the business unit are accurately valued in order to establish a risk-adjusted allocation of the NIM at the transaction level.

The FTP system also isolates the business units from fluctuations in their NIM resulting from mismatch IRR. The matched-term FTP (MTFTP) method most accurately captures the risk components of the NIM and therefore is an effective method of quantifying the risk-adjusted return for application in the RAPM process. Furthermore, given that the transfer rates are derived from a market-based yield curve, prospective deals can be priced and their profitability established prior to actual booking of the deal.

Various adjustments to the market-based yield curve can be made in order to execute bank strategies through that line managers and business units are sensitised to these strategies by means of the transfer rates on which their performance are measured. Strategies pertaining to credit risk, liquidity premium and option/prepayment risk adjustments can effectively be incorporated in the derivation of the transfer rates. Therefore, accountability is established for managing the various risks contributing to the NIM (profitability) and management performance are measured through the broader RAPM tools to which MTFTP contribute. The MTFTP process is therefore a powerful tool to incorporate ALM strategies in the business units and to execute the ALM IRR policy of the bank. The CFU/ALM has the ability to measure and manage both historic and prospective IRR from a risk-adjusted basis.

8.2.8 HOW CAN THE INFORMATION FROM THE FTP PROCESS BE APPLIED IN THE ALM RISK MEASUREMENT PROCESS?

The integration of the MTFTP information in the ALM simulation model was discussed in chapter 7. The formulation of input assumptions for the dynamic simulation model are required to project future anticipated balance sheet positions and associated income statement results. This requires that the existing business in the balance sheet is applied as foundation for risk analysis from which it is expanded to include various balance sheet and pricing strategies appropriate to the exogenous factors such as interest rate scenarios and customer behaviour.

In formulating the input strategies in terms of pricing and new business assumptions, the RAPM results as supplied by the MTFTP system may be applied. Given that the existing business' risk-adjusted analysis is available the future strategies are formulated to endeavour the business

lines, customers and products which will contribute most to profitability. These strategies are focused on the optimisation of the risk-reward trade-off for shareholders. The measurement of IRR form the simulation model are therefore based on inputs derived from performance measurement results and effectively translates into IRR exposures realistically obtained from strategies sensitised to the IRR management policy of the bank.

The application of gap analysis, duration analysis, EAR- and EVE analyses are done consistent to the measurement of profitability i.e. the application of repricing terms and profiles of floating rate products and non-maturity deposit accounts. By applying the transfer rates or spreads to the ALM simulation model and comparing to the forecast of the customer rate's based NII, the CFU has the ability to calculate its prospective cumulative mismatch profitability impact. The integration of the MTFTP results in the ALM simulation model may further assist with the continuous financial planning and budget process of the bank.

8.3 LIMITATIONS OF STUDY

This section examines the limitations of this study and its effects on the results.

This study focused primarily in setting a background to performance measurement and ALM with specific reference to managing IRR.

The management of liquidity risk is the responsibility of ALM. The FTP mechanism has the ability to incorporate liquidity premiums in the derivation of the transfer rates, which will sensitise the bank to the ALM liquidity risk management policy. Liquidity risk is an important topic which requires a dedicated study to honour its importance. This was beyond the scope of this dissertation given the primary focus on the management of the IRR component. It is acknowledged that it is important in deriving strategies that each risk may impact on another and this can be managed within an enterprise-perspective of risk management and as such of ALM. Reference to the publications from March 2008 till September 2008, on liquidity risk management by the researcher can be made in Bank Asset/Liability Management.

Complexities surrounding the derivation of valuation and transfer rates for NMD accounts and floating indexed rate products are a challenge to ALM and FTP. The valuation of these instruments may have a significant impact on the risk and profitability profile of a customer,

product and organisation. The repricing of NMD-accounts was incorporated in the analysis in the form of assumptions which were not validated in terms of mathematical/statistical analyses. The impact is deemed to be null in that the concept was presented and incorporated in the analysis.

The effectiveness of IRR (mismatch) management is not addressed in that it would require the application of RAPM methodologies on the CFU in measuring the contribution of its management actions pertaining to optimising the mismatch spread or IRR.

The impact of customer options may be significant. The quantification of option-adjusted spreads requires highly technical and quantitative techniques in measuring the customer's propensity to early settle its loan partially or in-full. Due to the technical nature of the topic of OAS and optionality it requires dedicated research beyond the scope of this dissertation. The impact of prepayments was noted as an important consideration in assessing the cash flows in IRR analysis especially for fixed-rate products.

8.4 OBJECTIVES AND RESULTS

This research attempted to provide a background to the need for performance measurement and ALM in banks in order to further explore the mechanics pertaining to the FTP and ALM IRR measurement and management processes. The risk-reward trade-off requires that the risk management function must incorporate the various risks in banking when assessing the relative profitability of its products, customers and units. The focus on IRR management in contributing to the continued health of a bank, thereby assisting the stability of the financial system, is also highly endorsed by bank supervisors and regulators.

The MTFTP process is an integral part of integrating the IRR management policy of the bank within a RAPM process. Through the derivation of market-based transfer rates which has the ability of being adjusted to sensitise the bank to the ALM IRR policy, an integrated IRR management methodology is achieved. The ability of the MTFTP method to isolate and transfer IRR to the CFU, together with allocating the risk-adjusted NIM to the applicable products, customers and business units, makes it a valuable tool for both the performance measurement and ALM functions.

The MTFTP results enable comparative risk-adjusted profitability assessments which can be applied to formulate strategies focused on optimising the risk-reward trade-off for the bank. Such strategies are a valuable input to the ALM simulation model to measure IRR and to the ALM (CFU) of the bank to manage IRR. Thus, MTFTP as a RAPM tool enables the integration of performance measurement and ALM. Through the isolation of the mismatch spread to the CFU, setting strategy adjustable market-based transfer rates and supplying risk-adjusted information from which balance sheet and pricing strategies are developed by the bank, the integration of performance measurement and ALM are achieved through the FTP system. The ALM process which focussed on risk management and control can evolve to a process of risk optimisation by integrating FTP in ALM.

These objectives were achieved by the study in that MTFTP was established as a RAPM tool and an ALM IRR policy mechanism which integrates performance measurement and ALM. This was achieved on the background of the need for ALM and performance measurement by providing an overview and understanding of banks, banking risks, supervisory influences and the role of risk management. The methodologies pertaining to performance measurement and ALM IRR measurement was discussed which enables the reader to understand the various metrics applied to these processes.

8.5 SUGGESTIONS FOR FUTURE WORK

Further research can combine the challenging aspects of replicating portfolios, break-charges for partial- and full settlements (optionality). This will assist both the performance measurement and ALM risk measurement to establish an effective valuation method, portraying the economic characteristics of products associated with these challenges.

The measurement of the effectiveness of mismatch IRR management is a problem which ALM practitioners face and which is increasingly required to be determined by senior bank management, shareholders and regulators. The concept of remaining-term FTP may be researched in this regard which may be combined with research conducted in assessing dynamic future orientated FTP methodologies.

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