THE RELATIONSHIP BETWEEN INTEREST RATE RISK AND NET INTEREST INCOME OF COMMERCIAL BANKS QUOTED AT THE NAIROBI STOCK EXCHANGE

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DECLARATION

This research is my original work and has not been presented for a degree in any other university.

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This research project has been submitted for examination with my approval as university supervisor.

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DEDICATION

I thank the almighty God, for I know it is only by His grace that I have come this far. His name be praised and glorified forever.

To my dad, Joseph and mum, Grace for your unfailing love and care during this long journey in search of knowledge. The recognition of the fact that you ensured that I satisfy my curiosity for higher education makes me feel very indebted to you.

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LIST OF ABBREVIATIONS

ANOVA	-	Analysis of Variance
BBK	-	Barclays Bank of Kenya Limited
CBK	-	Central Bank of Kenya
DTB	-	Diamond Trust Bank Limited
Equity	-	Equity Bank Limited
HFCK	-	Housing Finance Company of Kenya Limited
NSE	-	Nairobi Stock Exchange
OBS	-	Off-Balance Sheet
OTC	-	Over-The- Counter
RSA	-	Rate-Sensitive Assets
RSL	-	Rate-Sensitive Liabilities
Stanchart	-	Standard Chartered Bank Kenya Limited

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ABSTRACT

Changes in banks' competitive environment, products, and services have heightened the importance of prudent interest rate risk management. Historically, the interest rate environment for banks has been fairly stable. More recently, interest rates have become more volatile, and banks have arguably become more exposed to such volatility because of the changing character of their liabilities.

Each year, the financial products offered and purchased by banks become more various and complex and many of these products pose risk to the banks. Many commercial banks have increased their holdings of long-term assets and liabilities, whose values are more sensitive to interest rate changes. Such changes mean that managing interest rate risk is far more important and complex than it has been in the past.

This study set out to determine the relationship between interest rate risk and net interest income of commercial banks in Kenya. Net interest income observed for 5-year period was regressed against interest rate risk in each year. Interest rate risk was measured as the interest rate sensitivity gap between assets and liabilities maturing/repricing in time-bands of less than three months, between three and twelve months and maturities in periods above one year. These three categories formed the independent variables for use in the study. The study found that there is a strong direct relationship between interest rate risk and net interest income of commercial banks. Specifically, interest rate sensitivity gap movements account for 58.0% of variations in net interest income.

Each of the three categories of interest rate sensitivity gap was found to positively contribute to net interest income. A unit increase in short term sensitivity gap (maturities in less than three months) results in 0.141 units increase in net interest income, while a unit increase in medium term sensitivity gap (maturities in between three and twelve months) results in 0.426 units increase net interest income. The study also found that a unit increase in long term sensitivity gap (maturities in periods above one year) results in 0.176 units increase in net interest income.

These results imply that proper interest rate risk management not only reduces a bank's exposure to the risk, but it also provides banks with an opportunity to stabilize and improve their net interest income. Overall, net interest income is increased by maintaining high positive medium term sensitivity gaps in an increasing interest rate environment and low negative medium term sensitivity gaps in a declining interest rate environment.

CHAPTER ONE: INTRODUCTION

1.1 Background

The acceptance and management of financial risk is inherent to the business of banking and banks' roles as financial intermediaries. To meet the demands of their customers and communities and to execute business strategies, banks make loans, purchase securities, and take deposits with different maturities and interest rates. These activities may leave a bank's earnings and capital exposed to movements in interest rates. This exposure is referred to as interest rate risk (Comptroller's Handbook, 1997).

Commercial banks measure interest rate risk by distributing interest-sensitive assets, liabilities and off-balance sheet positions into "time bands" according to their maturity (if fixed rate) or time remaining to their next repricing (if floating rate). In most cases, these bands are: up to one month; from one month to three months; from three months to six months; from six months to one year; from one year to five years; and five years and over. The sensitivity gap between assets and liabilities measures respective changes in assets and liabilities due to an interest rate shock and is a key determinant of bank net interest income. The gap reflects the repricing frequency of assets and liabilities (Mays, 1999).

According to Central Bank of Kenya (CBK), the size of the sensitivity gap for a given time band – that is, assets minus liabilities plus off balance- sheet exposures that reprice or mature within that time band – gives an indication of the financial institution's repricing (interest rate) risk exposure. The nature and complexity of a bank's business activities and overall levels of risk should determine how sophisticated its management of interest rate risk must be. Every well-managed bank, however, will have a process that enables bank management to identify, measure, monitor, and control interest rate risk in a timely and comprehensive manner. The adequacy and effectiveness of a bank's interest rate risk management are important in determining whether a bank's level of interest rate risk exposure poses supervisory concerns or requires additional capital. Overall, a bank should ensure that its risk management policies are such that it does not hold low yielding investments in a high interest rate environment.

Different types of banks, identified based on the specialization and asset size, respond in a predictable yet fundamentally dissimilar way to unanticipated credit, interest rate and term structure shocks. Most banks are sensitive in varying degrees to credit, interest rate and term structure shocks. Large and more diversified banks seem to be less sensitive to interest rate or term structure shocks, but more sensitive to credit shocks. Credit card specialists seem unique in that they are able to factor unanticipated credit shocks into their pricing. The composition of assets and liabilities, in terms of their repricing frequencies, help accentuate or mute the effects of rising short-term interest rates on bank net interest income (Hanweck, 2003).

Brewer (2001) studied the value of using interest rate derivatives to manage risk at banking organizations in the United States of America and found that when interest rates dropped sharply, large positive short term gaps resulted in a drop in net interest income as banks immediately lowered the rates on lending while still paying higher fixed rates on their deposits. The banks later learned that if changes in revenue from assets perfectly matched the changes in expense from liabilities, then a rise or fall in interest rates would have an equal and off-setting effect on both sides of the balance sheet. In principle, perfect matching leaves a bank's earnings or market value unaffected in changes in interest rates (Brewer, 2001).

Hanweck (2003), studied the sensitivity of bank net interest margins to credit, interest rate, and term structure shocks found that the greater the proportion of short-term assets and non-maturing deposits a bank holds, the more positive the effect of an increase in short-term interest rates would have on net interest income. These results are thus consistent with Brewer's (2001) findings.

According to the Basel Committee (2001), interest rate risk is the exposure of a bank's financial condition to adverse movements in interest rates. Interest rate risk can be divided into two - fair value interest rate risk and cash flow interest rate risk (International Accounting Standard No. 32). Fair value interest rate risk is the risk that the value of a financial instrument will fluctuate because of changes in market interest

rates, while cash flow interest rate is the risk that future cash flows of a financial instrument will fluctuate because of changes in market interest rates.

Comptroller's Handbook (1997) defines interest rate risk as risk to earnings or capital arising from movement of interest rates and notes that it arises from differences between the timing of rate changes and the timing of cash flows. This is the definition adopted for this study.

In banking literature, a bank's exposure to interest rate risk is measured by the difference between the duration of assets, weighted by dollars of assets, and the duration of liabilities, weighted by dollars of liabilities. The larger the difference, or duration gap, the more sensitive is the bank's shareholder value to changes in interest rates. If the gap is equal to zero, the shareholder is protected against changes in interest rates. To the extent that banks try to match the durations of their assets and liabilities, they can encounter conflicts between the desired duration and opportunities for profits. This comes out when asset duration alters the duration of the existing portfolios, when the bank is unable to issue long duration liabilities, or when liquidity issues prevent the needed adjustments. For greater flexibility and probably greater profitability, most banks keep an approximately hedged position (Brewer, 2001).

1.2 Research Problem

The movement of interest rates affects a bank's reported earnings and book capital by changing net interest income, the market value of financial instruments and other interest sensitive income and expenses, such as mortgage servicing fees. Changes in interest rates also affect a bank's underlying economic value. The value of a bank's assets, liabilities, and interest-rate-related, off-balance-sheet contracts is affected by a change in rates because the present value of future cash flows, and in some cases the cash flows themselves, is changed. In banks that manage trading activities separately, the exposure of earnings and capital to those activities because of changes in market factors is referred to as price risk. Banks differ, however, in the level and degree of interest rate risk they are willing to assume. Some banks seek to minimize their interest rate risk exposure. Such banks generally do not deliberately take positions to benefit from a particular movement in interest rates. Rather, they try to match the maturities and

repricing dates of their assets and liabilities. Other banks are willing to assume a greater level of interest rate risk and may choose to take interest rate positions or to leave them open (Comptroller's Handbook, 1997).

A bank can alter its interest rate risk exposure by changing investment, lending, funding, and pricing strategies and by managing the maturities and repricings of these portfolios to achieve a desired risk profile. Many banks also use off-balance-sheet derivatives, such as interest rate swaps, to adjust their interest rate risk profile. From an earnings perspective, a bank should consider the effect of interest rate risk on net income and net interest income in order to fully assess the contribution of non-interest income and operating expenses to the interest rate risk exposure of the bank. In particular, a bank with significant fee income should assess the extent to which that fee income is sensitive to rate changes. From a capital perspective, a bank should consider how intermediate (two years to five years) and long-term (more than five years) positions may affect the bank's future financial performance. Since the value of instruments with intermediate and long maturities can be especially sensitive to interest rate changes, it is important for a bank to monitor and control the level of these exposures (Comptroller's Handbook, 1997).

This study seeks to determine whether there is a relationship between banks' interest rate risk and net interest income. Specifically, the study seeks to find out whether a bank can stabilize its net interest income by effective management of the interest rate risk measured by interest rate sensitivity gap between assets and liabilities maturing/repricing in time-bands of less than three months, between three and twelve months and periods above one year.

1.3 Objective of the Study

To determine the relationship between interest rate risk and net interest income of commercial banks in Kenya.

1.4 Hypothesis

Null Hypothesis

H0: There is no relationship between interest rate risk and net interest income of commercial banks in Kenya.

Alternative Hypothesis

H1: There is a relationship between interest rate risk and net interest income of commercial banks in Kenya.

1.5 Importance of the Study

Changes in interest rates can have adverse effects both on a bank's earnings and its economic value (Basel Committee on Banking Supervision, 2004). In the earnings perspective, the focus of analysis is the impact of changes in interest rates on accrued or reported earnings. This is the traditional approach to interest rate risk assessment taken by many banks. Variation in earnings is an important focal point for interest rate risk analysis because reduced earnings or outright losses can threaten the financial stability of an institution by undermining its capital adequacy and by reducing market confidence. In this regard, the component of earnings that has traditionally received the most attention is net interest income (i.e. the difference between total interest income and total interest expense). This focus reflects both the importance of net interest income in banks' overall earnings and its direct and easily understood link to changes in interest rates.

Instruments that are not marked to market may already contain embedded gains or losses due to past rate movements. These gains or losses may be reflected over time in

the bank's earnings. This study is thus expected to bring out key issues in interest rate management that, if considered by Kenyan banks, will reduce banks' problems arising from improper risk management.

The study will particularly useful to the following:

Central Bank of Kenya

The Central Bank of Kenya (CBK) is established under the Central Bank of Kenya Act (Cap 491) with the principal object of formulating and implementing monetary policy directed to achieving and maintaining stability in the general level of prices (Section 4(1) of the Act). The Bank regulates the banking industry in Kenya through enforcement of the Banking Act (Cap 488) and the CBK Prudential Guidelines. The regulatory role of CBK is aimed at maintaining confidence in the monetary system and in particular, the well-being of banks through proper risk management system. One of the ways in which the Central Bank of Kenya controls interest rates is by setting and monitoring the 91-day and 182-day Treasury bill rates, which are often used by banks as their base lending rates. Among the provisions of the Central Bank of Kenya (Amendment) Bill, 2000 was to ensure that the maximum interest rate charged on loans and advances is the 91-day treasury bill published by CBK on the last Friday of each month, plus 3% (Kibe, 2003). The Central Bank of Kenya will thus benefit from this study as it sets Treasury bill rates and prescribes ways of managing interest rate risks by commercial banks in Kenya.

Commercial Banks

Banks play a major role in maintaining confidence in the monetary system through their close relationship with regulatory authorities and governments and the regulations imposed on them by those governments (International Accounting Standards No. 30). These regulations are strict and sometimes prohibitive to the profit maximization objective, since there is a limit on the amount of interest that can be charged on loans and advances and depositors may not be willing to keep their funds with banks that pay low interest rates on their deposits. With this cap and floor restriction, which is the main source of a bank's profits, managers of banks need to be careful on how profits can be maximised by managing the assets and liabilities in a way that increases profits, but

does not expose their capital and earnings when the interest rates fluctuate. This concept is what the study focuses on, and thus bank managers are expected to benefit from its findings.

The users of financial statements of a bank need relevant, reliable and comparable information which assists them in evaluating the financial position and performance of the bank and which is useful to them in making economic decisions. They also need information which gives them a better understanding of the special characteristics of the operations of a bank. Users need such information even though a bank is subject to supervision and provides the regulatory authorities with information that is not always available to the public. Disclosures in the financial statements of a bank therefore need to be sufficiently comprehensive to meet the needs of users, within the constraint of what it is reasonable to require of management (International Accounting Standards No. 30). A review of disclosure on interest rate risk (notes to the financial statements of banks) reveals differing levels of disclosure, with some banks only providing minimum analysis of the maturity periods of their assets and liabilities. This may make it impossible for potential investors to fully understand extend of a bank's exposure and therefore not make optimal economic decisions. The study is expected to help banks in assessing their level of disclosure against that of their competitors and the benefits (or otherwise) of providing too much or too little information to users of financial statements.

Shareholders

These are motivated by a high return on their investment. They are therefore interested in a bank's solvency i.e. the excess of assets over liabilities or the adequacy of the bank's capital (International Accounting Standards No. 30). Although the interest rate risk is reflected in the financial statements most shareholders do not understand it, its relationship with net interest income and its implications on capital and reserves, and thus the shareholders value. This study will be useful in highlighting the effects net interest income to shareholders value, mechanisms used by banks to control and manage the risk and how profits can be maximised by proper management of the risk. This will thus lend confidence to shareholders as they interrogate those charged with governance of banks.

Tax Authorities

Tax authorities are interested in the accurate recording of all financial transactions and the timely remittance of any taxes due. Banks are required to withhold and remit tax on interest paid to depositors. A further tax is payable on the annual profits of banks. This research will provide tax authorities with insights into contributors of net interest income and help them assess where tax incentives can be offered to banks considering the interest rate exposure to banks' earnings and the increased competition in the banking industry.

Depositors

Depositors can be either individuals or other banks. These provide substantial financing to banks and are interested in the stability of banks and the interest rates on their funds. They need confidence that their funds are soundly invested to maintain the banks profitability and to avoid liquidity and solvency risks. They would, at a minimum, expect a bank to have funds available for withdrawal as and when needed. In Kenya, the depositor protection fund, which provides depositor insurance restricts itself to compensation of only KShs 100,000 if a bank goes bankrupt, yet depositors could be holding much more substantial amounts of money with the banks. This study is therefore expected to help depositors understand banks' interest rate spreads, banks' exposure to interest rate risk, the relationship between net interest income and interest rate risk and how different banks manage the interest rate risk, and therefore help them in making a choice of where to keep their funds.

Academicians

The study will offer an extension of knowledge of net interest income and risk management by banks in Kenya. It will reach conclusions that are useful to scholars, tutors and students of finance and economics especially in the areas of monetary policy, banking practice and financial institutions and markets on relationship between net interest income and interest rate risk. The study is also expected to provide a basis for further research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Net Interest Income

The analysis of net interest income is an attempt to measure the cost of financial intermediation, that is, the difference between the gross cost paid by a borrower to a bank and the net return received by a depositor (Brock and Suarez, 2000). Generally, high interest income is taken to be unfavorable because it leads to disintermediation. Low deposit rates represent unattractive returns for maintaining deposit accounts hence discouraging savings. High loan rates, on the other hand, make the cost of funds increasingly prohibitive to potential users thereby inhibiting investment activity. Nevertheless, while high net interest spreads have usually been associated with inefficiency, they may also contribute in the strengthening of a country's banking system (Sanders and Schumacher, 2000). This happens when profits earned from high spreads are being channeled by banks to their capital bases. For example, high spreads and healthy capital ratios were both observed among Colombian banks (Barajas, Steiner, and Salazar, 1999).

On the other hand, very low spreads cannot always be taken positively especially in liberalized but inadequately regulated environments where certain mechanisms ensuring the closure of or intervention in poorly capitalized or unstable banks are absent. If weak banks are allowed to continue operating, there is the likelihood that they will adopt the strategy of offering lower loan rates to gain additional market share or to grow out of their troubles. This was presumed in some Latin American countries in the period after financial liberalization reforms were instituted in the region over the last decade (Brock and Suarez, 2000).

2.2 Modeling Net Interest Income

There are at least two modeling frameworks for net interest income. The first framework is the Ho and Saunders (1981) dealer model. This model has been extended and modified by McShane and Sharpe (1985), Allen (1988) and Angbazo (1997). It has also been applied in different settings by Ho and Saunders (1981), Saunders and Schumacher (2000), Brock and Suarez (2000) and Drakos (2003). The alternative model is the firm theoretic approach developed by Klein (1971) and Monti (1972). This model

views the banking firm in a static setting where demands and supplies of deposits and loans simultaneously clear both markets. Following the same line of research, this framework was further explored by Zarruk (1989) and Wong (1997). Finally, there is the specification and estimation of Barajas, Steiner, and Salazar (1999) that can also be categorized under the firm theoretic approach.

Despite significant regulatory concern paid to the interest-rate risk that banks face (Basel Committee on Banking Supervision, 2004), research on a key component of earnings that may be most sensitive to interest shocks—namely, bank net interest margins—has been limited (Hanweck 2005). Theoretical models of net interest margins have typically derived an optimal margin for a bank, given the uncertainty, the competitive structure of the market in which it operates, and the degree of its management's risk aversion. The fundamental assumption of bank behavior in these models is that the net interest margin is an objective to be maximized. In the dealer model developed by Ho and Saunders (1981), bank uncertainty results from an asynchronous and random arrival of loans and deposits. A banking firm that maximizes the utility of shareholder wealth selects an optimal markup (markdown) for loans (deposits) that minimizes the risks of surplus in the demand for deposits or in the supply of loans.

2.3 Factors Influencing Net Interest Margins

Ho and Saunders (1981) control for idiosyncratic factors that influence the net interest margins of an individual bank, and derive a "pure interest margin," which is assumed to be universal across banks. They find that this "pure interest margin" depends on the degree of management risk aversion, the size of bank transactions, the banking market structure, and interest-rate volatility, with the rate volatility dominating the change in the pure interest margin over time.

Allen (1988) extends the single-product model of Ho and Saunders (1981) to include heterogeneous loans and deposits, and posits that pure interest spreads may be reduced as a result of product diversification. Saunders and Schumacher (2000) apply the dealer model to six European countries and the United States, using data for 614 banks for the

period from 1988 to 1995, and find that regulatory requirements and interest-rate volatility have significant effects on bank interest-rate margins across these countries.

Angbazo (1997) develops an empirical model, using Call Report data for different size classes of banks for the period between 1989 and 1993, incorporating credit risk into the basic net interest margin (NIM) model, and finds that the net interest margins of commercial banks reflect both default and interest-rate risk premia and that banks of different sizes are sensitive to different types of risk. Angbazo (1997) finds that among commercial banks with assets greater than $1 billion, net interest margins of money-center banks are sensitive to credit risk but not to interest-rate risk, whereas the NIM of regional banks are sensitive to interest-rate risk but not to credit risk. In addition, Angbazo (1997) finds that off-balance-sheet items do affect net interest margins for all bank types except regional banks. Individual off-balance-sheet items such as loan commitments, letters of credit, net securities, and net acceptances acquired, swaps, and options have varying degrees of statistical significance across bank types.

Zarruk (1989) presents an alternative theoretical model of net interest margins for a banking firm that maximizes an expected utility of profits that relies on the "cost of goods sold" approach. Uncertainty is introduced to the model through the deposit supply function that contains a random element. Zarruk (1989) posits that under a reasonable assumption of decreasing absolute risk aversion, the bank's spread increases with the amount of equity capital and decreases with deposit variability. Risk-averse firms lower the risk of profit variability by increasing the deposit rate. Zarruk and Madura (1992) show that when uncertainty arises from loan losses, deposit insurance, and capital regulations, a higher uncertainty of loan losses will have a negative effect on net interest margins.

Madura and Zarruk (1995) find that bank interest rate risk varies among countries, a finding that supports the need to capture interest-rate risk differentials in the risk-based capital requirements. However, Wong (1997) introduces multiple sources of uncertainty to the model and finds that size-preserving increases in the bank's market power, an increase in the marginal administrative cost of loans, and mean-preserving increases in credit risk and interest-rate risk have positive effects on the bank spread. Both the dealer

and cost-of-goods models of net interest margins have two important limitations. First, these models are single-horizon, static models in which homogenous assets and liabilities are priced at prevailing loan and deposit rates on the basis of the same reference rate. In reality, bank portfolios are characterized by heterogeneous assets and liabilities that have different security, maturity, and repricing structures that often extend far beyond a single horizon. As a result, assuming that bankers do not have perfect foresight, decisions regarding loans and deposits made in one period affect net interest margins in subsequent periods as banks face changes in interest-rate volatility, the yield curve, and credit risk. Banks' ability to respond to these shocks in the period t is constrained by the ex ante composition of their assets and liabilities and their capacity to price changes in risks effectively. In addition, the credit cycle and the strength of new loan demand determine the magnitude of the effect of interest-rate shocks on banks' earnings. In this regard, Hasan and Sarkar (2002) show that banks with a larger lending slack, or a greater amount of "loans-in-process," are less vulnerable to interest-rate risk than banks with a smaller amount of loans in process.

Doliente (2003) attempted to identify factors that drive bank net interest margins in Southeast Asia using the dealer model developed by Ho and Saunders (1981). The study found that bank-specific factors, namely collateral, liquid assets, loan quality, operating expenses, and capital, as the determinants of Southeast Asian bank spreads. Also explaining the region's net interest margins are interest rate volatility and the non-competitive market structure of its banking systems.

2.4 Sources of Interest Rate Risk

Interest rate risk can come from a variety of forms, including repricing risk, yield curve risk and basis risk (English, 2002). The primary and most often discussed form of interest rate risk arises from timing differences in the maturity (for fixed rate) and repricing (for floating rate) of bank assets, liabilities and off-balance-sheet (OBS) positions. While such repricing mismatches are fundamental to the business of banking, they can expose a bank's income and underlying economic value to unanticipated fluctuations as interest rates vary. For instance, a bank that funded a long-term fixed rate loan with a short-term deposit could face a decline in both the future income arising from the position and its underlying value if interest rates increase. These declines arise

because the cash flows on the loan are fixed over its lifetime while the interest paid on the funding is variable, and increases after the short-term deposit matures (Basel Committee, 2001).

Repricing mismatches can also expose a bank to changes in the slope and shape of the yield curve. Yield curve risk arises when unanticipated shifts of the yield curve have adverse effects on a bank's income or underlying economic value. For instance, the underlying 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, even if the position is hedged against parallel movements in the yield curve (Basel Committee, 2001).

Another important source of interest rate risk (commonly referred to as basis risk) arises from imperfect correlation in the adjustment of the rates earned and paid on different instruments with otherwise similar repricing characteristics. When interest rates change, these differences can give rise to unexpected changes in the cash flows and earnings spread between assets, liabilities and OBS instruments of similar maturities or repricing frequencies. For example, a strategy of funding a one year loan that reprices monthly based on the one month U.S. Treasury Bill rate, with a one-year deposit that reprices monthly based on one month Libor, exposes the institution to the risk that the spread between the two index rates may change unexpectedly (Basel Committee, 2001).

An additional and increasingly important source of interest rate risk arises from the options embedded in many bank assets, liabilities and OBS portfolios. Formally, an option provides the holder the right, but not the obligation, to buy, sell, or in some manner alter the cash flow of an instrument or financial contract. Options may be stand alone instruments such as exchange-traded options and over-the-counter (OTC) contracts, or they may be embedded within otherwise standard instruments. While banks use exchange-traded and OTC-options in both trading and non-trading accounts, instruments with embedded options are generally most important in non-trading activities. They include various types of bonds and notes with call or put provisions, loans which give borrowers the right to prepay balances, and various types of non-maturity deposit instruments which give depositors the right to withdraw funds at any

time, often without any penalties. If not adequately managed, the asymmetrical payoff characteristics of instruments with optionality features can pose significant risk particularly to those who sell them, since the options held, both explicit and embedded, are generally exercised to the advantage of the holder and the disadvantage of the seller. Moreover, an increasing array of options can involve significant leverage which can magnify the influences (both negative and positive) of option positions on the financial condition of the firm (Basel Committee, 2001).

2.5 Market Interest Rates in Kenya

The Kenyan annualized average 91-day Treasury bill interest rate trend during the period 2001 to 2005 formed a smooth U-shape (CBK website). The average rate decreased from 12.73% in 2001 to 8.94% in 2002 and sharply decreased to 3.67% in 2003. The rate further dived to stand at 2.86% in 2004, followed by a sharp increase to 8.44% in 2005. The Central Bank of Kenya (Amendment) Bill 2000 which was aimed at controlling interest rates received assent on 6th August 2001, making it an Act of parliament. It was not however until 2003 when the then finance minister brought the Act into operation at various aspects such as, requirements that a borrower stops repayment once it is clear that the loan is not performing and the interest charge equals the principal (Kilongosi, 2005).

2.6 Interest Rate Risk Management

Interest rate risk is the current or prospective risk to earnings and capital arising from adverse movements in interest rates. Excessive interest rate risk can pose a significant threat to a financial institution's earnings and capital base. Changes in interest rates affect a financial institution's earnings by changing its net interest income and the level of other interest-sensitive income and operating expenses. Changes in interest rates thus can have adverse effects both on a financial institution's earnings, capital and its economic value. The goal of interest rate risk management is to maintain a financial institution's interest rate risk exposure within self-imposed parameters over a range of possible changes in interest rates. Sound interest rate risk management involves the application of four basic elements in the management of assets, liabilities and off-balance-sheet instruments. These are appropriate board and senior management

oversight, adequate risk management polices, procedures and limits, appropriate risk measurement and monitoring functions and comprehensive internal controls and independent audits (CBK, 2005).

The specific manner in which a financial institution applies these elements in managing its interest rate risk will depend upon the complexity and nature of its holdings and activities as well as on the level of interest rate risk exposure. What constitutes adequate interest rate risk management practices can therefore vary considerably. For example, less complex financial institutions whose senior managers are actively involved in the details of day-to-day operations may be able to rely on relatively basic interest rate risk management processes. However, other institutions that have more complex and wide-ranging activities are likely to require more elaborate and formal interest rate risk management processes, to address their broad range of financial activities and to provide senior management with the information they need to monitor and direct day-to-day activities. Moreover, the more complex interest rate risk management processes employed at such financial institutions require adequate internal controls that include audits or other appropriate oversight mechanisms to ensure the integrity and accuracy of the information used by senior management in overseeing compliance with policies and limits (CBK, 2005).

2.6.1 Board and senior management oversight

The board of directors has the ultimate responsibility for understanding the nature and the level of interest rate risk taken by the financial institution. The board should therefore formulate and approve broad business strategies and policies that govern or influence the interest rate risk of the financial institution. Accordingly, the board of directors is responsible for approving the overall policies with respect to interest rate risk and for ensuring that management takes the steps necessary to identify, measure, monitor and control these risks. It should also review the overall objectives of the financial institution with respect to interest rate risk and should ensure the provision of clear guidance regarding the level of interest rate risk acceptable to the financial institution (CBK, 2005).

The board should also approve policies that identify lines of authority and responsibility for managing interest rate risk exposures. As such management is responsible for ensuring that the financial institution has adequate policies and procedures for managing interest rate risk on both a long-term and day-to-day basis and that it maintains clear lines of authority and responsibility for managing and controlling this risk. The board should also periodically review information that is sufficient in detail and timeliness to allow it to understand and assess the performance of senior management in monitoring and controlling these risks in compliance with the financial institution's board-approved policies. Management should be mandated by the board to be responsible for maintaining appropriate limits on risk taking, maintaining adequate systems and standards for measuring risk, maintaining standards for valuing positions and measuring performance, maintaining a comprehensive interest rate risk reporting and interest rate risk management review process and effective internal controls (CBK, 2005).

2.6.2 Policies, procedures and limits

Financial institutions should have clearly defined policies and procedures for limiting and controlling interest rate risk on both on- and off- balance sheet positions. These policies should be applied on a consolidated basis and as appropriate, at specific affiliates or other units of the financial institution. Such policies and procedures should delineate lines of responsibility and accountability over interest rate risk management decisions and should clearly define authorized instruments, hedging strategies and position taking opportunities, identify the types of instruments and activities that the financial institution may employ or conduct, thus acting as a means through which the board can communicate their tolerance of risk on a consolidated basis and at different legal entities, identify quantitative parameters that define the level of interest rate risk acceptable for the financial institution and where appropriate, such limits should be further specified for certain types of instruments, portfolios and activities, be reviewed periodically and revised as needed, so as to define the specific procedures and approvals necessary for exceptions to policies, limits and authorizations and delineate a clear set of institutional procedures for acquiring specific instruments, managing portfolios and controlling the financial institution's aggregate interest rate risk exposure (CBK, 2005).

Prior to introducing a new product, hedging, or position-taking strategy, management should ensure that adequate operational procedures and risk control systems are in place. The board or its appropriate delegated committee should also approve major hedging or risk management initiatives in advance of their implementation. Proposals to undertake new instruments or new strategies should contain a description of the relevant product or strategy, an identification of the resources required to establish sound and effective interest rate risk management of the product or activity, an analysis of the reasonableness of the proposed activities in relation to the financial condition and capital levels and the procedures to be used to measure, monitor and control the risks of the proposed product or activity (CBK, 2005).

2.6.3 Limits

An appropriate limit system should among others enable management to control interest rate risk exposures, initiate discussion about opportunities and risks and monitor actual risk taking against predetermined risk tolerances, ensure that positions that exceed certain predetermined levels receive prompt management attention be consistent with overall approach to measuring interest rate risk and should be approved by the board of directors and re-evaluated periodically. The system should be appropriate to the size, complexity and capital adequacy of the financial institution as well as its ability to measure and manage its risk and identifiable with individual business unit, portfolios, instrument types or specific instruments (CBK, 2005).

Financial institutions must have adequate information systems for measuring, monitoring, controlling and reporting interest rate exposures. Reports must be provided on a timely basis to the board of directors, senior management and, where appropriate, individual business line managers. Some of the board reports that should be provided include violation of approved responsibilities by managers when taking interest rate risk exposures or investing in un- approved instruments, excesses over approved interest rate limits and any exceptions highlighted by the internal auditor (CBK, 2005).

2.7 Effects of Interest Rate Risk on Banks' Interest Margins

Changes in market interest rates can have large effects on banks' net interest margins if interest rate risk is not managed carefully (English, 2002). For example, the secondary banking crisis in the United Kingdom in the 1970s reflected, at least in part, the funding of longer-term assets with short-term liabilities. Similarly, funding of long-term, fixed rate mortgages with savings deposits led to a very sharp drop in net interest margins at US thrift institutions in the early 1980s when interest rates rose to historic highs and the yield curve inverted. The result was actually negative net interest income for two years at US thrifts, after net interest margins had averaged nearly 1.5% over the preceding decade (English, 2002).

The conventional view among financial market observers, including academics and journalists, appears to be that interest rate changes and the slope of the yield curve have significant effects on banks' net interest income. In this view, returns on bank liabilities are thought to be relatively closely tied to short-term rates, and to adjust to changes in short-term rates relatively quickly. By contrast, returns on bank assets are seen as more closely tied to longer-term. While the flows of interest income and expense are not, strictly speaking, cash flows (because of the effects of accrual accounting), they should nonetheless provide an effective benchmark for considering interest rate risk (English, 2002).

Normally, interest rates can have adverse effects both on a bank's earnings and its economic value. This has given rise to two separate, but complementary, perspectives for assessing a bank's interest rate risk exposure (Basel Committee, 2001).

2.7.1 Earnings perspective

In the earnings perspective, the focus of analysis is the impact of changes in interest rates on accrual or reported earnings. This is the traditional approach to interest rate risk assessment taken by many banks. Variation in earnings is an important focal point for interest rate risk analysis because reduced earnings or outright losses can threaten the financial stability of an institution by undermining its capital adequacy and by reducing

market confidence. In this regard, the component of earnings that has traditionally received the most attention is net interest income (i.e. the difference between total interest income and total interest expense). This focus reflects both the importance of net interest income in banks' overall earnings and its direct and easily understood link to changes in interest rates. However, as banks have expanded increasingly into activities that generate fee-based and other non-interest income, a broader focus on overall net income - incorporating both interest and non-interest income and expenses - has become more common. The non-interest income arising from many activities, such as loan servicing and various asset securitization programs can be highly sensitive to market interest rates. For example, some banks provide the servicing and loan administration function for mortgage loan pools in return for a fee based on the volume of assets it administers (Basel Committee, 2001).

When interest rates fall, the servicing bank may experience a decline in its fee income as the underlying mortgages prepay. In addition, even traditional sources of non-interest income such as transaction processing fees are becoming more interest rate sensitive. This increased sensitivity has led both bank management and supervisors to take a broader view of the potential effects of changes in market interest rates on bank earnings and to factor these broader effects into their estimated earnings under different interest rate environments (Basel Committee, 2001).

2.7.2 Economic value perspective

Variation in market interest rates can also affect the economic value of a bank's assets, liabilities and OBS positions. Thus, the sensitivity of a bank's economic value to fluctuations in interest rates is a particularly important consideration of shareholders, management and supervisors alike. The economic value of an instrument represents an assessment of the present value of its expected net cash flows, discounted to reflect market rates. By extension, the economic value of a bank can be viewed as the present value of its expected net cash flows, defined as the expected cash flows on assets minus the expected cash flows on liabilities plus the expected net cash flows on OBS positions. In this sense, the economic value perspective reflects one view of the sensitivity of the net worth of the bank to fluctuations in interest rates (Basel Committee, 2001).

Since the economic value perspective considers the potential impact of interest rate changes on the present value of all future cash flows, it provides a more comprehensive view of the potential long-term effects of changes in interest rates than is offered by the earnings perspective. This comprehensive view is important since changes in near-term earnings – the typical focus of the earnings perspective - may not provide an accurate indication of the impact of interest rate movements on the bank's overall positions (Basel Committee, 2001).

The earnings and economic value perspectives discussed thus far focus on how future changes in interest rates may affect a bank's financial performance. When evaluating the level of interest rate risk it is willing and able to assume, a bank should also consider the impact that past interest rates may have on future performance. In particular, instruments that are not marked to market may already contain embedded gains or losses due to past rate movements. These gains or losses may be reflected over time in the bank's earnings. For example, a long term fixed rate loan entered into when interest rates were low and refunded more recently with liabilities bearing a higher rate of interest will, over its remaining life, represent a drain on the bank's resources (Basel Committee, 2001).

2.8 Measuring and Monitoring Interest Rate Risk

In general, but depending on the complexity and range of its activities, a financial institution should have interest rate risk measurement and monitoring systems that assess the effects of rate changes on both earnings and economic value of the institution and provide meaningful measures of financial institution's current levels of interest rate risk exposure. In addition, monitoring systems should be capable of identifying any excessive exposures that might arise and assessing all material interest rate risks associated with a financial institution's assets, liabilities and off-balance-sheet positions. They should also utilize generally accepted financial concepts and risk measurement techniques and have well documented assumptions and parameters (CBK, 2005).

2.8.1 Measurement

A bank's interest rate risk reflects the extent to which its financial condition is affected by changes in market interest rates (English, 2002). There are two different ways of thinking about such effects. The first approach focuses on the impact of changes in market interest rates on the value of bank assets, liabilities and off-balance sheet positions (potentially including those that are not marked to market for reporting purposes), and so arrives at an overall assessment of the impact of changes in market interest rates on the economic value of the bank (English, 2002).

The second approach focuses on the implications of movements in market rates for the future cash flows that the bank will obtain. Since the present discounted value of the bank's cash flows must equal the economic value of the bank, these two approaches are consistent and both can be useful. For example, a focus on flows may suggest impending liquidity problems as cash flow dwindles. Alternatively, a sharp decline in economic value may imply that the bank is insolvent, even if operations continue to provide cash in the near term. In either case, action on the part of both bank managers and national authorities would seem appropriate (English, 2002).

To assess directly the extent of a bank's interest rate risk following either of these two perspectives, one would need information on the pricing of the bank's assets and liabilities, including repricing periods and base rates. Moreover, this data would need to be supplemented by information on the adjustments that the bank is likely to make to the rates on assets and liabilities that it can reprice at its discretion following changes in market rates. One would also require information on the likelihood that bank customers would choose to repay loans or withdraw funds early as a result of changes in market rates. Finally, one would need information sufficient to allow an evaluation of other potential sources of interest rate risk, including the interest sensitivity of fee income and off-balance sheet exposures. In addition to its inherent complexity, such a direct approach is difficult for the researcher to implement because the necessary information is lacking. There is a paucity of data on the repricing intervals of banks' assets and liabilities in many countries. In addition, while there has been considerable study of the

pricing of some types of deposits and loans, such information is hardly complete (English, 2002).

The risk measurement system should support a meaningful evaluation of the effect of stressful market conditions on the financial institution. Stress testing should be designed to provide information on the kinds of conditions under which the financial institution's strategies or positions would be most vulnerable and thus may be tailored to the risk characteristics of the institution. Possible stress scenarios might include abrupt changes in the general level of interest rates, changes in the relationships among key market rates (i.e., basis risk), changes in the slope and the shape of the yield curve (i.e., yield curve risk), changes in the liquidity of key financial markets or changes in the volatility of market rates. In addition, stress scenarios should include conditions under which key business assumptions and parameters break down (CBK, 2005).

The stress testing of assumptions used for illiquid instruments and instruments with uncertain contractual maturities is particularly critical to achieving an understanding of the financial institution's risk profile. In conducting stress tests, special consideration should be given to instruments or markets where concentrations exist as such positions may be more difficult to liquidate or offset in stressful situations. Financial institutions should consider "worst case" scenarios in addition to more probable events. Management and the board of directors should periodically review both the design and the results of such stress tests, and ensure that appropriate contingency plans are in place (CBK, 2005).

The simplest techniques for measuring a financial institution's interest rate risk exposure begin with a maturity/repricing schedule that distributes interest-sensitive assets, liabilities and off-balance sheet positions into "time bands" according to their maturity (if fixed rate) or time remaining to their next repricing (if floating rate). These schedules can be used to generate simple indicators of the interest rate risk sensitivity of both earnings and economic value to changing interest rates. When this approach is used to assess the interest rate risk of current earnings, it is typically referred to as gap analysis. The size of the gap for a given time band – that is, assets minus liabilities plus

off balance-sheet exposures that reprice or mature within that time band – gives an indication of the financial institution's repricing risk exposure (CBK, 2005).

A maturity/repricing schedule can also be used to evaluate the effects of changing interest rates on a financial institution's economic value by applying sensitivity weights to each time band. Typically, such weights are based on estimates of the assets and liabilities that fall into each time-band, where duration is a measure of the percent change in the economic value of a position that will occur given a small change in the level of interest rates. Duration-based weights can be used in combination with a maturity/repricing schedule to provide a rough approximation of the change in a financial institution's economic value that would occur given a particular set of changes in market interest rates. Financial institutions may employ more sophisticated interest rate risk measurement systems than those based on simple maturity/repricing schedules such as, simulation techniques which typically involve detailed assessments of 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. In static simulations, the cash flows arising solely from the current on-and off-balance sheet positions are assessed. In a dynamic simulation approach, the simulation builds in more detailed assumptions about the future course of interest rates and expected changes in a financial institution's business activity over that time (CBK, 2005).

These more sophisticated techniques allow for dynamic interaction of payments streams and interest rates, and better capture the effect of embedded or explicit options. Regardless of the measurement system, the usefulness of each technique depends on the validity of the underlying assumptions and the accuracy of the basic methodologies used to model interest rate risk exposure. In designing interest rate risk measurement systems, financial institutions should ensure that the degree of detail about the nature of their interest-sensitive positions is commensurate with the complexity and risk inherent in those positions. For instance, using gap analysis, the precision of interest rate risk measurement depends in part on the number of time bands into which positions are aggregated. Clearly, aggregation of positions/cash flows into broad time bands implies some loss of precision. In practice, the financial institution must assess the significance

of the potential loss of precision in determining the extent of aggregation and simplification to be built into the measurement approach (CBK, 2005).

When measuring interest rate risk exposure, two further aspects call for more specific comment: the treatment of those positions where behavioral maturity differs from contractual maturity and the treatment of positions denominated in different currencies. Positions such as savings and time deposits may have contractual maturities or may be open-ended, but in either case, depositors generally have the option to make withdrawals at any time. In addition, financial institutions often choose not to move rates paid on these deposits in line with changes in market rates. These factors complicate the measurement of interest rate risk change when interest rates vary (CBK, 2005).

Financial institutions with positions denominated in different currencies can expose themselves to interest rate risk in each of these currencies. Since yield curves vary from currency to currency, financial institutions generally need to assess exposures in each. Financial institutions with the necessary skill and sophistication and with material multi-currency exposures may choose to include in their risk measurement process methods to aggregate their exposures in different currencies using assumptions about the correlation between interest rates in different currencies. A financial institution that uses correlation assumptions to aggregate its risk exposures should periodically review the stability and accuracy of those assumptions. The financial institution should also evaluate what its potential risk exposure would be in the event that such correlations break down (CBK, 2005).

2.8.2 Management information system

An accurate, informative, and timely management information system is essential for managing interest rate risk exposure, both to inform management and to support compliance with board policy. Reporting of risk measures should be regular and should clearly compare current exposure to policy limits. In addition, past forecasts or risk estimates should be compared with actual results to identify any modeling shortcomings. The board on a regular basis should review reports detailing the interest rate risk exposure of the financial institution. While the types of reports prepared for the

board and for various levels of management will vary based on the financial institution's interest rate risk profile, they should, at a minimum include summaries of the financial institution's aggregate exposures, reports demonstrating the financial institution's compliance with policies and limits, results of stress tests including those assessing breakdown in key assumptions and parameters and summaries of the findings of reviews of interest rate risk policies, procedures, and the adequacy of the interest rate risk measurement systems, including any findings of internal and external auditors and retained consultants. The duties of the individuals involved in the risk measurement, monitoring and control functions must be sufficiently separate and independent from the business decision makers and position takers to ensure the avoidance of conflicts of interest (CBK, 2005).

2.8.3 Internal controls and audit

Financial institutions should have adequate internal controls to ensure the integrity of their interest rate risk management process. These internal controls should be an integral part of the institution's overall system of internal control. They should promote effective and efficient operations, reliable financial and regulatory reporting, and compliance with CBK's prudential and regulatory requirements. An effective system of internal control for interest rate risk includes a strong control environment. These should include appropriate approval processes, exposure limits, reconciliation, reviews and other mechanisms designed to provide a reasonable assurance that the institution's interest rate risk management objectives are achieved (CBK, 2005).

Other internal controls include adequate process for identifying and evaluating risk, establishment of control activities such as policies, procedures and methodologies, adequate information systems and continual review of adherence to established policies and procedures. This is an important element of financial institution's internal control system over its interest rate risk management process such reviews and evaluations should be conducted regularly by internal auditors or other individuals who are independent of the function they are assigned to review. In those instances where internal auditors conduct the independent review, financial institutions are encouraged to have the risk measurement, monitoring and control functions periodically reviewed by external auditors (CBK, 2005).

2.9 Interest Income and Interest Rate Risk

Empirical evidence using aggregate bank loan and time deposit data from 1985 to 1996 indicated that low-slack banks in United States of America had significantly more interest-rate risk than high-slack banks (Hanweck, 2005). Predictions were also made regarding the effect of deposit and lending rate parameters on bank credit availability that was not empirically tested with the aggregate data. An important limitation of both the dealer and cost-of-goods models of net interest margins is that they treat the banking industry either as being homogenous or as having limited heterogeneous traits based only on their asset size. However, banks with distinct production-line specializations usually differ in terms of their business models, pricing power, and funding structure, all of which likely affect net interest margin sensitivity to interest-rate and other shocks. For instance, in the 1980s and early 1990s, credit card interest rates were typically viewed as "sticky" or insensitive to market rates, a view suggesting imperfect market competition (Ausubel, 1991; Calem and Mester, 1995). This view would imply that net interest margins of credit card banks, as a group, would be significantly less sensitive to interest rate shocks than other banks.

Furletti (2003) documents notable changes in credit card pricing due to intense competition over the past decade. However, it is not clear how these changes have affected credit card specialists' sensitivity to interest-rate and other shocks. In comparison, mortgage lenders, as a group, have a balance sheet with a significant mismatch in the maturity of their assets and liabilities, and they are therefore more likely to be sensitive to changes in the yield curve.

A well-known simple theory of the interbank market builds on the assumption that reserves are held by banks only to meet the requirement, and hence that banks regard balances held on different days of the averaging period as perfect substitutes (Angelini, 2004). This theory has two strong testable implications. First, the overnight interbank interest rate, typically used by most modern central banks as an operational target, should behave like a martingale – the current value of the rate should be the best predictor of tomorrow's value (Hamilton, 1996). Second, the reactivity of the demand

for reserves to the overnight rate should be infinite – tiny movements in the rate should trigger shifts in the demand for funds large enough to eliminate predictable patterns in the rate itself. A large literature has focused on testing the first implication, consistently rejecting the martingale hypothesis (Hamilton, 1997; Hayashi 2001; Prati *et al.*, 2003). The evidence concerning the second testable implication is far less abundant, but also strongly rejects the hypothesis that the interest rate elasticity of the demand for reserves is infinite (Hamilton, 1997;Angelini, 2003).

Several explanations have been given for rejection of the theory, all involving a reason why in practice reserves on different days of the maintenance period are not perfect substitutes. These include market frictions such as fixed or transaction costs (Kopecky and Tucker, 1993; Hamilton 1996; Clouse and Dow, 1999; Bartolini *et al.*, 2001), credit line arrangements (Spindt and Hoffmeister, 1988; Hamilton, 1996), generic liquidity benefits of reserves (Ho and Saunders, 1985; Campbell, 1987; Hamilton, 1996), payment system patterns and daily overdraft penalties (Furfine, 2000), risk aversion on the part of banks (Ho and Saunders, 1985; Angelini, 2000), specific features of the monetary policy operational framework (Pérez Quirós and Rodríguez Mendizábal, 2003).

Risk aversion can affect both the level of the demand for reserves and its interest rate elasticity (Ho and Saunders, 1985). Specifically, higher risk-aversion should increase the demand for funds and reduce its interest rate elasticity. Banks' reactivity to interest rates may be influenced by the costs of setting up and running an efficient cash management desk – including compensation of skilled treasurers, hardware, software and rental of space and equipment among others.

Kilongosi (2005), basing his study on a model that Hanweck (2005) used to test for sensitivity of net interest margin to interest rate shocks tested the extent of variations in net interest margin for commercial banks in Kenya owing to interest rate risk for the period between the fourth quarter of 2002 and the second quarter of 2005. In the study, net interest margin was measured by average net interest income as a percentage of average earning assets while interest rate risk indicators used were the volatility of 91-day monthly treasury yield, net short term assets as a percentage of earning assets and

non-maturing deposits as a percentage of earning assets. A dummy variable was introduced to capture marginal effect when the volatility of 91-day monthly treasury yield increased in the quarter. The study found that interest rate risk (as measured by these variables) contributes 50.4% influence of the total variations in net bank interest margin of commercial banks in Kenya with 18.8% variation in net interest margin when the risk was measured by the volatility of 91-day monthly treasury yield, 32.3% when the risk was measured by the net short term assets as a percentage of earning assets and 33.0% if measured by non-maturing deposits as a percentage of earning assets.

The Basel Committee (2001) notes that changes in interest rates affect a bank's earnings by changing its net interest income and the level of other interest-sensitive income and operating expenses. Changes in interest rates also affect the underlying value of the bank's assets, liabilities and off-balance sheet instruments because the present value of future cash flows (and in some cases, the cash flows themselves) change when interest rates change. Accordingly, an effective risk management process that maintains interest rate risk within prudent levels is essential to the safety and soundness of banks.

According to the committee, changes in interest rates can have adverse effects both on a bank's earnings and its economic value. In the earnings perspective, the focus of analysis is the impact of changes in interest rates on accrued or reported earnings. This is the traditional approach to interest rate risk assessment taken by many banks. Variation in earnings is an important focal point for interest rate risk analysis because reduced earnings or outright losses can threaten the financial stability of an institution by undermining its capital adequacy and by reducing market confidence. In this regard, the component of earnings that has traditionally received the most attention is net interest income which is the difference between total interest income and total interest expense. This focus reflects both the importance of net interest income in banks' overall earnings and its direct and easily understood link to changes in interest rates.

The Basel Committee (2001) notes that a negative, or liability-sensitive, gap occurs when liabilities exceed assets (including off-balance sheet positions) in a given time band. This means that an increase in market interest rates could cause a decline in net

interest income. Conversely, a positive, or asset-sensitive, gap implies that the bank's net interest income could decline as a result of a decrease in the level of interest rates.

Comptroller's Handbook (1997), notes that fluctuations in interest rates generally affect reported earnings through changes in a bank's net interest income. Net interest income will vary because of differences in the timing of accrual changes (repricing risk), changing rate and yield curve relationships (basis and yield curve risks), and options positions. Changes in the general level of market interest rates also may cause changes in the volume and mix of a bank's balance sheet products. For example, when economic activity continues to expand while interest rates are rising, commercial loan demand may increase while residential mortgage loan growth and prepayments slow.

The Comptroller's Handbook (1997) agrees with the Basel Committee on relationship between interest rate risk and net interest income/earnings of a bank. According to the handbook, gap (maturity or repricing) limits can be designed to reduce the potential exposure to a bank's earnings or capital from changes in interest rates. The limits control the volume or amount of repricing imbalances in a given time period. These limits often are expressed by the ratio of rate-sensitive assets (RSA) to rate-sensitive liabilities (RSL) in a given time period. A ratio greater than one suggests that the bank is asset-sensitive and has more assets than liabilities subject to repricing. All other factors being constant, the earnings of such a bank generally will be reduced by falling interest rates. An RSA/RSL ratio less than one means that the bank is liability-sensitive and that its earnings may be reduced by rising interest rates.

CBK (2005) notes that excessive interest rate risk can pose a significant threat to a financial institution's earnings and capital base. Changes in interest rates affect a financial institution's earnings by changing its net interest income and the level of other interest-sensitive income and operating expenses. Changes in interest rates thus can have adverse effects both on a financial institution's earnings, capital and its economic value. According to the article, the goal of interest rate risk management is to maintain a financial institution's interest rate risk exposure within self-imposed parameters over a range of possible changes in interest rates.

The simplest techniques for measuring a financial institution's interest rate risk exposure begin with a maturity/repricing schedule that distributes interest-sensitive assets, liabilities and off-balance sheet positions into "time bands" according to their maturity (if fixed rate) or time remaining to their next repricing (if floating rate) (CBK, 2005). These schedules can be used to generate simple indicators of the interest rate risk sensitivity of both earnings and economic value to changing interest rates. When this approach is used to assess the interest rate risk of current earnings, it is typically referred to as gap analysis. The size of the gap for a given time band – that is, assets minus liabilities plus off balance-sheet exposures that reprice or mature within that time band – gives an indication of the financial institution's repricing risk exposure.

A maturity/repricing schedule can also be used to evaluate the effects of changing interest rates on a financial institution's economic value by applying sensitivity weights to each time band. Typically, such weights are based on estimates of the assets and liabilities that fall into each time-band, where duration is a measure of the percent change in the economic value of a position that will occur given a small change in the level of interest rates. Duration-based weights can be used in combination with a maturity/repricing schedule to provide a rough approximation of the change in a financial institution's economic value that would occur given a particular set of changes in market interest rates (CBK, 2005).

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Research Design

The research was an empirical study carried out as a survey of commercial banks quoted at the Nairobi Stock Exchange, registered and operating in Kenya as of 31 December 2005.

3.2 Population

The population of interest in this study consisted of commercial banks in Kenya as of 31 December 2005. Due to limited availability of data from some banks, especially the private banks, the population constituted banks quoted at the Nairobi Stock Exchange, registered and operating in Kenya as of 31 December 2005.

3.3 Data Collection

Secondary data was used for the study. The data was collected from financial statements of the quoted banks for the 5-year period from 2001 to 2005. This period was deliberately selected because banks are required to prepare interest rate risk tables that reflect assets and liabilities maturing or being repriced in 1 month to 3 months, 3 months to 6 months, 6 months to 1 year, from 1 year to 5 years, and from 5 years and over.

3.4 Data Analysis

This study used the multiple regression technique for analysing the data. Regression analysis is used when a researcher is interested in finding out whether an independent variable predicts a given dependent variable. Multiple regression attempts to determine whether a group of variables together predict a given dependent variable.

A typical multiple regression model is of the form:

$\mathbf{Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots + \beta_n X_n + \epsilon}$

Where:

Y	is the dependent variable;
α	is a constant, the value of Y all X are zero;
$\beta_{1,2,\ldots,n}$	are the regression coefficients or change induced in Y by each X;
$X_{1,2,\ldots,n}$	are independent variables; and
ϵ	is an error term.

In this study, Net Interest income (NI) for each year for each bank was regressed against three independent variables, namely: Interest Rate Sensitivity Gap for assets and liabilities maturing in less than three months (IRSG 1), Interest Rate Sensitivity Gap for assets and liabilities maturing between three and twelve months (IRSG 2) and Interest Rate Sensitivity Gap for assets and liabilities maturing beyond one year (IRSG 3).

The regression equation was as follows:

$\mathbf{NI = \alpha + \beta_1 (IRSG\ 1) + \beta_2 (IRSG\ 2) + \beta_3 (IRSG\ 3) + \epsilon}$

Where:

NI	is net interest income of a given bank;
α	is the value of interest income when IRSG is zero (means there is no gap as total assets in each category is exactly equal to total liabilities in that category);
$\beta_{1,2,3}$	are the regression coefficients or change induced in net interest income by each IRSG;
IRSG 1,2,3	are the interest rate sensitivity gaps in the categories of assets and liabilities maturing in less than 3 months (IRSG 1), between 3 and 12 months (IRSG 2) and more than 1 year (IRSG 3);
ϵ	is an error term

CHAPTER FOUR: DATA ANALYSIS AND FINDINGS

4.1 Introduction

The data analysis was guided by the research objective which was to determine the relationship between interest rate risk and net interest income of commercial banks in Kenya. The body of the report only contains information that directly relates to the study objectives while the appendices contain other information and statistics used in preparing the report. The main method used for data analysis is multiple regression analysis.

Banks are required to prepare interest rate risk tables that reflect assets and liabilities maturing or being repriced in one month to three months, three months to six months, six months to one year, from one year to five years, and from five years and over. Unfortunately, different banks exhibit different levels of disclosure of the repricing/maturity periods of their assets and liabilities. As shown on Appendix 1, National Bank of Kenya (NBK) provides the highest level of disclosure, showing assets and liabilities repricing/maturing in one month, between one and three months, between three and six months, between six and twelve months, between one and three years, between three and twelve years, and those repricing/maturing after five years. On the other hand, Barclays Bank of Kenya (BBK) discloses only the bare minimum asset and liability categories. These are assets and liabilities repricing/maturing in one month, between one and three months, between three and twelve months, and after one year.

Due to the differences in levels of disclosure, three definitive repricing/maturity periods of bank asset and liabilities were obtained and data stratified on this basis (Appendix 1). These are assets and liabilities repricing/maturing in less than three months, assets and liabilities repricing/maturing in between three and twelve months and assets and liabilities repricing/maturing in more than one year. The less-than-three months repricing maturity category is in tandem with the 91-day treasury bill and is thus useful in determining the level of net interest income derived from lending and investments that are based on the 91-day treasury bill rates. Moreover, the three months to twelve months category reflects the one-year bonds and other short and medium term

investments. The over-one year category represents mainly long-term loans and other investments.

4.2 Regression Results

4.2.1 Overall model summary

Net Interest income (NI) for each year for each bank was regressed against three independent variables, namely: Interest Rate Sensitivity Gap for assets and liabilities maturing/repricing in less than three months (IRSG 1), Interest Rate Sensitivity Gap for assets and liabilities maturing/repricing in between three and twelve months (IRSG 2) and Interest Rate Sensitivity Gap for assets and liabilities maturing/repricing in more than one year (IRSG 3). Regression analysis was conducted using SPSS. Correlation tests were also estimated using the same package.

The results obtained from the regression analysis are presented and discussed below. This section restricts itself to the overall model results (tables 1 to 4). Other detailed analyses of the model regression results are discussed in sections 4.2.2 and 4.2.3.

Table 1: Overall Model Summary

R	R^2	Adjusted R^2	Standard Error of the Estimate
.781[a]	.611	.580	1,454,027.626

a Predictors: (Constant), IRSG1, IRSG2, and IRSG3 (thousands of Kenya Shillings)
Source: Research data

The multiple regression correlation coefficient, R of 78.1% indicates that there is a strong positive relationship between net interest income and interest rate risk. This implies that banks can stabilize their earnings by effective interest rate risk management. The coefficient of determination, R^2 of 0.611 indicates that 61.1% of variation in net interest income is explained by interest rate sensitivity gaps. This R^2 however only tells us how much of the variance in net interest income is accounted for by the regression model from the sample (commercial banks quoted at the Nairobi Stock Exchange). To get the actual variation in net interest income for the entire population of commercial banks in Kenya, we determine the adjusted R^2, 0.580, which implies that the interest rate sensitivity gaps variables explain 58.0% of the variation in

net interest income of commercial banks in Kenya.

F-ratio was used to test the goodness of fit of the regression model in predicting net interest income using interest rate sensitivity gaps. This was computed using analysis of the variance (ANOVA) as shown in Table 2. The table shows sums of squares and the degrees of freedom associated with each. From these two values, the average sums of squares (the mean squares) were calculated by dividing the sums of squares by the associated degrees of freedom. The F-ratio was then computed as the quotient of the regression and the residual mean squares, at 19.86. This F value is statistically significant at $p<.001$ (last column of the table), implying that there is a less than 0.1% chance that an F-ratio this large would happen by chance alone. Usually, social scientists accept any probability below .05 as being statistically meaningful and so any probability value below .05 is regarded as indicative of genuine effect (Field, 2005). We can therefore conclude that interest rate sensitivity gaps predict interest income significantly well, and that the relationship between net interest income and interest rate sensitivity gaps is genuine.

Table 2: Overall Model Analysis of variance (ANOVA)[b]

	Sum of Squares	df	Mean Square	F	p-value
Regression	125,961,553,369,792.500	3	41,987,184,456,597.500	19.860	.000[a]
Residual	80,339,460,834,884.900	38	2,114,196,337,760.129		
Total	206,301,014,204,677.400	41			

a Predictors: (Constant), IRSG1, IRSG2, and IRSG3 (thousands)
b Dependent Variable: Net interest income (NI) (thousands)
Source: Research data

Table 3 shows the model coefficients. The table shows that all the explanatory variables (IRSG1, IRSG2 and IRSG3) positively and significantly explain the net interest income since the p-values in all the cases are less than 0.05 at 5% level of significance. The t statistic for the coefficients indicates that each coefficient is not only big relative to its standard error, but also statistically different from zero, implying that a unit increase interest rate sensitivity gap results in increase in net interest income. Of the three categories of interest rate sensitivity gap, interest rate sensitivity gap for assets and liabilities maturing/repricing in more than three months but in less than twelve months is the largest contributor to net interest income. A unit increase in this gap results in

0.426 increase in net interest income. Since the values in the study were expressed in thousands, it means that an increase in the gap by KShs 1,000 results in KShs 426 increase in net interest income. A unit increase in short term sensitivity gap (maturities in less than three months) results in 0.141 increase in net interest income, while a unit increase in long term sensitivity gap (maturities in periods above one year) results in 0.176 increase in net interest income.

Table 3: Overall Model Coefficients

	B	Std. Error	t	p-value
(Constant)	1,106,250.712	305,349.028	3.623	.001
IRSG1	.141	.029	4.877	.000
IRSG2	.426	.108	3.962	.000
IRSG3	.176	.038	4.665	.000

Dependent Variable: Net interest income (NI) (thousands)
Source: Research data

The regression relationship between the net interest income and the interest rate sensitivity gaps can thus be modelled as follows:

NI = 1,106,250.712 +0.141 (IRSG 1) + 0.426 (IRSG 2) + 0.176 (IRSG 3)

The model predicts that if a bank's assets and liabilities in all the three categories mature/reprice in the same proportion and time, implying no sensitivity gap, the bank can make a net interest income of KShs 1.1 billion from its interest earning assets and interest bearing liabilities regardless of the direction of movement in interest rates. The model further shows that additional net interest income can be generated by maintaining positive sensitivity gaps in each of the three categories in an increasing interest rate environment or negative sensitivity gaps in each of the three categories in a declining interest rate environment. Net interest income is however maximised when the biggest gap is in assets and liabilities maturing/repricing in between three and twelve months. High sensitivity gaps in the short term assets result in low net interest incomes. These results imply that banks should take deposits that are callable in more than three months but in less than a year should hold more than proportionate investments in 182-day treasury bonds and medium term loans and bonds in an increasing interest rate

environment. This situation should however be reversed in a declining interest rate environment.

The correlations matrix in table 4 below shows that there exists a negative and significant relationship between short term and long term gaps (Pearson correlation coefficient = -0.804, p-value=0.000<0.01 at 1% level of significance). There is however no significant relationship between short term and medium term gaps and between medium term and long term gaps. This means that the higher the interest rate sensitivity gap in short-term assets and liabilities, the lower interest rate sensitivity gap in long term assets and liabilities vice-versa. Medium term interest rate sensitivity gap increases with decrease in short term interest rate sensitivity gap and increases with increase in long term interest rate sensitivity gap. This relationship is however not strong.

Table 4: Correlations Matrix

		IRSG1	IRSG2	IRSG3
IRSG1	Pearson Correlation	1	-.069	-.804(**)
	P-value	.	.664	.000
IRSG2	Pearson Correlation	-.069	1	.264
	P-value	.664	.	.092
IRSG3	Pearson Correlation	-.804(**)	.264	1
	P-value	.000	.092	.

** Correlation is significant at the 0.01 level (2-tailed).
Source: Research data

The results of the correlation matrix indicate that it takes more than a year for short-term mismatches in a banks assets and liability portfolios to be corrected. This correction process is uniform as assets and liabilities mature/reprice in the short term (less than three months), medium term (between three months and one year) and long term (over one year). Since the highest amount of net interest income is achieved when the medium term gap is the highest, banks should focus on upfront portfolios in this category, as opposed to upfront portfolios in short term and or long term gaps.

4.2.2 Regression by year

Tables 5 to 7 show regression results when the overall research model is analysed by year. There results are consistent with overall regression results in tables 1 to 3. The year-on year model summary in table 5 indicates that the model variables well explained net interest income in the years 2001, 2003 and 2005 where the R^2 (coefficient of determination) was 92.5%, 92.6% and 85.6% respectively. The adjusted R^2 (explaining the scenario if the entire population of banks was used) was 86.8%, 87.1% and 77.0% respectively. In these years, the F-ratio (explained in section 4.2.1) was the highest and statistically significant, that is, 16.332 at p=.010 in 2001, 16.782 at p=.010 in 2003 and 9.914 p=.010 in 2005 (see table 6, ANOVA by year). In the years with lower R^2, that is, years 2002 and 2004, the model variables did not well explain the net interest income. This is further confirmed by low values of the F-ratio (table 6, ANOVA by year) and low t-statistic values (table 7, Coefficients by year). The t-statistic was explained in section 4.2.1.

Table 5: Regression summary by year

Year	R	R^2	Adjusted R^2	Std. Error of the Estimate	Durbin Watson Test
2001	.962	.925	.868	845,190.765	2.269
2002	.718	.516	.153	1,944,385.523	1.931
2003	.962	.926	.871	807,225.433	2.082
2004	.803	.644	.431	1,774,844.551	2.093
2005	.925	.856	.770	1,257,295.628	2.393

Predictors: (Constant), IRSG3, IRSG1, IRSG2
Source: Research data

Durbin Watson Test was used to test for serial correlations between standard errors of the estimates to find out if these were auto-correlated. The test statistic can vary between 0 and 4 with a value of 2 meaning that the residuals are uncorrelated (Field, 2005). The observed values of the statistic were approximately 2, and thus the conclusion that there was no correlation between the standard errors.

The model is statistically significant for the years, 2001, 2003 and 2005 as shown in table 6 where the p-values is less than 0.05 at 5% level of significance. The mean squares were derived as a quotient the regression and the residual sums of squares and the respective degrees of freedom. The regression mean squares were then divided by

the residual mean squares to obtain the F-ratio, that is, variation in net interest income explained each year by each of the interest rate sensitivity gaps. The implication of the F-ratio in each year and its significance is as explained earlier in this section.

Table 6: ANOVA by year

Year		Sum of Squares	df	Mean Square	F	p-value
2001	Regression	34,999,341,814,826	3	11,666,447,271,609	16.332	.010
	Residual	2,857,389,717,816	4	714,347,429,454		
	Total	37,856,731,532,642	7			
2002	Regression	16,136,869,616,051	3	5,378,956,538,684	1.423	.360
	Residual	15,122,540,252,571	4	3,780,635,063,143		
	Total	31,259,409,868,623	7			
2003	Regression	32,805,508,340,096	3	10,935,169,446,699	16.782	.010
	Residual	2,606,451,598,827	4	651,612,899,707		
	Total	35,411,959,938,923	7			
2004	Regression	28,516,515,115,249	3	9,505,505,038,416	3.018	.133
	Residual	15,750,365,906,434	5	3,150,073,181,287		
	Total	44,266,881,021,684	8			
2005	Regression	47,014,982,488,296	3	15,671,660,829,432	9.914	.015
	Residual	7,903,961,476,102	5	1,580,792,295,220		
	Total	54,918,943,964,398	8			

Predictors: (Constant), IRSG3, IRSG1, IRSG2
Dependent Variable: N1
Source: Research data

Table 7, coefficients by year, shows that the significance of the interest sensitivity gaps in explaining the net interest income varied year by year. In 2001, short term and long term interest rate sensitivity gaps positively and significantly explained the net interest income (high t-statistic values at p=.003 and p=.040 respectively. None of the interest sensitivity gaps significantly explained the net interest income in 2002 and 2004. In 2003, medium term sensitivity gap positively and significantly explained the net interest income while in 2005 all the interest sensitivity gaps variables positively explained the net interest income. These results are in line with the explanation given earlier in this section.

From the coefficients by year we observe in three of the five cases that interest sensitivity gaps significantly explain the net interest income. There exists a positive relationship between the net interest income and interest sensitivity gaps as indicated by the coefficients. Overall, medium term sensitivity gap contributes the highest portion of

the variation in net interest income as shown by the coefficients table (table 7) whereby for the years in which the model well explained the net interest income, the largest coefficients were found in the medium term interest rate sensitivity gap, that is 92.1% with t-statistic of 2.701 (p=0.054) in year 2001, 91.5% with t-statistic of 6.108 (p=0.004) in year 2003 and 61.0% with t-statistic of 3.457 (p=0.018) in year 2005.

Table 7: Coefficients by year

Year		B	Std. Error	t	p-value
2001	(Constant)	973,983.807	443,677.696	2.195	.093
	IRSG1	.429	.066	6.477	.003
	IRSG2	.921	.341	2.701	.054
	IRSG3	.254	.085	2.997	.040
2002	(Constant)	1,211,995.273	927,335.835	1.307	.261
	IRSG1	.237	.169	1.401	.234
	IRSG2	.215	.387	.555	.609
	IRSG3	.229	.179	1.278	.270
2003	(Constant)	930,267.362	447,888.021	2.077	.106
	IRSG1	-.043	.044	-.987	.379
	IRSG2	.915	.150	6.108	.004
	IRSG3	-.003	.065	-.039	.970
2004	(Constant)	1,126,482.043	802,261.716	1.404	.219
	IRSG1	.130	.066	1.978	.105
	IRSG2	.590	.379	1.556	.180
	IRSG3	.143	.090	1.586	.173
2005	(Constant)	596,157.808	622,798.276	.957	.382
	IRSG1	.151	.043	3.529	.017
	IRSG2	.610	.176	3.457	.018
	IRSG3	.206	.053	3.866	.012

Source: Research data

4.2.3 Regression by bank

Table 8, regression summary by bank shows regression results when the overall research model is analysed by bank. The table shows that the predictor variables (interest rate sensitivity gaps) best explain the net interest income for almost all the banks except HFCK (see the adjusted R^2 column). This exception could be attributed to the nature of the bank's business. As opposed to all other banks, HFCK is a mortgage finance institution licensed under the Banking Act (Cap.488) to promote the flow of both private and public savings into financing home ownership. As such, its main assets are mortgage loans advanced to borrowers that may not attract interest income at the same

rates as the other banks whose business centres on deposit taking and lending. HFCK's interest rate sensitivity gaps may thus be erratic and this is confirmed by the large standard error compared to the other banks. This has an effect of adjusted R^2 for the bank.

Table 8: Regression by bank

Bank	R	R^2	Adjusted R^2	Std. Error of the Estimate
BBK	.999	.998	.992	67,545.792
CFC	.997	.995	.979	56,767.262
DTB	.998	.996	.985	25,146.603
Equity	1.000	1.000	1.000	.
HFCK	.853	.728	-.087	423,766.712
KCB	.970	.940	.761	379,423.161
NBK	.957	.915	.660	459,317.087
NIC	.959	.921	.682	106,210.270
Stanchart	.946	.894	.576	222,463.110

Predictors: (Constant), IRSG3, IRSG2, IRSG1
Dependent Variable: NI
Source: Research data

NBK and KCB also have a large standard errors. This could be attributed to the non-performing loans that have dogged the banks over the years, which may have led the bank into suspending interest income charge on such loans. Although the banks may fit within the recommended interest rate sensitivity gaps, they may not benefit from a changing interest rate environment. According to the Banking Survey (2006), NBK and KCB topped in the list banks ranked according to the level on net non-performing loans and advances.

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS, RECOMMENDATIONS, LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

5.1 Summary of Findings and Conclusions

5.1.1 Summary of findings

The study set out to determine whether there is a relationship between banks' interest rate sensitivity gap and net interest income. At the outset, the net interest income, its models and the factors influencing it were reviewed. Also reviewed were the sources of interest rate risk, its measurement, its management and its effects on net interest income.

Net interest income observed in a period of five years was regressed against interest rate sensitivity gap of assets and liabilities in each year. The interest rate sensitivity gap was stratified into three definitive categories, that is, maturities in less than three months, maturities in between three and twelve months and maturities in periods above one year. These three categories formed the independent variables for use in the study. It is clear from the study that there is a strong direct relationship between interest rate risk and net interest income of commercial banks. Specifically, interest rate sensitivity gap accounts for 58.0% of variations in net interest income. These results led to rejection of the null hypothesis.

Each of the three categories of interest rate sensitivity gap was found to positively contribute to net interest income. A unit increase in short term sensitivity gap (maturities in less than three months) results in 0.141 units increase in net interest income, while a unit increase in medium term sensitivity gap (maturities in between three and twelve months) results in 0.426 units increase net interest income. The study also found that a unit increase in long term sensitivity gap (maturities in periods above one year) results in 0.176 units increase in net interest income.

Finally the study found a strong that the higher the short term sensitivity gap, the lower the long term gap and vice-versa, implying that it takes more than a year for short-term mismatches in assets and liabilities to be corrected. This was found detrimental to a bank's net interest income as the income is maximized at positive medium term gaps, in an interest rate increasing environment.

5.1.2 Conclusions

The regression and correlation analysis used by this study provides a definitive evidence of existence of a strong relationship between interest rate risk and net interest income. These results were largely homogenous when regression was performed by bank and by year. The study has demonstrated the fact that proper interest rate risk management not only reduces a banks' exposure to risk, but it also provides banks with an opportunity to stabilize and improve their net interest income. An appropriate composition of a bank's assets and liabilities, in terms of their maturities/repricing frequencies, helps amplify or moderate the effects of changes and volatility in short-term interest rates on the net interest income, a concept that banks can utilise for their advantage.

Net interest income increases when high positive medium term sensitivity gaps are maintained in a rising interest rate environment and conversely, low negative medium term sensitivity gaps in a falling interest rate environment. Banks should thus ensure that their interest rate management policies are focussed on this asset/liability holding pattern in a volatile interest rate environment. Maintaining short term and long term sensitivity gaps is a risk-averse strategy that does not maximise shareholders' returns, and should be discouraged by banks. Also considered a risk-averse approach to interest rate risk management is the maintenance of a zero sensitivity gap. Whilst it ensures that a bank's earnings and capital are protected from fluctuations in interest rates, it does not provide a bank with an opportunity to increase its net interest income by taking advantage of the interest rate fluctuations.

The study thus leads to a conclusion that banks maximise their net interest income, and therefore their earnings, if they take deposits that are callable in more than three months but in less than a year while holding more than proportionate investments in 182-day treasury and bonds or if the deposits are taken to finance medium term loans and other medium term interest-earning assets in an increasing interest rate environment. This situation should however be reversed in a declining interest rate environment.

5.2 Recommendations

There is a resounding call for banks to re-look at their asset and liability portfolios. The immediate proposal is that they should try and achieve a perfect match in maturities (if fixed rate) or time remaining to their next repricing (if floating rate) of their assets and liabilities. The perfect match is seen as a risk-averse attempt in streamlining a bank's balance sheet as what it achieves is a full off-set of interest income generated by its assets and the interest expense from its liabilities, leaving no exposure its earnings and economic value. This approach should be adopted by banks which have loss-making trends, and would like to at least eliminate losses/exposures emanating from interest-earning-asset and interest-bearing-liability transactions.

There is however a more risk taking approach of adjusting the portfolio of assets and liabilities to take profits when interest rates rise and losses when they fall. According to English (2002), realizing profits from changes in interest rates does not represent a speculation, and is risky perhaps risky than other profit opportunities. This study has shown that each of the sensitivity gaps results to a positive contribution to net interest income, if interest rates rise. The contribution is highest in the medium term gap, that is, the gap in assets and liabilities maturing/repricing in between in more than three months but in less than one year. After one year, this benefit is however eroded.

Even if banks avoid mismatches in the pricing of their assets and liabilities on average, particular banks, or even the industry as a whole, could have significant interest rate exposures on occasion. Some banks will presumably make mistakes, while others may choose to mismatch maturities at times in order to profit from forecast movements in interest rates. Banks must establish and enforce operating limits and other practices that maintain exposures within levels consistent with their internal policies. They should also measure their vulnerability to loss under stressful market conditions and consider those results when establishing and reviewing their policies and limits for interest rate risk. The banks' information system should be designed in a manner that ensures effective measuring, monitoring, controlling and reporting of interest rate sensitivity gaps. Overall, a bank's internal policies and limits should ensure that there is always a high positive medium term sensitivity gap in an increasing interest rate environment,

and a low negative term sensitivity gap in a declining interest rate environment. Bank regulators and supervisors should ensure that their guidelines and regulations are in line with this.

More broadly, the net interest income of the banking sector could be exposed to interest rate changes for a period if a large number of banks, presumably responding to the same or similar market signals, choose to take on similar exposures. Moreover, even if banks avoid interest rate risk associated with their net interest income, there are other possible sources of interest rate risk. As a result, banks and their supervisors need to remain alert to developments that could lead to excessive exposure to changes in market interest rates. This should be aimed at turning the exposures into opportunities for increasing banks' net interest income.

5.3 Limitation of the Study

The largest limitation for this research was in the way different banks group the categories of the maturity/repricing of their assets and liabilities. When it was expected that the interest rate risk tables in the financial statements of banks would be similar considering that all banks sampled are bound by similar NSE rules and CBK requirements, the study was disappointed by the fact different banks have different extends of disclosure (see appendix 1), and therefore the data stratification employed to make comparison and analysis possible was restricted to only three time bands.

5.4 Suggestions for Further Research

The overall model results indicated a relationship between interest rate risk and net interest income of commercial banks in Kenya. This study found that 58.0% of variation in net interest income is explained by interest rate sensitivity gaps. Future studies could seek to find out what explains the remaining 42.0% of variation in net interest income.

The study was conducted around a period when hedging activities were not largely employed by commercial banks in Kenya to manage interest rate risk and take advantage of the interest rate changes. These activities include the use derivatives like

interest swaps and options, and have proved successful in banking organisations in developed countries like the United States of America. Banks in Kenya are also moving to use of such derivatives. Future studies in this area could thus explain the effectiveness of hedging activities and point out as to whether they also help banks to stabilise their net interest income.

The study did not consider the interaction between interest rate risk and other risks, such as credit risk, liquidity risk, foreign exchange risk, operational risk, reputation risk and regulatory risks. Changes in the level of interest rates may be compounded by effects of these risks to affect banks' net interest income in various ways. Future studies may seek to determine the combined effect of these risks on net interest income.

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B APPENDICES

B.1 Appendix 1: Summary of level of disclosure of interest rate sensitivity gap by banks

	Due in 3 months		3 to 12 months		Over 1 year		
Barclays	1 month	1-3 months	3-12 months		Over 1 year		
Stanchart	Upto 3 months		3-6 months	6 - 12 months	1-3 years	Over 3 years	
KCB	1 month	1-3 months	3-12 months		1-5 years		Over 5 years
HFCK	Due on demand	Due in 3 months	3-12 months		1-5 years		Over 5 years
CFC	1-3 months		3-6 months	6 - 12 months	1-3 years	3-5 yrs	Over 5 years
DTB	1 month	1-3 months	3-12 months		1-5 years		
NBK	1 month	1-3 months	3-6 months	6 - 12 months	1-3 years	3-5 yrs	Over 5 years
NIC	1 month	1-3 months	4-6 months	7 - 12 months	1-3 years	Over 3 years	
Equity	1 month	1-3 months	3-12 months		1-5 years		Over 5 years

Source: Financial Statements Published by the Banks

B.2 Appendix 2: Detailed year-on-year interest rate sensitivity gaps and net interest income

Note: All amounts are in Kenya Shillings 'Thousands'

BBK

	Description	Algebra	As used in this study	2001	2002	2003	2004	2005
Independent variable 1:	1 to 3 months sensitivity gap	**X1**	**IRSG 1**	10,963,000	4,435,000	12,268,000	20,777,000	20,963,000
Independent variable 2:	3 to 6 months sensitivity gap	**X2**	**IRSG 2**	(176,000)	1,267,000	6,792,000	3,553,000	5,821,000
Independent variable 3:	Over 1 year sensitivity gap	**X3**	**IRSG 3**	2,158,000	5,116,000	84,000	(2,619,000)	(277,000)
Dependent variable	Net interest income	**Y**	**NI**	**6,771,000**	**6,389,000**	**7,181,000**	**7,633,000**	**8,388,000**

STANCHART

	Description	Algebra	As used in this study	2001	2002	2003	2004	2005
Independent variable 1:	1 to 3 months sensitivity gap	**X1**	**IRSG 1**	4,420,950	2,041,818	3,022,117	9,008,670	673,781
Independent variable 2:	3 to 6 months sensitivity gap	**X2**	**IRSG 2**	144,564	6,670,104	4,273,609	(196,209)	(104,665)
Independent variable 3:	Over 1 year sensitivity gap	**X3**	**IRSG 3**	6,018,133	7,625,133	11,122,287	11,703,842	22,796,488
Dependent variable	Net interest income	**Y**	**NI**	**4,005,317**	**4,091,422**	**3,834,480**	**3,676,033**	**4,577,513**

KCB

	Description	Algebra	As used in this study	2001	2002	2003	2004	2005
Independent variable 1:	1 to 3 months sensitivity gap	**X1**	**IRSG 1**	(18,475,940)	(18,397,846)	(37,719,940)	(40,985,446)	(47,154,251)
Independent variable 2:	3 to 6 months sensitivity gap	**X2**	**IRSG 2**	4,811,507	2,820,088	874,247	2,558,332	3,231,734
Independent variable 3:	Over 1 year sensitivity gap	**X3**	**IRSG 3**	24,409,705	24,654,341	23,159,764	35,582,188	40,667,206
Dependent variable	Net interest income	**Y**	**NI**	**3,597,525**	**2,644,301**	**3,225,894**	**3,579,934**	**4,766,292**

HFCK

	Description	Algebra	As used in this study	2001	2002	2003	2004	2005
Independent variable 1:	1 to 3 months sensitivity gap	**X1**	**IRSG 1**	3,393,262	(4,998,382)	(4,113,098)	(5,758,536)	2,734,699
Independent variable 2:	3 to 6 months sensitivity gap	**X2**	**IRSG 2**	(2,362,188)	682,513	(488,843)	(1,954,164)	(836,958)
Independent variable 3:	Over 1 year sensitivity gap	**X3**	**IRSG 3**	(1,004,278)	4,831,325	5,024,816	(1,227,016)	(1,112,027)
Dependent variable	Net interest income	**Y**	**NI**	**628,700**	**900,526**	**1,636,214**	**905,249**	**663,547**

CFC

	Description	Algebra	As used in this study	2001	2002	2003	2004	2005
Independent variable 1:	1 to 3 months sensitivity gap	**X1**	**IRSG 1**	4,177,919	2,942,847	(658,468)	(20,237)	(2,465,072)
Independent variable 2:	3 to 6 months sensitivity gap	**X2**	**IRSG 2**	(2,192,869)	(1,122,305)	17,324	505,792	654,562
Independent variable 3:	Over 1 year sensitivity gap	**X3**	**IRSG 3**	151,747	603,838	2,901,468	6,948,593	9,554,716
Dependent variable	Net interest income	**Y**	**NI**	**641,834**	**594,977**	**710,221**	**1,113,418**	**1,519,649**

DTB

	Description	Algebra	As used in this study	2001	2002	2003	2004	2005
Independent variable 1:	1 to 3 months sensitivity gap	**X1**	**IRSG 1**	26,715	(342,605)	612,779	1,292,020	2,618,545
Independent variable 2:	3 to 6 months sensitivity gap	**X2**	**IRSG 2**	34,265	623,000	134,319	(1,338,486)	(2,545,067)
Independent variable 3:	Over 1 year sensitivity gap	**X3**	**IRSG 3**	1,000	315,200	(21,599)	(93,580)	43,267
Dependent variable	Net interest income	**Y**	**NI**	**296,717**	**352,358**	**431,156**	**537,864**	**811,211**

NBK

	Description	Algebra	As used in this study	2001	2002	2003	2004	2005
Independent variable 1:	1 to 3 months sensitivity gap	**X1**	**IRSG 1**	(9,313,979)	(8,454,102)	(8,393,441)	(9,997,270)	(11,667,553)
Independent variable 2:	3 to 6 months sensitivity gap	**X2**	**IRSG 2**	2,127,494	1,462,543	1,113,890	1,290,664	84,628
Independent variable 3:	Over 1 year sensitivity gap	**X3**	**IRSG 3**	5,414,071	3,285,362	19,006,854	20,914,130	21,370,279
Dependent variable	Net interest income	**Y**	**NI**	**1,135,489**	**2,230,671**	**2,642,322**	**2,752,708**	**3,218,251**

NIC

	Description	Algebra	As used in this study	2001	2002	2003	2004	2005
Independent variable 1:	1 to 3 months sensitivity gap	**X1**	**IRSG 1**	1,148,799	726,172	1,117,102	(7,805,562)	(10,896,308)
Independent variable 2:	3 to 6 months sensitivity gap	**X2**	**IRSG 2**	(73,841)	315,824	47,029	1,947,591	2,760,235
Independent variable 3:	Over 1 year sensitivity gap	**X3**	**IRSG 3**	110,640	336,636	325,595	7,101,904	8,682,742
Dependent variable	Net interest income	**Y**	**NI**	**749,382**	**693,882**	**777,586**	**862,015**	**1,169,472**

EQUITY

	Description	Algebra	As used in this study	2001	2002	2003	2004	2005
Independent variable 1:	1 to 3 months sensitivity gap	**X1**	**IRSG 1**	N/a	N/a	N/a	1,328,956	1,674,384
Independent variable 2:	3 to 6 months sensitivity gap	**X2**	**IRSG 2**	N/a	N/a	N/a	1,592,141	2,602,301
Independent variable 3:	Over 1 year sensitivity gap	**X3**	**IRSG 3**	N/a	N/a	N/a	(2,637,414)	(4,446,764)
Dependent variable	Net interest income	**Y**	**NI**	N/a	N/a	N/a	**395,637**	**865,503**

Source: Financial Statements Published by the Banks