

THE EFFECT OF INTEREST RATE VOLATILITY ON MONEY DEMAND IN KENYA

BY

ANN NYAGUTHII GITHINJI

**A RESEARCH PROJECT SUBMITTED TO THE SCHOOL OF ECONOMICS OF THE
PARTIALFULFILLMENT FOR THE AWARD OF THE DEGREE OF MASTER OF
ARTS IN ECONOMICS OF THE UNIVERSITY OF NAIROBI.**

NOVEMBER, 2015

DECLARATION

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

Signature _____ Date _____

Reg. No.X50/64363/2013

Anne N. Githinji

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

Signature _____ Date _____

Ms. Susan A. Ayako

DEDICATION

I dedicate this research project to my beloved parents for their priceless sacrifice.

ACKNOWLEDGEMENTS

I take this opportunity to thank all who assisted me in many ways to prepare this research paper. First, I am greatly indebted to my supervisor Ms. Susan A. Ayako who made this learning process enjoyable through her valuable and knowledgeable comments throughout every stage of this research paper.

I further extend thanks the School of Economics, University of Nairobi for the resources extended my way. I also thank my fellow classmates without whom the learning process would not have been smooth.

Special mention goes to my former classmates Joseph Abuga, Mercy Muturi, Mercy Mukhanyi and Douglas Nyabaro who guided me in valuable group discussions.

I express my sincere appreciation to my family for the sacrifices they have made to enable me reach this stage in life.

Most of all I thank the Almighty God for his grace, guidance and wisdom which he granted to me through this academic journey.

Finally I take responsibility for all comments, errors or opinions within this research paper.

TABLE OF CONTENTS

Declaration.....	ii
Dedication	iii
Acknowledgements	iv
List of Tables	vii
List of Figures.....	viii
Abstract.....	ix
Acronyms and Abbreviations	x
Operational Definition of Terms	xi
CHAPTER ONE:INTRODUCTION.....	1
1.1 Background of the Study	1
1.2 Bank Interest Rates and Bank Interest Spread in Kenya	1
1.1.2 Development of Interest Rate Volatility	5
1.1.3 Interest Rate Volatility, Interest Rate Level and Velocity.....	7
1.1.4 Types of Money demand	8
1.1.4.1Transaction Demand for Money	8
1.1.4.2Precautionary Demand for Money.....	8
1.1.4.3 Speculative Demand for Money	9
1.2 Statement of the Problem.....	9
1.3 Research Questions.....	10
1.4 Objectives of the Study.....	10
1.4.1 General Objective	10
1.4.2 Specific Objectives	10
1.5 Justification of the Study	10
1.6 Scope and Limitation of the study	10
1.7 Organization of the Study	11
CHAPTER TWO:LITERATURE REVIEW.....	12
2.1 Introduction.....	12
2.2 Theoretical Literature Review	12
2.2.1 The Loanable Funds Theory	12

2.2.2 Portfolio Theory of Money Demand.....	13
2.2.3 Transaction Demand for Money Theory.....	13
2.3 Empirical Literature Review.....	13
2.4 Overview of the Literature Review.....	16
CHAPTER THREE:RESEARCH METHODOLOGY	17
3.1 Introduction.....	17
3.2 Theoretical Framework.....	17
3.3 Empirical Model Specification	17
3.4 Variable Definition and Expected Sign	19
3.5 Data Sources	20
3.6 Time Series Properties	20
3.7 Diagnostic Tests.....	21
CHAPTER FOUR: RESULTS AND DISCUSSIONS.....	22
4.1 Introduction.....	22
4.2 Descriptive Statistics.....	22
4.3 Trend Analysis	23
4.4 Diagnostic Tests.....	25
4.4.1 Unit Root Tests	26
4.4.2 Co-integration	27
4.5 Regression Results	28
4.6 Post Estimation Tests.....	29
CHAPTER FIVE:SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS	33
5.1 Introduction.....	33
5.2 Summary and Conclusions of the Study Findings.....	33
5.3 Policy Recommendations.....	34
5.4 Further Areas of Study.....	34
REFERENCES.....	35
APPENDICES: Table A1: The data set used for the study	37

LIST OF TABLES

Table 3.1: Variable Definition, Measurement and Expected sign	19
Table 4.1: Summary Statistics.....	22
Table 4.2: Stationarity Test	26
Table 4.3: The Engle-Granger Test.....	27
Table 4.4: Regression Results of Log -Linear Model	28
Table 4.5: Variance Inflation Factors	29
Table 4.6: Breusch-Godfrey LM test for autocorrelation.....	30
Table 4.7: Breusch-Pagan Test for Heteroscedasticity	30
Table 4.8: Ramsey RESET test for model specification	31

LIST OF FIGURES

Figure 1.1: Differenced Series of Monthly Average of Sample of Short Term Rates (Jan 1991- June 2008)	2
Figure 1.2: Kenya's Interest Rate Spread compared with other regions (1996-2010)	3
Figure 1.3: Interest Rates Trends (2002-2012)	4
Figure 1.4: Interest Rate Spread by Bank Size	5
Figure 4.1: Trends on Exchange Rate, Broad Money, Real Interest Rate and Financial Innovation	23
Figure 4.2: Interest Rate Volatility	24
Figure 4.3: Gross Domestic Product.....	25

ABSTRACT

Studies have shown that interest rate volatility has the potential to affect the economic performance and monetary policy decisions of a country through the effect on demand for money. A factor that increases the demand for money may adversely affect economic performance by increasing nominal income and velocity of money circulation. This study was conducted with the main objective of evaluating the existing relationship between money demand and interest rate volatility in Kenya. The study was based on trend analysis of variables of interest, namely, money demand, interest rate volatility, GDP, inflation, exchange rate, population growth rate and financial innovation. Secondary data obtained from various statistical abstracts for the period 1980-2014 was used in this particular study. The frequency of the data collected was annual, thus providing an adequate exploration of the nature and pattern of the study variables. Ordinary Least Square (OLS) was employed as an estimation technique in modeling the relationship between money demand and interest rate volatility. The study variables used were volatility of interest rate as a variable of interest, GDP, interest rates, inflation rates, population growth rate, financial innovation and exchange rates as other control variables. Broad money demand was used as a dependent variable. The study hypotheses were tested at 90%, 95% and 99% confidence intervals. From the study results, it was shown that interest rate volatility, first differences of GDP, inflation rates, financial innovation and first difference of exchange rates were statistically significant while interest rates and the second difference of population growth rates were insignificant in determining money demand in Kenya. Further, volatility of interest rates and first differences of GDP were negatively related to money demand in Kenya. On the other hand, inflation rates, financial innovation and the first difference of exchange rates were found to have a positive relationship with money demand in Kenya. High interest rate volatility can also cause a decline of money velocity which in turn affects money demand. Therefore to control for interest rate volatility to achieve desired demand for money in Kenya, the study suggests that the government through Central Bank together with the parliamentary monetary committee to consider revising monetary tools like open market operations, interest rate controls, credit controls among others. Policymakers and practitioners should ensure availability of derivative instruments to enable savers and investors cope with volatility. In addition, fixed-interest rate term finance contracts can be availed, at a higher cost than variable-interest term finance contracts.

ACRONYMS AND ABBREVIATIONS

APR: Average Percentage Rate

CBK: Central Bank of Kenya

CBR: Central Bank Rate

EAC: East Africa Community

GDP: Gross Domestic Product

GNP: Gross National Product

IRV: Interest Rate Volatility

KBRR: Kenya Bankers Reference Rate

MS: Money Supply

SAP: Structural Adjustment Program

SSA: Sub-Saharan Africa

OPERATIONAL DEFINITION OF TERMS

Bond Maturity: It is the date or period when the issuer is entitled to repay the principal amount of the bond back to the holder.

Bond: A debt instrument issued for a period of not less than one year with the purpose of raising debt capital by borrowing.

Equilibrium Real Rate of Interest: It is the rate of time preference or the rate of return on real investment. It is also the social rate of time preference such that the total private savings are equal to the total private investment.

Hedging Pressure of Preferred Habitat Theory: Postulates that, lenders and borrowers have different preferences in bonds they issue or hold; that is, some individuals prefer to issue or hold long-term bonds and short-term bonds. Risk averse investors must be induced by attractive rates to relocate a portfolio in favor of less desired maturities. Thus, this theory argues that, interest rates do not influence the underlying patterns of bond yields.

Inflation: It is sustained rise of general price of products within an economy during a certain period of time (usually one year).

Interest Rate: It is the percentage charged by lenders on the total amount of a loan.

Liquidity Preferences Theory of the term structure of interest rates: It is the theory that seeks to explain the downward slope of the aggregate money demand curve in terms of the need by an individual to hold stock of cash to meet financial obligations as and when they fall due.

M1: This is narrowly defined money. This includes currency and coins.

M2: This is M1 and short-term time deposits in banks and 24-hour money market funds.

M3: This is a combination of M2, long-term time deposits and money market funds with more than 24-hour maturity. It is also M2 plus foreign currency deposits held by residents.

Market Segmentation Theory of the term structure of interest rates: Postulates that investors are considerably risk averse. They only operate within their desired bond market; that is, either short-term bond market or long-term bond market.

Money Demand: It is the desire to hold money in form of cash and/ or bank demand deposits.

Nominal Interest Rate: It is the interest rate before taking consideration of rate of inflation. It is the rate indicated in deposit agreements and loans. Fisher, (1947) defines it as the sum of real interest rate and inflation.

Rational Expectation Theory: This postulates that current individual's actions or behavior will be guided by their motivation towards the future. For instance, the future expected interest earnings will determine individual's desire to purchase bonds today. An individual can choose to hold a long-term bond or short-term bonds that are sequentially replaced over the specific period of the long-term bond.

Real Interest Rate: It is the interest rate after adjusting for inflation. The Fisher equation simply defines it as nominal interest rate less inflation rate.

Volatility of Interest rates: It is the measure of the dispersion of interest rate (or returns from any other financial instrument) in a given period of time (usually one year). A simple measure of this is how much interest rates move up or down on average per week, day or month.

Yield Curve: It is a curve indicating how interest rates or yields, offered by a bond issuer, vary according to maturity or duration of bonds. It is also referred to as the term structure of interest rates.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Understanding interest rate volatility is important, especially for formulating and implementing monetary policy. According to Walsh (1984), an increase in interest rate volatility leads to structural changes within the financial sector, thereby influencing demand for money. Any factor that has a positive effect on demand for money can adversely affect the economy through its negative effect on nominal income (Celikoz & Arslan, 2011). Nominal interest rate consists of two components namely, the expected real rate of return and inflation rate. Thus, nominal interest rate volatility may result from the volatility of real rate of return or inflation rate. It can also be caused by volatility in both the real rate of return and inflation rate.

Empirical studies have established that an increase in real interest rate volatility will lead to a rise in money demand. In addition, several studies have showed that a negative relationship exists between demand for money and inflation volatility. This is attributed to the fact that an increase in volatility of inflation results into a situation in which very liquid assets such as money (cash) becomes risky to hold since their value reduces significantly during high inflation. The main risk associated with inflation rate volatility is that it results into reallocation of investment portfolios from nominal assets to tangible assets such as commodity inventories. This further increases inflation rate, which ultimately affects the demand for money negatively (Celikoz & Arslan, 2011).

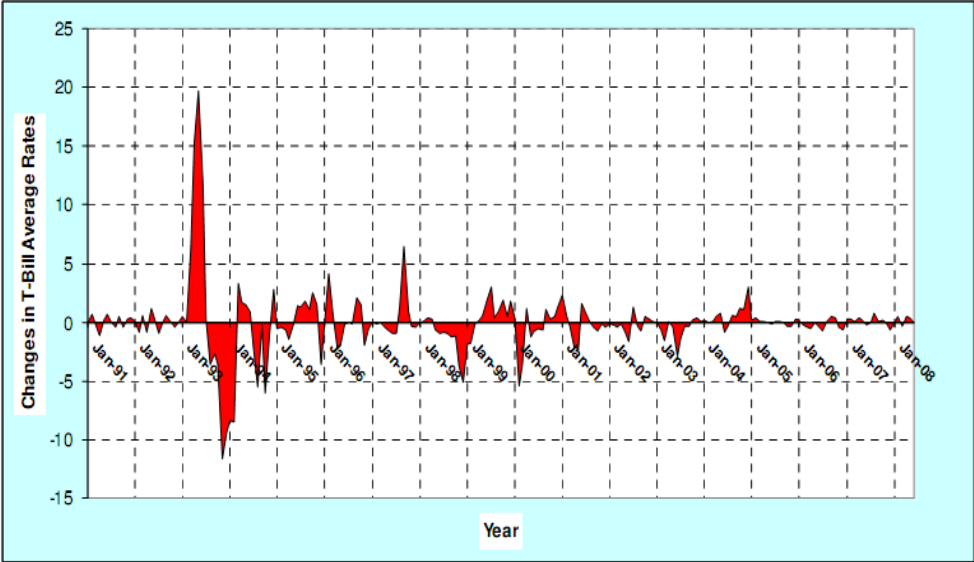
1.2 Bank Interest Rates and Bank Interest Spread in Kenya

In Kenya, lending interest rates charged by commercial banks are determined by among other factors, the cost of liquidity, deposit interest rate, banks' operating costs, and the cost of holding cash. Deposit interest rate is mainly influenced by the lender's (bank) financial stability often proxied by bank's cash ratio (Olweny, 2011). According to Olweny (2011), the cost of holding cash is determined by the amount of cash that banks need to satisfy customers' demand expectations. Banks also have to take into account their operational costs when determining their base lending rate. The operating costs include the costs associated with running a bank, as well

as, acquiring capital, technology, and staff. These costs can often be reduced by enhancing efficiency at firm level. Prior to the introduction of structural adjustment programs (SAPs) in the 1980s, Kenya’s financial system experienced severe repression. The government relied mainly on direct control of interest rate as its principal monetary instrument. As a result, interest rates were always kept below market rates. However, SAPs led to deregulation of interest rates. As a result, interest rate rose by 4 %, reaching a high of 14 % in 1991. Competition among lending financial institutions also increased. This led to a decrease in the interest rate differential that existed between banks and deposit taking financial institutions.

The government started selling treasury bonds through competitive auction system in 1989. This marked the beginning of deregulation of interest rates. Figure 1.1 shows the changes in short-term interest rates after deregulation. It can be observed that sporadic changes of interest rates between years 1993 and 1994 can be attributed to the political events of the multipartism in the country. Further, this similar behavior is observed although with lower magnitude compared to the first one between years 1997 and 1998 which is likely to be triggered by the global financial crisis.

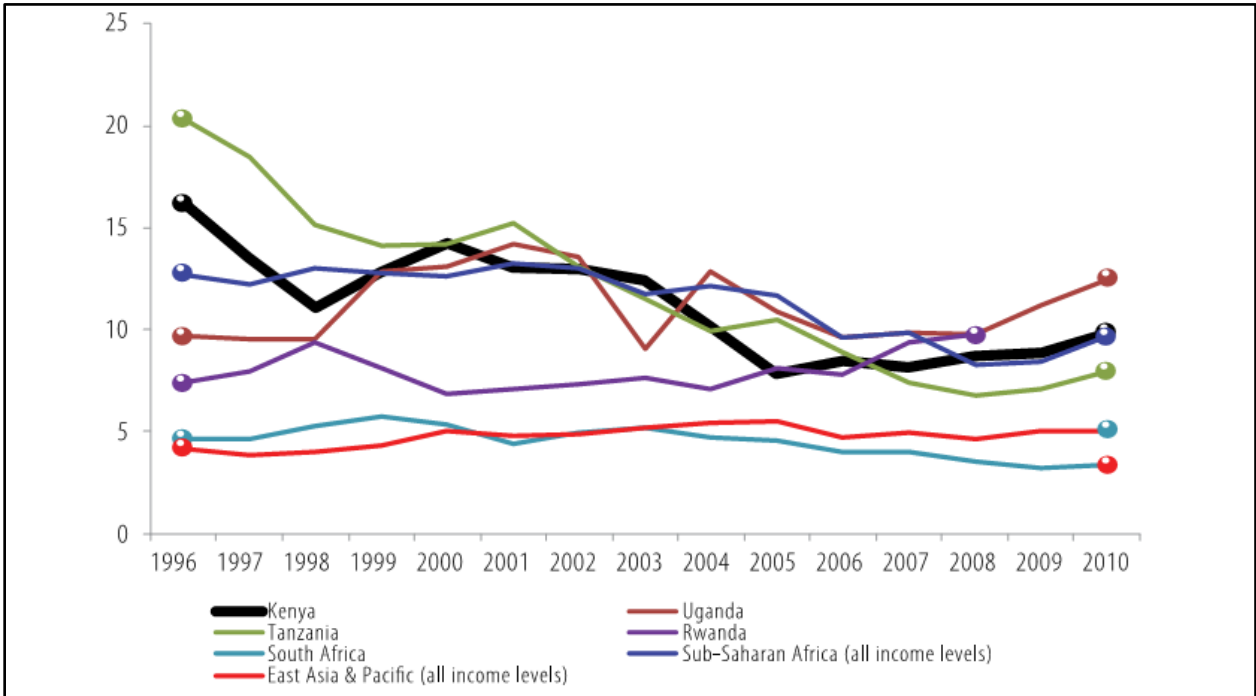
Figure 1.1: Differenced Series of Monthly Average of Sample of Short Term Rates (Jan 1991-June 2008)



Adapted from Were and Wambua, (2013)

Figure 1.2 compares interest rate spread in select countries for the period 1996 to 2010. It shows that Kenya's interest rate spread in general is comparable to the average for Sub-Saharan Africa (Were & Wambua, 2013). Nevertheless, Kenya's interest rate spread is still significantly higher than that for South Africa, East Asia, and the Pacific Region. Within the East Africa Community (EAC), Uganda has the highest interest rate, followed by Kenya, Tanzania, and Rwanda, (WDI, 2010). This shows that high interest rate spread is not only a problem in Kenya but also in other countries. However, the interest spread has been declining since 1990s.

Figure 1.2: Kenya's Interest Rate Spread compared with other regions (1996-2010)

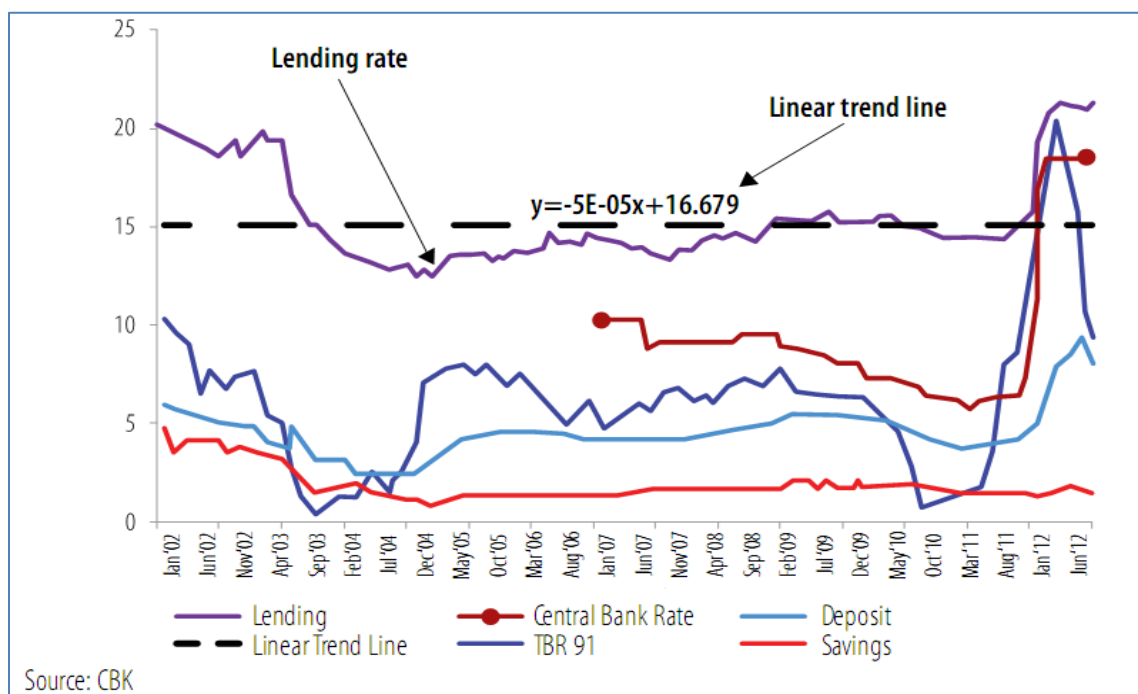


Source: World Development Indicators (2010)

According to Figure 1.3, lending interest rate has been declining steadily from 2002 to 2012. However, in mid 2000s the decline in lending interest rates was generally slower than that for other interests. The decline in lending interest rate was attributed to among other factors, monetary easing policies such as the reduction of policy rate from 8.5 % in 2009 to 5.75 % in 2011 (Were & Wambua, 2013). Similarly, the reduction of cash reserve ratio from 5 % to 4.5 % in mid 2009 contributed to the decline in lending interest rate.

From 2002 to 2012, Kenya’s treasury bills rate reduced from 8.46 % in January 2009 to nearly 1.63 % in July 2010. By contrast, lending interest rate declined only marginally from 14.78 % in January 2009 to 14.9 % in July 2010. In 2011, the Central Bank of Kenya resorted to monetary tightening by raising the Central Bank Rate (CBR) to 18 %. Consequently, lending interest rate increased immediately by up to 20 %. This suggests that lending interest rates in Kenya are more likely to increase than to reduce in response to monetary policy. The savings rate has only changed marginally, with average being 1.6% between 2009 and 2011.

Figure 1.3: Interest Rates Trends (2002-2012)

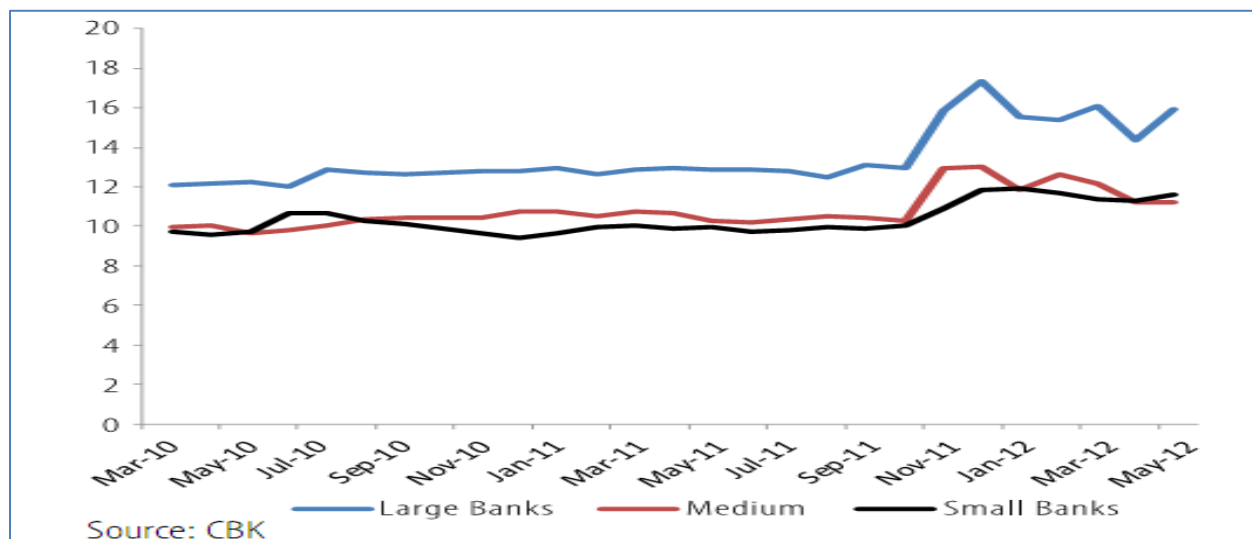


Source: Central Bank of Kenya (2013)

Figure 1.4 compares interest rate spread among different sizes of banks. The figure shows that in general, large banks have higher interest rate spread than small and medium sized banks. Small banks generally have lower interest rate spreads. This is attributed to the fact that small banks with low capitalization often find it difficult to raise funds. As a result, they have to increase their deposit interest rates to increase their deposits, which they use to issue loans. This reduces their interest rate spread. Trend analysis reveals that interest rate spread in general increased

marginally from approximately 9.95 % in 2002 to 10.6 % in 2011. It further rose to nearly 12.2% in early 2012.

Figure 1.4: Interest Rate Spread by Bank Size



Source: Central Bank of Kenya (2013)

1.1.2 Development of Interest Rate Volatility

Garner (1986) acknowledges that business cycle is among the major factors that cause volatility of interest rate. For instance, a recession causes a reduction in real output, which in turn affects interest rate due to the fact that the level of economic activity influences demand for money and credit. Thus, large shocks in the economy often lead to high volatility. Inflation rate, actual and expected, is also a major determinant of interest rate volatility. The gross domestic product (GDP) deflator is one of the measures of inflation. A significant increase or decrease in GDP deflator is likely to cause interest rate volatility. Low inflation expectations leads to a reduction in nominal interest rate because borrowers often demand low interest rates when they expect little depreciation of the currency during loan repayment. Similarly, lenders are more likely to accept low nominal interest rates when they expect low inflation rate.

The oil shocks of 1974 and 1979 led to an increase in the cost of doing business in several countries including the US, thereby causing interest rate volatility. The high cost of oil was passed to consumers in terms of high cost of goods and services. This led to high inflation rate,

which was worsened by expectations of higher inflation due to oil shortages. High actual inflation rate leads to uncertainty concerning future rates of inflation. Consequently, significant fluctuations in actual and expected inflation rate cause interest rate volatility.

Interest rate volatility can also result from deregulation of interest rates on various types of credit and bank deposits. In Kenya, the Monetary Control Act 1980 led to deregulation by linking bank deposit rates to money market securities. Following removal of interest rate ceiling on mortgages and consumer credit, the volatility of interest rate has become higher than the pre-deregulation period. In the pre-deregulation period, lenders equated the demand and supply for credit by adjusting the non-price terms and loan conditions such as maturity and minimum down payment. Currently, much of the adjustment occurs through changes in interest rates. Garner (1986) notes that interest rates may have to increase much more than expected under deregulation in order to achieve the desired level of credit demand. Thus, deregulation can also lead to interest rate volatility.

The policy choices of central banks also contribute to the volatility of interest rates. For instance, the high volatility of interest rates in early 1980s was caused by the operation procedures of the Federal Reserve in October 1979. At first, Federal Reserve executed monetary policy mainly based on federal funds rate. Despite that federal funds changed from time to time, the policy of Federal Reserve to some extent smoothed the short-term interest rates. The Federal Reserve introduced the change that was made to put emphasis on attaining a target path for non-borrowed reserves.

The Federal Open Market Committee (FOMC) was willing to endure wider swings of short-term interest rates. According to Garner (1986), increases and decreases in money demand, and correspondingly in the demand for bank reserves, were no longer accommodated in the short run but were allowed to affect the scarcity of reserves and therefore, interest rates. As per the anticipation of economists, greater volatility of interest rates characterized the non-borrowed reserve operating procedures. Economists still do not have consensus over the essential role of monetary policy operating procedures together with other explanatory procedures. This implies

that, to some extent, central bank operating procedures have a significant effect on the volatility of interest rates.

1.1.3 Interest Rate Volatility, Interest Rate Level and Velocity

Garner (1986) maintains that, although interest rate uncertainty may not affect money demand, greater interest rate volatility could have broad macroeconomic consequences. Actually, a higher interest rate uncertainty could increase the average level of interest rates by raising the demand for money. Similarly, long-term assets tend to become less attractive in case of greater risk of price fluctuations associated with the swings in interest rates. Thus, the interest rate uncertainty could increase long-term interest rate through increasing their risk premiums (Garner, 1986).

Sequentially, a higher average level for interest rates (in long term) could depress real output as well as the employment in numerous ways. For instance, higher long term interest rates discourage business fixed investment, residential construction, and interest-sensitive consumer spending. Further, within the system of flexible exchange rates, higher interest rates tend to attract foreign capital inflows, which cause domestic currency to appreciate (Garner, 1986). A currency that is strong in the market will culminate into the decline of real economic activity via the reduction of exports and also dampening production especially within import-competing industries.

High interest rate volatility can also cause a decline of money velocity. Money velocity (the rate of money turnover) is equal to nominal gross domestic product (GNP) divided by the supply of money (MS – money supply) (Garner, 1986). Therefore, when high volatility of demand raises the desired money holdings, then, the velocity of money will decline. As such, the relationship between money supply and GNP will be different when interest rate volatility is constant. Following the aforementioned reasons, the effects of volatility of interest rates on the demand for money are essential in the formulation of monetary policy of a country (Garner, 1986). For example, policy makers may set target growth ranges which are based partially on the anticipated behavior of money velocity in the following year. An anticipated increase of demand for money and the subsequent unexpected decline of money velocity caused by higher uncertainties in interest rates may mandate a faster money growth so as to achieve the desirable economic results

(Garner, 1986). A failure to put into consideration the effects of changes in volatility of interest rates may lead to the pursuit of an erroneous money growth objective tools.

1.1.4 Types of Money demand

Money demand emanates from the money's properties of transaction use and the quality of store of value. There are three forms of money demand; that is, the transaction demand for money, the precautionary demand for money and the speculative demand for money.

1.1.4.1 Transaction Demand for Money

The transaction demand for money is the demand of money by the businesses and households to hold money balances instead of holding other assets like stocks, bonds, or any other forms of financial instruments (Shim, & Siegel, 1993). Mainly households and businesses prefer to hold money in order to undertake daily payments and purchases of goods and services. The level of nominal GDP (gross domestic product) determines the transaction demand for money. That is, the larger the monetary value of services and goods within an economy, the large the size of transaction demand for money. The rise in demand for money emanates from the rise of price and/ or real output. According to Shim and Siegel (1993), this type of money demand does not depend on the rate of interest; however, it varies directly with the level of national income only (Shim, & Siegel, 1993). As such, the transaction demand for money is not influenced in any way by the volatility of interest rates.

1.1.4.2 Precautionary Demand for Money

Shim and Siegel (1993) defines the precautionary demand for money as the demand for money used to make any unforeseen payment. Households and business hold some amounts of money because they intend to spend it on unplanned purchases such as the purchase of medical services for family or the emergence maintenance of a factory. The precautionary demand for money is inversely influenced by the level of interest rate and related directly to the level of national income only (Shim, & Siegel, 1993). Therefore, volatility of interest rates does may have effect on the precautionary demand for money.

1.1.4.3 Speculative Demand for Money

The speculative demand for money is the demand for money in the expectation (or anticipation) of higher rates of return or (higher interest rates) in the future (Shim, & Siegel, 1993). That is, individuals consider holding larger money balances in case they anticipate the rise of interest rates in the future instead of tying the money on the bonds now. The speculative demand for money has an inverse relationship with the interest rates. Consequently, the total demand curve of the demand for money of liquidity is also downward sloped when plotted against interest rates (Shim, & Siegel, 1993). In regard to the relationship between the volatility of interest rates and money demand, there are mixed results in reference to empirical evidence; however, the theory considers the positive correlation as the eminent one.

1.2 Statement of the Problem

Volatility of interest rates has been noted in numerous economies. This has the potential to affect the economic performance of a country. Garner, (1986) suggests that one channel by which interest rate volatility affect economic performance and monetary policy decisions is through the demand for money. A factor that increases the demand for money may adversely affect economic performance by increasing nominal income and velocity of money circulation, (Arslan and Celikoz, 2011). Similarly, it's argued that it may be probable and to a high degree that uncertainty should raise the demand for cash balances, which eventually leads to reduced velocity. This implies that the increase of money demand will show greater reluctance by financial investors towards holding of securities. Prospective bond issuers will have the incentive to increase the interest rates they offer on bonds. In addition, the volatility of interest rates could affect monetary policy since the rise of money demand emanating from high volatility of interest rates could require the central bank to increase its target growth ranges for monetary aggregates (Garner, 1986). Few empirical studies have confirmed the importance of the influence of volatility of interest rate on the demand of money and in particular in Kenyan economy. This research study seeks to address the effects of volatility of interest rates on the demand of money in Kenya.

1.3 Research Questions

1. What are the trends of interest rate volatility in Kenya over the entire study period?
2. What is the effect of interest rates volatility on money demand in Kenya?
3. What are the relevant policy interventions required based on the study findings?

1.4 Objectives of the Study

1.4.1 General Objective

The main aim of this study is to determine the effects of interest rate volatility on money demand in Kenya for the period 1980 to 2014.

1.4.2 Specific Objectives

1. To identify interest rate volatility trend for Kenya during the study period.
2. To determine the effect of interest rate volatility on the demand for money while controlling for conventional determinants of money demand.
3. To propose appropriate policy recommendations in line with the findings of the study.

1.5 Justification of the Study

This study reviews the effects of interest rate volatility on money demand in Kenyan economy. The study results are necessary as they enhance the knowledge of how interest rate volatility predicts money demand in Kenya. On the other hand, the study shall provide an insight on how the Central Bank of Kenya (CBK), commercial banks in Kenya and other financial systems should take into account in their policies to control money demand through borrowing and savings. For instance the Monetary Policy Committee may benefit greatly from the findings of this paper. The study provides vital knowledge to institutional investors and individual households that influence their investment decisions.

1.6 Scope and Limitation of the study

This research study given the constraints of time and data, considered the effects of interest rate volatility on money demand in Kenya. As such, the research study has not covered other countries.

The research study relied on yearly data collected from 1980 to 2014. The reason for this was majorly because of availability of reliable data and in order to be able to meet the minimum sample requirements for a time series data, where $n=30$. This data was obtained from Kenya's money credit markets particularly the banking sector.

Putting into consideration that the demand of money in Kenya is still on the nascent stage, the size of money demand that is influenced by interest rate volatility is not well defined.

Confidentiality of bank interest rates and presence of hidden charges makes the data obtained not to be in a position to explain the money demand in Kenya. The Central Bank of Kenya has recently introduced the KBRR which in turn has an effect on the APR. Once data on APR charged by banks is available for a long time frame, a similar study may be undertaken for purposes of comparing research findings.

1.7 Organization of the Study

This research proposal is divided into five chapters. First, is the introduction which covers, the background of the study, research objectives, research questions, justification of the study, scope of the study and limitations of the study. The second part is the literature review. In this part, the research project explains the theoretical approaches towards the effects of interest rate volatility on the money demand. Further, this part compiles the empirical studies that examine the relationship between the demand of money and the volatility of interest rate. The third part is the research methodology, which explains the theoretical framework; model specification; data and time series properties. Chapter four presents the empirical results and the interpretation of the same. Finally, chapter five provides a summary of the study, conclusions and policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this chapter we shall present both theoretical and empirical literatures regarding factors affecting money demand with a key focus on interest rate volatility. This shall give us more insight on money demand in Kenya and thus set the basis of the study.

2.2 Theoretical Literature Review

The interest rate constitutes the %age paid or charged for use of money. Interest rate is charged on borrowed money, which is commonly referred to as loan. According to Muriuki (2013), the interest rate constitutes the %age charged by lenders on the total amount of a loan. In particular, interest rate is the %age payable based on the principal amount of the loan within a specified period of time. It is the borrowers who pay interest rates to the lenders. Mostly banks charge higher interest rates. Higher interest rates imply that few individuals and businesses are willing or able to make borrowing. Higher interest rates lower money demand, amount of credit meant to fund purchases and consumer demand (Muriuki, 2013). Further, higher interest rates encourage individuals to make savings due to the attractive interest rate on savings. Higher interest rates lead to inadequate capital, a problem that is more severe for expanding businesses. Insufficient liquidity may lead to a downturn in economic activities.

2.2.1 The Loanable Funds Theory

The loanable funds theory of interest rate builds on the classical savings and investment theory of interest rate. The main agreement of the loanable funds theory is that equilibrium interest rate in an economy is determined at the point where the supply and demand for loanable funds are equal. In this case, interest rate can be seen as the price of the loanable funds. The theory is based on the assumption that the loanable funds market is fully integrated with perfect mobility of capital. It also assumes that there is perfect competition, which makes borrowers and buyers price takers. In this theory, interest rate is determined using a partial equilibrium model in which

all factors except interest rate are held constant. This means that interest rate is the only macroeconomic factor that determines the demand and supply of loanable funds.

The supply of loanable funds is determined by the aggregate savings in the economy, supply of money, and aggregate dishoarding of money. Since savings and aggregate dishoarding are increasing functions of interest rate, and money supply is often exogenous, the supply of money is expected to be an increasing function of interest rate. The demand for loanable funds is determined by gross investment expenditure and incremental demand for money (hoarding). Demand for loanable funds is a decreasing function of interest rate. Thus, the factors that determine the supply and demand for loanable funds will lead to equilibrium interest rate.

2.2.2 Portfolio Theory of Money Demand

Numerous theories have advocated for diverse relationships (positive or negative) between interest rate volatility and the demand of money Choudhry, (1999). Portfolio theory of money demand indicates that high interest rate volatility leads to a high demand for money. Although money is a desirable asset within financial portfolios, its returns proxied by interest rate are often lower than that of other assets. This is attributed to the fact that during high interest rate volatility, the value of money will relatively remain intact, while the value of assets such as bonds will change. This makes money less risky (Celikoz & Arslan, 2011).

2.2.3 Transaction Demand for Money Theory

Celikoz and Arslan (2011) noted that the transaction demand for money also increases when interest rate volatility increases. The risk associated with holding non-cash assets rises when interest rate volatility increases. Thus, individuals and firms will demand large risk free cash balances. This means that the demand for money and interest rate volatility have a positive relationship.

2.3 Empirical Literature Review

Longstaff and Schwartz (1993) established a negative relationship between interest rate volatility and bond yields. This means that an increase in interest rate volatility leads to a reduction in

bond yields. A decline in bond yields forces individuals to sell their portfolios and keep cash. This shows that the relationship between interest rate volatility and demand for money is positive.

Celikoz and Arslan (2011) studied the effect of interest rate volatility on money demand in Turkey. Their study showed that volatility of interest rate had a positive relationship with demand for money. However, the relationship was not statistically significant. GDP had a positive and significant relationship with demand for money in the long run. Other factors that were found to affect the demand of money negatively included inflation rate and exchange rate.

Walsh (1984) noted that a change in the manner in which money supply is adjusted affects the returns associated with other assets. A change in monetary policy was found to cause significant variations in interest rates and income elasticity of demand for money. This change was attributed to the fact that changes in bond prices are mainly determined by the policy decisions of monetary authorities.

Baba, Hendry and Stan (1993) investigated the relationship between interest rate volatility and transaction demand for money (M1) using the co-integration approach. Other independent variables that were considered in the study included treasury bill rate, real GNP, and inflation rate. Their study showed that the long term risk associated with interest rate volatility is positively correlated with the real demand for money.

Choudhry (1999) also used the co-integration approach to examine the relationship between interest rate volatility and demand for money (M1). The study considered both short and long-term interest rates for the period 1954-1996. The study found that the volatility associated with both long-term and short-term interest rate had a negative effect on real M1 demand.

Garner (1986) examined the effect of interest rate volatility on M1 using quarterly and annual data. Using annual data, the researcher found a negative and statistically significant relationship with M1. However, the relationship turned positive but statistically insignificant when quarterly data was used.

Payne (1992) estimated the relationship between 91-day T-bills rate and real M1 before and after 1979 period. In this study interest rate volatility was measured using two different methods. This included the four and eight-quarter moving standard deviation of actual interest rate, as well as, the moving standard deviation of anticipated interest rate. The study established a negative but insignificant relationship between real M1 and four-quarter moving standard deviation, anticipated interest volatility, and actual interest rate volatility in both periods. The coefficient of the eight-quarter moving standard deviation was statistically insignificant in the before 1979 period. The coefficient of actual interest rate volatility was positive and statistically significant.

Falls and Zangeneh (1989) studied the relationship between interest rate volatility and the demand for real M1 and M2. They used an interaction term that was developed as a product of 91-day T-bills rate and interest rate variance. Their study failed to support Walsh (1984) hypothesis, which states that an increase or decrease in interest volatility will cause an increase or decrease in income elasticity of money demand.

Using the Johnsen-Juselius approach to co-integration, Saglam (2005) investigated the effect of time deposit interest rate volatility on demand for money in Turkey. Interest volatility was estimated using moving sample standard deviation method. The study found that time deposit interest rate volatility has a negative relationship with demand for money. However, treasury bills rate volatility had a positive effect on demand for money.

Brousseau and Durre (2013) in their study of money market interest rates showed that the rates influenced monetary policy stance. Their study found that an increase in volatility might influence policy decisions through the yield curve over a period, thereby causing a higher risk premium. The authors also ascertain existence of measures of volatility of interest rates; historical volatility measures, model based volatility measures and the market based implied volatility measure. Consequently, the researchers concluded that interest rate volatility in longer maturities provide information concerning the underlying macroeconomic uncertainty, as well as, investors' perception on economic outlook.

2.4 Overview of the Literature Review

From both theoretical and empirical findings regarding the effects of volatility of interest rates on money demand, various factors affecting money demand have been revealed. Some of the factors include, Gross domestic product, inflation, exchange rate, interest rate volatility, financial innovation, treasury bills among others, (Brousseau and Durre, 2013; Falls and Zangeneh, 1989; Celikoz and Arslan, 2011; Litternman, et al., 1991). From the empirical literature, there are various measures of volatility of interest rates classified into three main categories; that is, historical volatility measures, model based volatility measures which includes conditional volatility models as well as stochastic volatility models and the market based implied volatility measure, (Brousseau and Durre, 2013). Different studies have given different effects of interest rate volatility on money demand in this chapter. Celikoz and Arslan (2011) note that, interest rate volatility has a positive effect on transaction demand for money; that is, the transaction demand for money increases with the increase of interest rate volatility. On the other hand, Longstaff and Scwartz (1993) note a positive correlation between interest rate volatility on bonds and the demand for money. They however, show that bond yields and interest rate volatility have a negative relationship which implies that the increase of interest rate volatility culminates into a decline of bond yields. Finally, Choudhry (1999), revealed a negative relationship whereby volatility of both long-term interest rates and short term interest rates had a negative effect on real M1 money demand. Although reviewed theoretical perspectives show multifaceted effects, the issues that relate to empirical studies demonstrate conflicting findings. Based on the reviewed studies, the debate on the effect of interest rate volatility on money demand in Kenya remains inconclusive. Therefore, this study is carried out to fill the gap by including more factors in the regression equation using the time series data collected for the period 1980-2014 and address various estimation issues which were not considered in the previous studies.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

In this chapter, the study presents the theoretical framework, empirical model, variable definition and expected signs, estimation issues and data sources. This section provides systematic procedures that will enable the research objective to be achieved.

3.2 Theoretical Framework

The underlying argument in the liquidity preference theory of money demand as summarized by Olweny, (2011) is that individual hold their wealth in either money or bonds and the interest rate is determined by the preference of holding either form of wealth. Thus expressing the demand for money in equation form becomes;

$$Md = f(y, i) \dots\dots\dots 3.1$$

Where Md is real demand for money, which is a function of real income (y) and interest rate (i) Real money demand is determined by among other factors, income, wealth, expenditure, opportunity cost of holding cash, and rate of return on money. Thus, equation 3.1 can be restated as:

$$Md = f Y, R \dots\dots\dots 3.2$$

Where Y includes income, wealth or expenditure in real terms and R is a vector of expected rates of return or the opportunity cost of keeping cash.

3.3 Empirical Model Specification

The study examined the effect of interest rate volatilities on real monetary aggregate money demand. The study employed Celikoz and Arslan (2011) log-linear money demand function. The independent variables utilized include volatility of interest rate on treasury bills, volatility of interest rate on time deposit, Inflation Rate and Exchange Rates. This model was further used by other authors like Bjornland (2005), Carruth and Sanchez-Fung (2000) as expressed below.

The model was expressed as;

$$M^d_t = \beta_0 + \beta_1 y_t + \beta_2 r m_t + \beta_3 r b_t + \beta_4 IRV + \beta_5 e_t + \beta_6 \Delta \rho_t + \varepsilon_t \dots\dots\dots 3.3$$

This function indicates that the real money demand on a specific time period (t) M^d_t depends on real income, y_t ; own rate of return on money, rm_t , which is also the deposit rate; interest rate, rb_t which is the rate of return on alternative assets to money; exchange rate e_t , which is the exchange rate of KES to the USD.; $\Delta\rho_t$ is the inflation rate; IRV is interest rate volatility, which is how wildly interest rates tend to increase or decrease on average and ε_t is the error term or the disturbance term is included in the model to capture the external influence.

According to Mutluer and Barlas, (2002) a log-linear form, indicates that the coefficients of the logarithmic variables can be interpreted as the long-run elasticity while the coefficients which are not expressed in logarithmic forms (interest rates) can be interpreted as the semi-elasticity.

The above model was expanded to accommodate other factors like financial innovation and population growth. This model has significant difference in the variables used by Bjornland (2005), Carruth and Sánchez-Fung (2000), since the former do not include financial innovation and population growth rate. The specified model was presented as below;

$$\ln m^d_t = \beta_0 + \beta_1 y_t + \beta_2 rm_t + \beta_3 rb_t + \beta_4 IRV + \beta_5 e_t + \beta_6 \Delta\rho_t + \beta_7 fi_t + \beta_8 pgr_t + \varepsilon_t \dots 3.4$$

Where:

$\ln M^d_t$ is the natural logarithm of money demanded in Kenya, fi_t , financial innovation which refers to technology advances which facilitate access to information, trading and means of payment, and to emergence of new financial instruments and services, Kipsang, (2014) and pgr_t , population growth rate, which is the yearly increase in the rate of population in a country. Other variables are as defined above.

Instead of interest rates, the volatility of interest rate as suggested by both Kenen and Rodrik (1986) which was also used by Arize (1998), to measure the exchange rate volatility was used for the study. This was constructed by the moving-sample standard deviation as expressed by Arize, (1998).

3.4 Variable Definition and Expected Sign

Table 3.1: Variable Definition, Measurement and Expected sign

Variables	Measurement	Expected sign
Dependent variable		
Money demand in Kenya (M3)-Broad money	This consists of M2 and M1. Long-term time deposits, money market funds with more than 24-hour maturity are included here. It is measured as a percentage of GDP.	
Independent variables		
Interest rate volatility	This is how much interest rates move up or down on average over a period of time. It is obtained from the moving-sample standard deviation.	Positive
National income/ GDP	This is the total market value of all final goods and services produced in a country in a given year. This is also measured in KES	Positive
Interest Rate	This represents the rate of return on alternative assets. It is measured as a percentage	Negative
Exchange rates	The average exchange rate of the local currency. Measured in KES.	Negative
Inflation	This refers to the general increase in price of goods and services in an economy. Measured as a percentage change in consumer price index.	Negative
Financial innovation	This refers to technological advances which facilitate access to information and emergence of new financial instruments and services and complete financial markets. This is measured as a ratio of M2 to M1	Positive
Population growth rate	The yearly rate of population growth; This influences the demand for local currency and thus likely to trigger interest rates in the local financial institutions	Positive

Note: Interest bearing deposits are included in broad money while the interest rate on treasury bills is expected to be negative indicating an alternative return of money. Rising inflation induces agents to hold real domestic assets instead of money; the inflation rate is expected to affect demand for money negatively. Since the foreign exchange rate measures the rate of return on holding foreign currency, an increase in the exchange rate implies that the domestic money is depreciated and the expected return from holding foreign money increases. It can be said that the sign of exchange rate is negative, since depreciating in domestic currency, causes agents to substitute foreign currency instead of domestic currency.

3.5 Data Sources

The study will use secondary data (time series data) that will be obtained from different sources. These include Kenya National Bureau of Statistics (KNBS), International Monetary Fund (IMF), and World Bank's database.

3.6 Time Series Properties

The time series properties of the data were verified before analysis to avoid spurious regression. This included examining the stochastic properties of the variables by calculating their variance, mean, kurtosis, and maximum and minimum values. The stationarity of the series was also examined using the Augmented Dickey Fuller test. It is important to establish if there is stationarity amongst the variables in order to avoid biased results. The study conducted first differences of the variances which were found to be having a unit root at level until they became stationary. Co-integration test was also done to enable determination of long-run or short run relationship between the dependent variable and explanatory variables. In the absence of Co-integration, the estimates would be spurious. The Engle- Granger test will be employed to this effect. Here, the residuals are generated and then the first differences, lagged values and lagged values of the first differences are included in another sub sequent regression as regressors. If the p-value is less than 0.05, the null hypothesis that there is no co-integration is rejected.

3.7 Diagnostic Tests

The empirical model was estimated by OLS. The assumptions required for OLS, that is, best linear unbiased estimator (BLUE) should therefore not be violated. The diagnostic tests conducted were normality tests, homoscedasticity and absence of correlation between the independent variable and error term, also known as autocorrelation. Once the above steps are carried out, then one can evaluate the empirical model used for the study which is critical for all econometric studies.

CHAPTER FOUR RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the analyzed results for both descriptive as well as econometric estimation regarding the influence of interest rate volatility on money demand in Kenya. The findings are presented through figures and tables.

4.2 Descriptive Statistics

The study explores the averages, standard deviations minimum and maximum of volatility of interest rate, exchange rate, broad money supply as a percentage of GDP, real exchange rate, inflation, financial innovation and population growth rate. As indicated in table 4.1 volatility has a mean of $-3.38e-06$ with a slight variation of 9.2. The largest variation is 37.22 while the minimum is -12.38. The broad money was on average 39.05% over the entire period of study with the minimum and maximum proportion being 26.68% and 59.1% respectively.

Table 4.1: Summary Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Volatility	35	-3.38e-06	9.196494	-12.37695	37.21891
Broad Money	35	39.0456	8.391484	26.68185	59.1
GDP	35	20244.75	14100.87	8188.095	59849.82
Interest rate	35	8.168729	6.422773	-5.776589	21.09633
Inflation rate	35	12.80681	8.719015	1.554328	45.97888
Financial innovation	35	2.165812	0.5495889	0.2154542	3.37991
Population growth rate	35	28.29317	7.785061	16.297	42.927
Exchange rate	35	51.79918	28.55959	7.57	88.81077

4.3 Trend Analysis

Figure 4.1: Trends on Exchange Rate, Broad Money, Real Interest Rate and Financial Innovation

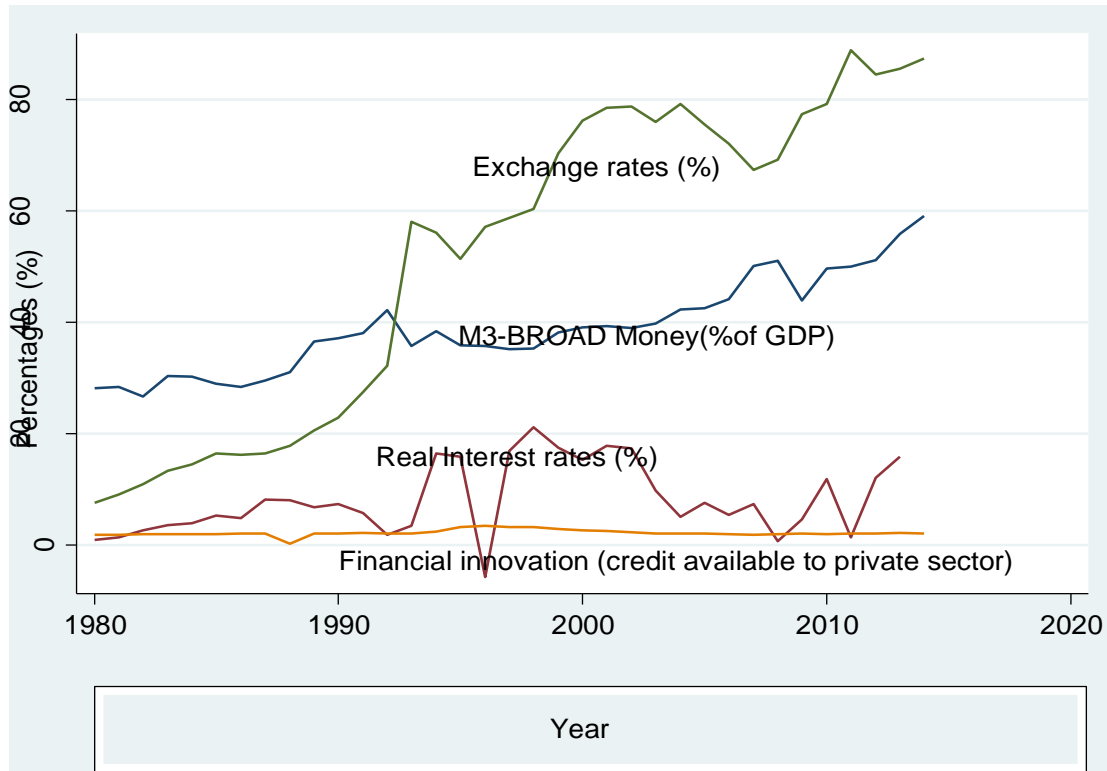
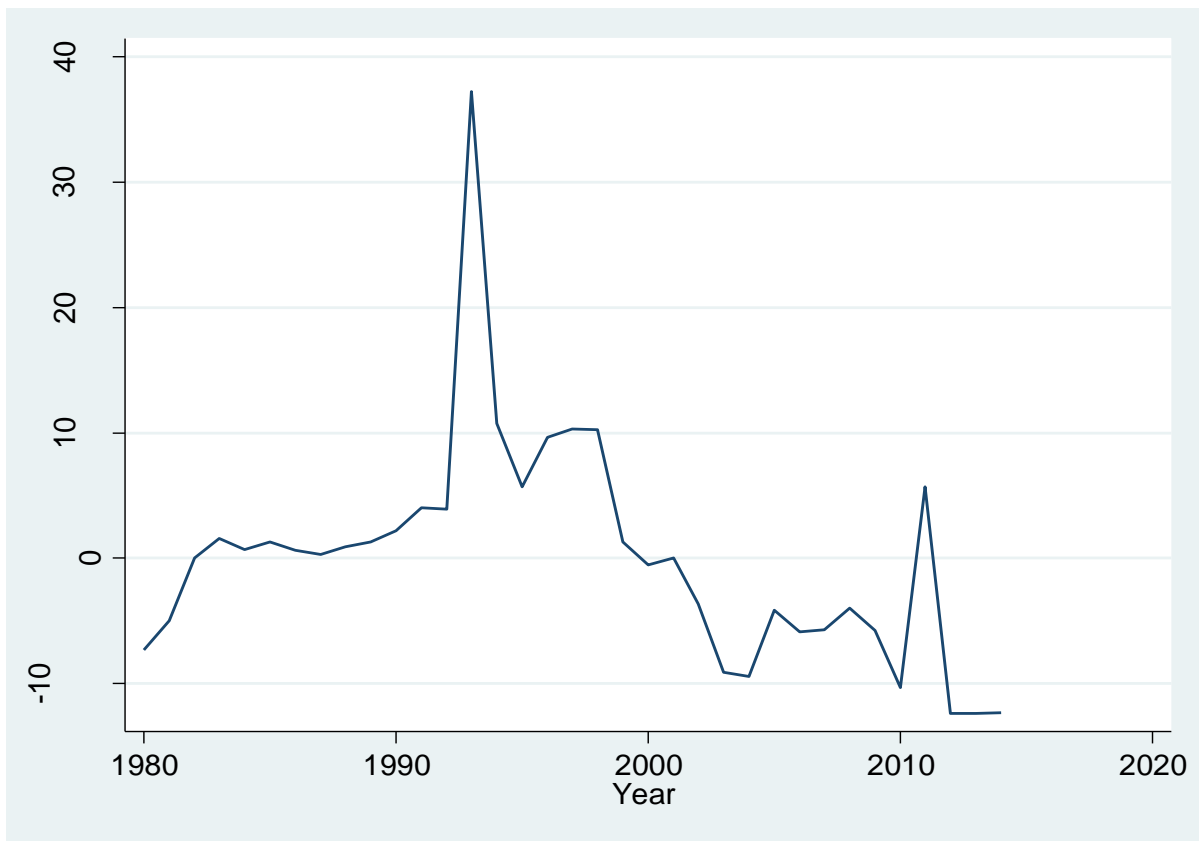


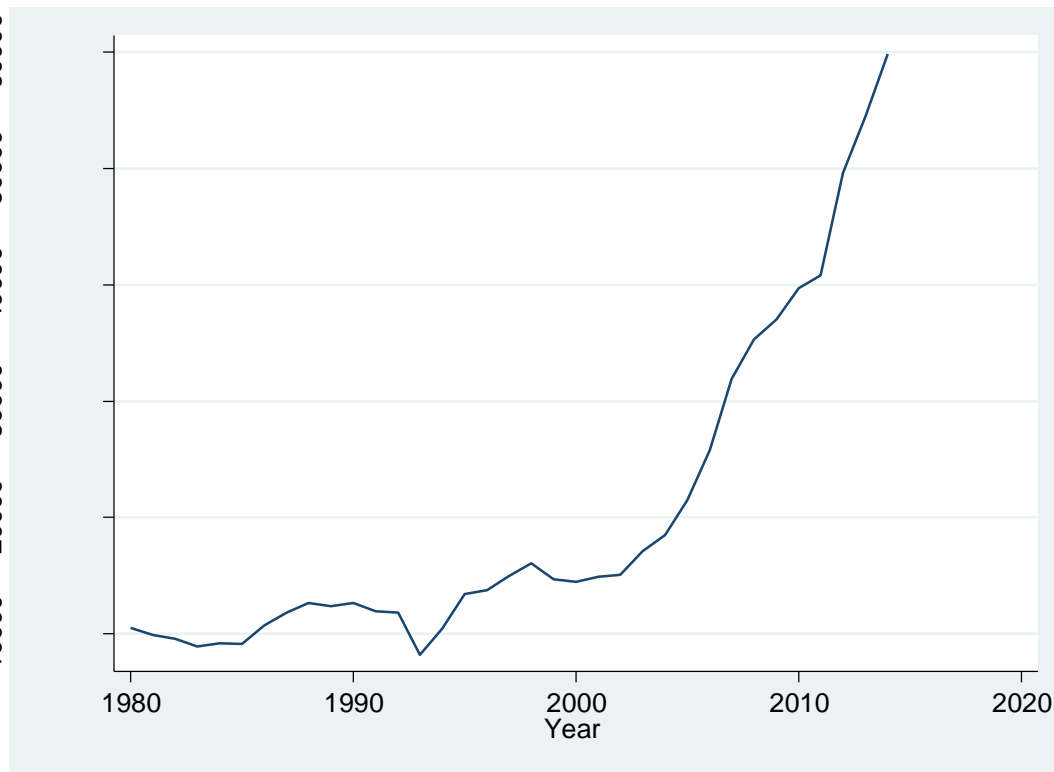
Figure 4.1 is a graphical illustration of trend of identified factors responsible in determining volatility of interest rates. There is an observed speedy rise of exchange rate from the start of period up to around 1992 thereafter, an increasing trend with a decreasing rate prevails until the end of the study period. Unlike the exchange rate, broad money indicates a slight increase throughout the period. However this increase is insignificant. Like exchange rate, real interest rate indicates a wavy trend which is consistent over the entire period of study. On the other hand, financial innovations are shown to have insignificant change throughout. This graphical illustration generally demonstrates inconsistencies in the period of study. This may be as a result of macroeconomic changes coupled with global financial crisis of the year 2008 together with social and political challenges of 1992, 1998 and 2007/2008.

Figure 4.2: Interest Rate Volatility



Volatility of interest rate experiences sporadic changes over the entire period of study. As indicated in the figure 4.2 the ‘ M’ shaped volatility shows an increasing trend with decreasing rate from the beginning of the study period to around the year 1993/1994. Between 1994 to 1996/1997 the country experienced the largest deviation ever seen in the entire period of study. Despite this deviation, between the year 1997 and 2009 there was a decreasing trend followed by a slight higher deviation between the year 2010 and 2012. This sporadic movements is as a result of various economic shocks as well as political events experienced at different periods

Figure 4.3: Gross Domestic Product



From figure 4.3, economic growth as measured by GDP portrays an increasing trend with increasing rate for the entire period of study. However, from the beginning of the study period to about the year 1991/1992 economic growth experienced a slight increase with almost constant rate. Thereafter the economic growth increased instantaneously and this may be attributed to structural adjustment programmes (SAPs).

4.4 Diagnostic Tests

The study conducted tests to verify various OLS assumptions as suggested in the methodology. They include unit root tests, co-integration, normality, autocorrelation, multicollinearity and heteroscedasticity.

4.4.1 Unit Root Tests

If variables are non-stationary, there is a tendency of the estimates to change over time. Unit root tests are used to detect non-stationarity in all the variables. This characteristic thus leads to the presence of spurious estimates. Therefore, if variables are found to be non-stationary, successful lagging is applied until the bias is eliminated. The null hypothesis in this case is that the variable under consideration is non-stationary or has got unit root. Augmented Dickey Fuller test is applied and out of all eight variables, only two variables are found to be stationary. However, upon conducting the first differences, they become stationary at lags zero.

Table 4.2: Stationarity Test

Variables	T statistics at lag (0) (-2.976)	T statistics at lag(0) after 1st differencing (-2.978)		Order of integration
Volatility	-3.056 (0.0300)	-	-	I(0)
Broad Money*	0.078 (0.9645)	-7.228 (0.0000)	-	I(1)
GDP*	5.108 (1.0000)	-2.868 (0.0493)	-	I(1)
Interest rate	-3.803 (0.0029)	-	-	I(0)
Inflation rate	-3.420 (0.0103)	-	-	I(0)
Financial innovation	-2.851 (0.0514)	-	-	I(0)
Population growth rate*	8.811 (1.0000)	-0.558 (0.8802)	-6.277 (0.0000)	I(2)
Exchange rate*	-0.955 (0.7692)	-5.417 (0.0000)	-	I(1)

*These variables have a unit root (H_0 : Variable is non-stationary¹).

¹ Condition: If the p-values are less than 0.05 we reject the null.

The results from Table 4.2, indicate volatility, interest rate, inflation, financial innovation, as being integrated of order zero while broad money, GDP and exchange rate were integrated of order one. On the other hand, population growth rate was integrated of order two. This implies that to be stationary, these variables which were integrated of order one and two had to be differenced once and twice respectively.

4.4.2 Co-integration

The study conducted co-integration analysis to establish existence of either a long run or short run relationship between money demand and interest rate volatility and among other independent variables. Having established the stationarity, the study generated the residuals and the first differences of the residual. The first differences, lagged values and lagged values of the first differences are included in another successive regression as model regressors. The null hypothesis of no long run relationship between volatility and other explanatory variables were tested against the alternative hypothesis of presence of long run relationship. From the results in the Table 8 below, the p-value of 0.000 is less than 0.05 implying that there is co-integration. This means that there is a long run relationship between money demand and volatility and explanatory variables. It implies that the variables under study move together in the same direction in the long run.

Table 4.3: The Engle-Granger Test

		Number of observations	= 30			
		F(2, 15)	= 25.47			
		Prob > F	=0.0000			
		R-squared	=0.6536			
		Adj R-squared	= 0.6279			
		Root MSE	= .09695			
D.uhat	Coef.	Std. Err.	t	P> t 	[95% Conf. Interval]	
Uhat						
L1.	1.014291	0.1543504	60.57	0.000	0.6975901	1.330992
LD.	-0.3836306	0.2234847	-1.72	0.098	-0.8421833	0.0749221
_cons	-0.0248448	0.5593811	00.04	0.965	-1.1726	1.12291

4.5 Regression Results

The main objective of this study was to establish the key factors that determine how interest rate volatility influences money demand in Kenya. Several multiple series for pre-test with key focus on presence of unit and co-integration needed in estimation were conducted which were necessary as they guided on the right transformation which led to determination of the appropriate transformation of the study variables and the relationship they exhibited through co-integration test. From co-integration, the variables were co-integrated and there was a long run relationship between them. The study therefore estimated the model and results are as indicated in Table 4.4

Table 4.4: Regression Results of Log -Linear Model

lnM3B	Coefficients	Std. Err.	t	P>t	[95% Conf.	Interval
Volatility	-0.0135512***	0.003988	-3.40	0.002	-0.0217821	-0.0053203
GDP						
D1.	0.000069***	0.0000134	5.17	0.000	0.0000415	0.0000966
Interest rate	0.0046861	0.0037006	1.27	0.218	-0.0029516	0.0123238
Inflation rate	0.0074218**	0.003493	2.12	0.044	0.0002126	0.014631
Financial innovation	0.0815276*	0.0437807	1.86	0.075	-0.0088313	0.1718864
PGR						
D2.	-0.14421	0.2897479	-0.50	0.623	-0.7422204	0.4538003
EXC						
D1.	0.0259876***	0.0057667	4.51	0.000	0.0140858	0.0378894
Constant	3.188275	0.1200645	26.55	0.000	2.940474	3.436076
Number of obs= 32						
F(7, 24) = 9.33						
Prob > F = 0.0000						
R-squared = 0.7313						
Adj R-squared = 0.6529						
Root MSE = 0.11308						

From the log linear model results, volatility, the first differences of GDP, inflation rate and financial innovation were significant factors in determining how interest rate volatility influences money demand in Kenya while interest rate and second differences of population growth rate were statistically insignificant. On overall model fitness, it was revealed that the probability value of 0.0000 which was less than 0.01 significant level implied that all the independent variables jointly and significantly determined money demand in Kenya at 1% significant level. Considering R squared the value of 0.7313 imply that the total proportion of dependent variable explained by independent variables is 73.13% while 26.87% is explained by other variables which are not considered in the regression or omitted variables.

4.6 Post Estimation Tests

4.6.1 Tests for Multicollinearity

Multicollinearity promotes biasness which arises when one or more pairs of independent variables are perfectly correlated to each other. The presence of Multicollinearity inflates the variance of parameter estimates leading to provision of wrong estimates and signs and thus incorrect conclusions. Table 4.5 indicates presence of Multicollinearity. The results show that inflation, population growth rate, expenditure, enrolment and remittances as variables with highest inflation factors promoting Multicollinearity since their $VIF > 10$.

Table 4.5: Variance Inflation Factors

Variable	VIF	1/VIF
Volatility	3.27	0.306056
Exchange rates		
D1.	2.62	0.381415
Inflation rates	2.46	0.406355
GDP		
D1.	2.38	0.420021
Financial innovation	1.51	0.663925
Interest rate	1.35	0.742591
Population growth rate		
D2.	1.08	0.923908
Mean VIF	2.10	

From the study, a correlation matrix was computed which indicates the relationship between various pairs of variables used in the study. The correlations were also low implying absence of Multicollinearity. See details at appendices (Table A1).

4.6.2 Autocorrelation

To test the assumption of non-autocorrelation, the Breusch Pagan test for autocorrelation was employed. This is meant to detect whether the error terms relates to any two different observations which are mutually independent. As shown in the study results in Table 4.6, it was found that there was no autocorrelation since the LM test has a p-value of 0.1650 which is more than 0.05.

Table 4.6: Breusch-Godfrey LM test for autocorrelation

Lags(p)	chi2	df	Prob> chi2
1	1.927	1	0.1650
H ₀ : No serial correlation			

4.6.3 Homoscedasticity

This refers to the constant variance of the error terms across all the observations. The residual plot method is used to test for it. The Breusch Pagan test for heteroscedasticity was also applied, where the p value of 0.9966 is more than 0.05. The findings indicate the absence of heteroscedasticity.

Table 4.7: Breusch-Pagan Test for Heteroscedasticity

Cook-Weisberg test for heteroscedasticity
Ho: Constant variance
Variables: Fitted values of lnM3B
Chi2(1) = 0.00
Prob > chi2 = 0.9966

H₀: Homoscedasticity

4.6.4 Model specification

The Ramsey reset test was also employed, to confirm if there were any missing variables and thus specification of the log linear model used.

Table 4.8: Ramsey RESET test for model specification

Test for specification using powers of the fitted values of lnM3B				
H ₀ : Model has no omitted variables				
		F(3, 21) = 2.24		
		Prob > F = 0.1132		

It is concluded that there is an insignificant p value implying the need to reject the null hypothesis, that there are no omitted variables. Therefore it means that variables of concern were considered. Therefore the model was well specified with the inclusion of important variables.

4.7 Discussion of the study

Based on the regression results, significant factors were considered for this study. If all factors were held constant, the study revealed that money demand will increase at 3.188%. On the other hand, higher interest volatility lowered money demand at 1% significance level by 0.01355% holding other factors constant. This study conflicts with the findings obtained by Baba, Hendry and Stan (1993) who investigated the relationship between interest rate volatility and transaction demand for money (M1) using the co-integration approach. The authors found that the long term risk associated with interest rate volatility is positively correlated with the real demand for money which concurred with the study results obtained in this study while Garner (1986), despite revealing a positive relationship with money demand, the relationship was statistically insignificant. Further, Choudhry (1999) found that the volatility associated with both long-term and short-term interest rate had a negative effect on real M1 demand.

For a unit rise in economic growth, the study found that money demand lowered by 0.000069% holding other factors constant at 1% significance level. This change is negligible.

This finding was contrary to the study results of Celikoz and Arslan (2011) showed that GDP had a positive and significant relationship with demand for money in the long run.

For a unit increase in inflation rate, it was found that at 5% significance level, money demand rose by 0.0074218% holding other factors constant. Celikoz and Arslan (2011) indicated that inflation rate affect the demand of money negatively.

At 10% significance level, higher financial innovation increased money demand by 0.0815276% holding other factors constant. This implies that increased credit availability to the private sector motivates demand for money.

Finally, money demand rose by 0.025987% holding other factors constant with a unit increase in exchange rate at 1% significance level. Similarly, Celikoz and Arslan (2011) found a contrary relationship which the study results that is they showed that exchange rate had a negative relationship.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Introduction

This chapter presents summary the findings of the study in relation to the objectives, literature review and main study variables. Conclusions based on the established relationship between money demand in Kenya and interest rate volatility are made and thus necessary recommendations are drawn. Further areas of study are captured as a way of filling the gaps identified in the study.

5.2 Summary and Conclusions of the Study Findings

This study was conducted with the main objective of evaluating the existing relationship between money demand and interest rate volatility in Kenya. The study was conducted via trend analysis and explored the nature and pattern of the study variables. Secondary data obtained from various statistical abstracts for the period 1980-2014 was used in this particular study. Ordinary Least Square (OLS) was employed as an estimation technique in modeling the relationship among the key and other moderating variables upon conducting various tests. The study variables used were volatility of interest rate as a variable of interest, GDP, interest rates, inflation rates, financial innovation, population growth rate and exchange rates as other control variables. Broad money was used as dependent variable. The hypothesis in this study was that interest rate volatility had a significant effect on money demand in Kenya. The study hypotheses were tested at 1%, 5% and 10% significance levels.

From the study results, it was shown that interest rate volatility, first differences of GDP, inflation rates, financial innovation and first difference of exchange rates were statistically significant while interest rates and the second difference of population growth rate were insignificant in determining money demand in Kenya. Further, volatility of interest rates and first differences of GDP were negatively related to money demand in Kenya. On the other hand, inflation rates, financial innovation and the first difference of exchange rates were found to have a positive relationship with money demand in Kenya.

In conclusion, literature indicates that large shocks in the economy often lead to high volatility of interest rates. On the other hand, high interest rate volatility can also cause a decline of money

velocity which in turn affects money demand. Therefore there is need to control for interest rate volatility to achieve desired demand for money.

5.3 Policy Recommendations

The aggregate savings in the economy, supply of money and aggregate dishoarding of money increase functions of interest rate and money supply which are often exogenous. This leads to the supply of money which is expected to be an increasing function of interest rate. Literature indicated that demand for loanable funds is determined by gross investment expenditure and incremental demand for money. This means that interest rate is the only macroeconomic factor that determines the demand and supply of loanable funds, similarly, the transaction demand for money also increases when interest rate volatility increases. Since the study revealed a negative and significant relationship, there is a need for the government through Central Bank together with the monetary policy committee to consider revising monetary tools like open market operations, interest rate controls, credit controls among others. This should be able to influence the demand for money while considering economic development.

5.4 Further Areas of Study

The study considered mainly the influence of interest rate volatility on money demand in Kenya. From the model specification, it was revealed that all important and relevant variables were considered. Further study should be conducted including only significant control variables explored in this study to determine the clear relationship between interest rate volatility and money demand. Since the study covered in Kenya, there is a need for further study of the same considering East Africa Countries adopting a dynamic panel analysis. There is need for future empirical studies to examine the significance of interest rate volatility on money demand. A similar study can be conducted, which will consider the influence of the Mundel- Fleming model and further increasing the data frequency to quarterly data, rather than annual. This will increase the sample size, but it will majorly depend on data availability.

REFERENCES

- Andersen, T., Bollerslev, T., & Diebold, F. (2002). Parameters and nonparametric measurement. *NBER Technical Working paper No. 279*, 1-64.
- Andersen, T., Bollerslev, T., & Meddahi, N. (2005). Correcting the errors: Volatility forecast evaluating using high frequency data and realized volatilities. *Econometrica*, 73(1), 279-296.
- Andersen, T., Bollerslev, T., Diebold, F., & Labys, P. (2001). The distribution of realized exchange rate volatility. *Journal of the American Statistical Association*, 96(453), 42-55.
- Baba, Y., Hendry, D. F., & Starr, R. M. (1992). The demand for M1 in the U.S.A., 1960-1988. *Review of Economic Studies*, 59(198), 25-61.
- Brousseau, V., & Durre, A. (2013, January). Interest rate volatility a consol rate-based measure. *European Central Bank: Working Paper Series*, No 1505, 1-38.
- Celikoz, Y. K., & Arslan, U. (2011, October). The effects of the interest rate volatility on Turkish money demand. *International Business Research*, 4(4), 286-297.
- Choudhry, T. (1999). Does interest rate volatility affect the US M1 demand function? Evidence from cointegration. *The Manchester School*, 67(6), 621-648.
- Fabozzi, F. J. & Leibowitz, M. L. (2007). *Fixed income analysis*, second edition. Hoboken, New Jersey: John Wiley & Sons.
- Fall, G. A., & Zangeneh, H. (1989). The interest rate volatility and the demand for money: The empirical evidence. *Quarterly Journal of Business and Economics*, 26, 26-42.
- Garner, C. A. (1986). Does interest rate volatility affect money demand? *Economic Review*, 25-37.
- Hansen, P., & Lunde, A. (2004). *An unbiased measure of realized variance*. Brown University, 1-27.
- Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, 12, 231-254.
- Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration – with applications to the demand for money. *Oxford Bulletin of Economics and Statistics*, 52, 169-210.
- Kimura, J. H. (1997). Interest rates in Kenya. *IPAR/ACPAK Seminar Report*, Nairobi.

- Litterman, R., Scheinkman, J., Weiss, L. (1991). Volatility and the yield curve. *Journal of Fixed Income*, 1(1991), 49-53.
- Longstaff, A. F., & Scwhartz, E. S. (1983). Interest rate volatility and bond prices. *Financial Analysts Journal July-August*, 70-74.
- Muriuki, N. M. (2013, October). *The effects of interest rates volatility on the growth of real estate market in Kenya* (Unpublished doctoral dissertation). University of Nairobi, Nairobi.
- Nampewo, D. (2013). What drives interest rate spread in Uganda banking sector? *International Journal of Economics and Finance*, 5(1), 76-85.
- Olweny, T. (2011, April). Modelling volatility of short-term interest rates in Kenya. *International Journal of Business and Social Science*, 2(7), 289-303.
- Payne, J. E. (1992). Money growth and interest rate volatility and the demand for money. *Journal of Economics and Finance*, 16(1), 103-114.
- Shim, J. K., & Siegel, J. G. (1993). *Macroeconomics*. Hauppauge, New York: Barron's Educational Series.
- Tobin, J. (1958). Liquidity preference as behavior towards risk. *Review of Economic Studies*, 25(67), 65-86.
- Walsh, E. C. (1984). Interest volatility and monetary policy. *Journal of Money, Credit and Banking*, 16(2), 133-150.
- Were, M., & Wambua, J. (2013). Assessing the determinants of interest rate spread of commercial banks in Kenya: An empirical investigation. *Kenya Bankers Association: One Industry , Transforming Kenya*, WPS/01/13, 1-25.

APPENDICES

Table A1: The data set used for the study

Year	M3B	volatility	gdp	interest	inflation	fi	pgr	exc
1980	28.17589	-7.32109	10512.03	0.942589	13.85818	1.836212	16.297	7.57
1981	28.34209	-4.97309	9913.352	1.410506	11.60305	1.872083	16.905	9.047498
1982	26.68185	0.00091	9548.191	2.605412	20.66672	1.992048	17.519	10.92233
1983	30.38808	1.57091	8877.561	3.572394	11.39778	1.911913	18.145	13.31152
1984	30.24395	0.66391	9188.705	3.83512	10.2841	1.891331	18.794	14.41388
1985	28.90107	1.32191	9103.748	5.257538	13.00657	1.962336	19.471	16.43212
1986	28.39891	0.64591	10740.89	4.864495	2.534276	1.996126	20.169	16.22574
1987	29.57702	0.28291	11824.91	8.15739	8.637673	2.032944	20.884	16.45449
1988	30.98193	0.89791	12638.78	8.026232	12.26496	0.215454	21.612	17.7471
1989	36.5178	1.27891	12372.61	6.815212	13.78932	2.106035	22.345	20.57247
1990	37.06523	2.20391	12659.05	7.332797	17.78181	2.085165	23.078	22.91477
1991	38.01601	4.01391	11931.3	5.745513	20.0845	2.164461	23.79	27.50787
1992	42.23227	3.94791	11794.39	1.825329	27.33236	2.009826	24.48	32.21683
1993	35.79169	37.21891	8188.095	3.413472	45.97888	2.06061	25.143	58.00133
1994	38.42265	10.73591	10419.44	16.42811	28.81439	2.418413	25.777	56.05058
1995	35.80718	5.70891	13420.85	15.80165	1.554328	3.157927	26.378	51.42983
1996	35.7708	9.67191	13732.75	-5.77659	8.864087	3.379911	26.984	57.11487
1997	35.16473	10.28891	14949.98	16.87957	11.36185	3.22917	27.594	58.73184
1998	35.24074	10.25391	16076.43	21.09633	6.722437	3.206885	28.173	60.3667
1999	38.15891	1.29491	14679.85	17.45405	5.742001	2.835338	28.818	70.32622
2000	39.02316	-0.52909	14456.55	15.32743	9.980025	2.635711	29.494	76.17554
2001	39.32703	0.01791	14891.63	17.8125	5.738598	2.478895	30.309	78.5632
2002	38.90672	-3.63109	15083.68	17.35814	1.961308	2.336759	31.147	78.74914
2003	39.7084	-9.07409	17095.03	9.770511	9.815691	2.038201	32.009	75.93557
2004	42.31659	-9.41109	18460.75	5.045258	11.62404	2.053991	32.894	79.17388
2005	42.54033	-4.15309	21493.28	7.609988	10.31278	2.054386	33.803	75.55411
2006	44.13801	-5.84509	25811.53	5.426264	14.45373	1.898311	34.738	72.10084
2007	50.07657	-5.70909	31921.25	7.314818	9.75888	1.786385	35.698	67.31764
2008	50.98023	-3.98909	35315.01	0.710642	26.23982	1.95121	36.686	69.17532
2009	43.9	-5.75909	37021.51	4.61571	9.234126	2.030773	37.7	77.35201
2010	49.7	-10.2991	39700.86	11.85799	3.961389	1.904405	38.5	79.23315
2011	50	5.72091	40831.81	1.326266	14.02155	2.013642	39.5	88.81077
2012	51.2	-12.3602	49617.32	12.07582	8.3	2.0669	40.7	84.5296
2013	55.8	-12.377	54443.18	15.79833	9.52	2.127415	41.8	85.56721
2014	59.1	-12.3101	59849.82		11.0373	2.062263	42.927	87.3753

Source: These include CBK, Kenya National Bureau of Statistics (KNBS), International Monetary Fund (IMF), and World Bank's database. **NB:** **M3B** represents broad money; **fi** is financial innovation; **pgr** is population growth rate and **exc** exchange rate