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**MEASURING EXCHANGE RATE RISK OF KENYA'S MAIN TRADING
CURRENCIES**

BY

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DECLARATION

This project, as presented in this paper is my original work and to the best of my knowledge has not been presented for any other university award in any university.

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Dateí í í í í í í í í ..

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This project has been submitted with my approval as the university supervisor.

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DR PHILLIPNGARE

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DEDICATION

To my dad for his tireless effort to educate me and my fiancée for her moral support and time.

ACKNOWLEDGMENT

The success of this research is heavily indebted to the Almighty God for peace of mind HE afforded me as I write this paper without him it would have been a work in vain. I also take this opportunity to express my sincere thanks to the staff at the University of Nairobi for providing me with the necessary facilities especially the post graduate library. From this facility I was able to access not only research reports from earlier similar findings but also scholarly publications from the wider academic world. I also acknowledge my supervisor Dr. Phillip Ngare for the guidance provided to me in doing this research.

I wish to pass my special thanks to the Central bank of Kenya for providing me with the required data used in this research.

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ABSTRACT

This study measures the exchange rate risk of Kenya's main trading currencies mainly the United States of America dollar, the Euro and the United Kingdom pound. The Value at Risk model is used to estimate this risk; in particular the parametric approach and the historical approach are used. Data from the central bank of Kenya is used showing the daily closing exchange rate of Kenyan shilling against these three currencies from the period that starts in January 2003 to December 2013 covering 2286 trading days.

The exchange rate data is analysed using SPSS and its fluctuations are observed over the period, with each currency exhibiting volatility. The results of the Value at Risk estimates show that at higher confidence levels like 99% the estimate is high compared to lower confidence levels like 90%. The two approaches in estimating Value at Risk show similar results with small differences at each confidence level.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Foreign Exchange Market also called Forex Market is a market in which participants are able to buy and sell currencies, exchange and speculate on currencies, they are able to trade one's currency for another. This is not a physical market but rather an interconnection of computers involving banks, commercial companies, Central banks, Investment management firms, Hedge funds and Retail Forex brokers and investors in different countries. The Forex Market is undoubtedly considered the world's largest financial market.

Exchange rate is the price at which purchases and sales of foreign currency take place, the exchange rate between two currencies represents the value of one country's currency in terms of another country's currency. In practice almost all trading of currencies take place in terms of US dollar. When we say that the dollar strengthened we mean that the value of a dollar rises so that it takes more foreign currency to buy a dollar.

Exchange rates are determined by various factors

1. Demand and supply.

Suppose there was a high demand for Kenyan goods then the value of Kenya shilling would appreciate and if markets were worried about the future value of the Kenyan economy they would tend to sell the shilling which would in turn lead to a fall in the value of the shilling.

2. Inflation Rate

A country with a lower inflation rate compared to another exhibits a rising currency value as its purchasing power increases relative to other currencies. Countries with higher inflation rates typically see the depreciation in their currency in relation to the currencies of their trading partners.

3. Interest Rates

Fluctuating interest rates exert influence over both on inflation and exchange rates and changing interest rates impact inflation and currency values, higher interest rates offer lenders in an economy a higher return relative to other countries. Therefore, higher interest rates attract foreign capital and cause the exchange rate to rise. The impact of higher interest rates is mitigated; however, if inflation in the country is much higher than in others, the opposite relationship exists for decreasing interest rates that is lower interest rates tend to lower exchange rates.

4. Current-Account Deficits

The current account is the balance of trade between a country and its trading partners, reflecting all payments between countries for goods and services, interest and dividends, A deficit in the current account shows the country is spending more on foreign trade than it is earning (value of imports is greater than value of exports), and that it is borrowing capital from foreign sources to make up for the deficit, In other words, the country requires more foreign currency than it receives through sales of exports and it supplies more of its own currency than foreigners demand for its products. The excess demand for foreign currency lowers the country's exchange

rate until domestic goods and services are cheap enough for foreigners and foreign assets are too expensive to generate sales for domestic interests.

5. Public Debt

Countries will engage in large scale deficit financing to pay for public sector projects and governmental funding. While such activities stimulates the domestic economy, nations with large public deficits are less attractive to foreign investors because a large debt encourages inflation and if inflation is high, the debt will be serviced and ultimately paid off with cheaper real dollars in the future.

If markets fear that a government may default on its debt, investors will sell their bonds causing a fall in the value of the exchange rate.

6. Terms of Trade

The terms of trade are related to current accounts and balance of payments and is a ratio comparing export prices. If the price of a country's exports rises by a greater rate than that of its imports, its terms of trade have favorably improved. Increasing terms of trade shows a greater demand for the country's exports. This in turn, results in rising revenues from exports, which provides increased demand for the country's currency (and an increase in the currency's value).

If the price of exports rises by a smaller rate than that of its imports, the currency's value will decrease in relation to its trading partners.

7. Political Stability and Economic Performance

Foreign investors inevitably seek out stable countries with strong economic performance in which to invest their capital. A country with such positive attributes will draw investment funds

away from other countries perceived to have a more political and economic risk. Political turmoil for example can cause a loss of confidence in a currency and a movement of capital to the currencies of more stable countries.

Exchange rates are quoted in two ways; Direct quotation that gives the home currency price of a unit of foreign currency; Indirect quotation that gives the foreign currency as a unit of the home currency.

The value of a country's currency is managed by each country through varying mechanisms and part of this involves identifying the exchange rate regime that will be suitable for its currency.

There are two types of exchange rates regimes; fixed exchange rate and floating exchange rate. If a currency is free floating, its exchange rate is allowed to vary against that of other currencies and is determined by the market forces of demand and supply.

A fixed exchange rate also known as pegged exchange rate is where by the government tries to keep the value of its currency constant against another currency. The government decides the value of its currency in terms of either a fixed weight of Gold, a fixed amount of another currency or a basket of other currencies. The central bank of a country remains committed at all times to buy and sell its currency at a fixed price. The central bank provides foreign currency needed to finance payment imbalances.

Floating exchange rates are expected to be more volatile as they are free to fluctuate. The volatility in exchange rates results in increase of exchange rate risk and adversely affects the international trade and investment decisions.

Also noteworthy is that a fixed exchange rate is not necessarily a show that a country has lower exchange rate volatility than a country using free floating exchange rate. Fixing the value of a country's currency on another country currency still leaves a country currency exposed to fluctuations in the other countries currency (Peter B Clark.al.2004) Each country must go for the exchange rate that best suits its economy.

During the era of the fixed exchange rate regime that covered the period of 1966-1992, Kenya, like many other developing countries, had to frequently devalue its currency in an attempt to reduce the negative effects of exchange rate risk on its economy.

Various studies particularly in the developed and middle-income countries have explored the impact of exchange rate risk and the associated uncertainty on trade, investment and economic growth.

Majority of these studies have found that exchange rate risk can affect trade directly through uncertainty and adjustment costs, and indirectly through its effect on the structure of output and investment.

The adoption of a floating exchange rate system in 1993 marked the climax of efforts by the central bank to mitigate this risk as the Kenyan currency became liberalized in the foreign exchange market.

Following the liberalization of the foreign exchange market Kenya attained monetary independence to control inflationary pressures but lost the nominal anchor to tie domestic prices down and thus globalization effects transmitted directly into the country.

When exchange rate volatility cannot be predicted, it creates uncertainty about the magnitude of profits to be realized from international trade. This uncertainty is referred as exchange rate uncertainty or exchange rate risk.

Also called currency risk is the financial risk that a business's operations or an investment's value will be affected by changes in exchange rates. For example, if money must be converted into a different currency to make a certain investment, changes in the value of the currency relative to the US dollar will affect the total loss or gain on the investment when the money is converted back. This risk usually affects businesses, but it can also affect individual investors who make international investment. There are different classifications on the financial risks, (Jorion 2006) categories them as follows

Market risk this is the risk that arises from movements in the level of volatility of market prices such as Exchange rate, Interest rate, Stock and commodity prices.

Credit Risk: This is the risk that originates from the fact that counterparties may be unwilling or unable to fulfill their contractual obligations.

Liquidity Risk: This is the risk that arises when a transaction cannot be conducted at prevailing market prices.

Operational Risk: This is the risk arising from human and technical errors for example fraud

Legal Risk: This is the risk that arises when a transaction proves unenforceable in law

In Financial mathematics there are various ways methods of measuring risk namely there are

1. Variance of return
2. Semi-variance of return
3. Shortfall probabilities
4. Value at Risk (VaR)
5. Tail value at risk (tail VaR)

In this study we shall be measuring exchange rate risk using VaR. It is a more popular measure of Exchange rate risk in that the risk is a percentile of a profit and loss distribution over a specified horizon (Dowd, 1998). It captures the nature of bad outcomes in a single number.

1.2 Problem Statement

When exchange rate volatility cannot be predicted, it creates uncertainty about the magnitude of profits to be realized from international trade, the appreciation and depreciation of the Kenyan shilling has attracted public attention especially from exporters who have argued that the strengthening shilling is eroding their competitiveness. Even a tiny variation in the rate could cost the businesses thousands of cash.

In view of these potential problems in this study we shall be measuring the exchange rate variation using the Value at Risk methodology, using daily Kenya shilling exchange rate to its main trading currencies

1.3 Broad Objective

The overall objective of this study will be to measure the exchange rate risk of Kenya's main trading currencies using the Value at Risk methodology using the parametric and historical approach.

1.4 Significance of the study

The study shall be of significance to the following participants of the foreign exchange market. Kenyan Importers who pay for goods and services using foreign currency. Exporters who from their businesses receive foreign currency and may want to convert that currency into Kenya currency. Portfolio Managers who buy or sell foreign stocks or bonds. Speculators involved in Forex trade who try to profit from changes in exchange rates since they sell currency positions if they expect their currency to depreciate and buy when they expect it to appreciate.

CHAPTER TWO

2.0 LITERATURE REVIEW

Since the adoption of a floating exchange rate regime in 1973, there has been observed high exchange rate volatility. Exchange rate volatility is defined as the risk associated with unexpected movements in the exchange rate. The high degree of volatility and uncertainty of exchange rate movements have led policy makers and researchers to measure the risk associated with this movements.

Kenya has adopted a flexible exchange rate regime since 1993. The exchange rate is one of the macroeconomic indicators that carry uncertainty typical of a financial indicator (kiptoo 2007). The volatility of the exchange rate is inevitably related with the risk exposure of changing exchange rates. The exposure towards changing exchange rates of foreign currencies is the measure in which monetary flows, coming from transactions in foreign currency, are sensible to the changing of exchange rates of that currency.

The VaR methodology has been widely adopted for measuring the market risk in bank trading portfolios among European countries during the 1990. According to Holton (2002), the beginning of VaR can be traced to the New York Stock Exchange in 1922. In 1972 Lietaer showed the practical VaR measure for foreign exchange rate, he supposed that the depreciation occurred normally, its conditional magnitude being normally distributed

VaR can be measured in several ways.

Manfredo and Leuthold(1997) indicate, that the parametric method uses the weighted average approach for estimating the standard deviation and correlation among portfolio asset, they further say that under the valuation of VaR through this method it is also possible on the basis of historical data to calculate volatility and correlation of the data to estimate future

covariance matrixes, however it is criticized majorly since it relates to the assumption of normality of the distribution of the exchange rates. Another criticism of this method is in forecasting for long horizons at the time when even one day forecast can fail

Historical Simulation is built on the assumption that the market will be stationary in the future. Manfredo and Leuthold (1997) indicate that the main idea behind this approach is to follow the historical price of assets. In each scenario a hypothetical price is simulated as the today price plus the changes of price in the past. Evaluation of the whole portfolio through simulated prices and portfolio values are ranked from smallest to largest and the designated risk tolerance level becomes the VaR estimate. A criticism to this approach is on the assumption that the returns are distributed and identically which over a longer time horizon may be violated (Manfredo, 1997)

Ho (2000) tried to do some comparisons between some of these methods to establish which one is the best for Asian market under volatile market conditions. The analysis showed that under confidence level 95% and 99% the estimation of VaR was most accurate in variance covariance method.

Hendricks (1996) analyses the performance of VaR approaches using historical data on exchange rate returns and finds that historical approach performs better at 95% than at 99% or higher confidence levels.

In the article of Angelidis and Degiannakis (2005), they investigated the accuracy of parametric and Historical methods in estimating VaR in three main markets, which includes stock exchanges, commodities and foreign exchange rates

Other similar articles discussing the use of VaR to measure the exchange rate risk of different currencies in different regions and countries include Wang Wu Chen Zhou (2009). In their article they analyse the exchange rate risk of Chinese Yuan by using VaR. Their research finds that the VaR values calculated by the historical method can measure the risk of exchange rate of Japanese yen against Chinese yuan more accurately.

Manzin A M and Janabi (2006) researched the foreign exchange trading risk with VaR in the case of Moroccan forex market and found that a VaR based approach into account holding period needed adjustments for the illiquidity of long and short currency positions.

This chapter majorly concentrated on literatures and articles that provide us the theoretical basis and ideas to measure the exchange rate risk Based on their results our research will focus on the exchange rate risk of Kenyan shilling against its main trading partners and try to estimate VaR for exchange rate risk using parametric and historical approaches.

CHAPTER THREE

3.0 METHODOLOGY

VaR generalizes the likelihood of underperforming by providing a statistical measure of downside risk. It assesses the potential losses on a financial instrument over a given future time period with a given confidence level.

Mathematically we can define VaR as below

For a continuous random variable X. VaR is determined as

$$\text{VaR}(X) = -t \text{ where } P(X < t) = a$$

For a discrete random variable, VaR is defined as

$$\text{VaR}(X) = -t \text{ where } t = \max \{ x : P(X < x) \leq a \}$$

Where a is the desired confidence level

t is the VaR estimate

The VaR estimate is a loss amount, a positive value at Risk indicates a loss while a negative Value at Risk indicates a profit

In estimating VaR we shall use the parametric and Historical approach. We first get the daily fluctuation in exchange rates using the log returns formula given in the next page

3.2 Daily Log Returns

The log return formula is defined as

$$R_t = \left(\ln\left(\frac{S_t}{S_{t-1}}\right) \right) * 100$$

R_t is the return at day t

S_t is the exchange rate at day t

S_{t-1} is the exchange rate on day preceding day t

3.3 PARAMETRIC METHOD

This method is also called the Analytical VaR approach this is because one of its fundamental assumptions is that the return distribution belongs to a family of parametric distribution such as the normal distribution. Parametric VaR can simply be expressed as:

$$F(\text{VaR}) = P(R \leq \text{VaR}) = \int_{-\infty}^{\text{VaR}} f(r) dr = a$$

In the above equation F and R represents the cumulative distribution function and the returns random variable respectively.

With standard normal distribution transform we get

$$(\text{VaR}) = P\left(Z \leq \frac{\text{VaR} - \mu}{\sigma}\right) = a$$

$$\text{VaR} = \mu + \sigma * z^{-1}(a)$$

μ is the mean return

σ is the standard deviation of the returns

Φ is the standard normal distribution function

α is the desired confidence level

3.4 HISTORICAL METHOD

This method looks back at the past performance of the exchange rates and makes the assumption that the past is a good indicator of the near-future or that the recent past will reproduce itself in the near-future again

In this approach the returns are arranged in an ascending order starting from the worst loss to the least loss. The desired confidence level then corresponds to percentile of the loss.

The Value at Risk estimate using this approach is then defined as

$$VaR = R - \mu_R$$

Where

R is the return that corresponds to the percentile of the confidence level specified.

μ_R is the mean of the return distribution

3.5 PARAMETERS INVOLVED

Holding Period this is the length of time the foreign exchange position is planned to be held or the horizon of risk analysis. When computing the daily Value at Risk we are estimating the worst expected loss that may occur by the end of the next trading day.

The assumption in calculating an N-day Value at Risk is given by

$$N_dayVaR = 1\text{-day VaR} * \sqrt{N}$$

Where

N is the length of time the currency position is held

Confidence level this is the probability at which the estimate is planned to be made it's a measure that expresses the accuracy of the result

3.6 ASSUMPTIONS OF Value at Risk

Assumption of Normality this is the assumption that the return distribution has a normal distribution. A distribution is normal if there is a high probability that any observation from the sample will have a value that is close to the mean and a low probability of having a value that is far from the mean

Stationary Requirement This assumes a 1 percent fluctuation in exchange rate is equally likely to occur at any point in time, it simplifies computations considerably.

Random walk assumption this assumption states that the day to day fluctuations in exchange rates are independent and that a decline in exchange rate on one day has no predictive power regarding on the exchange rate on the next day.

Non-negativity requirement this stipulates that financial assets with limited liability for example exchange rates cannot attain negative values.

Time consistency requirement this assumption states that all single period assumptions hold over the multi-period time horizon.

CHAPTER FOUR

4.0 DATA ANALYSIS AND RESULTS

The Data used in this research is foreign exchange data from 4th January 2003 to 31st December 2013 provided by the Central bank of Kenya, it consists of daily exchange rates against the Kenyan shilling for the following six currencies, US dollar, Chinese Yuan and Euro.

Descriptive statistics of KES/USD RETURNS

Mean	-0.001998152
Standard Error	0.01067642
Median	-0.000505981
Mode	-0.70537345
Standard Deviation	0.510462385
Sample Variance	0.260571847
Kurtosis	3.27263058
Skewness	-0.223436533
Range	7.567625489
Minimum	-4.446582132
Maximum	3.121043357
Sum	-4.567775196
Count	2286

Table 4.1

Descriptive statistics of KES/EURO returns

Mean	-0.005230862
Standard Error	0.016678621
Median	-0.002444231
Mode	0.237995028
Standard Deviation	0.797440438
Sample Variance	0.635911252
Kurtosis	3.463939449
Skewness	-0.265633748
Range	8.546941799
Minimum	-5.089078511
Maximum	3.457863288
Sum	-11.95775035
Count	2286

Table 4.2

Descriptive statistics of KES/STERLING POUND returns

Mean	0.001882623
Standard Error	0.016353627
Median	-0.001602257
Mode	-0.210502821
Standard Deviation	0.781901786
Sample Variance	0.611370402
Kurtosis	4.728710529
Skewness	0.089125299
Range	9.998988242
Minimum	-4.931433289
Maximum	5.067554953
Sum	4.303675281
Count	2286

Table 4.3

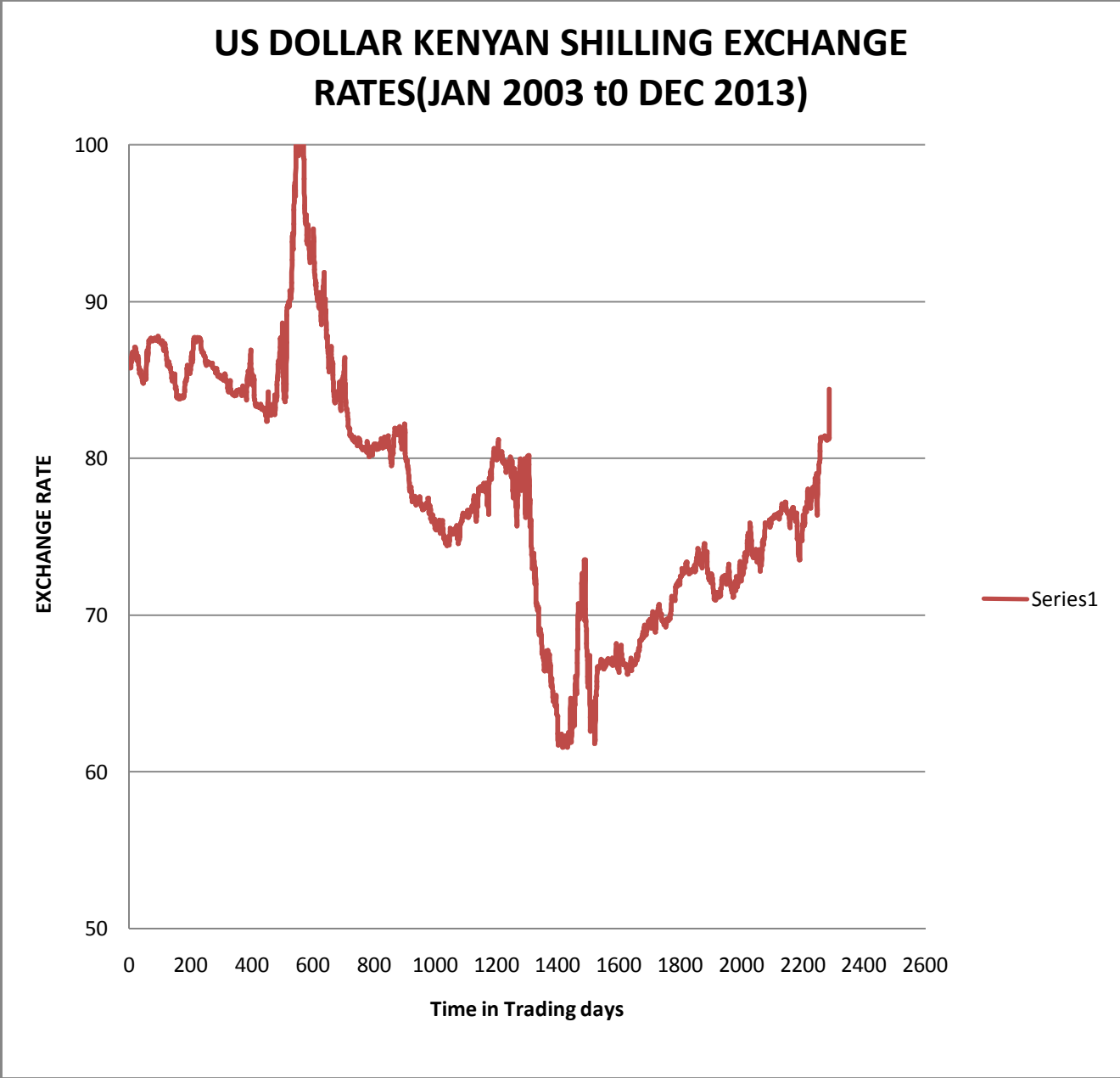


Figure 4.1.1

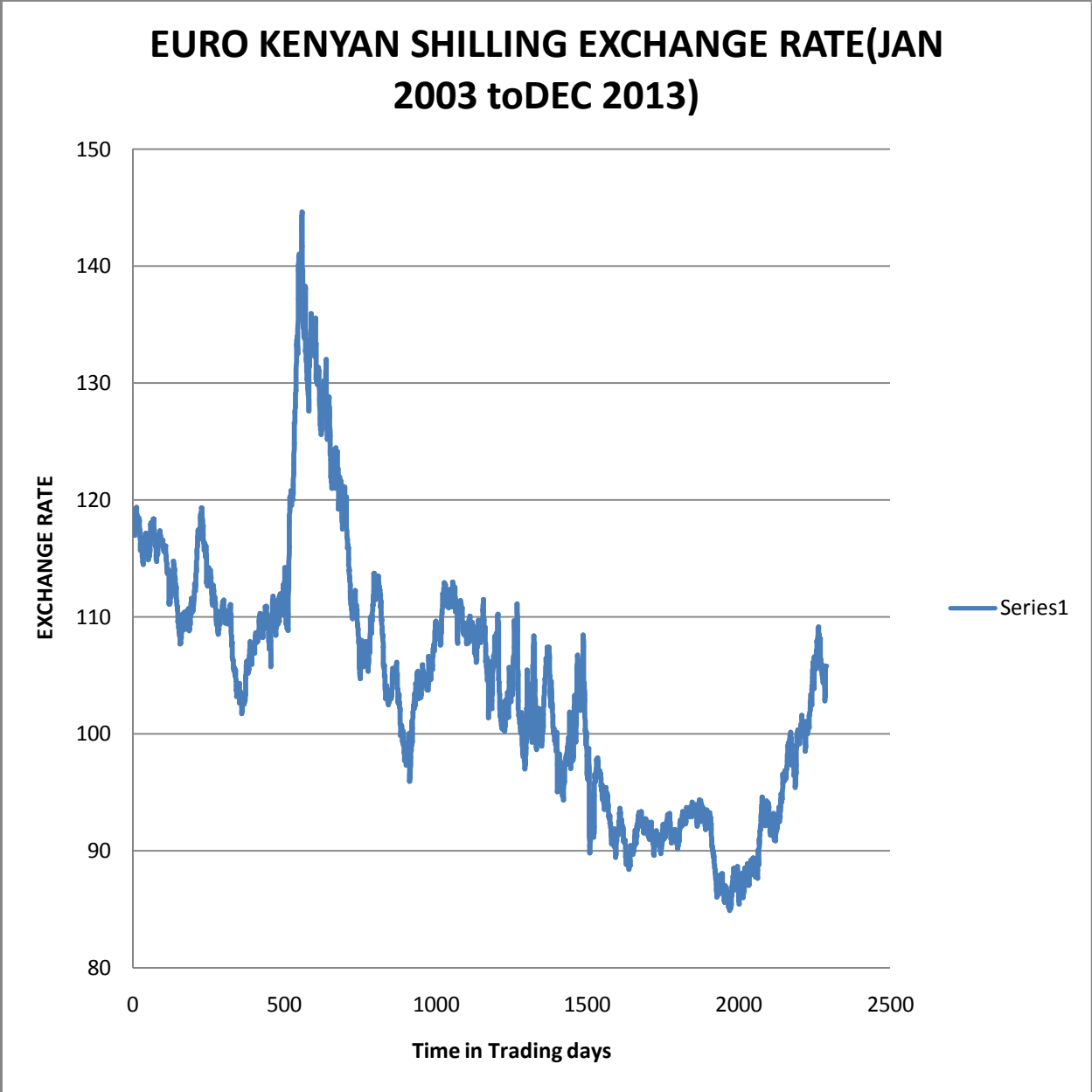


Figure 4.1.2

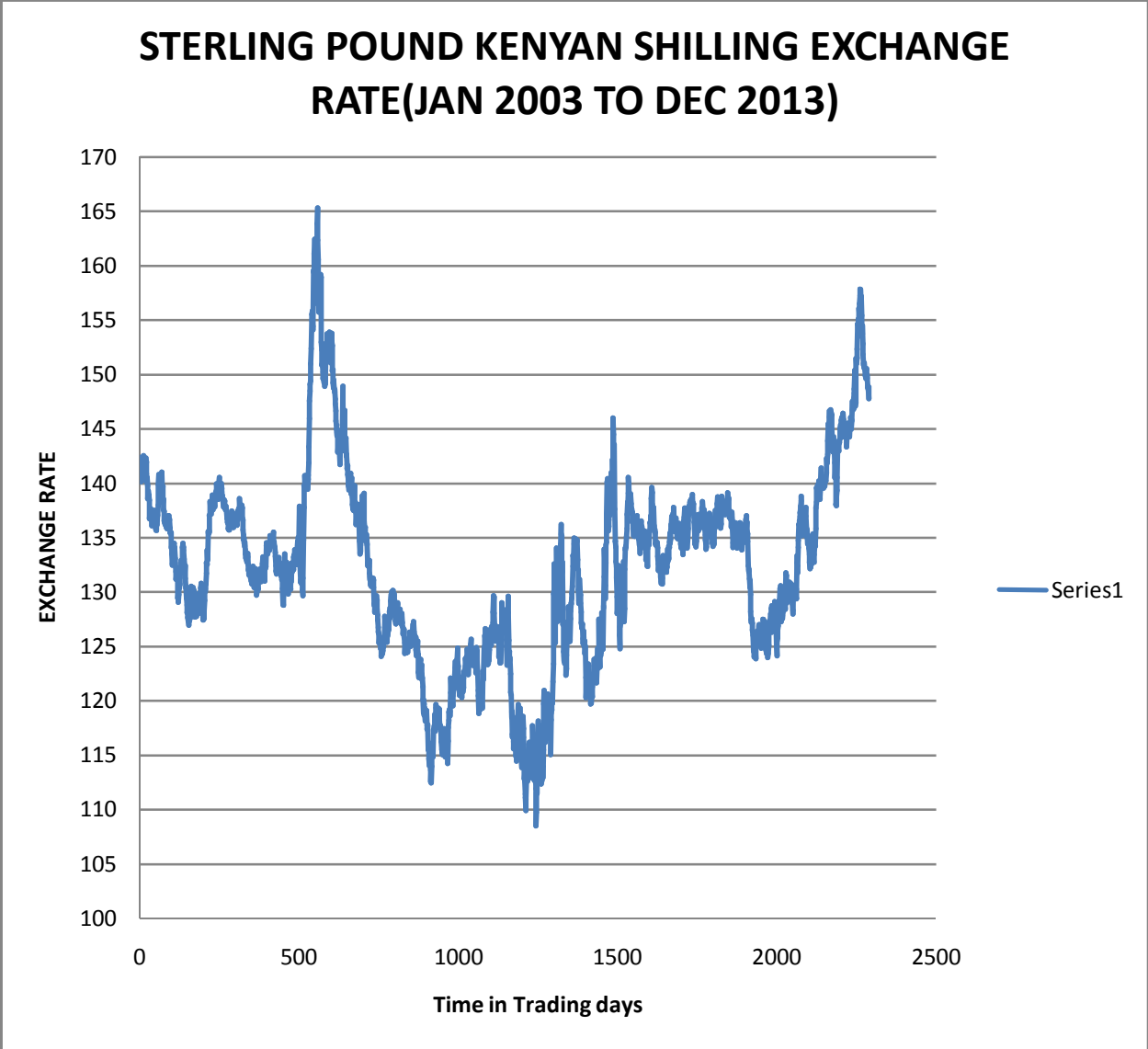


Figure 4.1.3

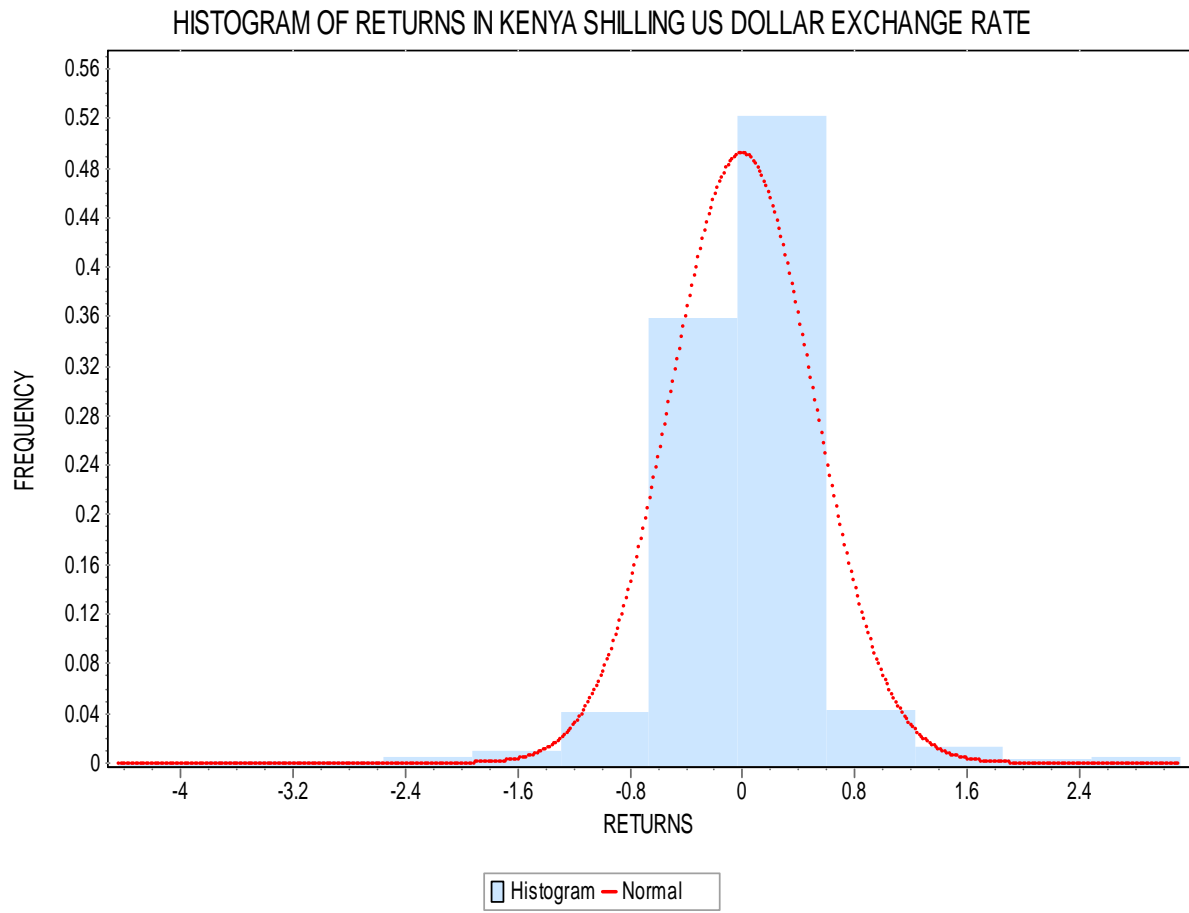


Figure 4.1.4

HISTOGRAM OF RETURNS IN KENYA SHILLING EURO EXCHANGE RATE

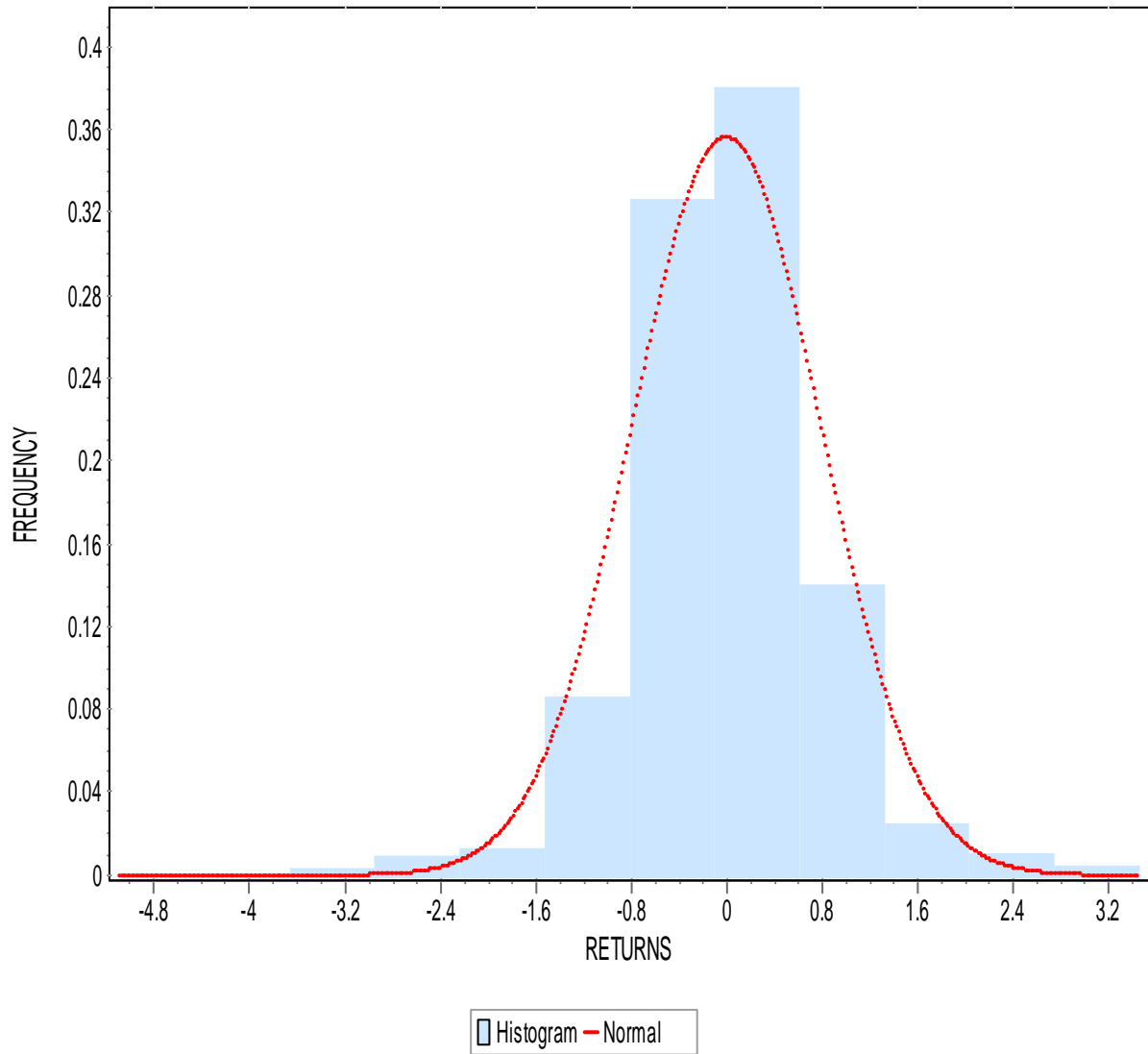


Figure 4.1.5

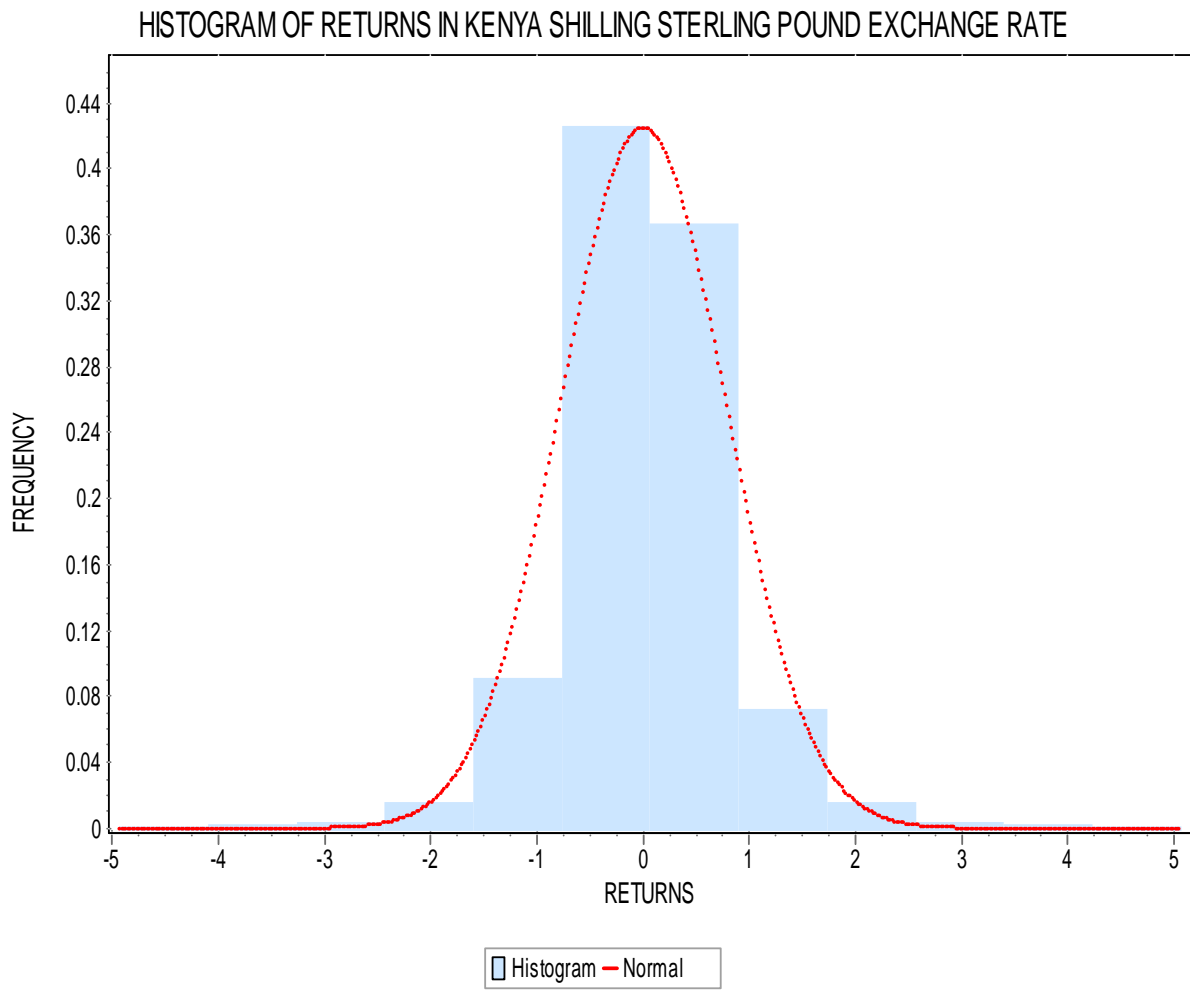


Figure 4.1.6

HISTORICAL APPROACH

Returns corresponding to specified confidence interval

Confidence interval	KES/USD	KES/EURO	KES/SRERLING POUND
91%	-0.46692	-0.90478	-0.82324
93%	-0.56947	-0.99725	-0.98145
95%	-0.73047	-1.1588	-1.14845
97%	-1.00005	-1.47335	-1.39042
99%	-1.62179	-2.44571	-2.09208

Table 4.4

VaR estimates using parametric approach

Confidence interval	KES/USD	KES/EURO	KES/SRERLING POUND
91%	-0.68893	-1.07214	-1.05013571
93%	-0.76497	-1.190247	-1.166599325
95%	-0.84152	-1.309146	-1.283844575
97%	-0.96962	-1.508103	-1.48003496
99%	-1.57498	-2.454539	-2.41330715

Table 4.

VaR estimates using Historical approach

Confidence interval	KES/USD	KES/EURO	KES/SRERLING POUND
91%	-0.464921	-0.89956	-0.825185
93%	-0.567471	-0.99203	-0.983395
95%	-0.728471	-1.15358	-1.150395
97%	-0.998051	-1.46813	-1.392365
99%	-1.619791	-2.44049	-2.094025

Table 4.6

CHAPTER FIVE

4.0 CONCLUSION AND RECOMMENDATION

In this study we measure the exchange rate risk in trading with Kenyan shilling main trading currencies using daily returns from the exchange rates provided by the Central bank of Kenya from the period January 2003 to December 2013. The data obtained was only for the trading days which are five days a week for the period covered. In total this is 2286 daily observations.

We use the VaR approach of measuring risk and in particular the parametric approach and historical approach. The time series of the available data shows fluctuations in the exchange rates of the currencies involved. This shows volatility in the period of our study, the descriptive statistics support this argument with the range of the returns being relative high. The range in Kenya shilling us dollar exchange rate is observed to be 7.57 while that of Kenyan shilling Euro exchange rate is 8.5 and that of Kenyan shilling sterling pound exchange rate is 9.999.

The VaR estimate in both approaches is relatively close to each other across all the confidence levels used. The estimates under both methods increase as the confidence level increase from 90% to 99%.

A choice of higher confidence level in estimating the Value at Risk results to a higher loss amount.

We recommend a further analysis of the exchange rate risk measurement be undertaken in particularly coming up with ways of mitigating the exchange rate risk while trading with Kenya's main trading currencies.

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