THE RELATIONSHIP BETWEEN INTEREST RATES AND EXCHANGE RATES IN KENYA

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UNITED STATES INTERNATIONAL UNIVERSITY
NAIROBI

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A Research Project Submitted to the School of Business in Partial Fulfillment of the Requirements for the Degree of Masters in Business Administration

UNITED STATES INTERNATIONAL UNIVERSITY
NAIROBI

SPRING 2003
STUDENT'S DECLARATION

I, the undersigned, declare that this is my original work and has not been submitted to any other college, institution or university other than the United States International University in Nairobi for academic credit.

Signed: [Signature]  Date: 26/05/03
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This project has been presented for examination with my approval as the appointed supervisors.

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Abstract.

The economic variables such as interest rate, exchange rate, inflation and gross domestic product (GDP) are known to be interrelated and to have an influence on each other. The objective of this study though, was to determine the relationship between exchange rates and interest rates in Kenya. To do this, we explored the trends in

- The interbank interest rates in Kenya,
- The interbank interest rate in the United State of America, and
- The exchange rates of the Kenya shilling to the U.S dollar.

Business people in Kenya are generally affected by both the interest rate and exchange rate especially since the liberalization of the economy and the opening of the Nairobi Stock Exchange (NSE) to foreign investors. Business people are always faced with the choice of investing their money in local or foreign currency. In Kenya, Kingori (1995) has done a study on the Efficient Market theory in order to determine whether this information can help business people make better investment decisions.

The research design was a census and the secondary data was collected from the Central Bank of Kenya and the Internet. The time period studied was from November 1993 to March 2002 in order to capture the liberalization period.

The study was a Time Series Analysis, using the International Fisher Effect as proxy, in nature and the population consisted of all interest rates on the 91-day Kenyan Treasury bill and the inter bank exchange rates for the US dollar as well as the monthly 91-day US treasury
Data analysis was done using econometric techniques using SAS computer package. Pearson correlation was determined, standard deviation, the Z-static, and the data was fitted onto a regression equation to establish the rate of flow of funds from Kenya to the developed world or vice versa.

The study revealed that there is a negative relationship between the two variables; exchange rate and interest rate at $-0.417$. The study also showed that the interest rates and exchange rates in the Kenya economy are quite volatile compared to the US economy. The researcher recommends a study using other macroeconomic variables such as inflation, gross domestic product and income levels. Research on the effects of high treasury bill rates on the economy as a whole would give further insights to the relationship of interest rates and alternative forms of investment.
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I was helped by my colleagues at Kenya Textile Training Institute to whom I am grateful for all the assistance they accorded me.

Finally, particular gratitude to my wife Leah Mitula for her friendship, patience and help during the period of study.
DEDICATION

To my late brother, Dickson Onyango;
For the inspiration to start this course
And my children, Dean and Laura.
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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

1.1.1 Interest Rates

The period November 1993 to March 2002 witnessed the interest rates on local borrowings becoming so high that further sums had to be borrowed just to cover interest payments. The 91-day Treasury bill rates touched highs of 84.4% and lows of 8.84% during this period. Prior to 1993, the economy was not liberalized; this meant that the exchange rate was managed by the Central Bank of Kenya and the relationship between the interest rate and exchange rate was not noticeable. However, in 1996, the Kenyan economy was completely liberalised. During the same period, the interest rates on borrowings were high as the Treasury bill rates were high and the money was being used to service foreign debt and budget deficit since Donor agencies were not giving the government Aid. Ever rising rates of interests crippled business growth in industry and affected the standard of living of everyone. Higher interest rates added to production costs thereby increasing consumer prices (CBK Monthly Economic Review, 1997)

Prices rose as a result of increased import duties and taxes as well as higher fees for social services. These taxes were imposed as the government tried to reduce its need to borrow by generating income it did not need to repay. A high inflation rate often results in high interest rates. By December 1996, inflation had gone up to around 20%, and the 91-day Treasury bill rates, the benchmark for commercial interest rates had increased
from 21% to 24.5% indicating a heightened pressure on Central Bank of Kenya to squeeze the money supply or raise money to finance the government budget deficit.

High interest rates were attributed to the Central Bank of Kenya's high cash ratio; a high interest rate on treasury bills; commercial banks' high cost base; high demand for credit from the private and government sectors and low overseas borrowings. The mandatory cash ratio that banks and other financial institutions keep with the Central Bank of Kenya bear no interest. Therefore the banks and financial institutions have to charge a premium to generate enough profits to cover the cost of that idle money.

1.1.2 Foreign exchange rate.

Foreign exchange is simply the mechanism which values foreign currencies in terms of the domestic currency (Madura, 2000). An exchange rate therefore is the price of one currency in terms of another. In Kenya, foreign exchange is needed by tourists, investors, importers, exporters and shoppers among other uses. The factors that affect exchange rates include changes in real gross domestic product, expected future inflation, interest rates, introduction of new and stronger currencies, extremely efficient foreign exchange markets, shifts in demand, changes in local money supply and expected future spot exchange rates.

1.1.3 Factors contributing to foreign exchange volume growth in the world

The volume of foreign exchange has experienced a spectacular growth ever since currencies were allowed to float freely against each other. The foreign exchange market
is by far the largest financial market in the world. This is due to increased trade between countries and the development of Information technology that allows trading to continue 24 hours in a day and because of the integration of the stock exchange market e.g. New York Stock Exchange with the other stock markets such as NIKKEI, among others. The opening up of the eastern part of Europe and communist countries such as China has also contributed to increased trade.

In Kenya, the growth of trade has been attributed to the liberalization of the markets mainly through the opening of many FOREX bureaus as well as the commercial banks removal of commissions for foreign exchange transactions (CBK Monthly Economic Review, 1999). The East African countries are in the process of integrating their stock exchange markets. This will result in a bigger market. While the daily worldwide turnover in 1977 was US $5 billion, in the early 1990s’ the estimate placed the average foreign exchange trading volume at over $650 billion daily, or $160 trillion a year (Shapiro, 1996). The reasons for this spectacular growth are:

1. Exchange rate volatility – as traders react to new information that is now available worldwide and expectations change, affecting exchange rates.
2. Interest rates volatility – due to international liberalization, demand and supply of money keeps changing.
4. Increased corporate interest – a growing desire on the part of companies and financial institutions to more actively manage their currency risk exposure.
5. Increased players' sophistication – participants in the market are more educated, informed and have access to technology and computer software.

6. Developments in telecommunications – easier, cheaper and accessible modes of communication such as mobile phones and e-mail.

7. Computer developments (software and hardware) – such as electronic transfer of money and e-business developments.

8. New foreign exchange instruments – such as development of electronic money and signatures, and credit cards.

1.2 Statement of the Problem

Business people in Kenya, including importers, exporters, investors, speculators are generally affected by both the interest rate and exchange rate especially since the opening of the Nairobi Stock Exchange to foreign investors. Business people have always been faced with the choice of either:

1. Investing their money in interest earning accounts; or

2. Investing in foreign currencies and converting them to local currencies when exchange rates are favourable.

Faced with such a choice, this study will seek to determine the relationship between interest rates and exchange rates. Establishing a relationship will enable the Central Bank and government to have a clearer picture of the effects of interest rate on exchange rate as this may play an important role in the process of formulation and implementation of monetary policies for economic development.
Having known the relationship that exists between the interest rates and exchange rate in Kenya, business people can then make better decisions as to where they should invest their money and hence maximise their wealth.

1.3 Objectives of the study

General Objective

The general objective of this study was to establish the relationship existing between interest rates and foreign exchange rates and how this relationship, can be used to determine the direction of the Kenyan economy.

Specific objectives

1. To determine the trends in the interbank interest rates in Kenya.
2. To determine the trends in the interbank interest rates in the U.S.
3. To determine the trends in the exchange rates of the US dollar and Kenya shilling in order to establish the relationship between the interest rate and exchange rate.

1.4 Importance of the study:

- To Business People:

This study will help business people understand how interest rates relate to exchange rates in Kenya. It will therefore help them to make decisions as to where they should invest their money.
To Nairobi Stock Exchange (NSE) and Stock Brokers:
Knowing the relationship that exists between the interest rates and exchange rates would assist the NSE and its brokers to forecast more accurately the price fluctuations and benefits that their foreign investors are likely to expect as a foreign exchange risk will be added to foreign owned portfolios.

To Central Bank of Kenya:
As the Central Bank influences interest rates and exchange rates in Kenya, it will have a clearer picture of the possible effects of the interest rate and exchange rate in Kenya. This information might assist the Central Bank to determine the money supply levels of Kenyan currency as well as foreign owned currency and help keep the interest rates and foreign exchange rate levels stable.

To Researchers:
It will open an avenue for further research.

1.5 Justification of the research
The study is of great importance to Kenya. There was an outcry over the high interest rates as was evidenced by the popularity of the Central Bank of Kenya Amendment Act 2000 (popularly known as the Donde Act) with the borrowers and the number of non-performing loans. If the relationship between interest rates and foreign exchange rates in Kenya is established, then Kenyans can have the option of saving their money in foreign currency or better still invest or borrow offshore.
The results will give the business community an opportunity to decide whether to invest in the foreign currency or interest earning accounts such as Treasury bills or both.

1.6 The Research Questions

The data that was collected and analysis helped us understand the following questions.

- Is there a relationship between interest rates and exchange rates in Kenya?
- Does change in interest rates also result in change in exchange rates?

1.7 Hypothesis

The hypothesis in this research was: -

No relationship exists between the interest rate and foreign exchange rate and a change in one leads to no change in the other.

1.8 Scope of Study

The time period of the study, that is, November 1993 to March 2002, may not have been adequate in measuring the relationship between the two variables. A study period that encompassed the preliberalization period as well as the post liberalization period would have been a better time frame for both quality and quantity as the factors that brought about liberalization would have been addressed. The average monthly interest and exchange rates were used – the more detailed daily rates could have given a clearer picture.
Treasury bills interest rates are not the only rates in the market. There are commercial banks interest rates on loans, deposits, mortgages and savings. This study was only limited to 91-day Treasury bills interest rates. A study on all interest rates and how they relate to exchange rates would have given a more comprehensive result.

This study only dealt with interbank spot exchange rates as the forwards market, currencies future market, options market and eurocurrencies markets do not exist in Kenya. The foreign exchange market in Kenya is however not limited to banks only. There is trading between commercial banks and the public, and more recently the forex bureaus that sprang up after liberalisation of the economy.

We focused on the exchange rates between the US dollar and the Kenyan shilling although there are other currencies such as the Euro, Sterling Pound, the Deutsche Mark and Japanese yen among others. Although the US dollar is more internationally accepted, other currencies are also important and studying them in future would certainly give a broader perspective.

1.9 Definition of Terms

Money Supply and Money Demand. The money supply is a policy variable that is controlled by the Central Bank of Kenya (CBK). Through instruments such as open market operations, the Central Bank directly controls the quantity of money supplied. Money demand has several determinants, including interest rates and the average level of
prices in the economy. People hold money because it is the medium of exchange (www.iun.edu)

The foreign exchange market. The foreign exchange market is not a physical place; rather it is an electronically linked network of banks, foreign exchange brokers, and dealers whose function is to bring together buyers and sellers of foreign exchange (Shapiro, 1996). The purpose of the foreign exchange market is to permit transfers of purchasing power denominated in one currency to another. Most currency transactions are channeled through the worldwide interbank market, the wholesale market in which major banks trade with one another.

The Spot Market. In the spot foreign exchange market, currencies are traded for immediate delivery, which is actually within two business days after the transaction has been concluded (Shapiro, 1996).

The Forward Market. In the forward market, contracts are made to buy or sell currencies for future delivery at a specified time, place and price.

Devaluation refers to a decrease in the stated par value of a pegged currency, one whose value is set by the government, an increase in par value is known as a revaluation.

In contrast, a floating currency, one whose value is set primarily by market forces is said to depreciate if it looses value and to appreciate if it gains value (Shapiro, 1996).

The Balance of Payments. The balance of payments is the difference between what a country buys and sells overseas. If exports are worth more in value than imports, there is a surplus; if imports are worth more than exports, there is a deficit. (Allen, 1996). The balance of payment is made up of several components:

- Imports and exports of visible goods
• Transactions in services
• Financial items (often called invisibles)
• The balancing item, or those transactions that cannot be traced
• Any changes in a country's currency reserves.

*Interest Rates.* Interest rate is the price of credit or borrowing money - the price that lenders receive and borrowers have to pay (Rose, 1994)

*Nominal Interest Rates.* These are the rates quoted in credit and deposit agreements.

*Real Interest Rates.* These are the rates that are obtained by deflating the nominal interest rates. The decrease in the real value of the funds over a given period is equal to the rate of inflation for that period.

*Inflation.* Inflation is an increase in the overall level of prices.

1.10 Anticipated problems and limitations

There are a host of other factors that influence interest rates and exchange rates such as expectations and inflation, among others. This research was, however, limited to only two variables of interest rates and exchange rates that possibly affect each other. Further studies should therefore be done to determine how other factors affect interest rates and exchange rates because they are not the only factors that affect each other.

1.11 Chapter Summary

In this chapter, we saw the meaning of interest rates and foreign exchange rates. The primary function of the foreign exchange market is to transfer purchasing power denominated in one currency to another and, thereby, facilitate international trade and
investment. The main function of interest rates is to induce lenders to give up the liquidity that money confers.

The study of the relationship between interest rates and exchange rates will be of importance to the Central Bank, the Nairobi Stock Exchange and Stock brokers, business people and to researchers. We saw that the general objective of this study was to determine the relationship between interest rates and exchange rates and how this relationship can be used to determine the direction of the Kenyan economy. The time period of the study was from November 1993 to March 2002 inclusive. The variables used were the 91-day treasury bills interest rates and the average monthly exchange rates as quoted by the Central Bank of Kenya.

Chapter two deals with the determinants of exchange rates and interest rates. The various theories that underlie the determination of foreign exchange are also explained. The secondary data of the study is comprised of average monthly interest rates and average monthly exchange rates. The data was analysed with the aid of descriptive statistics and it revealed that the relationship between the two variables is not direct.
CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Interest Rates

The rate of interest is a price of credit or borrowing money and as with any other price, it is determined by the interaction of demand and supply and, in turn, helps determine demand for and supply of credit or loanable funds. An interest rate is therefore a price established by the interaction of the supply of and the demand for, future claims on resources (Apps et. al., 1984)

The main function of the interest rate is to induce lenders to give up the consumption of money. Other factors that influence interest rates are credit worthiness of the borrower, time factor and inflation. But why do interest rates differ? The reason why we have different rates of interest is because any particular interest rate is made up of a number of different elements (Bond, 1984): -

1. **Reward for parting with liquidity.** Interest is a reward for parting with liquidity. Hence the greater the reward, the greater the willingness to forgo liquidity. But if this were the only factor, all rates of interest would be the same.

2. **Credit worthiness of the borrower.** Any loan of money carries with it the risk of non-repayment. In some cases, the risk of default may be almost completely absent, as in the UK and Switzerland. In other cases the risk of default is greater. Interest rates will reflect the degree of risk and we may regard any particular rate of interest as incorporating a "risk premium" which compensates for the risk undertaken.
3. **Time factor.** The longer the term of the loan, the greater the uncertainty attached to the loan and for this enhanced uncertainty, the lender will expect a higher reward. Time value of money should also be taken into consideration as with time, the value of money depreciates therefore the longer the term of the loan, the greater the reward.

4. **Inflation factor.** In an economy with a significant degree of inflation, we might also expect lenders to seek a higher rate of interest in order to compensate for the expected loss of real value of the capital.

All investments carry uncertainty with them. The short-term investor enjoys capital certainty but income uncertainty because the market value of the investment is unlikely to vary greatly because of the short-term maturity. The long-term investor enjoys income certainty but capital uncertainty because the investor knows his income is assured for a long time to come but the market value of the investment may change quite markedly by the time the investment matures. Evidence over long periods of time indicates that generally, lenders prefer capital certainty to income certainty (Rongs, 1984).

With the internationalisation of capital markets, interest rate changes in one financial centre may have a considerable impact on rates in other centres. In particular, the importance of the US dollar (and of the American economy) is likely to create a situation in which worldwide interest rates are led by developments in the US economy. This leads to investments being relatively stable in economies worldwide and as such investments are contained within their countries.
After the September 11th 2001 World Trade Centre bombing, consumer confidence declined and as such, people held on to their dollars. To create consumer confidence and encourage spending, the US government reduced interest rates. The collapse of companies such as Enron and Worldcom led to the world-wide revision of accounting standards and harsher penalties being imposed on accountants who do not follow rules and regulations.

The causes of increases in nominal interest rates are: -

- Reductions in the money supply.
- Increased actual or expected rates of inflation.
- Increases in the level of economic activity.
- Increases in interest rates in overseas financial markets. (Apps, et. al., 1994).

2.1.1 The Relationship between Domestic and International Interest rates

The three broad influences linking interest rates in one country with those elsewhere in the world are: -

1. The economic environment

A robust economy experiencing a high growth rate generates confidence. The high level of confidence is reflected in a low rate of expected defaults on loans. This leads to low interest rates as compared to other economies. Macroeconomic factors also have an effect on the interest rates. These include savings of Gross Domestic Product (GDP) which stands at 6% in Kenya, non-performing loans in banks that currently stand at 30% of the GDP and investments, which stand at 14% of GDP among others.
2. Expectations of Movements in Exchange Rates

Expectations that the value of the currency is going to depreciate relative to other currencies will lead investors to require a premium to compensate for any loss in international purchasing power resulting from such depreciation. This premium will naturally make interest rates higher in that country than elsewhere.

3. Actual or Expected Inflation Rates Relative to other Countries.

A country with a high inflation rate relative to interest rates in other countries will carry a higher interest rate since investors will require a premium in terms of interest rates to compensate for the loss in purchasing power that the high rate of inflation involves. High interest rates can be used to sustain the value of the shilling when depreciation looks likely (Apps et al., 1994).

Central Bank of Kenya was set to lose its vast powers in the management of the country's monetary policies as the controversial Central Bank of Kenya Amendment Act 2000 (Donde Act) was adopted by parliament. The Act states that the Monetary policy committee shall advise the Central Bank on the formulation and implementation of monetary policy, including the levels of the treasury bill rates. The committee shall submit a report of its operations to parliament once every six months (CBK Amendment Act, 2000).

The Donde Act wants to see interest controls pegged to treasury bills. The Act fixes lending rates at no more than four percent above the prevailing treasury bill rate and interest rates on deposits at no less than three percent below the treasury bill rate. The
Act forbids banks from charging accumulated interest greater than the amount of the original loan (CBK Amendment Act, 2000).

However, in January 2002, the Act was declared unconstitutional in court although the Kenya Bankers Association, which had gone to court to challenge it wanted the whole Act thrown out. The Central Bank governor on January 29, 2002 said the CBK would not implement the Act. The Act is not popular with the government and banks, as such controls are considered undesirable because they are contrary to the policy of economic liberalisation adopted by the government in 1993. (Daily Nation, 19 April 2002)

A bill aimed at nullifying the Donde Act’s prime purpose – controlling interest rates was published on 18 April 2002. The new bill seeks to remove two vital clauses – the one which makes it mandatory for banks to charge interest rates pegged to treasury bills and another which forbids banks to charge accumulated interest greater than the amount of the original loan. The Government of Kenya wants a money market free from state control. In the new Central Bank of Kenya Amendment Bill it will not be mandatory for the committee to submit to parliament half-year reports as required by the present Act (Daily Nation, 19 April, 2002)

The parliamentary committee on finance which undertook a study tour on the United States, United Kingdom and South Africa to compare systems used by those countries concluded that the role of the monetary policy committee in the money market is crucial and consistent with the practice worldwide, especially countries that have liberalised their
economies. The parliamentary committee on finance concluded that the changes are essential preconditions for achieving the government's central economic objectives of high and stable level of economic growth and employment.

Most banks in Kenya are facing a major challenge because of unpaid loans. From an economic point of view, it was unrealistic for banks to expect that loans borrowed in an era of prohibitively high interest rates would ever become repayable. A good example is the Barclays' Bank/ Alliance Hotels saga where a Ksh.300million loan grew into a KShs. 1.2 billion debacle and the Bank had to attach the property of the shareholders after a long protracted battle in court.

2.1.2 Interest Rate hedging Techniques:

1. Interest rate and Currency Swaps

Corporate financial managers use swaps to arrange complex innovative financing that reduce borrowing costs and increase control over interest rate risk and foreign currency exposure. In fact, few Eurobonds are issued without at least one swap behind them to give the borrower cheaper or in some way more desirable funds. Through the swap, a perceived risk can be traded in one market or currency for a liability in another. The swap has led to a refinement of risk management technique, which in turn has facilitated corporate involvement in international capital markets.

There are two main types of swaps, coupon swaps and basis swaps. In a coupon swap, one party pays a fixed rate calculated at the time of trade as a spread to a particular
treasury bond, and the other side pays a floating rate that resets periodically throughout the life of the deal against a designated index. In a basis swap, two parties exchange floating interest payments based on different reference rates. Basically, using this relatively straightforward mechanism, interest rate swaps transform debt issues, assets, liabilities or any cash flow from type to type and with some variation in the transaction structure – from currency to currency (Rivera-Batiz et. al, 1994).

It should be noted that two conditions must be satisfied for a swap to be attractive to the parties concerned:

a) The parties should face different comparative costs of capital.

b) The preference of each party should be to borrow in the market in which its comparative cost is higher.

2. **Forward Rate Agreements**

Here a contract is written today at a stated rate for a promised future rate of interest at a specified time and place. It is only at the time of interest rate payment that one pays the agreed rate and the profit (or less) on the payment date is the difference between the market rate and the agreed forward rate.

3. **Futures Contract**

A futures contract is similar to a forward rate agreement except for a fundamental difference that changes in the futures contract price are settled daily.
4. **Others.**

The other methods of hedging against interest rates are options contract, collars, swaptions among various other financial innovations (Rivera-Batiz et. al, 1994).

### 2.2 The Relationship between Interest Rates and Exchange Rates

Under a freely floating system spot exchange rates are theoretically determined by the interplay of differing national rates of inflation, interest rate and the forward premium or discount. There are theories that underlie the determination of foreign exchange. These are:

1. The Fisher Effect.
2. The International Fisher Effect.
3. The Theory of Interest Rate Parity
4. The Theory of Purchasing Power Parity

#### 2.2.1 Exchange Rates and International Parity Conditions/Relations.

Buyers and sellers of foreign exchange are interested in using the foreign currency to purchase assets (that yield returns) and commodities (that yield utility). Thus commodity prices and asset returns must affect supply and demand for currency; and, by extension, currency exchange rates. International parity conditions/relations give a link between exchange rates, interest rates and commodity prices:

#### 2.2.2 **The Fisher Effect**

The theory states that nominal interest rates in each country are equal to the required real rate of return to the investor plus the expected rate of inflation. Therefore in a world
where investors can buy any interest bearing securities, real rates of return should tend toward equality everywhere but nominal rates of interest will vary by the difference in expected rates of inflation.

The graph below shows a more general case of the Fisher Effect. The vertical axis shows the percent higher or lower forecast rate of inflation in the foreign country relative to the home country, and the horizontal axis shows the percent difference in interest rates for the same time period.
Where \( x_0 \) is the percent difference in interest rates, foreign relative to home currency and \( y_0 \) is percent forecast difference in the rate of inflation foreign relative to home currency.

The point I shows the position where the 4% higher forecast of inflation is consistent with a 4% higher rate of interest. It should be noted that the Fisher effect exists only for short maturity government securities such as treasury bills and notes (Eiteman et al., 1979).

The Fisher effect is based on the notion that:

\[
i = f(r, \pi^e)
\]

Where \( i \) = nominal interest rate; \( r \) = real exchange rate (which is the investor’s required rate of return on investment since this represents the purchasing power of the return on investment); \( \pi^e \) = the expected rate of inflation.

The Fisher effect can be expressed as:

\[
1 + r = \frac{1 + i}{1 + \pi^e}
\]  
(1.0)

\[
\Rightarrow (1 + i) = (1 + r)(1 + \pi^e)
\]

Eq.(1.0) shows that investors will always demand a nominal rate higher than the real rate to compensate them for the expected inflation that will erode the purchasing power of returns on investment.

**2.2.3 The International Fisher Effect.**

The International Fisher Effect holds that the spot exchange rate should change in an equal but opposite direction to the difference in interest rates between two countries.
Where more than one currency is involved, the Fisher effect generalizes to the International Fisher Relation, which gives the ratio of nominal investment values in terms of relative real interest rates and expected inflation rates:

\[
\frac{1 + i_x}{1 + i_y} = \frac{(1 + r_x)(1 + \pi^x_x)}{(1 + r_y)(1 + \pi^x_y)}
\]  

(2.0)

Where the subscripts \(x\) and \(y\) refer to countries (π currencies) \(X\) and \(Y\) respectively.

If expected real returns on identical assets were higher in one country than another, arbitrage would cause capital to flow from the country with a lower real return to the country with higher real return. Assuming perfect competitive markets (with free mobility of capital and negligible transactions costs etc), this arbitrage would continue until real returns become equal (Grabbe, 1996) Consequently, equation (2.0) becomes:

\[
\frac{1 + i_x}{1 + i_y} = \frac{1 + \pi^x_x}{1 + \pi^x_y}
\]  

(3.0)

The graph overleaf shows a general case of the International Fisher Effect. The vertical axis shows the forecast rate of change in the spot exchange rate and the horizontal axis shows the difference in interest rates. The parity line therefore shows the International Fisher Effect. Point F shows the position where the 4% forecast depreciation is equal to the 4% higher rate of interest (Eiteman et. al, 1979).
International Fisher Effect

Where $x_1$ is percent difference in rate of inflation, foreign relative to home country and $y_1$ is percent forecast rate of change of spot exchange rate, foreign relative to home country.

It should be noted that as a result of the International Fisher effect, forecasters and forecasting models almost always include a variable which captures relative interest rate when forecasting changes in a country's spot exchange rate.

2.2.3.1 Derivation of the International Fisher Effect

The precise relationship between the interest rate differential of two countries and the expected exchange rate change according to International Fisher Effect can be derived as follows. First, the actual return to investors who invest in money market securities (such
as short-term bank deposits) in their home country is simply the interest rate offered on those securities. However, the actual return to investors who invest in a foreign money market security depends on not only the foreign interest rate \((i_f)\) but also the percent change in the value of the foreign currency \((e_f)\) denoting the security. The formula for the actual or so-called “effective” (exchange rate adjusted) return on a foreign bank deposit (or any money market security) is

\[
r = (1 + i_f) (1 + e_f) - 1
\]

(4.0)

According to the International Fisher Effect, the effective return on a foreign investment should on average be equal to the effective return on a domestic investment. Therefore, the International Fisher Effect suggests that the expected return on a foreign money market investment is equal to the interest rate on a local money market investment:

\[
E(r) = i_h
\]

(5.0)

Where \(r\) is the effective return on the foreign deposit and \(i_h\) is the interest rate on the home deposit. We can determine the degree by which the foreign currency must change in order to make investments in both countries generate similar returns. Take the previous formula for what determines \(r\), and set it equal to \(i_h\) as follows:

\[
r = i_h
\]

\[
(1 + i_f) (1 + e_f) - 1 = i_h
\]

Now solve for \(e_f\)

\[
(1 + i_f) (1 + e_f) = (1 + i_h)
\]

\[
(1 + e_f) = \frac{(1 + i_h)}{(1 + i_f)}
\]

\[
e_f = \frac{(1 + i_h)}{(1 + i_f)} - 1
\]

(6.0)
As verified here, the International Fisher Effect theory contends that when \( i_h > i_f, e_f \) will be positive, because the relatively low foreign interest rate reflects relatively low inflationary expectations in the foreign country. That is, the foreign currency will appreciate when the foreign interest rate is lower than the home interest rate. This appreciation will improve the foreign return to investors from the home country, making returns on the foreign securities similar to returns on home securities. Conversely, when \( i_f > i_h, e_f \) will be negative. That is, the foreign currency will depreciate when the foreign interest rate exceeds the home interest rate. The depreciation will reduce the return on foreign securities from the perspective of investors in the home country, making returns on foreign securities no higher than returns on home securities (Eiteman et.al, 1979)

2.2.4 Interest Rate Parity Theory.

The theory of Interest rate parity states that except for transaction cost a difference in national interest rates of securities of similar risk and maturity should be equal but opposite in sign to the forward exchange rate discount or premium for the foreign currency. Interest rate parity theory is based on the notion of covered interest arbitrage. Covered interest arbitrage involves borrowing in one currency, selling the borrowed currency on the spot market, investing the proceeds of the sale and simultaneously buying back the borrowed currency on the forward market (Eiteman et.al., 1979)

Consider borrowing sh.1 at interest rate \( i_h \), selling the sh.1 in order to buy \( SS_{yx} \) (at the spot exchange rate of \( \$S_{yx} \) for sh.1), and investing the proceeds in a \$-denominated asset.
If $i_x$ and $i_y$ are the interest rates in Kenya and U.S respectively, then with the forward transaction, the shilling value of the investment will be:

$$\frac{S_{xy}}{F_{yx}}(1 + i_y)$$  \hspace{1cm} (7.0)

Where $F_{yx} = \text{forward exchange rate of } S_F \text{ for sh.1}$

The possibility of covered interest arbitrage disappears when the shilling cost of borrowing (in the illustration above) is just equal to the shilling gain from lending/investing in dollars. And if there is no possibility of covered interest arbitrage, expression (7.0) must be equal to $(1 + ix)$ that must be paid on the shilling loan. This equality implies the interest rate parity relation:

$$\frac{1 + i_y}{1 + i_x} = \frac{F_{yx}}{S_{yx}}$$  \hspace{1cm} (8.0)

But $\frac{F_{yx}}{S_{yx}} = 1 + f$,

Where $f$ is the forward premium (discount) i.e the proportion by which a country’s forward exchange rate exceeds (falls below) its spot rate. Thus eq. (8.0) becomes,

$$\frac{1 + i_x}{1 + i_y} = 1 + f$$

$\rightarrow$ $1 + i_x = (1 + f)(1 + i_y)$

$= 1 + i_y + f + f.i_y$

$\rightarrow$ $i_x = i_y + f$  \hspace{1cm} (9.0)

(Since $f.i_y$ is typically negligible and can be ignored altogether)

$\rightarrow$ $i_x - i_y = f$
The interest rate parity relation states that in perfect money markets, the forward discount or premium on the foreign exchange market is equal to the relative difference between the two interest rates (Madura, 2000).

**Interest Rate Parity**

Where $x_2$ is the percent forward premium or discount on foreign currency and $y_2$ is percent difference in interest rates, foreign relative to home country.

The graph shows the general case of Interest rate parity. The vertical axis shows the difference in interest rates in favour of the foreign currency and the horizontal axis the
forward premium or the discount on the currency. The Interest Rate Parity line shows the equilibrium state but transaction costs cause the line to be a band rather than a thin line. Transaction costs arise from the foreign exchange brokerage costs on spot and forward contracts as well as from the investment brokerage cost on buying and selling securities. Point X shows the approximate position where 4% higher rate of interest is offset by a 4% discount on the forward rate.

The rationale for interest rate parity stems from use of a technique of covered Interest arbitrage. The main impact of the theory of Interest Rate Parity on forecasting is its explanation of movements in the forward rate which by itself may be the single predictor of the future spot exchange rate. Interest rate parity also explains the simultaneous reaction of short-term interest rates to changes in the forward rate.

2.2.5 Purchasing Power Parity Theory (PPPT).

Purchasing power parity (PPP) is simple empirical proposition that, once converted to a common currency, national price levels should be equal. The basic idea is that if goods market arbitrage enforces broad parity in prices across a sufficient range of individual goods (the law of one price), then there should also be a high correlation in aggregate price levels. The modern origins of purchasing power parity trace to a series of influential articles, the Swedish economist Gustav Cassel (1921,1922) where he promoted the use of PPP as a means for setting relative gold parities. Basically, he proposed calculating cumulative inflation rates from the beginning of 1914 and using these inflation differentials to calculate the exchange rate changes needed to maintain PPP (Rogoff, 1996).
Though purchasing power parity had been discussed previously by classical economists such as John Stuart Mill, Viscount Goschen, Alfred Marshall and Ludwig von Mises, Cassel was really the first to treat PPP as a practical empirical theory. Cassel’s writings were quite influential and PPP calculations played an important role in the debate over Britain’s much-criticized decision to try to restore its pre-war mint parity with the dollar in 1925. Today various versions of purchasing power parity are used in a wide range of applications: from choosing the right initial exchange rate for a newly independent country, to forecasting medium- and long-term (forward) real exchange rates, to trying to adjust for price differentials in international comparisons of income (Rogoff, 1996)

2.2.5.1 The General Theory of Employment, Interest and Money

The absolute purchasing power parity relationship states that there should be equality between domestic prices, \( P \), and foreign prices converted into domestic currency, \( eP^* \) or

\[
P = eP^*
\]

This can be transformed into an expression for exchange rate: -

\[
e = \frac{P}{P^*}
\]

(10.0)

The implication is the higher the domestic price level relative to foreign prices, the higher the exchange rate must be in order to maintain Purchasing Power Parity. In the Keynesian context, domestic output is determined by the aggregate demand for domestic goods. Demand is determined by domestic absorption and trade balance. The trade balance represents the difference between domestic exports and the value of the imports, where domestic exports correspond to the foreign demand for domestic goods and as with demand relationship, depend on relative prices and foreign income. As the relative price
of foreign goods increase, foreign residents will switch their spending out of foreign and into domestic goods, with a consequent positive effect on domestic exports. Similarly, as foreign income increases, some of that income will be spent on domestic goods and domestic exports will expand.

An increase in the relative price of foreign goods results in a switch of domestic demand away from the relatively more expensive foreign goods and towards domestic goods. This switch reduced domestic imports. A rise in domestic income on the other hand, is associated with higher imports because some of the additional income will be spent on foreign goods (Rivera – Batiz et al, 1994).

Purchasing Power Parity Theory, a theory linking inflation and exchange rate movements, is based on the notion of the law of one price. The law of one price states that identical commodities or goods must have the same price, quoted in one currency, in all markets; otherwise arbitrageurs would continuously exploit the price differentials until the prices in all markets are equalized, thereby eliminating the potential for profit. PPPT is defined as:

\[ E(S'_{yx}) = \frac{1 + \pi^x_y \cdot S_{yx}}{1 + \pi^x_x} \]  \hspace{1cm} (11.0)

Where \( E(S'_{yx}) \) is the expected spot rate of currency Y for currency X in one period’s time.

Thus according to the Purchasing Power Parity Theory, the expected spot rate in one period’s time is equal to the current spot rate times a factor reflecting the relative
expected rates of inflation in the two countries. If currency X has a lower expected rate of inflation compared to that of currency Y, then currency Y is expected to depreciate and vice versa.

Since $S_{yx}$ is already known (hence given/constant), eq. (11.0) requires equality between expected changes in the relative prices of goods in currency Y and currency X (as determined by their relative expected inflation rates), and expected changes in the spot exchange rates. Purchasing Power Parity Theory also implies that there will be equality in the amount of real goods that equivalent amounts of different currencies in the foreign exchange market will buy (Grabbe, 1996)

The graph overleaf shows a general case of purchasing power parity. The vertical axis shows the percent appreciation of the foreign currency relative to the home currency and the horizontal axis shows the percent higher or lower rate of inflation in the foreign country relative to the home country. The diagonal parity line shows the equilibrium position between a change in the exchange rate and relative inflation rate. For example, at point P the equilibrium is where inflation is 4% higher, when the forecast rate of change of spot exchange rate for foreign currency is –4 (Eiteman et. al, 1979).
Purchasing Power Parity

Where $x_3$ is percent difference in rate of inflation, foreign relative to home country and $y_3$ is percent forecast rate of change of spot exchange rate for foreign currency.

2.2.6 Forward Rate Parity Theory.

Where $x_3$ is the percent difference in rate of inflation, foreign relative to home currency and $y_3$ is percent forecast rate of change of spot exchange rate for foreign currency.

This theory is based on the notion of unbiasedness. Unbiasedness is said to obtain when the forward market is efficient and investors are risk-neutral, so that the forward rate is equal to the expected value of the spot rate at the time the contract matures. Thus,

$$F_{yx} = E(S'_{yx})$$  \hspace{1cm} (12.0)
Equality (12.0) can also be stated in terms of a forward discount or premium relative to the current spot rate:

\[ \frac{F_{yx} - S_{yx}}{S_{yx}} = \frac{E(S'_{yx}) - S_{yx}}{S_{yx}} \]  

(13.0)

Where L.H.S of eq.(13.0) is the forward discount or premium (given that \( S_{yx} \) is current spot rate).

If equality (12.0) failed to hold due to, say, \( F_{yx} \) systematically exceeding \( E(S'_{yx}) \), potential traders in the forward market would expect to be better off waiting until the end of the period to make their exchanges.

Equalities (3.0) – (12.0) together imply that in equilibrium in the foreign exchange markets for spot and future contracts,

\[ \frac{1 + i_x}{1 + i_y} = \frac{1 + \pi^e_x}{1 + \pi^e_y} = \frac{E(S'_{yx})}{S_{yx}} = \frac{F_{yx}}{S_{yx}} \]

which together imply that zero expected speculative gains from further arbitrage are possible (Madura, 2000).

2.3 The 91-day Treasury bill rate and Major determinants

Interest rate is described as the price charged to a borrower for the loans advanced. (New Universal Library of Encyclopedias, 1985). Interest rates can also be defined as the price a borrower must pay to secure scarce loanable funds from a lender for an agreed upon period (Rose, 1994). It is thus the total required fee that a borrower must pay a lender to obtain the use of credit for a stipulated period divided by the amount of credit actually made available to the borrower. Treasury bills are marketable securities the government sells in order to pay off maturing debt and raise the cash needed to run the central
government. When one buys these securities, they are lending their money to the Kenyan government, at a price. By convention the interest rate is usually expressed in percent per annum. More importantly, however, the 91-day Treasury bill interest level is accepted to be the key determinant of other interest rates.

A decline in Treasury bill rates leads to the easing of commercial bank interest rates that in turn fuels the fall of savings and deposit rates. Likewise, ascending Treasury bill rates will lead to higher lending rates and therefore higher savings and deposit rates. This emanates from the fact that the Treasury bill is arguably a risk-free investment since the government backs it. Governments are able to repay Treasury bill obligations through collection of various taxes or simply by printing money. For these reasons, the Treasury bill is accepted to be the key determinant of other interest rates (Treasury Bulletin 3, 1999).

Treasury bills in Kenya were first issued in 1965. An amount of Kshs 20 million was issued to help meet temporary cash shortage. In March 1969, Treasury bills were made public by way of Gazette notice. In 1997, CBK reversed its policy and the minimum investment in Treasury bills went up to Kshs 1 million from Kshs 100,000 in both primary and open market operations. Small investors were given the option of investing in floating rate treasury bonds, which have a minimum maturity of one year.

Currently, the method for pricing is the tender method, which enables the buyers to determine what interest they will charge, but at the same time gives the government a
number of rates to choose from. This method was adopted after economic liberalisation in 1991. The amount issued in each auction varies, depending on the financing requirement of the government as well as the stance of monetary policy. Allocation of bills floated under the new auction system is done competitively and is based on discount rate starting with the lowest tender rate. In the year 2002, the level of treasury bills per issue has ranged from Kshs. 4.5 billion on May 7th to Kshs. 6.5 billion on 21st June.

In any market, there are two key variables - quantity and price. The immediate determinants of these are accepted to be forces of supply and demand. Whereas interest rates sometimes reflect changes in the market mood and expectations, it is these fundamental factors of demand and supply that dominate the direction of interest rates. The general level of interest rates is determined by the willingness of treasury bills borrowers to pay, and the return demanded by lenders of funds.

The level of government borrowing is one such factor that determines the rate of interest. Inadequate revenue collection caused by poor economic environment and the impact thereof on the productive sectors' performance can lead to higher interest rates. Improved revenue collection and or decreased government expenditure on the other hand can lead to decreased borrowings and thus lower interest rates. In the CBK monthly review of June 1997, Central Bank points out that increased government domestic borrowing requirement for purposes of financing the deficit as well as external debt servicing continued to influence the Treasury bill market rates on the upward trend. Due to the withdrawal of donor funding, the government borrows domestically to cover budget
deficit and to meet their foreign debt obligation, by selling treasury bills, hence interest rates go up. High interest rates swallow up domestic savings. When the government borrows from such as the National Social Security Fund to service the treasury bills auctioned at phenomenal interest rates, the savings are swallowed up in a bizarre cycle of public indebtedness. Instead of being used for domestic capital formation, domestic savings are used to service debt (Daily Nation, 22nd October 2000).

Inflation is yet another strong determinant of interest rates. A high inflation rate will increase the price of goods and services and consequently the demand for credit that will ultimately result in high interest rates. Neo-classical loanable funds theory of interest rates and that of Keynes liquidity preference theory hold that the equilibrium interest rate in a market economy is determined by forces of demand and supply for loanable funds (ceteris peribus). Interest rates tend to increase with the rise in inflation. In Kenya, interest rates have exhibited an uncommon relationship with inflation rates. It's not suprising to experience high interest rates despite low inflation. In 1997, determination to contain inflationary pressures necessitated new sales of Treasury bills by the Central Bank to sterilise excess liquidity injected into the economy (CBK monthly economic review July, 1997).

Overseas financial markets also impact the interest rate levels here in Kenya. It is argued that countries with higher interest rates will typically attract hot money and likewise countries with low interest rates will encourage short-term investors to pull out of such markets. Therefore countries interested in protecting the value of their currencies will
ensure interest rates are high enough while those that want to have their currencies weaker will maintain lower interest rates. For example, Japan maintains a near zero rate interest policy in order to have its currency's value as low as possible to support export growth (Treasury Bulletin 3, 1999).

The cash requirement ratio will affect the interest rate level too. When the Central Bank and the money market as a whole put a downward movement in the cash requirement ratio such as the one done in October 1997 where the ratio was reduced from 18% to 15%, interest rates will generally fall. This is partly because the increased liquidity arising from the decrease will find accommodation in Treasury bills. Banks will typically have to maintain lower balances at the Central Bank and some of the surplus is bound to go into the Treasury bill market and other sectors. To service foreign debt the government borrows domestic savings from pension firms such as National Social Security Fund. Thus instead of being used for domestic capital formation, domestic savings are used to service debt. With increased funds (supply) the treasury bill is expected to drop (Daily Nation 22nd October, 2000).

The foreign exchange market is also said to influence the interest rate levels in the country. For example, when the local currency unit devalues significantly, imports become very expensive and unfavourable on the economy because of the likelihood of causing inflation. As a corrective measure, Central Bank will resort to tighter monetary policy by absorbing more funds in the Treasury bills in order to ease the pressure on the
shilling. Holders of foreign currency will also be found to convert their foreign currency holdings and seek the improved Treasury bill rates (CBK monthly review Sept, 1999).

Generally, interest rates in developing countries are found to be very volatile over time. Developing nations are likely to have their financial systems to be rudimentary and characterised by a degree of political influence and control by the central governments (over interest rate, foreign exchange etc) not usually found in more developed nations (Todaro, 1992). In the Central Bank Annual Report (1999), Central Bank clearly states that as a result of the reduction in the mandatory cash ratio (set by the Central Bank) and the resulting liquidity injection, interest rates fell from 25.5% in June 1998 to 9.8% in June 1999. The report says that further drops in the interest rates were facilitated by the determination to reduce the government domestic debt and at the same time shift the balance of the domestic public debt to longer maturities in Treasury bonds. (Bonds are medium term borrowing instruments that mature between 1 and 3 years in the Kenyan context).

2.4 Exchange Rates
Exchange rates can be defined as prices of one country's money in terms of other countries' money. For example, £1 = KShs. 114. The major participants in the foreign exchange market are the large commercial banks, foreign exchange brokers in the interbank market, commercial customers, primarily multi-national corporations, and Central Banks, which intervene in the market from time to time to smooth exchange rate fluctuations or to maintain target exchange rates (Shapiro, 1996). The banks partly
operate in the market on behalf of their customers and partly operate on their own account.

Foreign exchange was necessitated by the need for foreign trade due to the comparative advantage enjoyed from this trade. Significant studies were done by David Ricardo (1800) where he said and I quote "Foreign trade, then whether fettered, encouraged or free will always continue, whatever may be the comparative difficulty of production in different countries. But it can only be regulated by altering the natural price, not the natural value at which commodities can be produced in those countries and that is affected by altering the distribution of products. This explanation confirms the option which was given elsewhere, that there is not a tax, a bounty or a prohibition on the importation or exportation of commodities which does not occasion a different distribution of products and which does not therefore everywhere alter both the natural and the market price of commodities.

It is evident then that the trade with a country may be so regulated that it shall at the same time be less beneficial to the country than a perfectly free trade. As it is disadvantageous to a single consumer to be restricted on his dealing to one particular shop, so it is disadvantages for a nation of consumers to be obliged to purchase of one particular country. If the shop or the country afforded the goods required the cheapest, they would be secure of selling them without any such exclusive privilege and if they did not sell cheaper. The general interest would require that they should not be encouraged to continue a trade which they could not carry on at an equal advantage with others. The
shop or the selling country might lose by the change of employments, but the general
benefit is never so fully secured as by the most productive distribution of the general
capital: that is to say, by a universally free trade” (Richardo, 1800).

2.4.1 Exchange rate determinants

In some economies, the exchange rate is fixed as a matter of administrative decision. In
the case of major world currencies such as the dollar, the pound, the mark and the yen,
the rates of exchange are market determined, that is, they are the prices at which the
various currencies exchange against one another and against other currencies which are
freely traded on the exchange markets (Apps, et.al., 1994).

The key economic factors that influence exchange rate movements through their effects
on demand and supply conditions are relative inflation rates, interest rates and income
levels as well as government controls. As these factors cause a change in international
trade or financial flows, they affect the demand for a currency or the supply of currency
for sale and therefore affect the equilibrium exchange rate. The factors that determine
exchange rates are:

1. Relative Prices

This theory says that the equilibrium exchange rate between currencies will be the rate at
which the domestic purchasing power of these currencies is equalised. For example, if $X$
units of currency in country A buy a given volume of goods and services and $Y$ units of
currency in country B buy the same volume of goods and services, the exchange rate will
be $X=Y$. Changes in relative inflation can affect international trade activities, which
influences the demand and supply of currencies, and therefore influences exchange rates. Assuming that both Kenya and South Africa firms sell goods that can serve as substitutes for each other. The sudden jump in Kenya's inflation should cause an increase in the Kenya demand for S. Africa's goods therefore also cause an increase in the Kenya demand for S. Africa rands. In addition, the jump in Kenya inflation should reduce the S. Africa desire for Kenya goods and therefore reduce the supply of rands for sale. The increased Kenya demand for rands and the reduced supply of rands for sale places upward pressure on the value of the rand. In the longer term, it is probably the case that the relative rates of inflation in different countries do affect exchange rates but the influence of inflation is only one of a number of different factors which have to be taken into consideration.

2. Interest Rates

Differences between the level of interest rates in two countries will influence the flow of funds from one country to another for investment purposes. High interest rates attract capital funds from overseas and also add to investor confidence, since they suggest that the government has strong policies to control domestic inflation. Capital inflows from abroad create an increased demand for domestic currency, thus pushing its exchange rate higher, all other things being equal. Real interest rate adjusts the nominal interest rate for inflation. The real interest rate is commonly compared among countries to assess exchange rate movements because it combines nominal interest rates and inflation, both of which influence exchange rates (Madura, 2000).
3. The position of the balance of payments

The balance of payments accounts reflect the actual flow of currencies related to international trade and capital movement, and the longer-term trends in these accounts influence exchange rate patterns. The current account shows the ability of a country to finance current overseas expenditure with current overseas earnings. A persistent current account surplus will tend to put upward pressure on the domestic currency's exchange rate. A deficit in balance of payments means that we are paying out more money abroad than we are taking in. This produces a demand for foreign exchange greater than the supply (Rose, 1994).

4. Government Controls

Governments can and do influence exchange rates via things such as interest rates. The governments of foreign countries can influence the equilibrium exchange rate in many ways, including

i) Imposition of foreign exchange barriers – there are limits to the amount of money that can be exported or imported into a country.

ii) The imposition of foreign trade barriers – is done to encourage the local industry and manufacturers.

iii) Intervening (buying and selling currencies by Central Banks) in the foreign exchange market and

iv) Affecting micro variables such as inflation, interest rates and income levels (Madura, 2000).
If Kenyan interest rates rose relative to S. Africa interest rates the expected reaction would be an increase in S.Africa’s supply of rands for sale to obtain more Kenyan shillings (in order to capitalise on high Kenyan money market yields). Yet if the S.Africa government places heavy tax on interest income earned by its people from foreign investments, this could discourage the exchange of rands for shillings.

Exchange rates may be influenced by the intervention of Central banks in the foreign exchange market. They do this by either buying or selling other currencies. Central banks can only influence exchange rates in the short term. If the underlying forces in the market are strong, then the central banks cannot resist them forever.

Rates of exchange affected by the general policies pursued by governments are likely to affect the currency. A tight money supply policy may be perceived as heading to a reduction in inflationary preserves and this may lead to a strengthening of the currency.

Political and social stability influence exchange rates. Firm and peaceful governments strengthen the market confidence whereas "strikes, riots and civil commotions" will reduce the market's confidence.

5. Expectations

Like other financial markets, foreign exchange markets react to any news that may have a future effect. In February 1999, when Honorable Nyachae resigned as Minister for Finance, the price of the shilling declined for sometime. Foreign exchange traders and investors simply became less certain of the path Kenya monetary policy would take in the

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days ahead. Nyachae was known to have pressured powerful people in the government to pay their bank loans. He also advocated for tighter government expenditure. The incoming finance minister was an unknown personality. The natural response to risk was to hold less of the asset whose risk had risen, investors tried to reduce their holdings of shillings and shilling-denominated bonds, driving down the prices in the process. Many institutional investors take currency positions based on anticipated interest rates movements in various countries. Foreign exchange rates can be very volatile because financial flow transactions are very responsive to news. Since signals of future economic conditions that affect exchange rates can change quickly, the speculative positions in currencies may adjust quickly, causing unclear patterns in exchange rates. A shift in the trust that people have for a currency can change its value now by changing its expected value in the future. The level of interest rates is also affected by trust in the future value of money. All else being equal, the greater the trust in the promise that money will maintain its purchasing power, the lower interest rates will be (Shapiro, 1996). It is not unusual for the dollar to strengthen substantially on a given day, only to weaken substantially on the next day (Madura, 2000).

6 Foreign Direct Investment

This refers to individuals, multinationals and other organisations that bring in money earned in another country to invest in a certain economy. If the amount of money involved is much, this type of investment can greatly influence the exchange rate as well as the interest rate of a country because it will affect the demand and supply of money, which will affect the cost of borrowing money as well as the exchange rate.
Interaction of factors

Trade-related factors and financial factors sometimes interact e.g. an increase in income levels sometimes causes expectations of higher interest rates and this can attract more financial inflows over a particular period. Some factors may place upward pressure on a currency's value while other factors place downward pressure on the currency's value. For example, in the early 1980's, the combination of high U.S.A interest rates, a somewhat depressed U.S economy and low inflation caused the dollar to strengthen against most currencies. In 1989, the dollar strengthened as relatively high U.S. interest rate attracted capital inflows from foreign countries. In addition, the U.S. balance of trade deficit had declined (Madura, 2000). The two factors that are most clearly monitored by foreign exchange market participants are relative inflation and interest rates.

2.5 Foreign Exchange Risk Management.

1 The Use of forward currency markets

A firm investigating or selling abroad in anticipation of future receipts of foreign currency in one period's time can insure (or hedge) against foreign exchange risks by selling the foreign currency, \( Y \), (e.g. U.S.$) forward for the home currency \( X \) (e.g. Ksh) at the known agreed forward rate \( F_{xy} = 1/F_{yx} \) that is known now, where \( F_{xy} \) is the number of units of currency \( X \) (Ksh.) per unit of currency \( Y \) (U.S.$) that are available from a forward contract for delivery in one period's time.

The present value \( (PV_t) \) of the cash received in currency \( X \) (Ksh) from hedging using the forward exchange rate is:
\[ PV_1 = F_{xy} V_y / (1 + i_x) \]  \hspace{1cm} (14.0)

Where \( V_y \) = cash generated by the project at the end of the period and \( i_x \) is the interest rate in currency \( X \).

2). **Neutralizing Foreign Exchange Exposure.**

The firm (Multi National Corporation, MNC) could make use of the financial markets internationally to neutralize its foreign exchange risk exposure. This exposure depends on the pattern of the flow of future receipts and payments under the project or overseas operation, together with the time profile of the firm’s net monetary assets less liabilities.

*Note:* Monetary assets include cash, debtors tax refund receivable etc; while monetary liabilities include creditors due, tax due, bonds due etc.

To neutralise its foreign exchange exposure, the firm can borrow against an excess of future receipts over future payments or its net positive monetary position if it fears a decline in the value of the foreign currency. The amount of borrowing, \( B_y \), in the foreign country that is required to neutralise the positive cash inflow of \( V_y \) from the project at the end of the period is given by:

\[ B_y (1 + i_y) = V_y \]  \hspace{1cm} (15.0)

So that the total repayment and interest on the foreign borrowing is just equal to the cash coming in from the project at the end of the period, where \( i_y \) is the interest rate on currency \( Y \).

Borrowing the amount \( B_y \) in the foreign currency generates cash at the start of the period of an amount equal to:

\[ PV_2 = B_y S_{xy} = V_y S_{xy} / (1 + i_y) \]  \hspace{1cm} (16.0)

Using eq.(15.0), where \( S_{xy} \) is the current spot rate of currency \( X \) for currency \( Y \).
If the interest rate parity theory holds, then
\[
\frac{1 + ix}{1 + iy} = \frac{S_{yx}}{F_{yx}} \tag{17.0}
\]
From eq. (17.0), we may show that \( PV_1 = PV_2 \) i.e. the present value of the cash generated is the same, whether the firm hedges using the forward currency market or neutralizes its future overseas cash flows by borrowing in the foreign currency.

3). The use of Derivatives.

The two risk management strategies mentioned above eliminate the risk of foreign exchange movements to the extent of ensuring a certain flow of currency X from the project, given a certain flow of currency Y from the project at the end of the period. However, this does not eliminate two remaining sources of risk:

i) The firm might have achieved a high cash flow in currency X through a better exchange rate from an appreciation in \( S_{xy} \) by waiting to see what the spot rate actually is at the end of the period, rather than opting for certainty; and

ii) The cash flow from the overseas project in currency Y may be uncertain, causing potential financial embarrassment to the firm if it sells its expected cash flow forward on the forward currency market or has to repay overseas borrowing out of this uncertain future cash flow.

The first source of risk (i) above involves the upside risk of a gain from the appreciation in \( S_{xy} \) which would be beneficial to the firm. However, the firm still wishes to limit its exposure to the downward risk of \( S_{xy} \) dropping in value. To still retain the benefit of the upside risk while limiting the downward risk, the firm can make use of currency options.
The firm could buy from its bank (or elsewhere) a put option in currency Y with an exercise date at the end of the period and with an exercise price of $P_{xy}$. If the actual spot rate, $S_{xy}$, drops below $P_{xy}$ at the end of the period, the firm can exercise the put option (i.e. sell its foreign exchange income of $V_y$ at the exercise price of $P_{xy}$ to avoid the fall in the spot rate). The converse is true.

4). Covered Interest Arbitrage.

Having considered the international parity relations above, it's necessary to appreciate that interest rates and currency values are also inter-related through two central valuation relations called "uncovered" and "covered interest parity". Let $i_t =$ home (Kenyan) interest rate at time $t$ and $i^*_t =$ foreign (say, U.S) interest rate at time $t$. Also let the spot exchange rate be Sh. St per U.S$ at time $t$ (i.e. the price of the foreign currency in terms of the home currency).

Consider an investor who is faced with an opportunity of investing sh 1 either locally or abroad (U/S). The return after 1 year of investing either in Kenya or U.S will be:

Kenya: $\text{Sh.1} (1 + i_t)$

U.S. : $\frac{\text{Sh.1}}{S_t} (1 + i^*_t)$

All the variables above are known to the investor except the exchange rate that will prevail at the end of the year. Let that exchange rate be $E_t S_{t+1}$ (i.e. the spot rate at period $t+1$ whose forecast or expected value we make in period $t$). Thus a dollar will buy sh. $E_t S_{t+1}$ at the end of the year. Therefore if the investor decides to invest abroad, his/her return of $\frac{\text{Sh.1}(1 + i^*_t)}{S_t}$
will, when converted back to the shilling, buy $1 + i^* \frac{E_t S_{t+1}}{S_t} $.

In equilibrium (i.e. when there is, on balance, no tendency for funds to move into or out of Kenya from the U.S. and vice versa), investing at home or abroad will have to yield exactly the same shilling return. Equilibrium requires that:

$$(1 + i) = (1 + i^*) \frac{E_t S_{t+1}}{S_t} \quad \text{(18.0)}$$

Note: the ratio $\frac{E_t S_{t+1}}{S_t}$ will be > 1 if the domestic currency i.e shilling will have depreciated (or foreign currency appreciated)

$$\frac{E_t S_{t+1}}{S_t} = 1 + E_t \Delta S_t \quad \text{(18.1)}$$

Where $E_t \Delta S_t$ = expected rate of depreciation/appreciation of domestic currency.

Substituting (18.1) into (18.0) yields,

$$(1 + i) = (1 + i^*) (1 + E_t \Delta S_t)$$

$$1 + i = 1 + i^* + E_t \Delta S_t + i^* E_t \Delta S_t$$

$$\Rightarrow (1 + i) = (1 + i^*) + E_t \Delta S_t \quad \text{(18.2)}$$

(Disregarding the typically negligible $i^*, E_t \Delta S_t$)

Eq. (18.2) defines the uncovered interest parity (UIP) condition that:

"The domestic interest rate must be higher (lower) that the foreign interest rate by an amount equal to the expected depreciation (appreciation) rate of the domestic currency"

Note: there is no straight answer to the cause -effect relationship e.g. whether increases in $E_t \Delta S_t$ cause $i$ to increase or $i^*$ to decrease; or whether interest rate differentials ($i^* - i$) cause expectations to change.

If instead of basing his/her decisions on expected rate of depreciation of domestic currency ($E_t S_{t+1}$), the investor ‘locks in’ the end-of-period exchange rate via the forward
market, the investor is insured against (hedged against) a lower dollar value than anticipated. The forward rate, \( F_{t+1} \), can be put in place of \( E_t S_{t+1} \) in the UIP equation (5.0). Hence,

\[
(1 + i_t) = \left(1 + i^*_t \right) \frac{F_{t+1}}{S_t}
\]

But \( \frac{F_{t+1}}{S_t} = 1 + f \),

Where \( f \) is the forward premium (discount) i.e. the proportion by which a currency’s forward exchange rate exceeds (falls below) its spot rate. Thus eq. (18.3) becomes:

\[
(1 + i_t) = \left(1 + i^*_t \right) (1 + f)
\]

\[
= 1 + i^*_t + f + i^*_t f
\]

\[
= 1 + i^*_t + f \text{ (disregarding } i^*_t f \text{ as before)}
\]

\[\rightarrow i_t = i^*_t + f \quad (18.4)\]

Eq. (18.4) defines the covered interest parity (CIP) condition that:

“The domestic interest rates must be higher (lower) than the foreign interest rate by an amount equal to the forward discount (premium) on the domestic currency”.

‘Covered’ interest parity gets its name from the fact that the forward contract provides a ‘cover’ to the foreign exchange risk in the series of transactions.

5). Currency Swaps

A currency swap is an exchange of debt obligations denominated in one currency for the service on an agreed upon principal amount of debt denominated in another currency. By swapping their future cash flow obligations, the counter parties are able to replace cash flows denominated in one currency with cash flows in a more desired currency. In this way, a corporation that has borrowed say, Japanese yen at a fixed interest rate can transform its yen debt into a fully hedged dollar liability.
There is therefore always an exchange of principal amounts at maturity at a predetermined exchange rate. Thus, the swap contract behaves like a long dated forward foreign exchange contract, where the forward rate is the current spot rate. It should however be noted that interest rate and currency swaps are almost the same (Shapiro, 1996).

6). Immunization

Interest rates are constantly changing due to changes in term structure in the level of interest rates. The investor faces interest rate risk between the time of investment and a future holding period. Interest rate risk comprises two risks: price risk and coupon reinvestment risk.

It is important to investors with a known holding period to eliminate these two risks and this elimination is referred to as immunization. In order to explain how immunization is done, we need to define duration. Duration is the weighted-average measure of a bond's life, where various time periods in which the bond generates cash flows are weighted according to the relative size of the present value of these flows. Specifically, duration (D) is equal to:

\[
D = \sum_{n=1}^{N} \frac{(n) (C_n)}{(1 + i)^n} \cdot \frac{1}{\sum_{n=1}^{N} \frac{(C_n)}{(1 + i)^n}}
\]

Where N is the life of the bond in years, C is the cash receipt at the end of year n equal to annual coupon except for the last year, when it is equal to the annual coupon plus the
maturity value and I is the yield to maturity. The numerator of the expression is the weighted present value of cash receipts: the denominator is the sum of all these present values, which is equal to the total present value or price of the bond. The n in parentheses in the numerator is the number of years from the present when the cash is received (1, 2, 3, and so on).

Therefore a bond can be immunized against interest rate risk under the assumption that the yield curve shifts, the shifts being parallel (all rates change by the same amount). A portfolio of bonds is immunized from the interest-rate risk if the duration of the portfolio is equal to the desired holding period (Fisher, D.E & Jordan, R.J, 1999).

2.6 Exchange Rates and Interest Rates in Kenya.

Most corporations in Kenya are foreign owned and they repatriate their profits in foreign exchange resulting in high demand for foreign exchange among the corporations and importers of goods and raw materials. Corporations are however encouraged to borrow locally for their financing but if interest rates are high they would be forced to borrow overseas (The Kenyan banker, 2000).

In developed economies, empirical studies have been carried out and the relationship between interest rates and all the other economic factors have been evaluated using Gross Domestic Product/ Gross National Product as proxies. This study focussed on the relationship between interest rates and exchange rate in Kenya in the context of the post
liberalization era and the period before the Central Bank amendment Act (2000) was implemented.

2.7 Efficient Market Hypothesis

The neoclassical Efficient Market Hypothesis (EMH) presumes that all relevant information about ‘economic fundamentals’ regarding future demand and supply currently exists and is readily available to all markets participants. This EMH claims that expectations of all rational agents are based on this available information. This information is presumably embodied in the historical market database and current market price signals. In the absence of government interference in the market place, these informed agents, acting on their own self-interest, will always perceive the future without making persistent errors. The actions of these rational agents will immediately establish the equilibrium exchange rate. Observed variations around this market equilibrium rate can be attributed to random shocks which will quickly be dampened down by the alert action of informed agents (Davidson, 1992).

One of the dominant finance themes in the academic literature since the 1960s has been the concept of an efficient capital market. Efficient capital market refers to the reflection of all available information in security prices, treasury bills, and foreign currency. It is therefore argued that treasury bills and foreign currency are always in equilibrium and that it is impossible for an investor to consistently beat the market.
There are 3 forms of market efficiency. The weak form of Efficient Market Hypothesis (EMH) states that all information contained in past price movements is fully reflected in current prices. The semi-strong form of EMH states that the current market prices reflect all publicly available information. If this is true, no abnormal returns can be earned by analysing exchange rates and interest rates on public information. Insiders can, however, make abnormal returns. The third form of EMH states that current market prices reflect all pertinent information whether publicly available or privately held. In this form, insiders would find it impossible to earn abnormal returns in the interest rates and foreign currency markets (Richard et. al, 1994).

The implication of an Efficient Capital Market is that any relevant new information will be reflected very quickly in security prices, as it becomes available. An investor will therefore not have any logical reason to expect to earn a higher than average return on security investment of a given level of risk. However, this does not mean that an investor can not earn a higher than average return but only that such an outcome should not be expected. Furthermore, some people have better forecasting ability than the rest. It is therefore possible to beat the EMH but only in rare circumstances (Richard et. al, 1994).

The importance of market efficiency to business firms and investors is crucial. For one, both will benefit on the whole because the market will perform its function in a less discriminatory and arbitrary manner than would otherwise be the case. Decisions made by management will be reflected very quickly in the interest rates and foreign exchange rates when the information becomes available to investors. Good decisions will typically
result in stable interest rates and exchange rates whereas poor ones will result in an increase in interest rates and foreign exchange rates.

But for the stock market professionals and investment advisors, the EMH is unpopular since their incomes depend on persuading investors that they can make money through profitable trading. The lack of consistent superior performance persistence among active managers is further evidence in support of the EMH. In reality, markets are neither completely inefficient nor perfectly efficient. While all markets are efficient to a certain extent, some are more efficient that others (Davidson, 1992).

Various studies touching on market efficiency in the NSE have been conducted locally. Kingori (1995) investigated the existence or otherwise of seasonalties of stock returns for the quoted companies on Nairobi Stock Exchange (NSE). Her aim was to establish whether stock returns at the NSE exhibit seasonal patterns. The study concludes that there was no seasonality evident in stock returns at the NSE.

Mwangi (1997) analysed the price movements for some selected stocks at the NSE. Her objective was to determine the factors that affect share price movements, in addition to developing a model that could be used to predict price movements. She concluded that it was not always possible to develop models that could accurately predict prices at the NSE because the parameters used in forecasting vary over time due to changes in the underlying earnings generating processes. The studies mentioned above helped to
determine that the Kenyan market is efficient and the data reflected the liberalized economy without government influence.

2.8 Chapter Summary

This chapter studied the process of determining exchange rates. In order to achieve certain economic or political objectives, governments often intervene on the currency markets to affect the exchange rate. Alternatively, the government can control the exchange rate directly by setting a price for its currency and then restricting access to the foreign exchange market. Exchange rates are also crucially affected by relative inflation rates, interest rates, and the position of balance of payment and expectations. The theories that underlie the determination of foreign exchange are the theory of Purchasing Power Parity, the Fisher Effect, the International Fisher Effect, the theory of Interest Rate Parity and the Forward Rate Parity Theory.

This chapter also focussed on analysing what influences interest rates. Interest rates rise when the demand for loanable funds increases. Rates fall when the demand decreases. Behind demand and supply are the borrowing requirements of businesses, households and governments, and the monetary policies of the Central Bank. Expectations also underlie the demand for and supply of loanable funds, especially expectations regarding inflation. In the absence of financial institutions whose explicit function is to limit severely the time rate of change in the spot exchange rate, expectations can readily become so elastic that any current unexpected changes in exchange rates, whether ephemeral or permanent, can induce destabilizing views about the future. In these circumstances, the existence of
an equilibrating price vector which includes foreign exchange rates cannot be easily demonstrated. Since the breakdown of the Bretton Woods Agreement, central banks have had to increase their active intervention in spot exchange markets to achieve some modicum of stability and calm the market's possible fears.
CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Research Design

This chapter deals with research methodology used to conduct the study. The design served to minimize the danger of collecting haphazard data and ensured that the data collected met the research objectives. It covered the nature of study, the population of study, sample size, and the data collection methods and data analysis techniques.

3.2 Nature of the study

The study was a Time series study set to find the relationship between interest rate and exchange rates using secondary data. Times Series is a sequence of values usually recorded at regular increasing intervals (yearly, monthly, weekly e.t.c). In this study, the monthly interval was used.

Regularity is critical to make sense when moving averages, auto correlations and volatility are calculated. It is important to note that Times series exhibit historicity as the past is an indicator of the future and that is why auto regression is used to predict the future of sales for example. It is also the reason why the past volatility may predict future volatility (Descombe, 1999).

3.3 Population

The population consisted of all the Treasury Bills quoted at the Nairobi Stock Exchange as from November 1993 to March 2002 in order to capture the liberalisation period.
census of all the Treasury Bills quoted at the Nairobi Stock Exchange was used in this study, the reason being that all banks trade in Treasury Bills and they use it as a benchmark to calculate the base lending interest rates that banks use.

Exchange rates of the Kenyan shilling to the U.S dollar was the interbank rates from Central bank of Kenya because banks use it as a benchmark for buying and selling foreign currency. We dealt with the US dollar because it's more internationally accepted and available in most countries. The US dollar is also the most traded currency and most other currencies use the dollar as a benchmark to determine other exchange rates.

The US treasury bills as from November 1993 to March 2002 as quoted by the Federal Reserve Bank of Chicago were also used.

3.4 Data and Variables

The data and variables on this research covered the period of November 1993 to March 2002. During this period significant interest rates changes took place with the 91-day Treasury bill touching highs of 84.40% and lows of 8.84%. This period, usually described as liberalised era, saw the interest rates being determined by market forces as a result of use of the tender method (Sunday Nation, 21 April, 2002).

For this kind of study, it was important for one to measure the exchange rate price movements in a declining interest rate regime as well as an ascending one. Indeed interest rates oscillated with wide swings over the period. It is for this main reason that
the researcher took up this period of study. The interest rates used were of the U.S. treasury bills of the Federal Reserve Bank of Chicago, the interbank exchange rates and Kenya treasury bill interest rates were provided by the Central Bank of Kenya.

3.5 Data collection

In this study, secondary data was used. The data of the study is comprised of three variables;

i) Nominal inter bank currency exchange rates

ii) Nominal monthly interest rates of the 91-day Kenyan treasury bills and

iii) Nominal 91-day US treasury bills.

The inter bank foreign exchange average rates at close of the month are available from the Central Bank of Kenya.

Interest rates for the same period of time forms the other part of the data. The 91-day Treasury bill was the proxy for the measure of interest rates in Kenya for two main reasons; its ability to influence other interest rates and for being arguably risk free. Treasury bills are typically short dated government securities that facilitate government borrowing.

The Central bank advertises through the newspapers for tenders of treasury bills every Friday to be received by 2.00 p.m. the following Thursday. The monetary policy committee meets every Thursday afternoon to process the applications and determine the successful applicants. The results are relayed to the media on late Thursday afternoon indicating the average amount of the successful bids. One is therefore able to determine the average rate of the successful bids of a particular auction.
3.6 The Model

The main line of enquiry was limited to the aggregate interest rates in Kenya and the U.S. (whose proxies were the 91-day treasury bills) and the floating value of the exchange rate (represented by the Kenya shilling price of the U.S dollar). The main hypothesis was that a positive relationship exists between the strength of the Kenya shilling relative to the U.S. dollar and the interest rates of both countries.

3.6.1 Research Model

It is assumed that business people will shift their funds to an area of higher gain and therefore use the interest rate parity theory equation to make a decision.

\[
\frac{1 + i_k}{1 + i_{u.s.}} = \frac{b}{S_{k/u.s}}
\]

Where \(i_k\) is the Kenya treasury bill interest rate; \(i_{u.s.}\) is the U.S. treasury bill interest rate; \(b\) is a constant the forward rate \(S_{k/u.s}\) is the spot exchange rate of Kenya shillings per U.S dollar.

The data on exchange rate and interest rates was fitted in a regression equation of the form

\[Y = a + bx + e\]

Where:

\(Y\) = dependant variable i.e. the interest rates \(= \frac{1 + i_k}{1 + i_{u.s.}}\)

\(a\) = a constant

\(b\) = coefficient showing relationship over a period of time.
x = the reciprocal of exchange rates = 1/S\textsubscript{k/u.s.}

\( e = \text{takes care of any error noises.} \)

### 3.6.2 Analysis

Since the model used was a correlation model seeking to study the degree of relation or association between two variables, the exchange rates and interest rates with the aim of seeing if there are movement of funds from Kenya to the U.S or vice versa.

The population correlation coefficient is given by:

\[
\rho = \frac{\Sigma xy}{N \sigma_x \sigma_y} = \frac{\sigma_{xy}}{\sigma_x \sigma_y}
\]

Where \( \rho \) = Population correlation coefficient.

x = Kenyan shilling to U.S dollar exchange rate.

y = Kenyan interest rate

\( \Sigma xy \) = sum of the cross product.

\( \sigma_{xy} \) = covariance of x and y

\( \sigma_x \sigma_y \) = standard deviation of x and y

N = the total number of the population

To make the statement more explicit \( \rho \) is expressed in the standard form

\[
\rho = \frac{\Sigma Z_x Z_y}{N}
\]

\( Z \) = The Z scores for the variables respectively.

From which it can be seen that the correlation coefficient is a covariance of standard scores.
3.7 Data Presentation

Once the data was collected from the CBK, the data preparation or clean up was undertaken. First, manual central editing was undertaken. Thereafter, tabulation was done by simply counting the numbers of elements and statistical analysis done. This facilitated charting using graphs.

The data was analysed with the aid of descriptive statistics such as means and correlation coefficients. This facilitated the reporting of the relationship between interest rates and exchange rates.

3.8 Chapter Summary

The design ensured that the data collected met the research objectives. The study was a Time series study set to find the relationship between interest rates and exchange rates. The population consisted of all the Kenyan and U.S 91-day treasury bill interest rates from November 1993 to March 2002 together with the Ksh / U.S. $ interbank exchange rates from the CBK for the same period.

It is assumed that business people will shift their funds to an area of higher gain. The model used was a correlation model seeking to study the degree of relation between interest rates and exchange rates. The data was analysed with the aid of descriptive statistics which facilitated the reporting of the relationship between interest rates and exchange rates.
CHAPTER FOUR

4.0 DATA ANALYSIS AND INTERPRETATION

The secondary data collected from the Central Bank of Kenya (CBK) and the Internet site is shown in Appendix 1. The data was analysed with the aid of descriptive statistics whose results are in Appendix 2. The results were interpreted based on correlation coefficient (ρ) shown in appendix 3. The interpretation is based on the value of ρ; where ρ = 1 indicates a perfect positive correlation, ρ = -1 indicates a perfect negative correlation and ρ = 0 indicates no linear correlation between the variables.

The value of the sample correlation was used to estimate the true population correlation. Large correlation coefficient indicates that one variable has a large influence on the other or the relationships might be causal or the variables being correlated have a number of causes in common. Small correlation on the other hand indicates that the variables are possibly not linearly related.

A test for the significance of the correlation was added to find if the value obtained was significantly greater than zero. The significance level used was 5%. Table 1 indicates the performance of the two variables. A column for the test statistic is also given that is compared with the critical value. Based on the last column of the tables, a declaration of whether the correlation is significantly above zero or not was made.

To calculate the test statistic this formula was used

\[ T = r \sqrt{\frac{n - 2}{1 - r^2}} \]

Where \( n \) is the sample size and \( r \) is the correlation coefficient.
Further, the two variables were lagged by periods ranging from one month to three months to see the possible effect of delaying one set of data on the strength of the relationship of the two variables. This was done to check on the possibility of a delayed response to changes on one set of data.

The results showed that the Ksh/ US$ exchange rate was the most volatile having a standard deviation of 10.92 followed by the Kenyan T. bill rate at 7.62, the least volatile was the U.S T. bill rates at 1.20. This confirms high volatility of exchange rates and interest rates in Kenya not typical in advanced economies. A look at the exchange rate and Kenyan interest rates using a graphical representation shows a negative relationship between the periods 01/11/98 to 01/03/2002. (see graph below)

![Actual Rates Graph]

The results of the correlation indicate that the two variables have a weak negative correlation at -0.471. When the T-bill interest rates in Kenya lagged by one month a stronger negative correlation is observed at -0.507, this negative correlation becomes
stronger with further lagging to -0.548 for a 2 months lag and -0.593 and for a 3 months lag.

When the Ksh/US$ exchange rate is lagged, the negative correlation becomes stronger at -0.500 for 1 month lagging getting strongest with 2 months lagging at -0.511 and then reduces to -0.509 with a 3 months lag. To find out if the value obtained is significantly greater than zero we test the significance of the correlation. The significance level to be used is 5%, which has a critical value of -1.675. The hypothesis is:

\[ H_0 : \rho = 0 \]

\[ H_1 : \rho > 0 \]

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Correlation Coefficient</strong></td>
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<tr>
<td>T-bill - US ex</td>
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<tr>
<td>T-bill lag 1 month</td>
</tr>
<tr>
<td>T-bill lag 2 months</td>
</tr>
<tr>
<td>T-bill lag 3 months</td>
</tr>
<tr>
<td>US ex lag 1 month</td>
</tr>
<tr>
<td>US ex lag 2 months</td>
</tr>
<tr>
<td>US ex lag 3 months</td>
</tr>
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</table>
Since the value of the calculated statistic is above the critical value, we conclude that there is a negative correlation between the two sets of data. Similar tests are carried out for the other scenarios.

From the table above, the study shows that the negative relationship between interest rates and exchange rates is enhanced when interest rates are lagged to the extent of 3 months. The researcher speculates that when interest rates change, exchange rates take some time to change due to the time it takes to import or export foreign currency (U.S.$) so as the enjoy the better interest rates wherever they may be. Consequently, a stronger relationship emerges when lagging is done.

To establish whether funds move to the U.S or remain in Kenya, the interest rate parity relationship resulted in the following equation (appendix 4)

\[ Y_t = 0.751 - 3.107x_t + 0.786y_{t-1} + 0.241 \]

This shows that there is a stronger relationship when the \( Y_t \) is lagged for one month \( y_{t-1} \). Therefore interest rates affect exchange rates at least one month after they change.

### 4.1 Chapter Summary

In this chapter, we saw that the data was analysed using descriptive statistics. The results were interpreted based on correlation coefficient. The value of the sample correlation was used to estimate the true population coefficient. The results of the correlation indicate that the two variables have a weak negative correlation at -0.471. The study showed that the negative relationship between interest rates and exchange rates is enhanced when interest rates are lagged to the extent of 3 months.
CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The main objective of this study was to determine the relationship between interest rates and exchange rates in Kenya. The study of the relationship between interest rates and exchange rates will be of importance to the Central Bank, the Nairobi Stock exchange and Stockbrokers, business people and to researchers.

The data was analysed with the aid of descriptive statistics which facilitated the reporting of the relationship between interest rates and exchange rates. The relationship between the two variables is not direct, as one cannot be certain whether a change in interest rate will cause a change in exchange rates and vice versa.

The study has revealed that indeed there is a negative relationship between the two variables measured at -0.471. The t-values were also significant at the 95% confidence level. When the interest rate is lagged by one month a stronger correlation of -0.507 emerges and when further lagging is done a stronger correlation is achieved of -0.548 and -0.593 for 2 and 3 month lagging respectively.

This study has also revealed that interest rates as measured by the 91-day treasury bills are quite volatile. This situation makes the market less attractive to foreign investors who are capable of bringing in the much-needed foreign capital for investments. The
government is therefore advised to aim at reducing volatility and stabilise the financial markets so as to attract investors.

The equation established through regression and using interest rate parity as a proxy is: -

$$Y_t = 0.751 - 3.107x_t + 0.786y_{t-1} + 0.241$$

The equation can be used to predict the forward rate of U.S $ and as such, the government is advised to open a forwards market to stop U.S. dollar movement from Kenya and to encourage innovation in the financial markets.

5.2 Recommendations for further study

The following recommendations have been suggested:

A study of the causal relationship between interest rates and exchange rates is suggested. The study can also be conducted using other macroeconomic variables such as inflation, money supply, and income levels among others. Other measures of interest rates could also be used such as deposit rates. Research on the effects of high treasury bill rates on the economy as a whole would give further insights to the relationship of interest rates and alternative forms of investment.

A study on the exchange rates of the other currencies and their relationship to changes in the US $ exchange rates and interest rates could also give further insights.
List of References


Edition, New Delhi, India: Prentice-Hall of India


USA: Prentice-Hall, Inc.

http://www.iun.edu

http://zimele.co.ke/press 0.1.html

http://www.nse.co.ke/history

unpublished MBA project, University of Nairobi

Act*, 2000 (Nairobi), 7th August

Kenyan Bankers co-operative society (1998) *The Kenyan Banker magazine*, Jan-
March Edition (Nairobi)

No.11 (Nairobi)

Kenyan Bankers co-operative society (1996) *The Kenyan Banker magazine*,
December Issue (Nairobi)

An unpublished MBA project, University of Nairobi

Atlantic University, USA: South-Western College Publishing.

Company

Nairobi Stock Exchange Pamphlet. (1999) The role of the stock exchange in economic Development(Nairobi)


Nyamute M.N., (1997) The relationship between the NSE index and major economic variables An unpublished MBA project, University of Nairobi


### APPENDIX 1

<table>
<thead>
<tr>
<th>Date</th>
<th>91 Day US T-bills rates. USTBLLS</th>
<th>U.S $ exchange rates USEXCH</th>
<th>91 Day Ksh T-Bill Rate TBILLSK</th>
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<td>41.27</td>
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** Correlation is significant at the 0.01 level (2-tailed).
**Regression**

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*a.* Predictors: (Constant), X  
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**ANOVA**

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<td>Total</td>
<td>110</td>
<td>312.622</td>
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</table>

*a.* Predictors: (Constant), X  
*b.* Dependent Variable: Y
### Coefficients

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Constant)</td>
<td>3.042</td>
<td>.914</td>
<td>3.327</td>
<td>.001</td>
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<tr>
<td>X</td>
<td>41.042</td>
<td>57.212</td>
<td>.069</td>
<td>.717</td>
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*a. Dependent Variable: Y*

### Residuals Statistics

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<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
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<tbody>
<tr>
<td>Predicted Value</td>
<td>55993652343750</td>
<td>4.03662729263306</td>
<td>3.68795382572704</td>
<td>.11556266282888</td>
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<td>Residual</td>
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<td>10.01624011993408</td>
<td>043228062951E-15</td>
<td>1.6818229010167</td>
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<tr>
<td>Std. Predicted Val</td>
<td>-1.108</td>
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<td>.000</td>
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<tr>
<td>Std. Residual</td>
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<td>5.928</td>
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<td>.995</td>
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*a. Dependent Variable: Y*
### Regression

#### Model Summary

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<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>Change Statistics</th>
<th>Durbin-Watson</th>
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<tbody>
<tr>
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<td>R Square Change</td>
<td>F Change</td>
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<tr>
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<td>.905</td>
<td>.43018981740665</td>
<td>.907</td>
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*a. Predictors: (Constant), Y2, X
b. Dependent Variable: Y*

#### ANOVA

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<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
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<tbody>
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<td>Regression</td>
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<td>96.284</td>
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<td>.000a</td>
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<td>Residual</td>
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<td>Total</td>
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</tbody>
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*a. Predictors: (Constant), Y2, X
b. Dependent Variable: Y*

#### Coefficients

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
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<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
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<tr>
<td>1</td>
<td>(Constant)</td>
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<tr>
<td></td>
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<td>Y2</td>
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*a. Dependent Variable: Y*