COMMERCIAL BANKS EXPOSURE TO INTEREST RATE RISK: A STUDY OF COMMERCIAL BANKS LISTED AT THE NAIROBI STOCK EXCHANGE

BY

KHAMIS SAID MATA

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Declaration

This research project report is my original work and has never been presented for a degree in any other university.

Signature ___________________________ Date: _____________________

SAID MATA KHAMIS

D61/P/8020/2004

This research project report has been submitted for examination with my approval as the University Supervisor.

Signature ___________________________ Date: _____________________

MR. LUTHER OTIENO

LECTURER

DEPARTMENT OF FINANCE AND ACCOUNTING

SCHOOL OF BUSINESS

UNIVERSITY OF NAIROBI

Dedication

This project is dedicated to my family members- my loving wife Nury and Aunt Mwanaisha for believing in me and for your patience throughout. My late grandma, Mbuche for always seeing a potential great man in me, I wish you lived just a little longer……..

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Abstract

The aim of this study was to establish the relationship of commercial banks exposure to interest rate risk and their performance (stock returns). In achieving this, the study applied historical data for the monthly average closing share prices for each of the eight listed banks; the monthly averages for the 91-day Treasury bill rates; and the monthly coupon rates for the 10-year Bond. The data was obtained from the Central Bank of Kenya and the Nairobi Stock Exchange. The study was based on the null hypothesis that the banks' stocks returns are not sensitive to the fluctuations in interest rates. The key tests that were applied revealed that a single augmented-market model was significant to all the 8 banks in establishing the relationship of their exposure to interest rate risk and their performance (stock returns), as opposed to eight separate bank-specific models.

The findings of the study indicated that banks' returns manifest sensitivity to fluctuations of interest rates when tested at 95% level of confidence. T-test on the coefficients for the long-term interest rate variable indicated strong sensitivity of stock returns to fluctuations in bond coupon rates. This implies that bank stock returns appear to be more negatively correlated with unanticipated short-term interest rates (T-BILLS), while the stock market views increased in long-term rates positively (T-BONDS). This explains why the banks' stocks returns were found to be more sensitive to changes in interest rate spreads in the long-run. The presence of auto-correlations in the residual terms further reinforced the findings that the banks' stocks returns are sensitive to fluctuations in interest rates when tests are performed at 95% level of confidence using a broad-based market augmented model.

Table of Contents

List of Tables

List of Abbreviations and Acronyms

ARIMA	:	Autoregressive Integrated Moving Average
CBK	:	Central Bank of Kenya
CMOs	:	Collateralized Mortgage Obligations
FOREX	:	Foreign Exchange
GDP	:	Gross Domestic Product
NPLs	:	Non-performing loans
NSE	:	Nairobi Stock Exchange
SAP	:	Structural Adjustment Programme
SPSS	:	Statistical Package for Social Sciences
TBILL	:	Treasury bill
TBOND	:	Treasury bond

CHAPTER ONE

1.0 INTRODUCTION

1.1. Background to the Study

An operational definition of a bank is given as: '. . . an institution whose current operations consist in granting loans and receiving deposits from the public' (Freixas and Rochet, 1997). Such traditional forms of intermediation are still the most important business types for credit institutions (Doran and Fitzpatrick, 2003), and it is this traditional form of intermediation that leaves banks open to interest rate exposure and to duration or maturity mismatch exposure, which arise when banks borrow short and lend long. As a result, credit institutions have increasingly used derivatives products as part of their interest rate exposure risk management strategy (Brewer et al., 2001), as well as on a speculative basis in response to the increasing development of banks' off-balance sheet business through financial innovation and also on behalf of non-bank customers.

Previous to the implementation of its Structural Adjustment Programme (SAP) in 1983, the financial sector in Kenya suffered from severe repression. Interest rates were maintained below market-clearing levels, and direct control of credit was the primary monetary control instrument of the authorities (Naude, 1995). Accompanying the SAP, interest rate deregulation took place. In September 1991, the maximum lending rate was increased from 10 to 14 %. The rediscounting rate for crop finance paper was raised to 11.25 %, while the minimum savings deposit rate was raised to 12.5 %. Between 1983 and 1987, the differentials between the interest rates of banks and non-bank financial institutions were narrowed. This improved the competitiveness of commercial banks. One of the first steps towards freeing interest rates was taken in 1989, when the government started selling Treasury Bonds through an auction. In 1991, interest rates were completely freed (Naude, 1995).

If banks engage in risky activities and suffer losses as a result, a principal-agent problem can occur, as indeed happened in the 'Southern Cone' countries [Argentina (1977-1980), Chile (1975-1981) and Uruguay (1977-1982] (Corbo et al, 1986; Corbo & de Melo, 1987; Urrutia, 1988; and Faruqi, 1993). In this regard, banks that suffered losses to their capital bases were tempted to invest in riskier projects in an attempt to quickly recover these losses. To attract deposits, especially when facing increased competition in the wake of financial liberalization, many banks increased deposit rates to very high levels, and often interest was paid by attracting new deposits, i.e. banks became engaged in Ponzi-schemes. As such, high deposit rates following a financial liberalization episode might be an indication that banks are in need of liquidity.

The potential impact of changes in market interest rates on commercial banks' revenues, costs, and profitability has long been a concern of policymakers and bankers. A fairly traditional view of banks is that they borrow short and lend long. That is, banks engage in financial intermediation activities such that the maturity structure of their assets may exceed the maturity structure of their liabilities. If so, then bank earnings and net worth could be negatively affected by unanticipated increases in interest rates. The exposure of bank profitability and net worth to unanticipated changes in interest rates is what is meant by the term interest-rate risk (Robinson, 1995).

Exposure to Interest Rate Risks

According to Doran (2004), the primary nature of the business of credit institutions consists of accepting deposits and issuing loans with different maturities and at different interest rates. This leaves them exposed to different types of risk, namely: interest rate risk, which arises from a bank accepting deposits and issuing loans at different interest rates; default risk - the risk of borrowers defaulting on loan repayments; and finally the liquidity risk which arises where the bank has insufficient funds at hand in a given time to deal with depositors' cash demands and day-to-day cash and regulatory requirements.

Interest rate risk is, in general, the potential for changes in rates to reduce a bank's earnings or value. As financial intermediaries, banks encounter interest rate risk in several ways. The primary and most often discussed source of interest rate risk stems from timing differences in the re-pricing of bank assets, liabilities, and off-balance-sheet instruments. These re-pricing mismatches are fundamental to the business of banking and generally occur from either borrowing short term to fund long-term assets or borrowing long term to fund short-term assets (Wright and Houpt, 1996).

Another important source of interest rate risk (also referred to as ''basis risk''), arises from imperfect correlation in the adjustment of the rates earned and paid on different instruments with otherwise similar re-pricing characteristics. When interest rates change, these differences can give rise to unexpected changes in the cash flows and earnings spread among assets, liabilities, and off-balance-sheet instruments of similar maturities or re-pricing frequencies (Wright and Houpt, 1996). Interest rate risk is, in general, the potential for changes in rates to reduce a bank's earnings or value. As financial intermediaries, banks encounter interest rate risk in several ways.

1.2. Problem Statement

Financial services, which account for 10.6% of GDP, expanded in real terms by 1.0% in 2001 compared with a growth of 0.4% in 2000. Banking institutions' profits before tax declined to Kshs 3.3bn during the first half of 2002 from Kshs 5.0bn realized during the comparable period of 2001(Central Bank of Kenya, 2002). The slowdown in profitability partly reflected the negative impact of non-performing loans (NPLs), as well as reduced interest income given the prevailing low interest environment at that time. Interest rates continued to decline in the twelve months to June 2002 following the downward trend in the 91-days Treasury bill rate. This continued to exert downward pressure on the interest rates. In December 2002, the country experienced a political transition.

In its 2003 annual report, the CBK reported that all the principal money market interest rates declined in tandem with the 91-day Treasury bills interest rate which eased from 8.6% in June 2002 to less than 3% in June 2003. Inter-bank interest rates, also followed on a declining trend; Interest rates on overdraft facilities and 3-month time deposits also maintained a downward trend in line with the fall in the 91-day Treasury bill rate; and in consistence with the decline in all interest rates, the average savings rate on bank deposits declined by 21% to 3.1% over the same period (Central Bank of Kenya, 2003). The rates have been gradually increasing since January 2004. The low interest rates increased domestic borrowing from commercial banks which has in turn led to growth in lending by commercial banks.

A number of studies (Robinson, 1995; Chance & Lane, 1980; Flannery, 1981 & 1983; Houpt and Embertsi, 1991) have examined the extent of banks' exposure to interest-rate risk. Most of these studies have used data on how bank stock prices react to interest-rate movements. Bank stock returns that respond to unexpected changes in interest rates indicate that banks are exposed to interest-rate risk. Other studies use bank accounting data to infer the average maturity structure of assets and liabilities and to judge the long-run effect on banks' profitability from changes in interest rates (Robinson, 1995).

An empirical study conducted in Kenya (Cherutoi, 2006) sought to establish the extent to which commercial banks are exposed to foreign exchange risk. While applying an augmented market model, Cherutoi (2006) regressed the Nairobi Stock Exchange (NSE)-share and banking sector indices against the daily percentage changes in US$/Kshs exchange rate. The study established that there is a high exposure of commercial banks in Kenya to FOREX risk. A annual report by the Barclays Bank of Kenya (BBK) [2003] further revealed that the key risks facing the banks in Kenya include credit risk, market risk, liquidity risk, interest rate risk, operational, legal and tax risks. Given the volume of interest-rate transactions that are conducted daily within the banking sector, there was need therefore to establish the extent of exposure to interest rate risks in order to ensure that that commercial banks' returns are commensurate with associated risks. To fill in this gap, this study sought to establish the extent to which the commercial banks' operations in Kenya are exposed to interest rate risk.

1.3. Objective of the Study

The study sought to establish the relationship of commercial banks exposure to interest rate risk and their performance (stock returns)

1.4. Significance of the Study

Commercial Banks: The findings of the study will inform banks in developing mechanisms for hedging such exposure by developing interest rate risk mitigation guidelines.

The Central Bank: Being the regulator of the operations of commercial banks, the study will inform the bank in formulating policies geared towards regulation of interest rates within the banking sector.

Empirical Evidence: Finally, the study forms a basis for future researchers and academicians who may be conducting research on risk exposure on related financial sector indicators or instruments.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1. Introduction

This chapter presents a review of the related literature on the subject under study presented by various researchers, scholars, analysts and authors. The researcher has drawn materials from several sources which are closely related to the theme and the objectives of the study. Models by writers are used to illustrate the various sub topics mentioned in the objectives of the study. The chapter is organized as follows:

2.2. Stock Returns and IR risk exposure in Banking

Maher (1997) investigated the bank stock returns for the United States for the period from 1976 to 1989 but found hardly any significant interest rate sensitivity. His conclusion was that the U.S. banks must have reduced there risk exposure by successfully employing risk management tools such as futures, option, swaps, etc. The second explanation is that there may not have been a large enough maturity risk premium in the term structure to justify a too high risk exposure. One important conclusion of this study was that the availability of more advanced risk management techniques such as off-balance sheet transactions have resulted in a smaller amount of interest rate sensitivity for banks. These insights on the relationship between maturity transformation and risk premium as well as between risk exposure and off-balance sheet activities had already been derived and shown much earlier by Bessler & Booth (1989) and Bessler, Booth, & Foote (1989).

In the long-run the maturity transformation of financial institutions can only be financially successful when the term structure includes a sufficiently large maturity risk premium and when the bank can report the assets and liabilities as book values instead of the fair market values. In this case banks would not have to reveal fully their exposure to interest rate changes and their risk of bank insolvency (Bessler & Booth, 1989). The plans for implementing Basle II forced banks to reveal their risk exposure and keep a sufficiently large equity position in order to be in a position to fully absorb all possible losses and to continue to deliver banking services.

In their study, Wolfgang and Opfar (2003) sought to analyze the importance of various macroeconomic factors in explaining the return structure for six German industry indices for the period from 1974 to 2000. A specific focus of this study was to investigate whether the financial institutions index reveals a different behavior relative to industrial indices. A comparison of the results for financial institutions and for five industrial indices revealed the greater sensitivity of the financial institutions industry to changes in long-term interest rates. Moreover, they found significant evidence that the relationship between interest rates and the returns for financial institutions is not stable over time but time variant. This is especially evident in periods of high long-term interest rates, i.e. usually an inverted yield curve. This relationship may be explained with the positive maturity transformation of banks.

One interesting result noted by Wolfgang and Opfar (2003) was that the sensitivity of bank stock returns to interest rates changes had not significantly decreased since the beginning of the 1990s although this could have been expected. The use of derivatives could have led to a reduction of the exposure to interest rate risk. The continuation of this policy result may be explained by the fact that one major source of bank revenue stems from maturity transformation. However, for all indices, Wolfgang and Opfar (2003) observed an increase in the sensitivity of stock returns to various macroeconomic factors. They also revealed that financial institutions have the lowest exposure to exchange rate changes.

2.3. Sources and Indicators of Interest Rate Risk

Interest rate risk is, in general, the potential for changes in rates to reduce a bank's earnings or value. As financial intermediaries, banks encounter interest rate risk in several ways. The primary and most often discussed source of interest rate risk stems from timing differences in the re-pricing of bank assets, liabilities, and off-balance-sheet instruments. These repricing mismatches are fundamental to the business of banking and generally occur from either borrowing short term to fund long-term assets or borrowing long term to fund short-term assets (Wright and Houpt, 1996).

Another important source of interest rate risk (also referred to as ‘‘basis risk’’), arises from imperfect correlation in the adjustment of the rates earned and paid on different instruments with otherwise similar re-pricing characteristics. When interest rates change, these differences can give rise to unexpected changes in the cash flows and earnings spread among assets, liabilities, and off-balance-sheet instruments of similar maturities or re-pricing frequencies (Wright and Houpt, 1996).

According to Houpt and Embersit (1991), an additional and increasingly important source of interest rate risk is the presence of options in many bank asset, liability, and off-balance-sheet portfolios. In its formal sense, 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 exist as standalone contracts that are traded on exchanges or arranged between two parties or they may be embedded within loan or investment products. Instruments with embedded options include various types of bonds and notes with call or put provisions, loans such as residential mortgages that give borrowers the right to prepay balances without penalty, and various types of deposit products that give depositors the right to withdraw funds at any time without penalty. If not adequately managed, options can pose significant risk to a banking institution because the options held by bank customers, both explicit and embedded, are generally exercised at the advantage of the holder and to the disadvantage of the bank. 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 a bank.

The conventional wisdom that interest rate risk does not pose a significant threat to the commercial banking system is supported by broad indicators. Most notably, the stability of commercial bank net interest margins (the ratio of net interest income to average assets) lends credence to this conclusion (Naude, 1995). Interest margins, however, offer only a partial view of interest rate risk. They may not reveal longer-term exposures that could cause losses to a bank if the volatility of rates increased or if market rates spiked sharply and remained at high levels. They also say little about the potential for changing interest rates to reduce the ‘‘economic’’ or ‘‘fair’’ value of a bank’s holdings. Economic or fair values represent the present value of all future cash flows of a bank’s current holdings of assets, liabilities, and off-balance sheet instruments (Wright and Houpt, 1996). Approaches focusing on the sensitivity of an institution’s economic value, therefore, involve assessing the effect a rate change has on the present value of its on- and off-balance-sheet instruments and whether such changes would increase or decrease the institution’s net worth. Although banks typically focus on near-term earnings, economic value analysis can serve as a leading indicator of the quality of net interest margins over the long term and help identify risk exposures not evident in an analysis of short-term earnings.

2.4. Measuring Banks’ Exposure to Interest Rate Risk

Historically, banks have focused on the effect that changing rates can have on their near-term reported earnings. Spurred in part by supervisory interest in the matter, more recently many banks have also been examining the effect of changing rates on the economic value of their net worth, defined as the net present value of all expected future cash flows discounted at prevailing market rates. By taking this approach - or more typically, considering the potential effect of rate changes on economic value as well as on earnings - banks are taking a longer-term perspective and considering the full effect of potential changes in market conditions (Brewer et al, 2001). As a result, they are more likely than before to avoid strategies that maximize current earnings at the cost of exposing future earnings to greater risk.

In principle, the most straightforward method of evaluating the effects of changes in market interest rates on banks’ economic well-being is to calculate the changes’ effects on bank net worth. The change in bank net worth resulting from a change in interest rates is equal to the change in the present value of current and expected revenues minus the change in the present value of current and expected costs (Robinson, 1995). A related concept to estimating interest rate risk is the calculation of the duration of bank assets and liabilities. Duration is defined as the weighted average maturity of the cash flows in present value terms. Duration measures the sensitivity of net worth to changes in interest rates by assessing the effects of interest-rate changes on the discounted value of future earnings. Calculating the duration of assets and liabilities, though, requires major assumptions about maturity structures and interest rates (Houpt and Embersit, 1991; and Santoni, 1984).

The ‘borrow short and lend long’ view of banks and the view’s role in interest-rate risk are easy to understand in terms of revenue and cost. Under this type of portfolio mismatch, an unanticipated increase in interest rates would raise costs relative to revenues for some time. As a result, the bank’s market value would decline in response to the increase in interest rates. A gap, or mismatch, in the asset/liability maturity structure is not the only factor that can expose banks to interest-rate movements, however. If unanticipated changes in interest rates affect the rate at which market participants discount the present value of banks’ future profit streams, then banks’ vulnerability to unexpected interest-rate movements would also increase. Also, bank revenues and costs may be affected by the level of interest rates and the variability or predictability of interest rates within each period.

Several techniques are used to measure the exposure of earnings and economic value to changes in interest rates. They range in complexity from those that rely on simple maturity and re-pricing tables to sophisticated, dynamic simulation models that are capable of valuing complex financial options (Houpt and Embersit, 1991).

2.4.1. Maturity and Re-pricing tables

A maturity and re-pricing table distributes assets, liabilities, and off-balance-sheet positions into time bands according to the time remaining to re-pricing or maturity, with the number and range of time bands varying from bank to bank. Assets and liabilities that lack specific (that is, contractual) re-pricing intervals or maturities are assigned maturities based often on subjective judgments about the ability of the institution to change - or to avoid changing - the interest rates it pays or receives. When completed, the table can be used as an indicator of interest rate risk exposure in terms of earnings or economic value. For evaluating exposure to earnings, a re-pricing table can be used to derive the mismatch (gap) between the amount of assets and the amount of liabilities that mature or re-price in each time period. By determining whether an excess of assets or liabilities will re-price in any given period, the effect of a rate change on net interest income can be roughly estimated.

For estimating the amount of economic value exposed to changing rates, maturity and re-pricing tables can be used in combination with risk weights derived from the price sensitivity of hypothetical instruments. These weights can be based either on a representative instrument's duration and a given interest rate shock or on the calculated percentage change in the instrument's present value for a specific rate scenario (Wright and Houpt, 1996). Though duration is a useful measure, it has the shortcoming of assuming that the rate of change in an instrument's price is linear, whether for rate moves of 1 or 500 basis points. The second approach, analyzing present values for a specific rate scenario, recognizes that many instruments have price sensitivities that are nonlinear (a characteristic called convexity) and tailors adjustments to cash flows (such as principal prepayments) to the specific magnitude and level of the rate shock.

In either case, when multiplied by the balances in their respective time bands, these weights provide an estimate of the net change in the economic value of an institution’s assets, liabilities, and off balance-sheet positions for a specific change in market rates. When expressed as a percentage of total assets, the net change, or ‘‘net position,’’ can also provide an index for comparing the risk of different institutions. Although rough, such relatively simple measures can often provide reasonable estimates of interest rate risk for many institutions, especially those that do not have atypical mortgage portfolios nor hold material amounts of more complex instruments such as Collateralized Mortgage Obligations (CMOs), structured notes, or options (Prasad and Rajan, 1995; Stone, 1974; and Houpt and Embersit, 1991).

2.4.2. Simulation Techniques

Simulation techniques provide much more sophisticated measures of risk by calculating the specific interest and principal cash flows of the institution for a given interest rate scenario. These calculations can be made considering only the current holdings of the balance sheet, or they can also consider the effect of new lending, investing, and funding strategies. In either case, risk can be identified by calculating changes in economic value or earnings from any variety of rate scenarios (Wright and Houpt, 1996).

Simulations may also incorporate hundreds of different interest rate scenarios (or “paths” through time) and corresponding cash flows. The results help institutions identify the possible range and likely effect of rate changes on earnings and economic values and can be most useful in managing interest rate risk, especially for institutions with concentrations in options that are either explicit or embedded in other instruments. Instrument valuations using simulation techniques may also be used as the basis for sensitivity weights used in simple time band models. However, such simulations can require significant computer resources and, as always, are only as good as the assumptions and modeling techniques they reflect (Drakos, 2001).

Indeed, whether a bank measures its interest rate risk relative to earnings or to economic value or whether it uses crude or sophisticated modeling techniques, the results will rely heavily on the assumptions used (Wright and Houpt, 1996). This point may be especially important when estimating the interest rate risk of depository institutions because of the critical effect core deposits can have on the effective level of risk. The rate sensitivity of core deposits may vary widely among banks depending on the geographic location of the depositors or on their other demographic characteristics. The sensitivity may also change over time, as depositors become more aware of their investment choices and as new alternatives emerge. Recognizing these variables, few institutions claim to measure this sensitivity well, and most banks use only subjective judgments to evaluate deposits that fund one-half or more of their total assets (Prasad and Rajan, 1995). This measurement conundrum makes estimates of interest rate risk especially difficult and underscores the lack of precision in any measure of bank interest rate risk.

2.4.3. The Basic Screening Model

According to Wright and Houpt (1996) the simple screening tool has been applied as the ‘‘basic model,’’ to identify commercial banks that may have exceptionally high levels of interest rate risk. The basic model uses Call Report data (report of condition and income) to estimate the interest rate risk of banks in terms of economic value by using time bands and sensitivity weights.

Gorton and Rosen (1995) used the limited data available from banks' Reports of Condition and Income (the Call Reports) on the maturity distribution of interest rate derivatives to derive estimates of the direction of interest rate risk exposure arising from these positions. Their conclusion was that the interest rate exposures arising from interest rate swaps tend to be mostly, though not completely, offset by exposures from other bank activities. Further, they found that the extent of offsetting varies with bank size, with large dealer banks experiencing the greatest amount of offset. Thus, Gorton and Rosen's results can also be interpreted as suggesting that the net impact of banks' interest rate swap activity is to increase interest rate risk exposures.

2.4.4. The augmented Market Model Approach

When using stock price data to estimate banks' exposure to interest-rate changes, a model of the determination of stock prices is needed. The market model is a widely used and relatively simple model of stock prices. To some degree, all stocks are affected by general economic conditions or overall economic activity. This relationship implies a fairly close connection between an individual security's return and the return on a broad-based, market-wide index of stocks (Chance and Lane, 1980). Therefore, the market model describes an individual security's return over a certain period as a function of the returns generated over that period on a market index of stocks. In this model, how an individual stock's return is affected by market-wide returns is widely referred to as the stock's beta (Houpt and Embertsi, 1991). For example, if beta equals one, the security's return moves one-for-one with the overall market. If beta is less than one, the security's return would change by a smaller amount than overall market returns, and if beta exceeds one, the change in the security's return would exceed the change in overall market returns. A stock with a beta greater than one implies that the security's return exhibits more cyclical movements than the overall market does (Robinson, 1995; Houpt and Embertsi, 1991; Chance and Lane, 1980).

When examining banks' interest-rate risk, an augmented-market model is used. The model is augmented by a variable that proxies for unanticipated interest-rate movements. If this interest-rate factor is negative and statistically significant, it suggests that banks' market value is adversely affected by increases in interest rates. A number of previous studies have used an augmented-market model to judge the sensitivity of bank security returns to unexpected interest rate movements. Flannery and James (1984), Aharony, Saunders, and Swary (1986), Sweeney and Warga (1986), Saunders and Yourougou (1990), and Yourougou (1990) all find evidence that bank stock returns are negatively related to interest-rate changes. Chance and Lane (1980), however, do not find much evidence that the stock prices of financial firms exhibit sensitivity to interest-rate fluctuations.

In his study on 48 banks in the US, Robinson (1995) applied an augmented-market model to determine if interest-rate risk had increased since the Basle Accord of 1989. Quarterly data from the 1973:1–1994:3 period was used. Instead of applying a bank-specific model for each bank, Robinson applied an F-test to assess whether a single augmented-market model applied to all the banks, as opposed to forty-eight separate bank-specific models. For both interest-rate variables, the tests were insignificant at the 5-percent level, indicating that the data could be pooled and a single regression equation estimated. Two interest-rate variables were used: the three-month Treasury bill rate, last trading day of the quarter (TBILL); and the rate on ten-year Treasury bonds, last trading day of the quarter (TBOND). Because the interest-rate sensitivity variables TBILL and TBOND were used as proxies for unanticipated changes in interest rates, the models were estimated using the residuals from an Autoregressive Integrated Moving Average (ARIMA) model of the two interest-rate series.

ARIMA models forecast a particular time series; say interest rates, by using prior movements in the series. In effect, ARIMA models are linear combinations of the series' own past values and, perhaps, past errors or innovations in the series. For TBILL, one lag of the series was used in the forecasting equation, while for TBOND, two lags of the series were used. Both of these models produced white noise residuals that were then used as proxies for unanticipated interest rate movements. The market model was algebraically presented as shown in equation 1.

$$RETURN_{it} = \alpha_{it} + \beta_{it}(MARKET)_t + \delta_{it}(RATE)_t + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Where:

$RETURN_{it}$	=	the (annualized) rate of return on bank i's stock in time period t;
MARKET	=	the rate of return on a broad market index of stocks at time t;
RATE	=	a measure of the change in interest rates from t–1 to t (Measured as percentage points),
$\alpha_{it,} \beta_{it} and \delta_{it}$	=	Regression constants and
ε_{it}	=	a random error term

In equation (1), the interest-rate sensitivity is the estimate of δ_{it}. R^2 is usually computed to give the proportion of the variation in RETURN that is explained by MARKET and RATE the post-Basle period. Using different measures of unanticipated interest-rate changes, evidence from bank stock returns provided some proof that banks altered their portfolios such that their stock returns were more sensitive to interest rate movements in the post-Basle period. Moreover, the stock market seemed to view movements in the interest-rate spread as a much more important factor in the post-Basle period. Robinson (1995) further recommended that an alternative approach that uses bank accounting data can offer additional insights into the extent of banks' exposure to interest-rate risk.

The market-model approach to interest rate risk measurement provides a way to assess the relationship between derivatives and interest rate risk exposure that avoids the simultaneity difficulties of some of the earlier work in this area. Derivatives (futures, options and swaps), are off-balance sheet instruments that allow banks to transform the duration of their balance sheets in order to manage market risk without incurring additional capital requirements. Choi, Elyasiani and Saunders (1996) used a three-factor model that incorporated changes in both interest rates and exchange rates to examine the relationship between derivatives and interest rate and exchange rates exposures. They estimated the model for a sample of 59 large U.S. banking companies and found a significant relationship between the resulting interest and exchange rate betas and the banks' interest rate and exchange rate derivatives usage. Because the focus of their analysis was on the joint impact of interest and exchange rate derivatives on risk exposure, it was difficult to derive a clear indication of the net impact of derivatives on interest rate risk exposure from their results.

According to Beverly (1996), the market-based measure of interest rate risk exposure can be seen as the "output" of banks' attempts to manage their interest rate risk exposure, using the "inputs" of balance sheet positions and derivatives. In other words, the interest rate risk measures captured by the market model take into account the banks' joint decision-making process concerning the on- and off-balance sheet components that contribute to overall interest rate risk exposure. Thus, the simultaneity problem in using both balance sheet gap measures and measures of derivatives usage in a single regression is avoided.

2.4.5. The Bank Accounting Data Approach

To judge the robustness of the results obtained with stock market data, estimates of the relationship between market conditions and bank revenues, costs, and net current operating earnings are obtained to assess the overall impact of interest-rate fluctuations on bank profitability. This approach was developed by Flannery (1981, 1983) to judge how large and long-lasting interest-rate effects are on bank revenues, costs, and earnings. Flannery (1981) argued that net current operating earnings are a more appropriate measure than net income because extraordinary income items and realized gains or losses on securities are often tax-related in their timing, which would obscure the true impact of interest-rate changes on bank profitability.

Flannery (1983) begun by recognizing that banks can reallocate only a portion of their earning assets and their liabilities in the short run in response to changing market conditions. This constraint primarily arose from the limitations imposed by prior portfolio decisions that could not be changed instantaneously. As a result, Flannery employed a partial-adjustment model to account for the lagged response of bank portfolio decisions to changing market conditions. For comparison's sake, the sample of banks consisted of the same forty-eight banks that were used in estimating the market models (Robinson, 1995) although the sample period was shorter (1973-1983).

Two different interest rates were used, this time the quarterly average of the three-month T-bill rate and the ten-year T-bond rate.

The partial-adjustment framework allows for the estimates of the long-run impact of interest-rate changes to be obtained. Equations (2) and (3) show the models that were used by Flannery (1983) in computing impacts of long-run interest rates changes. The equations respectively represent the partial adjustment framework for revenues and costs.

$$\frac{R_t}{TA_{t-1}} = \lambda_0 + \lambda_1\left(\frac{R}{TA}\right)_{t-1} + \lambda_2 r_t + \lambda_3 \sigma_t^2 + \lambda_4\left[r_t\left(\frac{TA_t - TA_{t-1}}{TA_{t-1}}\right)\right] + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

Where:

R_t	=	Total operating revenues in period t
TA_t	=	Total assets in period t
r_t	=	The current market interest rates
σ_t^2	=	Intra-period variability in r_t

The first four terms incorporate a partial adjustment framework for revenue to its equilibrium level if all investable funds are placed in assets earning the current market rate. The term associated with λ_4 represents the return on net new assets. The expected signs on the coefficients are λ_0, λ_2, and $\lambda_4 > 0$; $0 < \lambda_1 < 1$; $\lambda_3 \leq \geq 0$. Current operating expenses are modeled as shown in equation 3.

$$\frac{C_t}{TA_{t-1}} = \beta_0 + \beta_1\left(\frac{C}{TA}\right)_{t-1} + \beta_2 r_t + \beta_3 \sigma_t^2 + \beta_4\left[r_t\left(\frac{TA_t - TA_{t-1}}{TA_{t-1}}\right)\right] + \mu_t \ldots\ldots\ldots\ldots\ldots \text{(3)}$$

Where C_t = total current operating expense in time t. The coefficients' expected signs and interpretations in equation 3 are analogous to those in equation 2. The dependent variables are expressed in basis points. The volatility measure is the standard deviation of the weekly interest rate series over the quarter. The long-run effect of a (permanent) change in market interest rates on operating ROA, or the difference between revenues and costs as a percent of assets, is defined by equation (4) below:

$$\frac{\lambda_2}{1-\lambda_1} - \frac{\beta_2}{1-\beta_1} \quad \ldots\ldots (4)$$

Finally, the partial-adjustment framework can supply another estimate of the effect of interest-rate changes on bank profitability. This involves computing of additional estimates of the long-run impact of changes in interest rates on banks' operating ROA. These estimates are based on results from a single-equation estimation that uses the ratio of net current operating earnings to assets as the dependent variable. Equation (5) is applied in modelling the estimates.

$$\frac{EA_t}{TA_{t-1}} = \gamma_0 + \gamma_1\left(\frac{EA}{TA}\right)_{t-1} + \gamma_2 r_t + \gamma_3 \sigma_t^2 + \gamma_4\left[r_t\left(\frac{TA_t - TA_{t-1}}{TA_{t-1}}\right)\right] + \tau_t \quad \ldots\ldots (5)$$

Where EA_t = net current operating earnings. The coefficients' expected signs and interpretations in equation 5 are analogous to those in equation 2. The volatility measure is the standard deviation of the weekly interest-rate series over the quarter. Equations 2, 3, and 5 are estimated using techniques described in Flannery (1983, 1981). Similar to Flannery, the volatility measure is not statistically significant in most of the equations estimated. The long-run impact of a change in market interest rates on banks' operating ROA is defined from equation (5) as shown by equation (6).

$$\frac{\gamma_2}{1-\gamma_1} \quad \ldots\ldots (6)$$

2.5. Chapter Summary

Unanticipated increases in interest rates are often viewed as harmful to banks. This assumption arises partly from the fact that banks are frequently viewed as institutions that borrow short and lend long. Because the implementation of the Basle risk-based capital standards did not include a capital charge for interest-rate risk, banks may have been encouraged to substitute interest-rate risk for credit risk in their portfolios. The chapter covered two approaches that are used to estimate interest-rate risk in commercial banks. One method relied on bank stock price data to judge the effects of interest rate increases on banks' market value, while the other approach used bank accounting data to infer long-run effects of interest-rate movements on bank profitability.

Empirical evidence from the estimates (presented by equations 2, 3, & 5) using data from the stock market as well as data from banks' balance sheets and income statements has provided some support for existence of interest rate risk in banks (Robinson, 1995; Houpt & Embertsi, 1991; Prasad & Rajan, 1995). The study by Robinson (1995) established that bank stock returns appeared to be more negatively correlated with unanticipated short-term interest rates, while the stock market views increased in long-term rates positively. Moreover, banks' market values were more sensitive to changes in interest rate spreads in the long-run. Estimates of the long-run impact of interest-rate changes on interest margins were greater after the approval of the Basle Accord, with evidence that net earnings at banks had become more adversely affected by permanent increases in interest rates, although this effect was not very large. This study sought to contribute to the existing literature by establishing the extent of Kenyan commercial banks' exposure to interest rate risk.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1. Research Design

The population of the study comprised of all the listed banks at the Nairobi Stock Exchange (NSE). The major activities of the banks comprise of provision of a wide range of products to both corporate and retail clients.

3.2. Data Sources

The data to be used for the study was drawn from the records of commercial banks that have been trading their shares at the Nairobi Stock Exchange (NSE) for the 5-year period June 2002 – December 2006. These include Barclays Bank of Kenya; Standard Chartered Bank; Diamond Trust Bank Kenya; CFC Bank; Housing Finance; National Bank of Kenya; Kenya Commercial Bank; and National Industrial Credit Bank. The rationale for the sample was based on two reasons: i) There was hardly little information available in the public domain for non-listed banks; ii) The research model for the study sought to establish the sensitivity and elasticity of returns on the banks' stocks against returns on the market index. The data comprised of monthly observations for the 10-year Treasury bond (TBOND) rate, the 91-day Treasury Bill rate (TBILL) and the individual banks monthly closing prices for shares. The shares were used to compute the monthly stock returns for the individual banks. Equation (7) was applied in computing stock returns:

$$R_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}} \quad \ldots\ldots (7)$$

Where: R_{it} = Stock return of the i^{th} bank at time t

P_{it} = the share closing price of the i^{th} bank at time t

P_{it-1} = the share closing price of the i^{th} bank at time t-1

3.3. Research Model

If fluctuations in interest rates have a material impact upon the assets and liabilities of a bank, then this should be reflected in stock prices. A bank which has a lot to lose when interest rates go up should be one where the stock price reacts sharply when interest rates go up (Robinson, 1995; Drakos, 2001). The 'market model' is a standard framework for measuring the sensitivity of an individual stock to fluctuations in the interest rates. It consists of the time-series regression represented by equation (8).

$$R_{it} = \alpha_0 + \beta_1 (TBILL)_{it} + \beta_2 (TBOND)_{it} + \varepsilon_{it} \quad \text{.................................} \quad (8)$$

Where:

R_{it} = Stock return of the i^{th} bank at time t

β_1, β_2 = Regression coefficients

ε_{it} = Error term

Equation (8) was regressed in two stages. First, regression was performed for individual banks and then for the combination of the eight banks.

3.4. Diagnostic Tests

3.4.1. F-Test

An F-test was used to assess whether a single augmented-market model is applicable to all the 8 banks, as opposed to eight separate bank-specific models. For both interest-rate variables, the tests were performed at the 5-percent level of significance, after which it was determined whether the data could be pooled and a single regression equation estimated.

3.4.2. Auto-Correlations test

ARIMA stands for Autoregressive Integrated Moving Average. ARIMA models forecast a particular time series; say interest rates, by using prior movements in the series. In effect, ARIMA models are linear combinations of the series' own past values and, perhaps, past errors or innovations in the series. For TBILL, one lag of the series was used in the forecasting equation, while for TBOND, two lags of the series was used. Both of these models produced white noise residuals that were then used as proxies for unanticipated interest rate movements.

In an ideal efficient market, the r_M, r_L and r_f time-series should be free of serial correlations. In the real world, many market imperfections may exist, particularly in the case of the government bond market (TBOND & TBILL), which suffers from non-transparency, barriers to access, regulatory constraints on short selling, and many more. In addition, the time-series of the market index (INDEX) can exhibit spurious autocorrelations owing to non-synchronous trading of index components (Lo & MacKinlay, 1990). Hence, significant serial correlations may be found in all the three time-series, i.e. r_M, r_L and r_f.

Auto-correlation test is a reliable measure for testing of either dependence or independence of random variables in a series. The serial correlation coefficient measures the relationship between the values of a random variable at time t and its value in the previous period (say t-1). Auto correlation test evidence whether the correlation coefficients for residuals are significantly different from zero. The test was based on equation (9):

$\Delta r_t = r_{t-1} + \delta_1 \Delta r_{t-1} + \delta_2 \Delta r_{t-2} + \delta_3 \Delta r_{t-3} + \ldots\ldots\ldots + \delta_n \Delta r_{t-n} + \varepsilon_t$ ……….….… (9)

Where:

δ	=	Coefficient of the error term
r_t	=	Residual from the regression equation
δ_i	=	Coefficient of the lagged residuals
Δr_t	=	$r_t - r_{t-1}$

The presence of autocorrelation was tested by regressing equation (9) and checking whether the δ_i's i =1, 2, 3,…..n have values between [-1, 1]. Values of zero for δ_i's i =1,2,3,…..n suggests no autocorrelation. Ljung-Box Q statistics were used to test for autocorrelations. Ljung-Box Q statistic follows the chi-square distribution with m degrees of freedom as shown in equation (10):

$LB = n(n+2)\sum_{k=1}^{m}(\hat{p}^2{}_k / n-k) \cong \chi^2(m)$ …………………………….. (10)

Where $\hat{p}^2{}_k$ = autocorrelation coefficients at lag k; and n = Sample size

CHAPTER FOUR

4.0 DATA ANALYSIS AND PRESENTATION

4.1. Introduction

This chapter presents the data analysis, interpretation, and discussion of the research findings. The chapter is organized as follows: Section 4.2 covers the descriptive characteristics of the sample; Section 4.3 covers the regression analysis to determine the extent of sensitivity of stock returns to fluctuations in interest rates; and Section 4.4 provides the diagnostic tests for the regression model that was applied.

4.2. Descriptive Characteristics of the Sample

The findings presented in Table 4.1 indicate the mean statistics for the monthly stock returns of the banks over the sample period (2002 – 2006). The findings indicate that on average, Barclays Bank stocks returned 3.78%; Standard Chartered Bank stocks returned 3.25%; CFC Bank stocks returned 5.53%; Diamond Trust Bank stocks returned 5.63%; Housing Finance stocks returned 1.22%; Kenya Commercial Bank stocks returned 7.3%; National Bank of Kenya stocks returned 8.5%; and National Industrial Credit Bank returned 5.0%. This indicates that the average monthly stock returns for the listed banks ranged between 1.2% and 8.5%. This cloud be attributed to the growth experienced in the Kenyan financial markets and the general economic growth experienced over the sample period.

Table 4.1: Mean statistics on Banks' stocks returns (2002 – 2006)

Bank	Average return realized	Standard Error
Barclays Bank	0.0378	0.0162
Standard Chartered Bank	0.0325	0.0131
CFC Bank	0.0553	0.0235
Diamond Trust Bank	0.0563	0.0229
Housing Finance	0.122	0.0803
Kenya Commercial Bank	0.073	0.0231
National Bank of Kenya	0.085	0.0348
National Industrial Credit	0.050	0.0197

Source: Field Data (2007)

4.3. Sensitivity of Stock Returns to Interest Rates' Changes

As indicated earlier in Section 3.3, equation (8) was regressed in two stages. First, the regression was performed for each of the banks; and secondly, regression was performed for a combination of the eight banks. Sections 4.3.1 and 4.3.2 respectively represent the analysis of findings based on these two approaches.

4.3.1. A Bank-Specific Approach

Table 4.2 presents the findings derived from regression of the model represented by equation (8). The model was first subjected to F-Tests to determine whether or not there existed a relationship between the dependent variable (Bank stock returns) and the two independent variables namely the Treasury bill rates (T-BILL) and the 10-year Bond Coupon rate (T-BOND). The F-Test hypothesized that the individual bank's stocks are not sensitive to fluctuations in the interest rates. The decision rule for the test was to reject H_0 if the computed F-statistics were greater than the critical values of a known F-Distribution with 2 and 52 degrees of freedom ($F_{0.05\,(2,\,52)} = 3.15$).

In addition, the coefficients for 'T-BILL' and 'T-BOND' variables were subjected to T-test to establish if the stock returns were sensitive to either of the variables. The findings led to acceptance of the null hypothesis which thus indicated that the stock returns were not sensitive to fluctuations in interest rates for all the banks over the sample period.

Table 4.2: Tests on sensitivity of stock returns to fluctuations of interest rates

Model: $R_{it} = \alpha_0 + \beta_1 (TBILL)_{it} + \beta_2 (TBOND)_{it} + \varepsilon_{it}$					
Bank	α_0	β_1	β_2	**F** $_{(2, 52)}$	**Decision**
Barclays Bank	0.069 **(1.277)**	0.002 **(0.231)**	(-0.004) **(-0.543)**	0.193	**Accept H_0**
Standard Chartered Bank	-0.002 **(-0.050)**	-0.014 **(-1.862)**	0.011 **(1.811)**	1.901	**Accept H_0**
CFC Bank	0.036 **(0.475)**	-0.024 **(-1.828)**	0.016 **(1.406)**	1.672	**Accept H_0**
Diamond Trust Bank	-0.092 **(-1.281)**	-0.024 **(-1.928)**	0.029 **(2.688)***	3.647	**Accept H_0**
Housing Finance	-0.115 **(-0.439)**	-0.068 **(-1.492)**	0.064 **(1.616)**	1.375	**Accept H_0**
Kenya Commercial Bank	-0.021 **(-0.272)**	-0.002 **(-0.182)**	0.011 **(0.942)**	0.826	**Accept H_0**
National Bank of Kenya	-0.060 **(-0.531)**	-0.019 **(-0.968)**	0.026 **(1.510)**	1.194	**Accept H_0**
National Industrial Credit	0.086 **(1.312)**	0.003 **(0.274)**	-0.005 **(-0.552)**	0.183	**Accept H_0**

Dependent Variable = Monthly Stock Returns
H_0: Individual bank's stocks are not sensitive to fluctuations in the interest rates
***** Denotes Significance at 5% level [Critical t-values = 1.96]
****** Denotes Significance at 1% level [Critical t-values = 2.57]
The t-statistics for the coefficients are in brackets
Critical F-values ($F_{0.05\ (2, 52)}$) **=** 3.15

4.3.2. A Broad-based Augmented Model Approach

Table 4.3 presents the findings derived from regression of the model represented by equation (8) for all the eight banks pooled together. The model was first subjected to F-Tests to determine whether or not there existed a relationship between the dependent variable (Bank stock returns) and the two independent variables namely the

Treasury bill rates (T-BILL) and the 10-year Bond Coupon rate (T-BOND). The F-Test hypothesized that the bank's stocks are not sensitive to fluctuations in the interest rates. The decision rule for the test was to reject H_0 if the computed F-statistics were greater than the critical values of a known F-Distribution with 2 and 419 degrees of freedom ($F_{0.05\,(2,\,419)} = 3.00$). In addition, the coefficients for 'T-BILL' and 'T-BOND' variables were subjected to T-test to establish if the stock returns were sensitive to either of the variables. The findings indicate that the null hypothesis was rejected thus implying that when the banks' returns are pooled together they manifest sensitivity to fluctuations of interest rates when tested at 95% level of confidence.

The F-Test results further revealed that the model was not significant at 99% level of confidence. However, T-test on the coefficient for the T-BOND variable β_2 indicates strong sensitivity of stock returns to fluctuations in bond coupon rates. The findings also indicate that bank stock returns appear to be more negatively correlated with unanticipated short-term interest rates (T-BILLS), while the stock market views increased in long-term rates positively (T-BONDS). This explains why the banks' stocks returns were found to be more sensitive to changes in interest rate spreads in the long-run.

Table 4.3: Tests on sensitivity of stock returns to fluctuations of interest rates

Model: $R_{it} = \alpha_0 + \beta_1 (TBILL)_{it} + \beta_2 (TBOND)_{it} + \varepsilon_{it}$					
	α_0	β_1	β_2	**$F_{(2,\,419)}$**	**Decision**
Combined Model	-0.014 **(0.740)**	-0.018 **(-2.460)***	0.019 **(2.921)****	4.313*	**Reject H_0**

Dependent Variable = Monthly Stock Returns
H_0: The Banking Sector's stock returns are not sensitive to fluctuations in the interest rates
***** Denotes Significance at 5% level [Critical t-values = 1.96]
****** Denotes Significance at 1% level [Critical t-values = 2.57]
The t-statistics for the coefficients are in brackets
Critical F-values ($F_{0.05\,(2,\,419)}$) = 3.00

4.4. Auto-Correlation Tests

Auto correlation test provided evidence on whether or not the correlation coefficients for residuals were significantly different from zero. The test was used as a diagnostic tool to verify the findings of Table 4.3. The presence of autocorrelation was tested by regressing equation (9) and checking whether the δ_i's i =1, 2, 3,…..n have values between [-1, 1]. Values of zero for δ_i's i =1,2,3,…..n suggests no autocorrelation. Ljung-Box Q statistics were used to test for autocorrelations. Ljung-Box Q statistic follows the chi-square distribution with m degrees of freedom as shown in equation (10). The null hypothesis for the tests was that there was absence of auto-correlations in the residual terms. The findings presented in Table 4.4 indicate Ljung-Box Q statistics generated up to the sixth order using SPSS®.

Table 4.4: Auto-correlation Tests Statistics Based on Combined Model

Ljung-Box Q statistics	P-values	Decision
1^{st} Order = 7.704	0.006**	Reject H_0
2^{nd} Order = 8.820	0.012*	Reject H_0
3^{rd} Order = 9.062	0.028*	Reject H_0

H_0: There is no auto-correlation (up to the 3^{rd} Lag)
***** Denotes Significance at 5% level
****** Denotes Significance at 1% level

The results from the Table 4.4 confirmed that there were significant autocorrelations in the residual terms derived from the combined sample model for the entire sample period (2002-2006). The order of auto-correlation was found to increase with the increase in the number of lags. The nonzero auto-correlation of the series associated with Ljung-Box Q statistics (which were found to be jointly significant at 5% level of significance), suggested that sensitivity of banks' stocks returns to fluctuations of interest rates do not follow a random walk model behaviour. The presence of auto-correlations further reinforced the findings of Tables 4.3 that the banks' stocks returns are sensitive to fluctuations in interest rates when tested at 95% level of confidence using a sector-specific modelling approach.

CHAPTER FIVE

5.0 DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

This chapter presents the discussion of findings, conclusions and recommendations derived from the findings of the study. The chapter also presents the limitations that were encountered in the study with suggestions for further improvement.

5.2. Discussion of Findings

The aim of this study was to establish the relationship of commercial banks exposure to interest rate risk and their performance (stock returns). In achieving this, the study applied historical data for the monthly average closing share prices for each of the eight listed banks; the monthly averages for the 91-day Treasury bill rates; and the monthly coupon rates for the 10-year Bond. The data was obtained from the Central Bank of Kenya and the Nairobi Stock Exchange.

The study was based on the null hypothesis that the banks' stocks returns are not sensitive to the fluctuations in interest rates. The key tests that were applied revealed that a single augmented-market model was significant to all the 8 banks in establishing the relationship of their exposure to interest rate risk and their performance (stock returns), as opposed to eight separate bank-specific models. The tests were performed at the 5-percent level of significance, after which it was determined that the data could be pooled and a single regression equation estimated.

The findings of the study indicated that banks' returns manifest sensitivity to fluctuations of interest rates when tested at 95% level of confidence. T-test on the coefficients for the long-term interest rate variable indicated strong sensitivity of stock returns to fluctuations in bond coupon rates. This implies that bank stock returns appear to be more negatively correlated with unanticipated short-term interest rates (T-BILLS), while the stock market views increased in long-term rates positively (T-BONDS). This explains why the banks' stocks returns were found to be more sensitive to changes in interest rate spreads in the long-run. The presence of auto-correlations in the residual terms further reinforced the findings that the banks' stocks returns are sensitive to fluctuations in interest rates when tests are performed at 95% level of confidence using a broad-based market augmented model.

The study compared two approaches, one based on individual security's return, and other based on the return on a broad-based, market-wide index of stocks. The coefficients were in all cases found to be less than one thus implying that the individual banks' returns would change by a smaller amount than overall market returns, and hence a broad-based model was more preferred. The findings of this study were in agreement to a number of previous studies which have successfully used an augmented-market model to judge the sensitivity of bank security returns to unexpected interest rate movements. Flannery and James (1984), Aharony, Saunders, and Swary (1986), Sweeney and Warga (1986), Saunders and Yourougou (1990), and Yourougou (1990) all find evidenced that bank stock returns are negatively related to interest-rate changes. The interest rate risk measures captured by the market model applied had taken into account the banks' joint decision-making process concerning the on- and off-balance sheet components that contribute to overall interest rate risk exposure. Thus, the simultaneity problem in using both balance sheet gap measures and measures of derivatives usage in a single regression was avoided.

5.3. Conclusions

In the Kenyan case, the findings have shown that if the banks were to borrow in the short-term and lend in the long term, an unanticipated increase in interest rates would raise costs relative to revenues for some time. As a result, the banks' stocks returns would decline in response to the increase in interest rates. Secondly, if unanticipated changes in interest rates affect the rate at which market participants discount the present value of banks' future profit streams, then banks' vulnerability to unexpected interest-rate movements would also increase. Also, bank revenues and costs may be affected by the level of interest rates and the variability or predictability of interest rates within each period. The findings also indicate that for many banks, the stock market returns process does exhibit strong interest rate sensitivity; i.e. the stock market is fully aware of interest rate risk when valuing banks' stocks. At the same time, there are only weak links between estimates of interest rate exposure obtained through the two methodologies applied.

5.4. Recommendations

5.4.1. To the Management of Commercial Banks

The study suggests that banks and their supervisors may benefit from computing interest rate exposure. The board of directors of a bank could use such estimates as an outside check upon risk management procedures. Supervisors could use such tools to isolate the most vulnerable banks in the system, and better allocate scarce supervisory capacity. In undertaking asset-transformation through acceptance of deposits and issuance of loans, commercial banks become exposed to interest rate risk through duration mismatch on their portfolio of fixed and floating interest rate assets and liabilities. As some of the collective investors' risks are passed onto the bank, the risk managers/ supervisors must be able to hedge against this mismatch. Effective hedging of interest rate risk is highly important both to the bank and to the financial system as a whole as it will reduce the banks' exposure to volatile interest rate movements. This will lessen the likelihood of extreme fluctuations in a bank's financial condition and reduce the probability of a bank becoming insolvent. This in turn reduces the amount of capital a bank must hold for regulatory requirements and thereby frees up extra capital for lending and other business.

5.4.2. For further Research

The study sought to establish the relationship of commercial banks exposure to interest rate risk and their performance (stock returns). Further research may be performed to establish the relationship between commercial banks exposure other forms of risks (foreign exchange risk, default risk, and liquidity risk) and their stock returns. This study applied monthly observations of the stock returns, 91-day Treasury bill rates, and the 10-year Bond coupon rate. To examine further the significance of the results achieved, empirical investigation on the banks exposure to interest rate risk can be done by applying weekly data. The use of more frequent observations may better capture the dynamics of financial time series.

5.5. Limitations of the Study

The study applied monthly observations, as opposed to weekly observations. This was occasioned by lack of documented time series data on the weekly closing values of the 91-day Treasury bill rates from the Central Bank of Kenya. These were relatively few especially considering that finer results could be obtained by using weekly rates.

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Appendix I: Stock Returns, T-BILLS and T-BOND (02 – 06)

Barclays Bank of Kenya

Year	Month	P_it	P_it-1	TBILL	TBOND	R_it
2002	June	85.00	82.50	7.338	14.00	0.0303030
2002	July	89.00	85.00	8.634	13.75	0.0470588
2002	August	84.00	89.00	8.340	12.00	-0.0561798
2002	September	80.00	84.00	7.601	14.25	-0.0476190
2002	October	84.00	80.00	8.065	11.25	0.0500000
2002	November	91.00	84.00	8.299	10.75	0.0833333
2002	December	101.00	91.00	8.378	11.50	0.1098901
2003	January	109.00	101.00	8.384	14.00	0.0792079
2003	February	120.00	109.00	7.774	13.50	0.1009174
2003	March	120.00	120.00	6.239	13.75	0.0000000
2003	April	136.00	120.00	6.254	11.50	0.1333333
2003	May	145.00	136.00	5.843	12.75	0.0661765
2003	June	131.00	145.00	2.998	9.50	-0.0965517
2003	July	134.00	131.00	1.537	5.25	0.0229008
2003	August	133.00	134.00	1.181	8.50	-0.0074627
2003	September	192.00	133.00	0.830	7.00	0.4436090
2003	October	190.00	192.00	1.003	6.50	-0.0104167
2003	November	267.00	190.00	1.280	4.00	0.4052632
2003	December	280.00	267.00	1.458	4.00	0.0486891
2004	January	297.00	280.00	1.580	6.75	0.0607143
2004	February	301.00	297.00	1.571	6.50	0.0134680
2004	March	228.00	301.00	1.592	7.50	-0.2425249
2004	April	238.00	228.00	2.110	4.75	0.0438596
2004	May	235.00	238.00	2.870	4.25	-0.0126050
2004	June	200.00	235.00	2.015	3.75	-0.1489362
2004	July	210.00	200.00	1.707	5.25	0.0500000
2004	August	204.00	210.00	2.267	7.00	-0.0285714
2004	September	204.00	204.00	2.749	4.50	0.0000000
2004	October	219.00	204.00	3.950	6.50	0.0735294
2004	November	214.00	219.00	5.061	6.75	-0.0228311
2004	December	200.00	214.00	8.043	8.50	-0.0654206
2005	January	215.00	200.00	8.259	7.50	0.0750000
2005	February	220.00	215.00	8.587	8.75	0.0232558
2005	March	209.00	220.00	8.630	10.25	-0.0500000
2005	April	216.00	209.00	8.681	11.63	0.0334928
2005	May	239.00	216.00	8.660	11.63	0.1064815
2005	June	252.00	239.00	8.502	12.50	0.0543933
2005	July	250.00	252.00	8.587	11.50	-0.0079365
2005	August	240.00	250.00	8.655	10.50	-0.0400000
2005	September	242.00	240.00	8.577	10.25	0.0083333
2005	October	250.00	242.00	8.188	12.25	0.0330579
2005	November	246.00	250.00	7.843	13.00	-0.0160000
2005	December	263.00	246.00	8.070	13.00	0.0691057
2006	January	272.00	263.00	8.233	13.25	0.0342205
2006	February	252.00	272.00	8.025	13.25	-0.0735294
2006	March	256.00	252.00	7.604	14.00	0.0158730
2006	April	264.00	256.00	7.016	11.25	0.0312500
2006	May	273.00	264.00	7.014	11.75	0.0340909
2006	June	288.00	273.00	6.596	10.00	0.0549451

2006	July	296.00	288.00	5.895	11.25	0.0277778
2006	August	05.00	296.00	5.955	14.00	0.0304054
2006	September	338.00	305.00	6.45	13.75	0.1081967
2006	October	84.00	338.00	6.83	8.25	0.4319527
2006	November	571.00	484.00	6.41	11.50	0.1797521
2006	December	454.00	571.00	5.73	12.00	-0.2049037

Standard Chartered Bank (K) Ltd

Year	**Month**	**P_it**	**P_it-1**	**TBILL**	**TBOND**	**R_it**
2002	June	52.00	49.50	7.338	14.00	0.0505051
2002	July	54.00	52.00	8.634	13.75	0.0384615
2002	August	51.50	54.00	8.340	12.00	-0.0462963
2002	September	55.00	51.50	7.601	14.25	0.0679612
2002	October	58.50	55.00	8.065	11.25	0.0636364
2002	November	57.00	58.50	8.299	10.75	-0.0256410
2002	December	62.00	57.00	8.378	11.50	0.0877193
2003	January	69.50	62.00	8.384	14.00	0.1209677
2003	February	71.50	69.50	7.774	13.50	0.0287770
2003	March	74.50	71.50	6.239	13.75	0.0419580
2003	April	91.00	74.50	6.254	11.50	0.2214765
2003	May	95.50	91.00	5.843	12.75	0.0494505
2003	June	93.00	95.50	2.998	9.50	-0.0261780
2003	July	92.50	93.00	1.537	5.25	-0.0053763
2003	August	102.00	92.50	1.181	8.50	0.1027027
2003	September	142.00	102.00	0.830	7.00	0.3921569
2003	October	151.00	142.00	1.003	6.50	0.0633803
2003	November	185.00	151.00	1.280	4.00	0.2251656
2003	December	185.00	185.00	1.458	4.00	0.0000000
2004	January	201.00	185.00	1.580	6.75	0.0864865
2004	February	245.00	201.00	1.571	6.50	0.2189055
2004	March	183.00	245.00	1.592	7.50	-0.2530612
2004	April	160.00	183.00	2.110	4.75	-0.1256831
2004	May	161.00	160.00	2.870	4.25	0.0062500
2004	June	130.00	161.00	2.015	3.75	-0.1925466
2004	July	142.00	130.00	1.707	5.25	0.0923077
2004	August	138.00	142.00	2.267	7.00	-0.0281690
2004	September	133.00	138.00	2.749	4.50	-0.0362319
2004	October	139.00	133.00	3.950	6.50	0.0451128
2004	November	134.00	139.00	5.061	6.75	-0.0359712
2004	December	122.00	134.00	8.043	8.50	-0.0895522
2005	January	123.00	122.00	8.259	7.50	0.0081967
2005	February	124.00	123.00	8.587	8.75	0.0081301
2005	March	118.00	124.00	8.630	10.25	-0.0483871
2005	April	125.00	118.00	8.681	11.63	0.0593220
2005	May	129.00	125.00	8.660	11.63	0.0320000
2005	June	130.00	129.00	8.502	12.50	0.0077519
2005	July	139.00	130.00	8.587	11.50	0.0692308
2005	August	139.00	139.00	8.655	10.50	0.0000000
2005	September	136.00	139.00	8.577	10.25	-0.0215827
2005	October	138.00	136.00	8.188	12.25	0.0147059
2005	November	139.00	138.00	7.843	13.00	0.0072464
2005	December	139.00	139.00	8.070	13.00	0.0000000
2006	January	142.00	139.00	8.233	13.25	0.0215827

2006	February	139.00	142.00	8.025	13.25	-0.0211268
2006	March	142.00	139.00	7.604	14.00	0.0215827
2006	April	148.00	142.00	7.016	11.25	0.0422535
2006	May	153.00	148.00	7.014	11.75	0.0337838
2006	June	155.00	153.00	6.596	10.00	0.0130719
2006	July	157.00	155.00	5.895	11.25	0.0129032
2006	August	59.00	157.00	5.955	14.00	0.0127389
2006	September	167.00	159.00	6.45	13.75	0.0503145
2006	October	92.00	167.00	6.83	8.25	0.1497006
2006	November	208.00	192.00	6.41	11.50	0.0833333
2006	December	227.00	208.00	5.73	12.00	0.0913462

Diamond Trust Bank of Kenya

Year	Month	P_it	P_it-1	TBILL	TBOND	R_it
2002	June	9.00	8.60	7.338	14.00	0.0465116
2002	July	9.00	9.00	8.634	13.75	0.0000000
2002	August	9.00	9.00	8.340	12.00	0.0000000
2002	September	11.00	9.00	7.601	14.25	0.2222222
2002	October	11.00	11.00	8.065	11.25	0.0000000
2002	November	10.50	11.00	8.299	10.75	-0.0454545
2002	December	10.00	10.50	8.378	11.50	-0.0476190
2003	January	12.70	10.00	8.384	14.00	0.2700000
2003	February	14.50	12.70	7.774	13.50	0.1417323
2003	March	16.65	14.50	6.239	13.75	0.1482759
2003	April	22.50	16.65	6.254	11.50	0.3513514
2003	May	28.50	22.50	5.843	12.75	0.2666667
2003	June	21.50	28.50	2.998	9.50	-0.2456140
2003	July	16.00	21.50	1.537	5.25	-0.2558140
2003	August	22.00	16.00	1.181	8.50	0.3750000
2003	September	28.00	22.00	0.830	7.00	0.2727273
2003	October	25.00	28.00	1.003	6.50	-0.1071429
2003	November	30.00	25.00	1.280	4.00	0.2000000
2003	December	28.00	30.00	1.458	4.00	-0.0666667
2004	January	48.50	28.00	1.580	6.75	0.7321429
2004	February	42.50	48.50	1.571	6.50	-0.1237113
2004	March	34.50	42.50	1.592	7.50	-0.1882353
2004	April	30.00	34.50	2.110	4.75	-0.1304348
2004	May	30.00	30.00	2.870	4.25	0.0000000
2004	June	30.00	30.00	2.015	3.75	0.0000000
2004	July	30.25	30.00	1.707	5.25	0.0083333
2004	August	30.00	30.25	2.267	7.00	-0.0082645
2004	September	25.75	30.00	2.749	4.50	-0.1416667
2004	October	28.25	25.75	3.950	6.50	0.0970874
2004	November	26.25	28.25	5.061	6.75	-0.0707965
2004	December	28.00	26.25	8.043	8.50	0.0666667
2005	January	29.00	28.00	8.259	7.50	0.0357143
2005	February	32.25	29.00	8.587	8.75	0.1120690
2005	March	34.00	32.25	8.630	10.25	0.0542636
2005	April	35.00	34.00	8.681	11.63	0.0294118
2005	May	27.00	35.00	8.660	11.63	-0.2285714
2005	June	29.00	27.00	8.502	12.50	0.0740741
2005	July	28.75	29.00	8.587	11.50	-0.0086207
2005	August	28.00	28.75	8.655	10.50	-0.0260870

2005	September	27.00	28.00	8.577	10.25	-0.0357143
2005	October	28.00	27.00	8.188	12.25	0.0370370
2005	November	28.75	28.00	7.843	13.00	0.0267857
2005	December	32.25	28.75	8.070	13.00	0.1217391
2006	January	40.00	32.25	8.233	13.25	0.2403101
2006	February	46.00	40.00	8.025	13.25	0.1500000
2006	March	48.00	46.00	7.604	14.00	0.0434783
2006	April	54.00	48.00	7.016	11.25	0.1250000
2006	May	57.00	54.00	7.014	11.75	0.0555556
2006	June	61.00	57.00	6.596	10.00	0.0701754
2006	July	64.00	61.00	5.895	11.25	0.0491803
2006	August	5.00	64.00	5.955	14.00	0.0156250
2006	September	79.00	65.00	6.45	13.75	0.2153846
2006	October	2.50	79.00	6.83	8.25	-0.0822785
2006	November	71.50	72.50	6.41	11.50	-0.0137931
2006	December	90.50	71.50	5.73	12.00	0.2657343

CFC Bank (K) Limited

Year	**Month**	**P_it**	**P_it-1**	**TBILL**	**TBOND**	**R_it**
2002	June	9.00	8.85	7.338	14.00	0.0169492
2002	July	9.00	9.00	8.634	13.75	0.0000000
2002	August	9.00	9.00	8.340	12.00	0.0000000
2002	September	9.30	9.00	7.601	14.25	0.0333333
2002	October	9.00	9.30	8.065	11.25	-0.0322581
2002	November	9.05	9.00	8.299	10.75	0.0055556
2002	December	9.20	9.05	8.378	11.50	0.0165746
2003	January	10.55	9.20	8.384	14.00	0.1467391
2003	February	12.50	10.55	7.774	13.50	0.1848341
2003	March	11.75	12.50	6.239	13.75	-0.0600000
2003	April	11.00	11.75	6.254	11.50	-0.0638298
2003	May	19.50	11.00	5.843	12.75	0.7727273
2003	June	19.00	19.50	2.998	9.50	-0.0256410
2003	July	17.15	19.00	1.537	5.25	-0.0973684
2003	August	16.10	17.15	1.181	8.50	-0.0612245
2003	September	24.25	16.10	0.830	7.00	0.5062112
2003	October	25.25	24.25	1.003	6.50	0.0412371
2003	November	28.50	25.25	1.280	4.00	0.1287129
2003	December	33.00	28.50	1.458	4.00	0.1578947
2004	January	58.50	33.00	1.580	6.75	0.7727273
2004	February	65.00	58.50	1.571	6.50	0.1111111
2004	March	59.00	65.00	1.592	7.50	-0.0923077
2004	April	54.00	59.00	2.110	4.75	-0.0847458
2004	May	51.00	54.00	2.870	4.25	-0.0555556
2004	June	45.75	51.00	2.015	3.75	-0.1029412
2004	July	44.00	45.75	1.707	5.25	-0.0382514
2004	August	42.00	44.00	2.267	7.00	-0.0454545
2004	September	45.25	42.00	2.749	4.50	0.0773810
2004	October	49.25	45.25	3.950	6.50	0.0883978
2004	November	55.00	49.25	5.061	6.75	0.1167513
2004	December	58.00	55.00	8.043	8.50	0.0545455
2005	January	53.00	58.00	8.259	7.50	-0.0862069
2005	February	55.00	53.00	8.587	8.75	0.0377358
2005	March	55.00	55.00	8.630	10.25	0.0000000
2005	April	56.50	55.00	8.681	11.63	0.0272727
2005	May	58.50	56.50	8.660	11.63	0.0353982

2005	June	67.00	58.50	8.502	12.50	0.1452991
2005	July	57.50	67.00	8.587	11.50	-0.1417910
2005	August	70.00	57.50	8.655	10.50	0.2173913
2005	September	70.00	70.00	8.577	10.25	0.0000000
2005	October	76.50	70.00	8.188	12.25	0.0928571
2005	November	75.00	76.50	7.843	13.00	-0.0196078
2005	December	75.00	75.00	8.070	13.00	0.0000000
2006	January	77.50	75.00	8.233	13.25	0.0333333
2006	February	68.00	77.50	8.025	13.25	-0.1225806
2006	March	71.00	68.00	7.604	14.00	0.0441176
2006	April	73.00	71.00	7.016	11.25	0.0281690
2006	May	74.00	73.00	7.014	11.75	0.0136986
2006	June	76.00	74.00	6.596	10.00	0.0270270
2006	July	79.00	76.00	5.895	11.25	0.0394737
2006	August	80.00	79.00	5.955	14.00	0.0126582
2006	September	88.50	80.00	6.45	13.75	0.1062500
2006	October	85.00	88.50	6.83	8.25	-0.0395480
2006	November	82.50	85.00	6.41	11.50	-0.0294118
2006	December	94.50	82.50	5.73	12.00	0.1454545

Housing Finance Limited

Year	Month	P_it	P_it-1	TBILL	TBOND	R_it
2002	June	3.70	3.25	7.338	14.00	0.1384615
2002	July	3.40	3.70	8.634	13.75	-0.0810811
2002	August	3.70	3.40	8.340	12.00	0.0882353
2002	September	3.00	3.70	7.601	14.25	-0.1891892
2002	October	3.50	3.00	8.065	11.25	0.1666667
2002	November	3.50	3.50	8.299	10.75	0.0000000
2002	December	5.20	3.50	8.378	11.50	0.4857143
2003	January	6.05	5.20	8.384	14.00	0.1634615
2003	February	6.60	6.05	7.774	13.50	0.0909091
2003	March	7.00	6.60	6.239	13.75	0.0606061
2003	April	8.65	7.00	6.254	11.50	0.2357143
2003	May	9.80	8.65	5.843	12.75	0.1329480
2003	June	51.00	9.80	2.998	9.50	4.2040816
2003	July	10.10	51.00	1.537	5.25	-0.8019608
2003	August	9.70	10.10	1.181	8.50	-0.0396040
2003	September	12.00	9.70	0.830	7.00	0.2371134
2003	October	12.15	12.00	1.003	6.50	0.0125000
2003	November	13.00	12.15	1.280	4.00	0.0699588
2003	December	12.05	13.00	1.458	4.00	-0.0730769
2004	January	18.90	12.05	1.580	6.75	0.5684647
2004	February	18.00	18.90	1.571	6.50	-0.0476190
2004	March	12.10	18.00	1.592	7.50	-0.3277778
2004	April	11.85	12.10	2.110	4.75	-0.0206612
2004	May	10.00	11.85	2.870	4.25	-0.1561181
2004	June	9.90	10.00	2.015	3.75	-0.0100000
2004	July	10.55	9.90	1.707	5.25	0.0656566
2004	August	11.00	10.55	2.267	7.00	0.0426540
2004	September	9.20	11.00	2.749	4.50	-0.1636364
2004	October	9.15	9.20	3.950	6.50	-0.0054348
2004	November	9.30	9.15	5.061	6.75	0.0163934
2004	December	8.50	9.30	8.043	8.50	-0.0860215
2005	January	10.35	8.50	8.259	7.50	0.2176471
2005	February	10.60	10.35	8.587	8.75	0.0241546

2005	March	9.45	10.60	8.630	10.25	-0.1084906
2005	April	9.55	9.45	8.681	11.63	0.0105820
2005	May	9.10	9.55	8.660	11.63	-0.0471204
2005	June	12.70	9.10	8.502	12.50	0.3956044
2005	July	13.95	12.70	8.587	11.50	0.0984252
2005	August	13.00	13.95	8.655	10.50	-0.0681004
2005	September	11.50	13.00	8.577	10.25	-0.1153846
2005	October	12.10	11.50	8.188	12.25	0.0521739
2005	November	13.00	12.10	7.843	13.00	0.0743802
2005	December	13.95	13.00	8.070	13.00	0.0730769
2006	January	16.90	13.95	8.233	13.25	0.2114695
2006	February	17.80	16.90	8.025	13.25	0.0532544
2006	March	22.50	17.80	7.604	14.00	0.2640449
2006	April	26.00	22.50	7.016	11.25	0.1555556
2006	May	29.00	26.00	7.014	11.75	0.1153846
2006	June	34.00	29.00	6.596	10.00	0.1724138
2006	July	36.00	34.00	5.895	11.25	0.0588235
2006	August	39.00	36.00	5.955	14.00	0.0833333
2006	September	55.50	39.00	6.45	13.75	0.4230769
2006	October	45.25	55.50	6.83	8.25	-0.1846847
2006	November	41.25	45.25	6.41	11.50	-0.0883978
2006	December	43.75	41.25	5.73	12.00	0.0606061

National Bank of Kenya Limited

Year	Month	P_it	P_it-1	TBILL	TBOND	R_it
2002	June	2.60	2.50	7.338	14.00	0.0400000
2002	July	2.50	2.60	8.634	13.75	-0.0384615
2002	August	2.60	2.50	8.340	12.00	0.0400000
2002	September	2.30	2.60	7.601	14.25	-0.1153846
2002	October	2.60	2.30	8.065	11.25	0.1304348
2002	November	3.35	2.60	8.299	10.75	0.2884615
2002	December	3.65	3.35	8.378	11.50	0.0895522
2003	January	6.30	3.65	8.384	14.00	0.7260274
2003	February	6.35	6.30	7.774	13.50	0.0079365
2003	March	5.45	6.35	6.239	13.75	-0.1417323
2003	April	5.80	5.45	6.254	11.50	0.0642202
2003	May	12.55	5.80	5.843	12.75	1.1637931
2003	June	14.90	12.55	2.998	9.50	0.1872510
2003	July	13.60	14.90	1.537	5.25	-0.0872483
2003	August	15.00	13.60	1.181	8.50	0.1029412
2003	September	14.40	15.00	0.830	7.00	-0.0400000
2003	October	13.00	14.40	1.003	6.50	-0.0972222
2003	November	14.15	13.00	1.280	4.00	0.0884615
2003	December	13.35	14.15	1.458	4.00	-0.0565371
2004	January	27.75	13.35	1.580	6.75	1.0786517
2004	February	35.75	27.75	1.571	6.50	0.2882883
2004	March	19.85	35.75	1.592	7.50	-0.4447552
2004	April	20.00	19.85	2.110	4.75	0.0075567
2004	May	19.45	20.00	2.870	4.25	-0.0275000
2004	June	18.75	19.45	2.015	3.75	-0.0359897
2004	July	17.25	18.75	1.707	5.25	-0.0800000
2004	August	17.55	17.25	2.267	7.00	0.0173913
2004	September	15.20	17.55	2.749	4.50	-0.1339031
2004	October	18.00	15.20	3.950	6.50	0.1842105
2004	November	17.90	18.00	5.061	6.75	-0.0055556

2004	December	18.90	17.90	8.043	8.50	0.0558659
2005	January	20.75	18.90	8.259	7.50	0.0978836
2005	February	19.00	20.75	8.587	8.75	-0.0843373
2005	March	18.20	19.00	8.630	10.25	-0.0421053
2005	April	16.65	18.20	8.681	11.63	-0.0851648
2005	May	19.30	16.65	8.660	11.63	0.1591592
2005	June	20.50	19.30	8.502	12.50	0.0621762
2005	July	24.75	20.50	8.587	11.50	0.2073171
2005	August	24.25	24.75	8.655	10.50	-0.0202020
2005	September	30.00	24.25	8.577	10.25	0.2371134
2005	October	29.25	30.00	8.188	12.25	-0.0250000
2005	November	28.25	29.25	7.843	13.00	-0.0341880
2005	December	28.75	28.25	8.070	13.00	0.0176991
2006	January	32.50	28.75	8.233	13.25	0.1304348
2006	February	33.00	32.50	8.025	13.25	0.0153846
2006	March	35.00	33.00	7.604	14.00	0.0606061
2006	April	37.00	35.00	7.016	11.25	0.0571429
2006	May	40.00	37.00	7.014	11.75	0.0810811
2006	June	42.00	40.00	6.596	10.00	0.0500000
2006	July	44.50	42.00	5.895	11.25	0.0595238
2006	August	8.50	44.50	5.955	14.00	0.0898876
2006	September	67.50	48.50	6.45	13.75	0.3917526
2006	October	0.50	67.50	6.83	8.25	-0.1037037
2006	November	59.50	60.50	6.41	11.50	-0.0165289
2006	December	65.50	59.50	5.73	12.00	0.1008403

Kenya Commercial Bank Limited

Year	Month	P_it	P_it-1	TBILL	TBOND	R_it
2002	June	10.15	10.50	7.338	14.00	-0.0333333
2002	July	10.30	10.15	8.634	13.75	0.0147783
2002	August	10.00	10.30	8.340	12.00	-0.0291262
2002	September	9.20	10.00	7.601	14.25	-0.0800000
2002	October	12.20	9.20	8.065	11.25	0.3260870
2002	November	12.00	12.20	8.299	10.75	-0.0163934
2002	December	18.70	12.00	8.378	11.50	0.5583333
2003	January	24.75	18.70	8.384	14.00	0.3235294
2003	February	23.00	24.75	7.774	13.50	-0.0707071
2003	March	29.25	23.00	6.239	13.75	0.2717391
2003	April	49.50	29.25	6.254	11.50	0.6923077
2003	May	55.00	49.50	5.843	12.75	0.1111111
2003	June	47.25	55.00	2.998	9.50	-0.1409091
2003	July	43.00	47.25	1.537	5.25	-0.0899471
2003	August	44.00	43.00	1.181	8.50	0.0232558
2003	September	52.50	44.00	0.830	7.00	0.1931818
2003	October	49.00	52.50	1.003	6.50	-0.0666667
2003	November	59.00	49.00	1.280	4.00	0.2040816
2003	December	54.00	59.00	1.458	4.00	-0.0847458
2004	January	83.50	54.00	1.580	6.75	0.5462963
2004	February	87.50	83.50	1.571	6.50	0.0479042
2004	March	65.00	87.50	1.592	7.50	-0.2571429
2004	April	56.00	65.00	2.110	4.75	-0.1384615
2004	May	59.50	56.00	2.870	4.25	0.0625000
2004	June	53.00	59.50	2.015	3.75	-0.1092437
2004	July	66.00	53.00	1.707	5.25	0.2452830
2004	August	60.00	66.00	2.267	7.00	-0.0909091

2004	September	59.50	60.00	2.749	4.50	-0.0083333
2004	October	60.00	59.50	3.950	6.50	0.0084034
2004	November	65.00	60.00	5.061	6.75	0.0833333
2004	December	64.00	65.00	8.043	8.50	-0.0153846
2005	January	70.00	64.00	8.259	7.50	0.0937500
2005	February	65.50	70.00	8.587	8.75	-0.0642857
2005	March	61.50	65.50	8.630	10.25	-0.0610687
2005	April	64.00	61.50	8.681	11.63	0.0406504
2005	May	68.00	64.00	8.660	11.63	0.0625000
2005	June	69.50	68.00	8.502	12.50	0.0220588
2005	July	76.50	69.50	8.587	11.50	0.1007194
2005	August	80.00	76.50	8.655	10.50	0.0457516
2005	September	84.00	80.00	8.577	10.25	0.0500000
2005	October	97.50	84.00	8.188	12.25	0.1607143
2005	November	109.00	97.50	7.843	13.00	0.1179487
2005	December	113.00	109.00	8.070	13.00	0.0366972
2006	January	115.00	113.00	8.233	13.25	0.0176991
2006	February	117.00	115.00	8.025	13.25	0.0173913
2006	March	122.00	117.00	7.604	14.00	0.0427350
2006	April	134.00	122.00	7.016	11.25	0.0983607
2006	May	152.00	134.00	7.014	11.75	0.1343284
2006	June	166.00	152.00	6.596	10.00	0.0921053
2006	July	172.00	166.00	5.895	11.25	0.0361446
2006	August	76.00	172.00	5.955	14.00	0.0232558
2006	September	193.00	176.00	6.45	13.75	0.0965909
2006	October	197.00	193.00	6.83	8.25	0.0207254
2006	November	213.00	197.00	6.41	11.50	0.0812183
2006	December	271.00	213.00	5.73	12.00	0.2723005

NIC Bank Limited

Year	Month	P_it	P_it-1	TBILL	TBOND	R_it
2002	June	13.10	12.70	7.338	14.00	0.0314961
2002	July	14.65	13.10	8.634	13.75	0.1183206
2002	August	14.50	14.65	8.340	12.00	-0.0102389
2002	September	13.40	14.50	7.601	14.25	-0.0758621
2002	October	13.60	13.40	8.065	11.25	0.0149254
2002	November	16.15	13.60	8.299	10.75	0.1875000
2002	December	19.70	16.15	8.378	11.50	0.2198142
2003	January	24.00	19.70	8.384	14.00	0.2182741
2003	February	24.00	24.00	7.774	13.50	0.0000000
2003	March	23.25	24.00	6.239	13.75	-0.0312500
2003	April	31.00	23.25	6.254	11.50	0.3333333
2003	May	28.75	31.00	5.843	12.75	-0.0725806
2003	June	26.00	28.75	2.998	9.50	-0.0956522
2003	July	31.50	26.00	1.537	5.25	0.2115385
2003	August	29.75	31.50	1.181	8.50	-0.0555556
2003	September	41.75	29.75	0.830	7.00	0.4033613
2003	October	38.25	41.75	1.003	6.50	-0.0838323
2003	November	49.00	38.25	1.280	4.00	0.2810458
2003	December	45.50	49.00	1.458	4.00	-0.0714286
2004	January	66.50	45.50	1.580	6.75	0.4615385

2004	February	54.00	66.50	1.571	6.50	-0.1879699
2004	March	45.00	54.00	1.592	7.50	-0.1666667
2004	April	50.00	45.00	2.110	4.75	0.1111111
2004	May	53.00	50.00	2.870	4.25	0.0600000
2004	June	49.25	53.00	2.015	3.75	-0.0707547
2004	July	52.50	49.25	1.707	5.25	0.0659898
2004	August	45.50	52.50	2.267	7.00	-0.1333333
2004	September	45.25	45.50	2.749	4.50	-0.0054945
2004	October	46.00	45.25	3.950	6.50	0.0165746
2004	November	50.00	46.00	5.061	6.75	0.0869565
2004	December	50.00	50.00	8.043	8.50	0.0000000
2005	January	50.50	50.00	8.259	7.50	0.0100000
2005	February	52.50	50.50	8.587	8.75	0.0396040
2005	March	50.00	52.50	8.630	10.25	-0.0476190
2005	April	47.25	50.00	8.681	11.63	-0.0550000
2005	May	47.00	47.25	8.660	11.63	-0.0052910
2005	June	52.00	47.00	8.502	12.50	0.1063830
2005	July	53.00	52.00	8.587	11.50	0.0192308
2005	August	52.00	53.00	8.655	10.50	-0.0188679
2005	September	48.00	52.00	8.577	10.25	-0.0769231
2005	October	51.00	48.00	8.188	12.25	0.0625000
2005	November	50.00	51.00	7.843	13.00	-0.0196078
2005	December	51.00	50.00	8.070	13.00	0.0200000
2006	January	54.00	51.00	8.233	13.25	0.0588235
2006	February	52.00	54.00	8.025	13.25	-0.0370370
2006	March	56.00	52.00	7.604	14.00	0.0769231
2006	April	62.00	56.00	7.016	11.25	0.1071429
2006	May	67.00	62.00	7.014	11.75	0.0806452
2006	June	72.00	67.00	6.596	10.00	0.0746269
2006	July	74.00	72.00	5.895	11.25	0.0277778
2006	August	89.00	74.00	5.955	14.00	0.2027027
2006	September	67.50	89.00	6.45	13.75	-0.2415730
2006	October	97.50	67.50	6.83	8.25	0.4444444
2006	November	102.00	97.50	6.41	11.50	0.0461538
2006	December	114.00	102.00	5.73	12.00	0.1176471