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The relationship between interbank transaction volume and exchange rate volatility in the Kenyan Shilling against the US Dollar

Mutahe Karuoro
Strathmore Business School (SBS)
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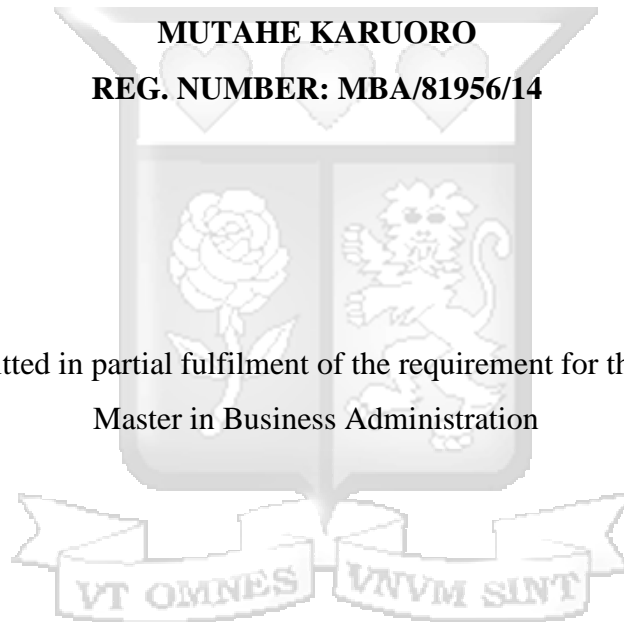
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**THE RELATIONSHIP BETWEEN INTERBANK TRANSACTION VOLUME AND
EXCHANGE RATE VOLATILITY IN THE KENYAN SHILLING AGAINST THE
US DOLLAR**

MUTAHE KARUORO
REG. NUMBER: MBA/81956/14

A Dissertation submitted in partial fulfilment of the requirement for the award of Degree of
Master in Business Administration



Strathmore Business School
Strathmore University
Nairobi, Kenya

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Mutahe Karuoro

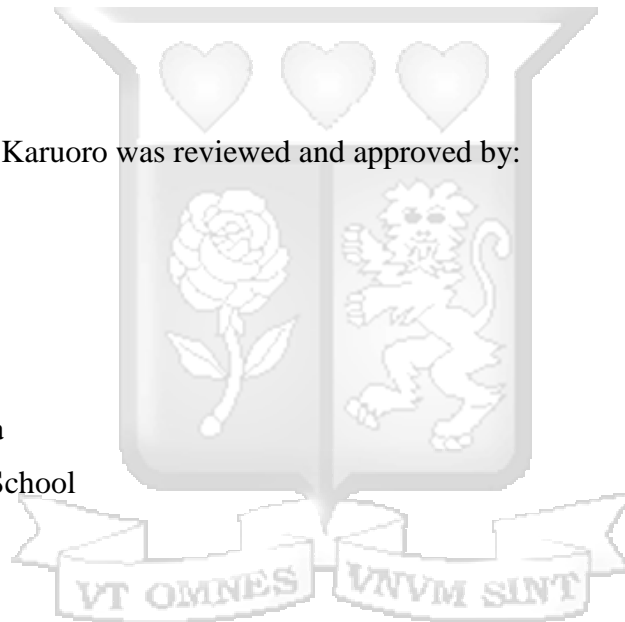
May 2018.

APPROVAL

This thesis of Mutahe Karuoro was reviewed and approved by:

Prof. Robert Mudida

Strathmore Business School



Dr. George Njenga,

Dean Strathmore Business School

Prof. Ruth Kiraka,

Dean, School of Graduate Studies

Strathmore University

ABSTRACT

The stability of exchange rate of a currency is an integral function of the overall economic performance of a country. This study sought to evaluate the effect of interbank transaction volumes on the exchange rate volatility of the Kenya Shilling against the US Dollar. The specific objectives were: to determine the causal relationship between interbank transaction volumes and exchange rate volatility of the Kenya Shilling against the US Dollar; to investigate the dynamic response of exchange rate to changes in interbank transaction volumes and to model exchange rate volatility. This study used secondary data for the period 2013 to 2017 from Central Bank of Kenya, Kenya National Bureau of Statistics and Thomson Reuters. The study used the Vector Error correction model to analyse the data. The findings of the study revealed that foreign exchange rate volatility and interbank trading volume are negatively related with no significant correlation between the variables. In addition, the study identified a negative relationship between interest rate and exchange rate volatility. The study recommends that the government should facilitate local manufacturing and production, which reduce reliance on imports arising from increased consumption of local products in the economy and increases exports. This would result in an improved balance of trade which in turn strengthens the local currency in relation to foreign currencies.



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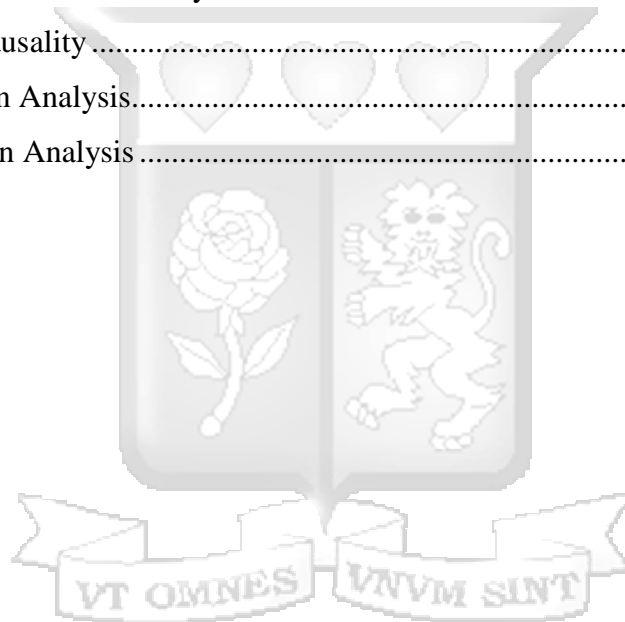
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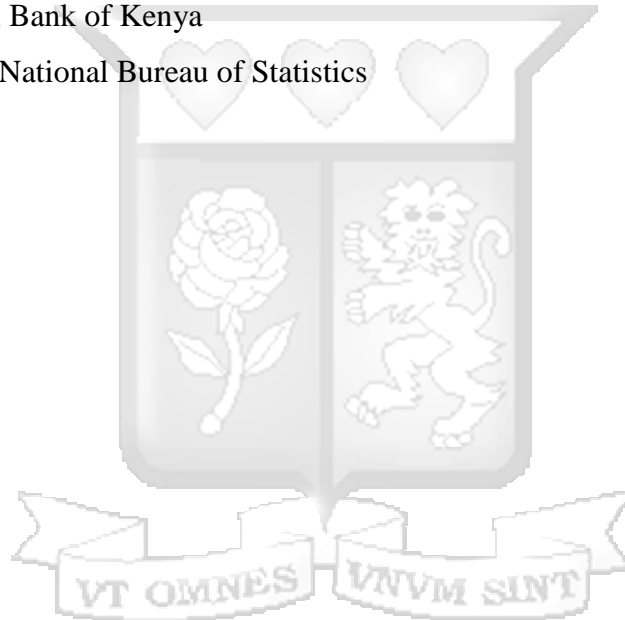
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ABBREVIATIONS

ADF:	Augmented Dickey Fuller
ARCH:	Autoregressive Conditional Heteroskedasticity
EXR:	Exchange Rate
GARCH:	Generalized Autoregressive Conditional Heteroskedasticity
IRF:	Impulse Response functions
OLS:	Ordinary Least Squares
VMA:	Vector Moving Average
CBK:	Central Bank of Kenya
KNBS:	Kenya National Bureau of Statistics



DEFINITION OF KEY TERMS

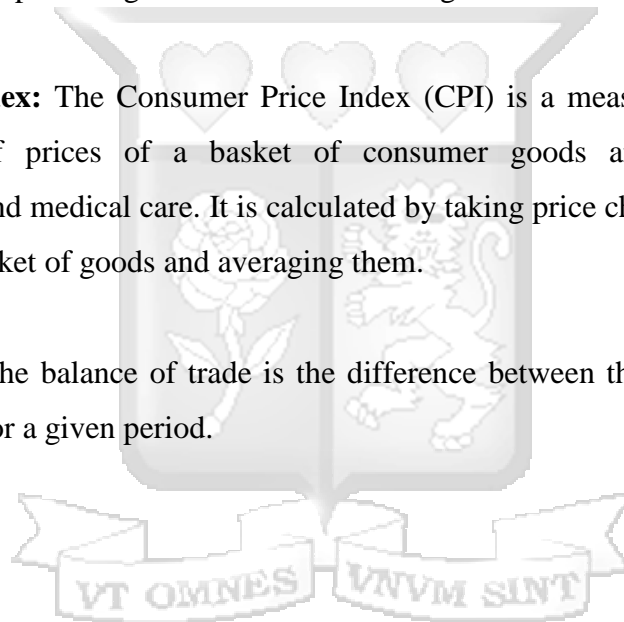
Interbank transaction: Describing any loan, deposit, transaction or other relationship between two banks. Interbank transactions provide a great deal of liquidity to the market. Interbank interest rates are often used as benchmarks for other rates.

Exchange rate volatility: Exchange rate volatility is defined as the risk associated with unexpected movements in the exchange rate.

Interest rate: the proportion of a loan that is charged as interest to the borrower, typically expressed as an annual percentage of the loan outstanding

Consumer Price Index: The Consumer Price Index (CPI) is a measure that examines the weighted average of prices of a basket of consumer goods and services, such as transportation, food and medical care. It is calculated by taking price changes for each item in the predetermined basket of goods and averaging them.

Balance of Trade: The balance of trade is the difference between the value of a country's imports and exports for a given period.



CHAPTER ONE: INTRODUCTION

1.1 Introduction

The significant role played by exchange rates cannot be underrated in a country's economy because it affects price level, productivity of firms, distribution of resources and investment decision (Taiwo, & Adesola, 2013). Charles (2006) concluded that exchange rate is a fundamental economic adjustment instrument and a complex and contentious econometric tool. Obadan (2006) argued that exchange rate connects the pricing system across countries thereby facilitating traders to compare price directly. For developing countries like Kenya, where financial markets are still underdeveloped, exchange rate volatility creates a risky business environment relating to profit uncertainties (World Bank & Ministry of Tourism, Trade, and Industry (MTTI), 2006).

The overriding theme of this study was to establish the relationship between interbank transaction volume and volatility in the US dollar and Kenyan shilling exchange rate. This chapter outlines the background of the study, statement of the problem, purpose of the study, objective of the study, research question, significance and scope of the study.

1.2 Background to the study

Exchange rate volatility refers to the depreciation or appreciation of currency value of any country in comparison to foreign currency (Abrams *et.al.* 2008). Today, currency volatility is one of the principle and essential issues that all countries are concerned about (Bordo & Harold, 2016). Outside the international trade market, the foreign exchange market is undoubtedly the world's biggest money related market. Trillions of US dollars (USD) are exchanged daily in the foreign exchange market in the world today. According to the April 2016 Triennial Central Bank Survey of FX and over-the -counter (OTC) derivatives, the average daily volume of foreign exchange traded was USD 5.1 trillion. This was even a drop from USD 5.4 trillion recorded during a similar period in 2013. Therefore, the issue of cash instability is important particularly to growing economies. The fluctuation of currencies has been

experienced since 1971 when the Bretton Woods system of exchange rates was abolished and the further adoption of the floating rate system in 1973.

A floating rate system is where the demand and supply of currencies determine the exchange rate price (Ojebiyi & Wilson, 2011). As indicated by Devarajan (2013) the rate of exchange among different monetary forms changes each day as speculators rethink new data. While a nation's legislature and national bank can attempt to impact its currency conversion scale with respect to different currencies, at last it is the free market that decides the actual swapping scale.

Ilhan (2006) defines exchange rate volatility as unforeseen variations in exchange rate and the risk thereof. He further postulates that econometrics considered sources of exchange rate volatility namely balance of payments, inflation, and interest rates have increasingly exhibited fluctuation tendencies. Such volatility affects both the cash flow of a firm's operations and the value of a firm (Farah, 2013). Theoretically, changes in exchange rate significantly results in economic uncertainty that can cause a direct change in stock prices (Ngerebo, 2012).

According to Stephen *et al.* (2013), all significant economies utilize a floating rate of exchange. When a nation's conversion standard goes down in the market, devaluation of the currency is eminent. The nation's currency has less acquiring power on account of the devaluation. Stephen *et al.* (2013) depicted the possibility of outside rate trade instabilities variances as misfortune or pick up of one coin against the other. Unusualness is in this way a fall in estimation of one currency against various money related structures. This misfortune or pick up of a currency is called outside rate exchange changes. It is this conformity in swapping scale that offer rising to undesirable effects on companies outside operations.

In recent years, Kenya has experienced an ongoing trend of unpredictable fluctuation of the Shilling with the most recent being in 2015 when the KES depreciated against USD recording a high rate of 106.035 on 07 September 2015 (CBK, 2017). Exchange Rate Volatility resulted in dire effects on employment opportunities, pricing, Gross Domestic Product, wages rates and interest rates. Over time, this has

resulted in speculation among key stakeholders such as investors without empirical verification being available to authenticate their arguments (Danga & Kiptui, 2016).

In order to control volatility, the Central Bank of Kenya has in the past sold foreign currency into the interbank market. While the Central Bank believes in allowing the market to determine the trading level of the local currency, it intervenes during periods of excess volatility that prevents the market from functioning efficiently. Therefore, the Bank does not support a particular level or direction of the currency but only intervenes to enhance stability and the planning horizon for the market participants (CBK, 2016). The stability of the exchange rate is important in the Kenyan economy because it plays a role in the stock market, foreign exchange market and has an impact on international trade (Kirui, Wawire, & Onono, 2014).

The Kenya Shilling is recorded to have been stable against the US Dollar in 2016 even as the global markets were volatile due to pressures from China's financial markets, and uncertainties in the advanced economies. Developments in the foreign exchange market were supported by a narrowing current account deficit with improved exports, strong diaspora remittances, and a lower oil import bill. CBK's foreign exchange reserves stood at USD 7,379.3 million (equivalent to 4.7 months of import cover) up from USD 7,023.7 million (equivalent to 4.5 months of import cover). The approval on March 14 of new IMF Precautionary Arrangements amounting to USD 1.5 billion covering 2 years reflects confidence in the country's macroeconomic policies and provides additional buffers against short-term shocks (CBK, 2016).

Kyule (2016) conducted a study on factors affecting Kenya shillings volatility against the United States dollar. He found out that Kenyan Shilling has been fluctuating over a substantial period of time almost 106 to the US dollar as at September 2015 and KES exchanged with USD at 107 in October 2011. It is now very clear on the instability of the KES following the deficit on the current account and the heap of unpaid liability of the nation. Kenya's open obligation remained at KES 3.2 trillion, around (60%) from household sources, with the rest of outside getting (40%) at the beginning of the monetary year 2016/2017. Nevertheless, add up

to open obligation is required to go up to 3.8 trillion by end year. What amount of this will be foreign sourced? This question gets to be essential while investigating the KES volatility issue as it adds to the issue of a lack of dollars

Exchange rates in Kenya have witnessed significant volatility since liberalisation in October 1993 (Njuguna et al., 2001), where factors that affect movements in the rates are analysed. The paper shows that an increase in the difference between domestic and foreign interest rates results in an appreciation of the exchange rate by attracting private capital flows. Similarly, improvements in the current account balance and net external inflows leads to an appreciation of the exchange rate (Calderon et al., 2001). However, although the exchange rate is expected to depreciate with a widening price differential, the study also found that key announcements, particularly by donors, affect the exchange rate.

The financial market in Kenya currently transacts between USD 350 to 500 million a day, that translates to between USD 12 and 15 billion a month. The Central Bank endeavours to keep foreign exchange reserves equivalent to 4 months of import cover that is currently slightly over USD 4 billion. This therefore means that were the CBK to intervene in an attempt to hold the exchange rate at a particular level or move it towards a certain direction, its holdings of reserves would not last a week.

The interbank market is the market in which individual banks transact their trading activities in order to meet their demand for and supply of short term funds. Participating banks are expected to have specialist knowledge of the credit market and keep up-to-date with key developments in the financial sector as well as the domestic economy and global trends. Importantly, each bank monitors the activities of co-participants in the market and hence the whole system amounts to conducting a peer monitoring mechanism among the participating banks, in a way this is different from the usual regulatory oversight of the central bank and the usual private monitoring candidates. Overall, it appears that the interbank market role of market discipline to complement government discipline is becoming increasingly important. Second, the potential market discipline role by the interbank market is particularly important as African countries seek to accomplish the transition from Basel I to

Basel II, and now Basel III, during which concerns about ‘one size fits all’ type of official bank regulation for emerging economies have been side-stepped, leaving open the option of exploiting ‘market discipline’ as a complementary regulatory tool (Murinde, 2010). Third, the existing studies have provided very limited understanding of interbank market especially in emerging economies. As one of the most important and developed financial markets in Africa, study of Kenya interbank market can provide important insight to fill in the research gap.

1.3 Statement of the Problem

The global financial crisis of 2008 significantly affected the financial markets and is considered to be the worst crisis since the great depression of 1929. The crisis which originated in the US financial market quickly spread to other developed, emerging and developing financial markets. As a result, the market experienced high volatility in the currency, equity and futures markets.

Exchange rate stability is considered an indispensable foundation and econometric in analyzing a country’s overall economic position. Numerous research works have documented the adverse costs of exchange rate fluctuations on various parts of the domestic economy. Still lacking is conclusive validation of how interbank transaction volumes affect exchange rate volatility among academics and practitioners—notably, concerning the nature of stock market linkages and the response of markets to shocks.

In 2011 Kenya experienced exchange rate overshooting from KES 83 to KES 107, the highest rate ever witnessed in Kenya since independence within span of 6 months. The exchange rate also rose steadily to over KES 106 in September 2015. This caused a lot of speculation among various stakeholders, including investors in the banking industry, with no empirical verification to authenticate their arguments. The largest volumes in the Kenyan foreign exchange market are found in the interbank market with billions of US Dollars traded yearly. The transactions support many clients who are banked by commercial banks engaging in import and export of goods and services.

Kyule (2016) sought to identify the factors that cause Kenya Shilling exchange rate volatility against the US Dollar. Osano (2016) on the other hand, sought to show the impact of a volatile exchange rate on the performance of listed commercial banks in Kenya. Jurion (1990) argued that a volatile exchange rate raises strategic and managerial concerns relating to losses and gains. Fundamentally, banks are considered critical in developing economies simply because their financial markets are still lagging leaving banks as the main source of finance for firms (Aron & Turner, 2008).

Previous studies have focused on elements that affect Kenya Shilling exchange rate volatility and the impact of exchange rate volatility on different sectors of the economy. This study sought to fill the empirical gap of effect of volumes on exchange rate volatility by investigating the effect of interbank transaction volumes on the exchange rate volatility of the Kenya Shilling against the US Dollar.

1.4 Research Objectives

1.4.1 General Objective

The overall objective of this study was to evaluate the effect of interbank transaction volumes on the exchange rate volatility of the Kenya Shilling against the US Dollar.

1.4.2 Specific Objectives

- i. To determine the causal relationship between interbank transaction volumes and exchange rate volatility of the Kenya Shilling against the US Dollar.
- ii. To investigate the response of exchange rate to shocks in interbank transaction volumes.
- iii. To model exchange rate volatility and establish the influence of interbank transaction volumes on exchange rate volatility of the Kenya Shilling against the US Dollar.

1.5 Research Questions

- i. What is the causal relationship between interbank transaction volumes and exchange rate volatility of the Kenya Shilling against the US Dollar?

- ii. What is the dynamic response of exchange rate to changes in interbank transaction volumes?
- iii. How do interbank transaction volumes influence exchange rate volatility of the Kenya Shilling against the US Dollar?

1.6 Scope of the Study

This research will be restricted to the evaluation of the impact of volumes traded in the interbank foreign exchange market in Kenya with specific focus of the Kenya Shilling-US Dollar exchange rate for the period 2013 to 2017.

1.7 Significance of the Study

The significance of the study is both academic and also for policy making.

1.7.1 Commercial bankers

Commercial banks account for the largest proportion of all trading of both a commercial and speculative nature and operate within an interbank market. This is essentially a market composed solely of commercial and investment banks which buy and sell currencies from each other. Strict trading relationships exist between the member banks and lines of credit are established between these banks before they are permitted to trade. Whenever the Central Bank buys foreign exchange, it is in effect, injecting liquidity into the market. When it sells foreign currency, it effectively mops up the local currency with the objective of achieving predetermined liquidity targets. Whether buying or selling foreign currency, the foreign exchange market activity in the bank should be understood in terms of its broader policy goals of enhancing confidence and predictability of the value of the currency while providing ample liquidity to the banking system.

1.7.2 Future researchers

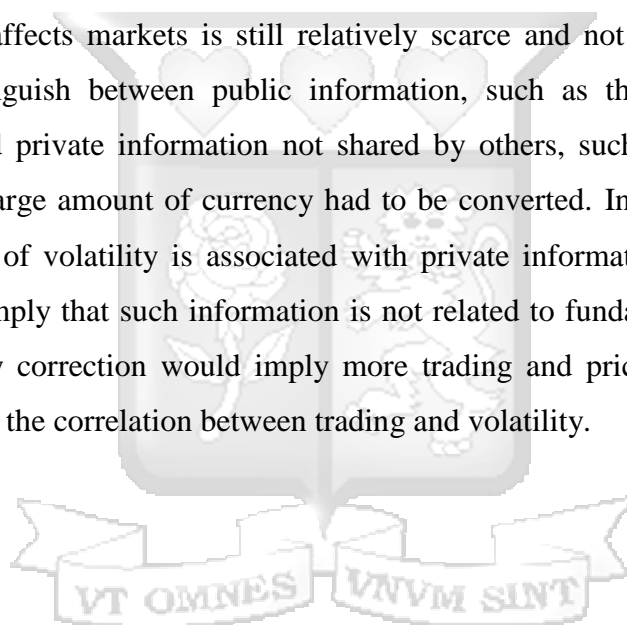
This study makes a contribution to debates in the developing country context on the effect of interbank transaction volume on the exchange rate volatility of the Kenya Shilling to the US Dollar. The findings can benefit academicians and future researchers as they can reference the literature for their study.

1.7.3 Central Bank of Kenya

The findings of this study will also help policy makers assess the impact of interbank transaction volume on exchange rate volatility of the Kenya Shilling to the US Dollar. This will assist in better decision making in regards to Central Bank intervention in the foreign exchange market in Kenya resulting in an efficient economy.

1.7.4 Traders

There are other major traders in the foreign exchange market. They include the importers, exporters, oil marketers and aviation service providers. Excess volatility could be the result of traders over-reacting to new information or incorporating into prices information that is not relevant. Empirical evidence on what type of information affects markets is still relatively scarce and not yet conclusive. Some studies distinguish between public information, such as the publication of new statistics, and private information not shared by others, such as knowledge that a particularly large amount of currency had to be converted. Indeed, it appears that a sizeable part of volatility is associated with private information, but this does not necessarily imply that such information is not related to fundamental developments. The volatility correction would imply more trading and price movements, further strengthening the correlation between trading and volatility.



CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presents the review of theoretical literature, conceptual framework, empirical review and overview of literature gap. The theoretical review captures the various theories that inform the study. The conceptual framework shows a figurative representation of the variables to be explored by this study. The empirical review explores the literature that focuses on the effect of interbank transaction volumes on exchange rate volatility. Lastly, the overview of literature gap summaries gaps in the existing studies.

2.2 Theoretical Review

This section reviews theoretical foundations that discuss and explain the casual relationship between interbank volumes and exchange rate volatility of the Kenya shilling against the US dollar. The theories discussed are trade theory and the international fisher effect.

2.2.1 Trade Theory

International Trade is the exchange of goods and services between countries. The process involves the conversion of one currency to another for payment purposes. (Lerner 1944) defined trade theory as the exchange of products with the genuine rate of exchange. Setting every single other variable settled, the trade theory expresses that the conversion standard can influence the economy's imports and exports. A fluctuation in the rate of exchange influences both the volume and value of exchange. On the off chance that the real rate of exchange ascends for the nation of origin i.e. on the off chance that there is a real devaluation, the family units in the domestic nation can get less remote merchandise and enterprises in return for a unit of household products and ventures. Along these lines a unit of outside great would give a greater number of local products, bringing about local family units purchasing less remote merchandise and remote families needing to buy generally more local products. The higher the real rate of exchange the more surplus in the net exports the nation will get.

However, Zhang (2008) criticized the trade theory as being limited to explaining exchange rate. Instead the researcher suggested extension of the trade theory to include price elasticity of demand for imports and exports as imperative components in deciding the impact of conversion scale changes on the exchange adjustment. Zhang (2008) argued that an expansion in exports and cut down on imports because of instability in the rate of exchange does not really mean an adjustment, or even a change, in the exchange adjust. Further, the trade balance is not bothered with the measures of physical products but rather with their real values (Zhang, 2008).

Nonetheless, the trade theory informs the current study since it brings out the concept of exchange rate as it involves the exchange of good and services between countries. The payment of these goods and services involves the conversion of currencies hence creating a demand or supply of the currencies involved. This study aims to evaluate the role of interbank transaction volumes in influencing foreign exchange rate volatility.

2.2.2 The International Fisher Effect

According to International Fisher Effect, one country's real interest rate is independent of monetary variables. The theory further suggests that foreign currencies with relatively high interest rates would depreciate because the high nominal interest rates reflect anticipated inflation. The nominal interest rate would also incorporate the default risk of an investment (Staikouras & Wood 2004). The International Fisher Effect (IFE) states that the difference in returns between two countries is equivalent to the variance in inflation rates (Shapiro 2007).

One of the most significant contributions of Fisher to the field of economics was his ability to establish the connection between inflation and the real and nominal interest rates. This association is known as the Fisher Effect. The Fisher Effect states a rise in the growth rate of the money supply will result in rise in inflation and rise in the nominal interest rate, which will equal the rise in the inflation rate. This Fisher Effect helps explain why inflation may not be seen as affecting the real interest rate in the long-run. In order for real interest rates not to be affected by inflation, the nominal interest rate must reflect the changes in the inflation rate. The Fisher effect is evident

in the banking industry that is, the interest rate an investor has on a savings account is really the nominal interest rate.

This theory is relevant for this study as it explains that countries don't adjust interest rates by the equal magnitude and central bankers have shifted focus from interest rate target to inflation target equilibrium, exchange rates such that the basket of goods and services purchased by one unit of a country's currency equals those purchased in the second country.

2.3 Review of Empirical Literature

This section explores the literature that focuses on the effect of interbank transaction volumes on exchange rate volatility. This section presents an analysis of other studies, methodology and findings for purposes of establishing the research gap. This section contains empirical literature from developed markets, Africa and Kenya.

Sveinn (2009) examined the relationship between trading volumes and volatility in the Icelandic foreign exchange interbank market. The study used a data set spanning more than seven years. The study used ARMA, ARIMA and GARCH models. The study found that trading volumes and volatility are positively correlated for the Icelandic interbank market. Further, the study concluded that the relationship was stronger in times of high volatility than low volatility.

Bjonnes *et al* (2005) analyzed the comprehensive foreign exchange volume data sets. The data set used was from the Swedish Central Bank and covers 90-95% of all daily worldwide trading of the Swedish Krona. The study used ARMA models. Galati (2010) also examined daily trading volumes of seven currencies from emerging market countries against the dollar. The study used ARMA, and GARCH models. Both studies found a positive correlation between unexpected volume and volatility, although Galati found that correlation between trading volumes and volatility was positive during "normal" periods but turn negative when volatility increases sharply.

Grammatikos and Saunders (1986) used contract disaggregated data on futures prices from four European currencies and the Japanese Yen to obtain evidence on the

relation between price volatility and volume of trading. The findings revealed a strong positive correlation between trading volume and price volatility. Based on the findings, the study concluded that maturity is not a suitable surrogate for the common directing variable. Specifically, while maturity has a strong effect on volume, no such relation is found for price variability. Finally, while in majority of cases price variability and trading volume are correlated, there are a significant number of cases in which a sequential relation appears to be present.

Karpoff (1987) provided an overview of nineteen empirical studies from the early literature that examined the volume-volatility relationship. The study used the Ordinary Least Square Regression technique to establish a relationship among the model variables, while Generalized Autoregressive Conditional Heteroskedasticity (GARCH) approach is employed in modelling the volatility. The results emanated from a variety of different market settings, such as futures, equity and foreign exchange, although most of the studies focused on stock and future markets due to the fact that data was more easily available in those markets than for foreign exchange. Galati (2010) attributes the lack of data to the fact that, unlike equity markets, foreign exchange markets are for the most decentralized. He further reiterates that the most comprehensive source of information in foreign exchange market, the “Central Bank Survey of Foreign Exchange and Derivatives Market Activity”, does not provide much time series data for trading volumes. As such, empirical studies of the foreign exchange volume-volatility relationship have resorted to using various alternative data sources to proxy for foreign exchange trading volumes. The empirical studies established that volume was positively related to the enormity of the price change.

In the African context, Owoeye (2013) examined exchange rate volatility and bank performance in Nigeria. The study utilized Ordinary Least Square Regression. The study examined capital deposit ratio and loan loss to total advances ratio as banks’ performance indicators to determine the impact of changes in exchange rate on banks’ performance in Nigeria. Both models demonstrated that the magnitude of influence of changes in exchange rate is dependent on the type of performance

indicator used. The study recommended that to improve the banks' capacity of channeling credit to the economy, a stable exchange rate is necessary.

Tarawalie, Ahoritor, and Umo (2014) investigated the impact of exchange-rate volatility on export performance in the WAMZ (the WAMZ countries include The Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone) countries using quarterly data for the period 1990–2010. The paper utilizes the Engel-Granger Dynamic OLS (DOLS) estimation technique to establish a cointegrating relationship among the model variables, while Generalized Autoregressive Conditional Heteroskedasticity (GARCH) approach is employed in modelling the real exchange rate volatility. In conformity with theoretical considerations, the results indicate that exchange-rate volatility exerts a significant negative effect upon export in Liberia, Nigeria and Sierra Leone, while a positive relationship is established in the case of The Gambia. However, its impact on Ghana and Guinea is found to be insignificant during the review period. While real effective exchange rate impacts export performance negatively in Gambia, Ghana and Nigeria, its impact in Guinea and Liberia is positive. In Sierra Leone, the relationship between real effective exchange rate and export performance is positive in the long run but negative in the short run.

Kyule (2016) study sought to identify the factors that affect Kenya shilling volatility against the US dollar. Data used in the study was collected from the central bank of Kenya and the Kenya bureau of statistics for a five-year period. The study used descriptive research design to portray the variables influencing Kenyan shilling volatility against the US dollar. The study adopted multiple linear regression to establish the relationship between the variable. The study concluded that there exists a positive relationship coefficient between GDP and Kenya shillings volatility, and a negative relationship with interest rates, inflation and balance of payments. The study found out that inflation decreases the availability of cash and makes it hard for the economy to afford purchases of goods and services. Inflation does not support Kenya shillings stability against foreign currency because it reduces the level of business activity in the economy, and therefore demand for foreign currency declines. The study found that Interest rates influences Kenya shillings instability. The study

presents a conceptual gap since it does not address the objectives of the current study.

Osano (2016) study examined the behavior of exchange rate over the study period and how this relates to the performance of listed commercial banks in Kenya. This study adopted a descriptive survey design as it aimed at giving an accurate presentation on the how a volatile exchange rate impacts on listed commercial banks overtime. The target population comprised the 11 listed commercial banks at the Nairobi Stock Exchange as at December 2015. The study used secondary data derived from the statutory financial statements generated by the listed commercial banks as well as the Central Bank of Kenya database. The study adopted multiple linear regression to establish the relationship between the variable. The study focused on the Kenya shilling Versus United States Dollar exchange rate because the dollar is the principal payment currency for majority of Kenya's international transactions and is considered a stable currency in the foreign markets. The study findings discovered a weak positive relationship using return on equity as a performance indicator. The study found out that the Kenyan Shilling USD was very volatile in the period under study and made recommendations to the Central Bank of Kenya to establish monetary thresholds or trigger values which can act as warning signs of volatility and as such can be monitored to increase the speed and responsiveness to the rapidly changing financial market in Kenya. The study presents a conceptual gap since it did not address the objectives of the current study.

Musa (2014) study sought to establish the effect of foreign exchange rate volatility on financial performance of local oil marketing companies in Kenya. The population under study was 55 oil marketing companies. The study adopted multiple linear regressions to establish the relationship between the variable. The findings on the background information revealed that the majority of the respondents were of male while females were the minority. The results indicated that there exists no significant relationship between inflation and financial performance with a p value of .392. In the same regard, the study revealed that there was no significant relationship between performance and interest rates with a p-value of (.497). Further the study showed no significant relationship between foreign exchange volatility and performance with a

p-value of (.306). This paper gives a recommendation that oil marketing companies should consider adopting Domestic or Multi-domestic strategies which are suitable for local economic environment other than applying global strategies that may be affected by forex volatility. The study further observes and recommends blending of foreign exchange rate risk management strategies that are best suited for the oil marketing companies.

Rutto and Ondiek (2014) examined the impact of exchange rate volatility on Kenya's tea exports. The research objective was to determine the impact of changes in exchange rate on tea exports, the contribution tea exports' earnings make to Kenya's economy and draw policy recommendations emanating from empirical findings for enhancing tea exports. Johansen and Julius Multivariate co-integration technique was applied to annual time series data for the period of 1970-2008 so as to recognize the short run as well as long run behavior of the variables in the study. Co-integration and error correction technique (ECM) developed by Engle and Granger was used. The study used Dickey fuller (DF) coupled with Augmented Dickey Fuller (ADF) as a measure of unit root test for stationarity. Phillips Perron (pp) on first difference was adopted to test stationarity in their first difference and testing co-integration feasibility. The results indicated Kenyan tea exports are negatively affected by changes in exchange rate. This paper recommends periodic monitoring of the exchange rate so as to reduce its impact and drawing of fiscal and monetary policy that would make exchange rate manageable.

2.4 Summary of literature

Sveinn (2009) study examined the relationship between trading volumes and volatility in the Icelandic foreign exchange interbank market. Bjonnes *et al.* (2005) analyzed the comprehensive foreign exchange volume data sets. The data set used is from the Swedish Central Bank and covers 90-95% of all daily worldwide trading of the Swedish Krona, and Galati examines daily trading volumes of seven currencies from emerging market countries against the US dollar. Grammatikos and Saunders (1986), study used contract disaggregated data on futures prices to obtain evidence on the relation between price variability and volume of trading. Owoeye (2013) examined exchange rate volatility and bank performance in Nigeria. Tarawalie,

Ahortor, and Umo (2014) investigated the impact of exchange-rate volatility on export performance in the WAMZ (the WAMZ countries include The Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone) countries using quarterly data for the period 1990–2010. These studies present a geographical gap since they were conducted in other countries. However, the current study was carried out in Kenya.

Osano (2016), study examined the behavior of exchange rate over the study period and how this relates to the performance of listed commercial banks in Kenya. This study adopted a descriptive survey design as it aimed at giving an accurate presentation on the how a volatile exchange rate impacts on listed commercial banks overtime. Kyule (2016) sought to identify the factors that affect Kenya shilling volatility against the US dollar. Data used in the study was collected from the central bank of Kenya and the Kenya bureau of statistics for a five-year period. The study used descriptive research design to portray the variables influencing Kenyan shilling volatility against the US dollar. These studies present a conceptual gap since they did not address the objectives of the current study. The current study sought to evaluate the effect of interbank transaction volumes on the exchange rate volatility of the Kenya Shilling against the US Dollar.

2.4 Research Gap

While there exists literature regarding factors that affect exchange rate volatility of the Kenya shilling against the US dollar ,in Kenya there is little research done on the effect of interbank transaction volumes on the exchange rate volatility of the Kenya shilling against the US Dollar. This study seeks to determine if the hypothesis proven by the various research conducted in other countries and regions applies in the Kenyan situation. Therefore this study seeks to add to existing literature by evaluating the effect of interbank transaction volumes on the exchange rate volatility of the Kenya Shilling against the US Dollar by using time series analysis.

2.6 Conceptual Framework

This section discusses the variables to be studied, their definitions and then illustrates their relationship in a conceptual framework diagram. Billions of US Dollar are traded daily in the global foreign exchange market especially the interbank market where all transactions congregate. The assumption was that the volume traded on a daily basis in the interbank market causes fluctuation in the exchange rate hence volatility.

In this study, the interbank transaction volume was the independent variable. The exchange rate volatility was the dependent variable in this study. The study assumed that volatility in exchange rate was influenced by interbank transaction volumes.

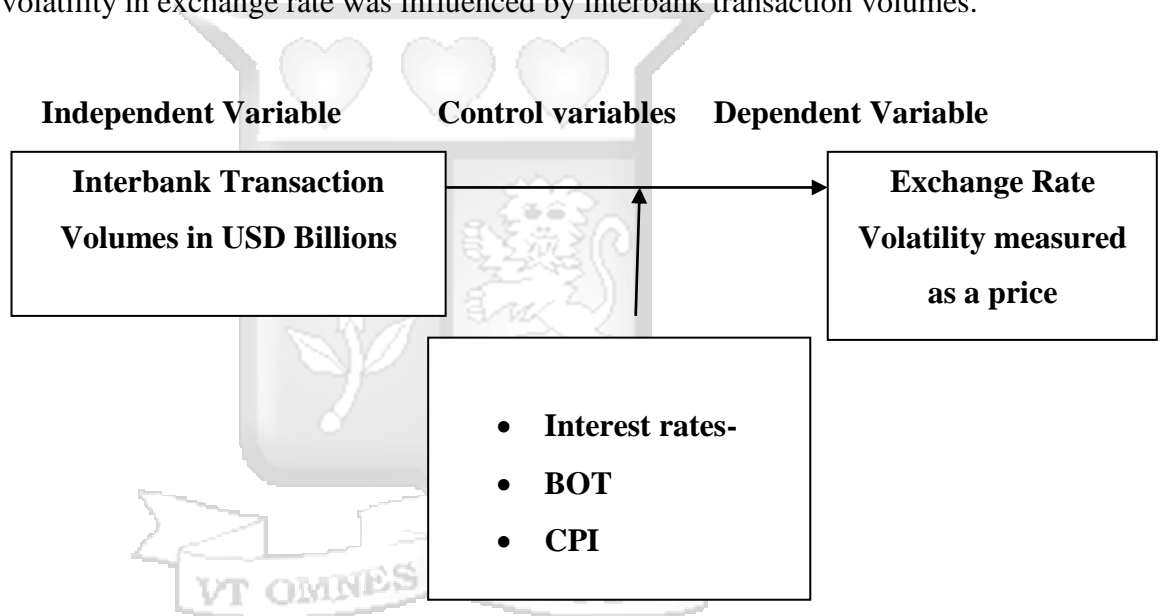


Figure 2.1: Conceptual Framework

Source: Author (2017)

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter offers the steps and methodologies that will be followed in executing the study. It discusses the research design, data collection instruments and procedures, and data analysis procedures.

3.2 Research Design

The study used a descriptive research. Glass & Hopkins (1984) define a descriptive research design as the mode of gathering data that outline happenings and then systematizes, tabularizes, illustrates, and explains the data collected and frequently uses graphic assistances e.g. charts and graphs to aid the users in appreciating the data dissemination. It also uses other measures that show difference and correlations between various variables (Cooper & Schindler, 2013). What is more, the use of a case study will turn out useful in the analysis of information in methodical manner when drawing valuable conclusions and recommendations (Mugenda & Mugenda, 2008). The use of this research design was justified by its power in letting the researcher carry out the desired measurements and analyze the observations in order to study the phenomena in detail and draw accurate conclusions and findings from the research.

3.3 Population and Sampling

The population was the forty-three banks that are governed by the Central Bank and the sample period was four years, 2013 to 2014.

3.4 Data Collection Procedure

The study used monthly time series data that was collected yearly from 2014 to 2017. Þórarinnsson, S. (2009). Volume and Volatility in the Icelandic Foreign Exchange Market study used the market closing rates from Reuters. This study obtained the

monthly average exchange closing rates for the Kenya shilling against US Dollar exchange rate from Reuters for the period 2014-2017. The study obtained the Foreign exchange volume, overnight interbank interest rate, balance of trade from CBK and consumer price index from KNBS.

3.5 Data Collection Instruments

This study used secondary data to evaluate and establish the effect of interbank transaction volumes on exchange rate volatility of the Kenyan shilling against the US dollar. Secondary data involves the collection and analysis of published material and information from sources such as annual reports, published data research centers and libraries. This study collected monthly data on interbank transaction volumes, exchange rate, inflation rate, interest rates as well as balance of trade. Only relevant data that meet the objective of the study was sought. A secondary data collection template was used to collect data (Appendix I).

3.6 Data Analysis and Presentation

The collected data was cleaned before analysis. Descriptive and inferential statistics were used. The study adopted a multiple regression model which was applied to study the relationship between the interbank transaction volumes and the exchange rate volatility of the Kenya Shilling against the US Dollar and regress each independent variable against the dependent variables. If they were positively correlated then the relationship was deemed to be significant and vice versa.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e$$

Where

Y= Exchange rate volatility

X₁= Interbank Transaction
Volumes

X₂= Interest Rates

X₃= Inflation

X₄= Balance of Trade

e = Random error term

β₀ = Regression constant

An analysis of variance table was used to tabulate the relationship between the foreign exchange volatility and the CBK intervention.

3.6.1 Unit Root Test

Unit root tests are used to determine if trending data should be first differenced or regressed on deterministic functions of time to render the data stationary. To test for stationarity the study used augmented Dickey Fuller (ADF) test. The ADF test tests the null hypothesis that a time series y_t is $I(1)$ against the alternative that it is $I(0)$ (Brooks, 2008). Therefore, the null and alternate hypothesis was:

$H_0: y_t \sim I(1)$

$H_1: y_t \sim I(0)$

The study also tested for cointegration especially if the two variables, interbank transaction volume and exchange rate volatility were found to be linearly combined. The study used the Engle Granger and Johansen tests.

3.6.2 Univariate and Multivariate Analysis

The study used both univariate and multivariate analysis such as the Granger causality. Granger causality is employed in situations where there is some relationship between two variables, but it is not known which variable causes the other to move. In this case, Granger causality test was employed to test the association between interbank trading volumes and exchange rate volatility.

Granger Causality tests were performed to investigate the short run causal relationship among the variables. Causality tests can be conducted in two different ways depending on the results of the long run analysis. The Granger test (1969) is suitable for analyzing the short-run relationship if no cointegration exists among the variables. On the other hand, when the variables of interest are cointegrated, the standard Granger test is specified and the error correction strategy suggested by Engle and Granger (1987) should be used (Enders, 2004). The Granger test examines whether including lags of one variable have predictive power for another variable.

To examine Granger causation between interbank trading volumes and exchange rate volatility, the study employed Granger causality test (Muhammad & Rasheed,

2002). Granger causality test was done through estimation of two regression equations expressed as follows:

$$EXR_t = \alpha + \beta_{11}EXR_{t-1} + \dots + \beta_{1p}EXR_{t-p} + \beta_{11}ITV_{t-1} + \dots + \beta_{1q}ITV_{t-q} + \varepsilon_t \dots \dots \dots 7$$

$$ITV_t = \alpha + \beta_{22}ITV_{t-1} + \dots + \beta_{2p}ITV_{t-p} + \beta_{22}EXR_{t-1} + \dots + \beta_{2q}EXR_{t-q} + \varepsilon_t \dots \dots \dots 8$$

Where; ε_t is the error term, t-i is the time lag. Equation (7) postulates that current exchange rate (EXR) is related to past values of interbank trading volumes (ITV) as well as past values of EXR. Similarly, equation (8) stipulates that (ITV) is related to past values of EXR as well as past values of ITV. Following equation 7 and 8, the following hypothesis was tested:

The hypothesis test of equation (7) was:

H₀; there is no causation from ITV to EXR

H₁; there is causation from ITV to EXR

Similarly, the hypothesis test for equation (8) will be:

H₀; there is no causation from EXR to ITV

H₁; there is causation from EXR to ITV

The four possible expectations were; [1] presence of unidirectional causality ITV to EXR, [2] presence of unidirectional causality from EXR to ITV, [3] ITV and EXR Granger cause each other, i.e., bilateral causality and [4] EXR, and ITV are independent of each other.

3.7 The Dynamics Response

Studies have found out that estimated coefficients of the VAR model have no economic interpretation because they are equal to reduced form equations. Sims (1980) came up with a method of estimating VAR coefficients to trace the dynamics path of a specific variable in a system, given a certain effect of innovation or a shock brought about by a change in a variable.

The dynamic response was estimated through Variance decomposition and the Impulse Response functions (IRF). VAR model can be written in the form of Vector Moving Average (VMA) where variables may be expressed as a function of the past and current values of the error terms. The VMA representation traced out the time path of shocks on the variables in VAR (Sims, 1980b)

3.7.1 The Impulse Response Functions

The impulse responses functions were delivered from Vector Moving Average. They linked the future values of the variables to the current values of error term (Enders & Granger, 1998)



CHAPTER 4: DATA ANALYSIS AND FINDINGS

4.1 Introduction

The main objective of this study was to evaluate the effect between interbank transaction volumes and exchange rate volatility of the Kenya shilling against the US Dollar. Monthly averages of foreign exchange volumes, exchange rate, overnight interbank interest rate, CPI and Balance of Payment from 2013 to 2017 were used in this study.

The analysis used time series analysis to evaluate the causality, dynamic response of interbank transaction volumes on Kenya Shilling and US Dollar exchange rate volatility. The findings of this analysis are presented in this chapter, arranged from descriptive, time series and regression analysis.

4.2 Descriptive Analysis

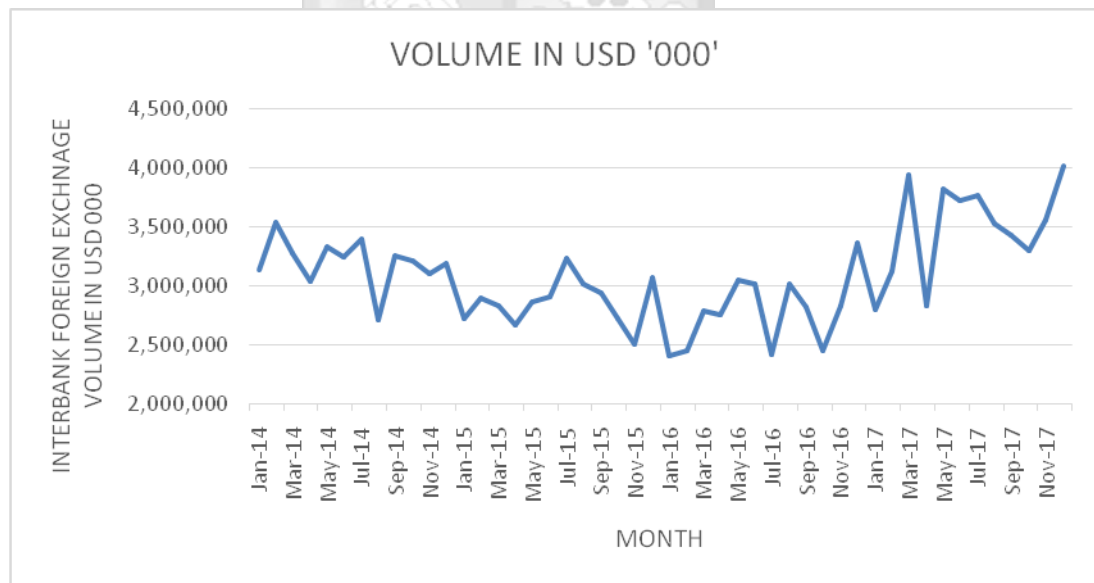


Figure 4.2: Interbank foreign exchange volumes Trend 2014-2017

Source CBK

Figure 4.2 above shows the trend of monthly interbank foreign exchange volumes for the period Jan 2014 to Dec 2017. The graph shows that there has been a rise and fall of foreign exchange volumes in the time chosen. There was an increase in interbank volumes in the period March 2017 which could be attributed to increased economic

activity in anticipation of the general election in August 2017. In May 2017, we can see a drop due to reduced government spending as the government year comes to a close.

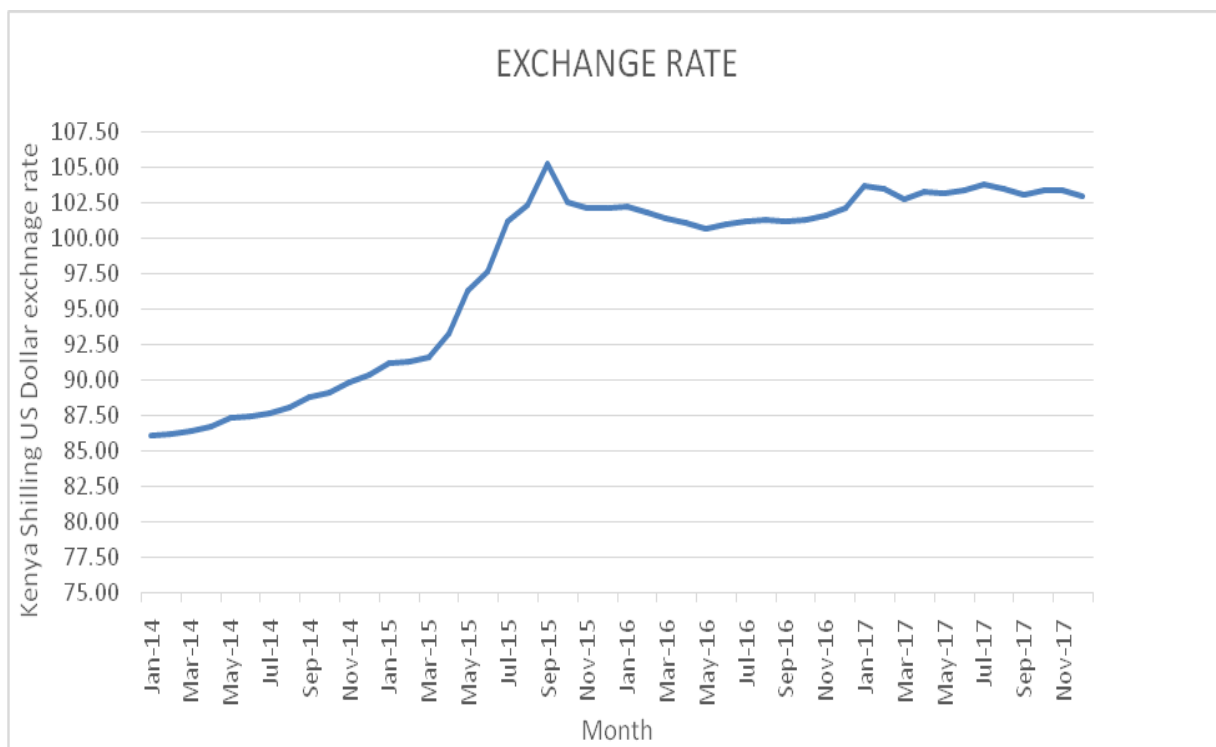


Figure 4.3: Exchange rate Trend

Source: Thomson Reuters

Figure 4.3 shows the Kenya Shilling continuously weakens from a high of 86 in Jan 2014 to a low of 105 to the dollar in September 2015. The depreciation of the Kenyan Shilling against the US Dollar was mainly due to the strengthening of the US Dollar against major world currencies as a result of economic recovery in the United States. There was also high US Dollar demand in the domestic market against low inflows. Thereafter the exchange rate remained fairly stable ranging between a high of 100 and 102.50 as a result of increased inflows from Diaspora remittances, tea earnings and a closer monitoring of the foreign exchange market by Central Bank of Kenya.

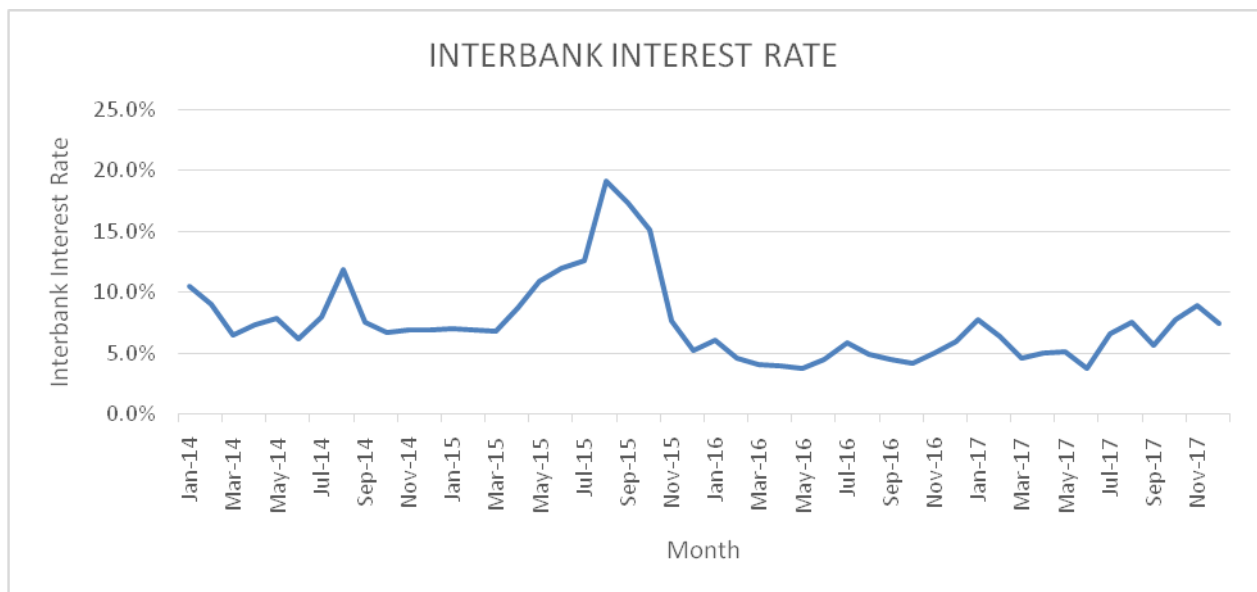


Figure 4.4: Interbank Interest Rate Trend 2014-2017

Source CBK

Figure 4.4 above shows the monthly average interbank interest rate for the period beginning January 2014 and ending December 2017. There was a rise of interest rates from June through September 2015 due to a tight monetary policy stance employed by Central Bank of Kenya. In addition, the placement of two banks into receivership created turbulence in the domestic financial markets resulting in market segmentation and concentration of liquidity in a few large banks causing a drop-in interest rates. Introduction of interest rate capping in September 2016 saw interest rates range between 5% and 9%.

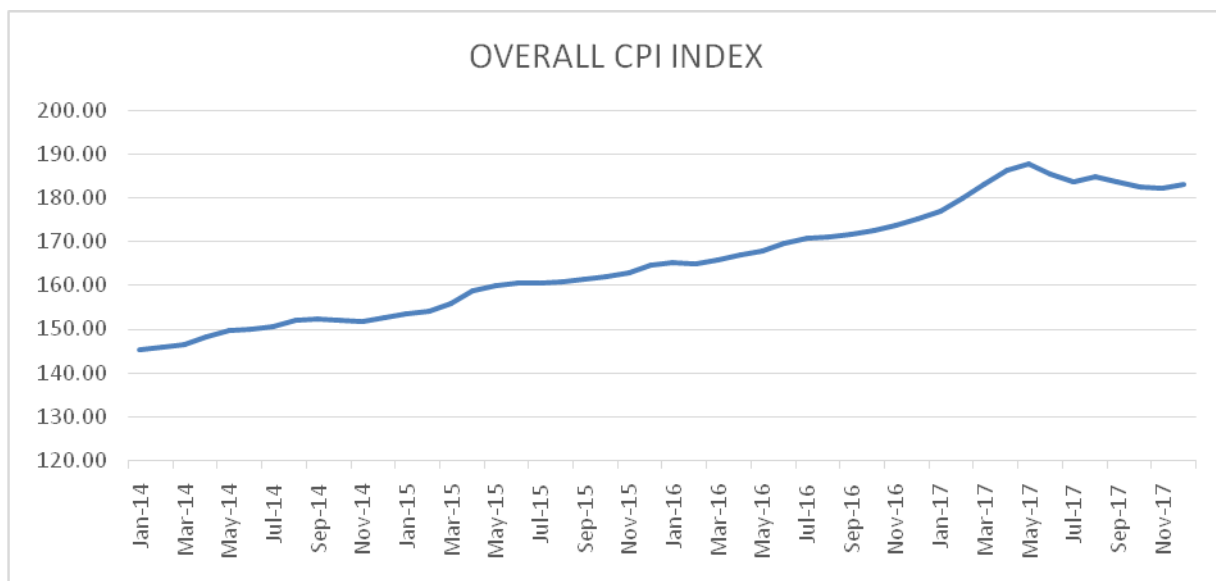


Figure 4.5: Consumer Price Index trend 2014-2017

Source KNBS

Figure 4.5 shows the overall consumer price index increase from January 2014 through to May 2017. This is due to combined factors such as increased global oil prices, increased consumption of crude oil for energy and transportation, and severe drought experienced across the country late 2016 to 2017.

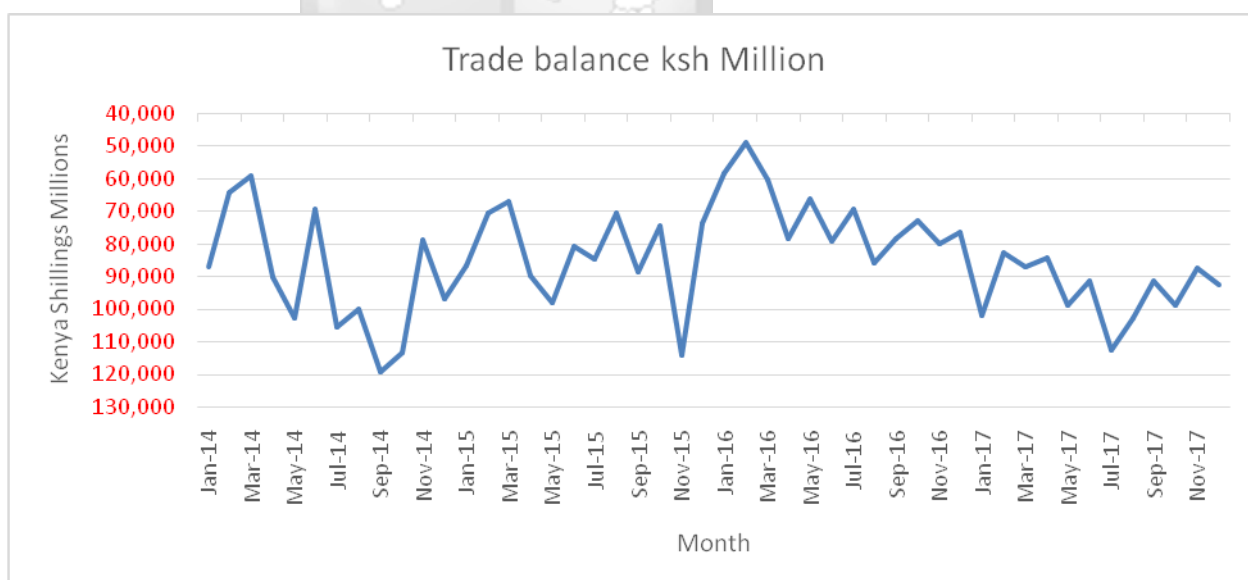


Figure 4.6: Trade Balance Trend 2014-2017

Source CBK

Figure 4.6 shows Kenya's Trade balance remained in the negative range with the highest deficit experienced in September 2014 and the lowest February 2016. Reduced earnings from agriculture and tourism during the period September 2014 and November 2015 as well as increase in the importation bill due to importation of machinery related to the construction of the Standard Gauge Railway contributed to the large Balance of Trade.

Table 4.1: Descriptive Statistics

	Exchange rate (ER)	Interbank Volume (ITV)	Trading Rate (IR)	Interest CPI	BOT
Mean	97.7	14.9	7.5	1.7	11.3
Median	101.2	14.9	6.8	1.6	11.4
Maximum	105.3	15.2	19.1	1.9	11.7
Minimum	86.1	14.7	3.8	1.5	10.8
Std. Dev.	6.6	0.1	3.3	0.1	0.2
Skewness	-0.7	0.1	1.7	0.2	-0.4
Kurtosis	1.7	2.5	5.9	1.8	2.9
Jarque-Bera	7.0	0.6	40.4	3.2	1.2
Probability	0.0	0.8	0.0	0.2	0.5
Sum	4688.3	716.8	358.4	79.5	543.9
Sum Sq. Dev.	2032.6	0.8	525.0	0.8	1.8
Observation s	48	48	48	48	48

The table 4.1 above presents some descriptive statistics for the five variables that is USD/KES exchange rate(ER), Interbank foreign exchange volumes (ITV), Consumer Price Index (CPI), Interbank interest rates (IR) and Balance of Trade (BOT). The average exchange rate of Kenya shillings against US dollar was 97.7, with a maximum of 105.3 and minimum of 86.1. There was an average deviation of 6.6 and the rate was normally distributed since the p value for Jarque Berra was less than 0.05. The average interbank transactions volume was USD 14.9 billion, with an

average standard deviation of 0.1. On average commercial banks charged an interest rate of 7.5% with a maximum of 19.1%. There was a wide variation in interest rate with an average standard deviation of 3.3%. On average consumer price index increased by 70% from a base rate of 100. On average balance of payment decreased by 11.3 and its variations had negative skewness indicating there were more exports as compared to imports.

4.3 Preliminary tests

4.3.1 Normality Test

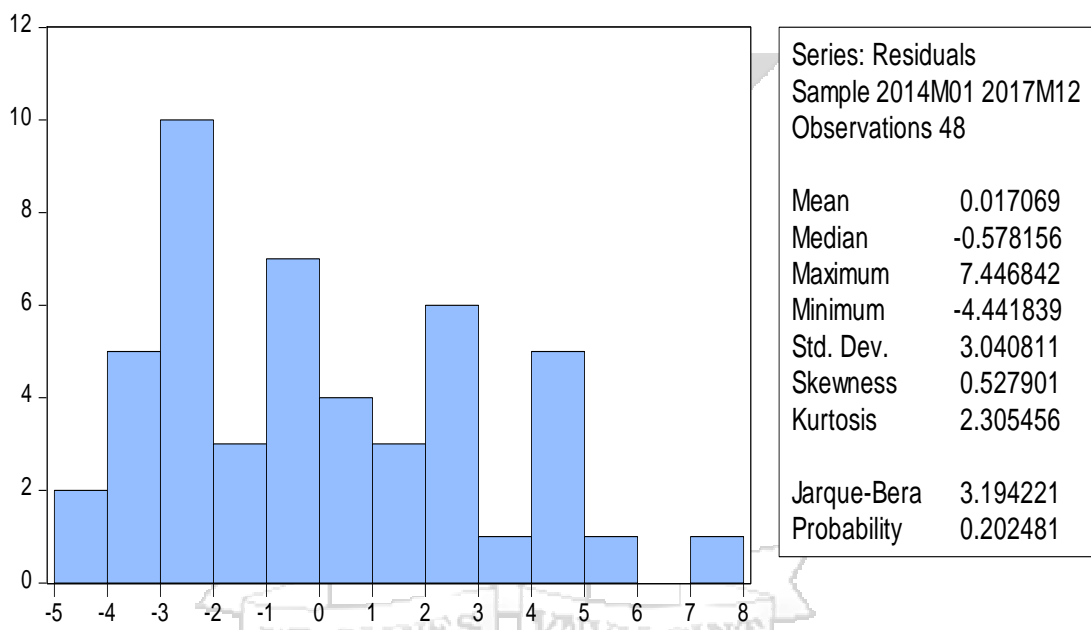


Figure 4.7: Normality Test of the Error Term

Normality of residuals was tested using histograms, results in Figure 4.7 revealed normality of the data. This was confirmed by Jarque Berra test results of 3.2 and p value of 0.2 .

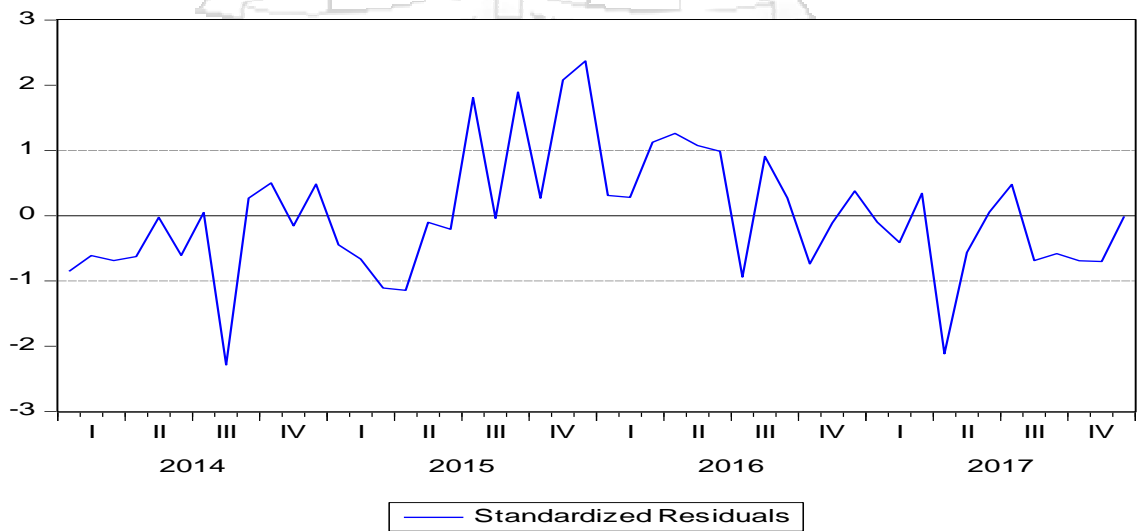
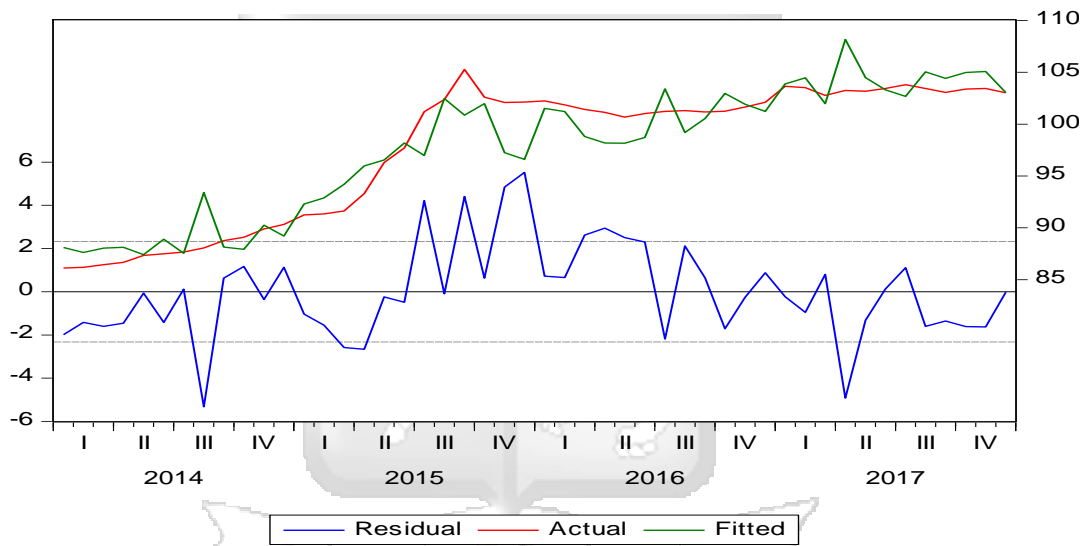
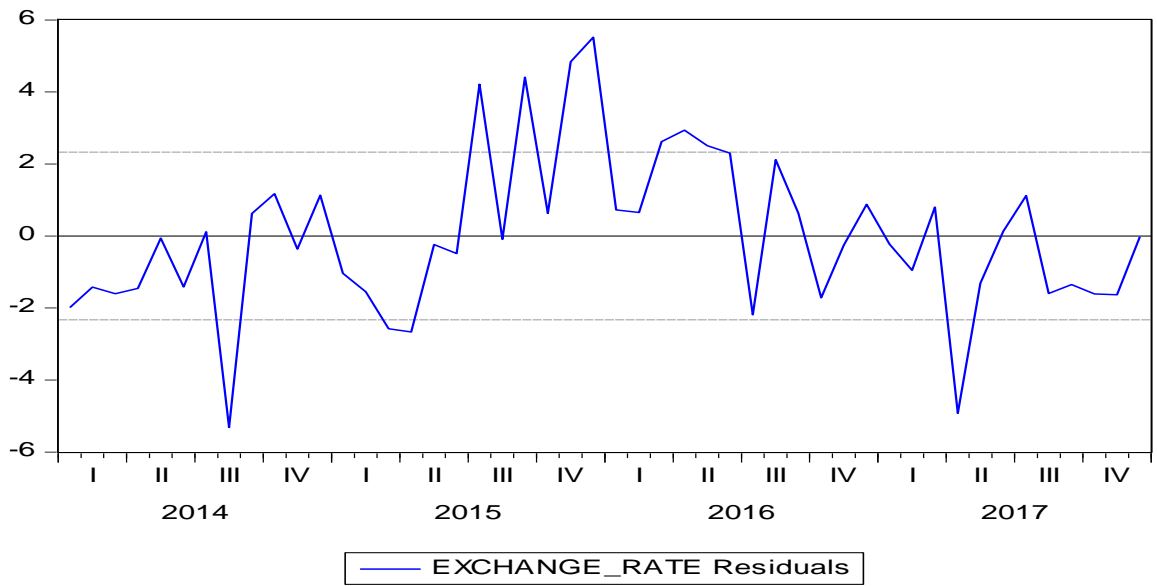


Figure 4.8: Randomness of the Error Term

The graphs in Figure 4.8 above tested the randomness of error term and revealed that there was no randomness of the error term.

4.3.2 Serial autocorrelation

Serial autocorrelation was tested using Breusch-Godfrey serial correlation test, results of the study revealed presence of serial correlation since p value was less than 0.05.

Table 4.2: Breusch-Godfrey Serial Correlation LM Test

F-statistic	154.05	Prob. F(1,43)	0.00
Obs*R-squared	37.53	Prob. Chi-Square(1)	0.00

4.3.3 Heteroskedasticity

Heteroskedasticity was tested using Breusch Pagan Godfrey test; in this test, null hypotheses states that there was no heteroskedasticity. As shown in Table 4.5, there was no enough evidence to warrant rejection of the null hypothesis and we conclude that there was no heteroskedasticity.

Table 4.3: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.60	Prob. F(4,43)	0.66
Obs*R-squared	2.55	Prob. Chi-Square(4)	0.64
Scaled explained SS	1.41	Prob. Chi-Square(4)	0.84

Since the all regression assumptions were violated and the data was time series in nature, it was appropriate to adopt time series analysis.

4.4 Time Series Analysis

4.4.1 Unit Root Test

The presence of stationarity in the data was tested using Augmented Dickey Fuller (ADF) test. ADF test null hypotheses that there is unit root against an alternative that there is no unit root.

Table 4.4: Unit Root Test at Levels

Variable	ADF Test at levels			
		T statistic	Critical Value at 5%	P value
Exchange Rate	Constant	-1.75	-2.93	0.40
	Constant and Trend	-0.62	-3.51	0.97
Interbank Transaction Volume	Constant	-1.03	-2.93	0.73
	Constant and Trend	-1.42	-3.51	0.84
Interest Rate	Constant	-2.35	-2.93	0.16
	Constant and Trend	-2.77	-3.51	0.22
CPI	Constant	-0.75	-2.93	0.82
	Constant and Trend	-3.7	-3.51	0.03
BOT	Constant	-4.35	-2.93	0.00
	Constant and Trend	-4.34	-3.51	0.00

Results in Table 4.4 revealed that exchange rate, interbank transaction volume, interest rate, CPI and BOT all had unit roots and were not stationary. The null

hypothesis was accepted since their p values were greater than 0.05. Consequently, all variables were differentiated to order one, similar to Rutto and Ondiek (2014) who also differentiated their data to the first difference.

Table 4.5: Unit Root Test at First Difference

Variable		ADF Test at levels		
		T statistic	Critical Value at 5%	P value
Exchange Rate	Constant	-2.82	-2.93	0.00
	Constant and Trend	-5.24	-3.51	0.00
Interbank Transaction Volume	Constant	-9.29	-2.93	0.00
	Constant and Trend	-9.62	-3.51	0.00
Interest Rate	Constant	-5.94	-2.93	0.00
	Constant and Trend	-5.87	-3.51	0.00
CPI	Constant	-4.44	-2.93	0.00
	Constant and Trend	-4.38	-3.51	0.01

Results shown in Table 4.5 below revealed that all variables were stationary at the first difference and we can conclude that there were integrated to order one I (1,1).

4.4.2 Lag Selection

There are alternative lag selection criterions, the current study adopted LR, FPE, AIC, SC and HQ.

Table 4.6: Lag Selection Criterion

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-140.937	NA	0.000392	6.345075	6.543841	6.419534
1	64.27188	356.8845	1.56E-07	-1.49008	-0.297490*	-1.04333
2	109.4777	68.79140*	6.75e-08*	-2.368594*	-0.18218	-1.549548*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Results shown in Table 4.6 revealed that the optimal number of lags was 2 as indicated by LR, FPE, AIC and HQ.

4.4.3 Cointegration

Since the study variables were integrated of order one, cointegration test was fitted. It was fitted using Johansen Cointegration due to its multivariate nature and has capability of examining concurrent cointegration between variables. Moreover, it can test both short and long run differences between variables. Significance of Eigen values was tested using Trace statistics.

Table 4.7: Cointegration

Hypothesized	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.57	92.91	69.82	0.00
At most 1 *	0.46	55.20	47.86	0.01
At most 2	0.33	27.60	29.80	0.09
At most 3	0.15	9.53	15.49	0.32
At most 4	0.05	2.09	3.84	0.15

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Results shown in Table 4.7 revealed that there were at most 2 cointegrating equations. Since the Trace statistics was greater than 0, and less than the number of variables under investigation it was appropriate to fit Vector Error Correction Model (VECM). These results indicated presence of long run relationship between exchange rate, interbank volume of transactions, interest rate, consumer price index and balance of trade.

4.4.4 Vector Error Correction Model

VECM results are summarized as shown in Table 4.8

Table 4.8: VECM

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.20	0.09	-2.25	0.03
C(2)	-6.14	2.11	-2.91	0.00
C(3)	0.09	0.19	0.51	0.61
C(4)	-0.09	0.22	-0.43	0.67
C(5)	6.64	2.20	3.02	0.00
C(6)	3.57	1.48	2.41	0.02
C(7)	0.12	0.09	1.31	0.19
C(8)	-0.15	0.08	-1.86	0.07
C(9)	-11.98	15.04	-0.80	0.43
C(10)	17.78	15.21	1.17	0.24
C(11)	-0.19	1.11	-0.17	0.87
C(12)	-0.47	0.82	-0.58	0.56
C(13)	0.31	0.21	1.48	0.14
C(14)	-0.02	0.01	-1.43	0.15
C(15)	-0.15	0.25	-0.58	0.56
C(16)	0.02	0.02	0.87	0.39
C(17)	-0.03	0.03	-1.03	0.31
C(18)	-0.65	0.27	-2.44	0.02
C(19)	-0.46	0.18	-2.56	0.01
C(20)	-0.01	0.01	-0.58	0.56

C(21)	0.00	0.01	0.31	0.76
C(22)	-1.97	1.82	-1.08	0.28
C(23)	1.67	1.84	0.91	0.37
C(24)	0.14	0.13	1.02	0.31
C(25)	0.25	0.10	2.48	0.01
C(26)	0.01	0.03	0.34	0.73
C(27)	-0.05	0.15	-0.32	0.75
C(28)	5.05	3.52	1.44	0.15
C(29)	1.61	0.31	5.20	0.00
C(30)	-0.35	0.36	-0.98	0.33
C(31)	2.40	3.67	0.66	0.51
C(32)	1.61	2.46	0.65	0.51
C(33)	0.00	0.16	0.00	1.00
C(34)	-0.30	0.13	-2.30	0.02
C(35)	-31.65	25.09	-1.26	0.21
C(36)	6.02	25.37	0.24	0.81
C(37)	1.33	1.84	0.72	0.47
C(38)	-1.03	1.36	-0.75	0.45
C(39)	-0.28	0.35	-0.81	0.42
C(40)	0.00	0.00	-0.91	0.36
C(41)	-0.01	0.02	-0.52	0.61
C(42)	0.00	0.00	0.42	0.67
C(43)	0.00	0.00	0.13	0.89
C(44)	0.02	0.02	0.81	0.42
C(45)	0.02	0.02	1.31	0.19
C(46)	0.00	0.00	-1.36	0.18
C(47)	0.00	0.00	-0.43	0.67
C(48)	0.75	0.17	4.40	0.00
C(49)	-0.43	0.17	-2.53	0.01
C(50)	0.01	0.01	0.50	0.62
C(51)	-0.01	0.01	-0.94	0.35
C(52)	0.01	0.00	2.20	0.03

C(53)	-0.07	0.01	-5.19	0.00
C(54)	-0.59	0.33	-1.80	0.07
C(55)	-0.02	0.03	-0.84	0.40
C(56)	0.03	0.03	0.87	0.38
C(57)	0.36	0.34	1.06	0.29
C(58)	0.34	0.23	1.50	0.13
C(59)	-0.03	0.01	-2.24	0.03
C(60)	0.00	0.01	-0.10	0.92
C(61)	-2.92	2.33	-1.25	0.21
C(62)	-1.90	2.36	-0.80	0.42
C(63)	0.34	0.17	1.96	0.05
C(64)	0.15	0.13	1.16	0.25
C(65)	0.04	0.03	1.36	0.18

The method used for selecting the lag length is the standard Information Criterion, IC(p), p being the lag order.

$$D(ER) = C(1)*(ER(-1) - 0.58*IR(-1) - 56.19*CPI(-1) + 24.49*BOT(-1) - 278.13) + C(2)*(ITV(-1) - 0.022*IR(-1) + 0.21*CPI(-1) - 0.69*BOT(-1) - 7.33) + C(3)*D(ER(-1)) + C(4)*D(ER(-2)) + C(5)*D(ITV(-1)) + C(6)*D(ITV(-2)) + C(7)*D(IR(-1)) + C(8)*D(IR(-2)) + C(9)*D(CPI(-1)) + C(10)*D(CPI(-2)) + C(11)*D(BOT(-1)) + C(12)*D(BOT(-2)) + C(13)$$

R-squared	0.49	Mean dependent variable	0.37
Adjusted R-squared	0.30	S.D. dependent variable	1.02
S.E. of regression	0.85	Sum squared residuals	23.18
Durbin-Watson stat	1.94		

The R² value of the model is 0.49. This means that 49% variability of the estimated value of ER, (D(ER)) is explained by the independent variables ER, IR, CPI, BOT and ITV. The adjusted R² is 0.3, meaning that the variation in the independent variables is 30% explained. The Sum of regression is 0.85. Durbin Watson stat is 1.94; meaning that there is no autocorrelation of the residuals as the value is

approaching 2. The mean dependent variable (DER) is 0.37 with the standard deviation being 1.02. The sum squared of the residuals is at 23.18.

$$D(ITV) = C(14)*(ER(-1) - 0.58*IR(-1) - 56.19*CPI(-1) + 24.5*BOT(-1) - 278.14) + C(15)*(ITV(-1) - 0.02*IR(-1) + 0.21*CPI(-1) - 0.69*BOT(-1) - 7.34) + C(16)*D(ER(-1)) + C(17)*D(ER(-2)) + C(18)*D(ITV(-1)) + C(19)*D(ITV(-2)) + C(20)*D(IR(-1)) + C(21)*D(IR(-2)) + C(22)*D(CPI(-1)) + C(23)*D(CPI(-2)) + C(24)*D(BOT(-1)) + C(25)*D(BOT(-2)) + C(26)$$

R-squared	0.58	Mean dependent variable	0.0045
Adjusted R-squared	0.42	S.D. dependent variable	0.1348
S.E. of regression	0.10	Sum squared residuals	0.3389
Durbin-Watson stat	1.93		

The R² value of the model is 0.58. This means that 58% variability of the estimated value of ITV, (D(ITV)) is explained by the independent variables ER, IR, CPI, BOT and ITV. The adjusted R² is 0.42, meaning that the variation in the independent variables is 42% explained. The Sum of regression is 0.10. Durbin Watson stat is 1.93, meaning that there is no autocorrelation of the residuals as the value is approaching 2. The mean dependent variable (DITV) is 0.0045 with the standard deviation being 0.1348. The sum squared of the residuals is at 0.3389.

$$D(IR) = C(27)*(ER(-1) - 0.58*INTEREST_RATE(-1) - 56.19*CPI(-1) + 24.5*BOT(-1) - 278.14) + C(28)*(ITV(-1) - 0.02*IR(-1) + 0.21*CPI(-1) - 0.69*BOT(-1) - 7.34) + C(29)*D(ER(-1)) + C(30)*D(ER(-2)) + C(31)*D(ITV(-1)) + C(32)*D(ITV(-2)) + C(33)*D(IR(-1)) + C(34)*D(IR(-2)) + C(35)*D(CPI(-1)) + C(36)*D(CPI(-2)) + C(37)*D(BOT(-1)) + C(38)*D(BOT(-2)) + C(39)$$

R-squared	0.68	Mean dependent variable	0.02
Adjusted R-squared	0.56	S.D. dependent variable	2.14
S.E. of regression	1.42	Sum squared residuals	64.45
Durbin-Watson stat	1.67		

The R² value of the model is 0.68. This means that 68% variability of the estimated value of IR, (D(IR)) is explained by the independent variables ER, IR, CPI, BOT and

ITV. The adjusted R² is 0.56, meaning that the variation in the independent variables is 56% explained. The Sum of regression is 1.42. Durbin Watson stat is 1.67, meaning that there is moderate to no autocorrelation of the residuals as the value is approaching 2. The mean dependent variable (DIR) is 0.02 with the standard deviation being 2.14. The sum squared of the residuals is at 64.45.

$$D(CPI) = C(40)*(ER(-1) - 0.58 *IR(-1) - 56.19*CPI(-1) + 24.50*BOT(-1) - 278.14) + C(41)*(ITV(-1) - 0.02*IR(-1) + 0.21*CPI(-1) - 0.69*BOT(-1) - 7.34) + C(42)*D(ER(-1)) + C(43)*D(ER(-2)) + C(44)*D(ITV(-1)) + C(45)*D(ITV(-2)) + C(46)*D(IR(-1)) + C(47)*D(IR(-2)) + C(48)*D(CPI(-1)) + C(49)*D(CPI(-2)) + C(50)*D(BOT(-1)) + C(51)*D(BOT(-2)) + C(52)$$

R-squared	0.48	Mean dependent variable	0.008
Adjusted R-squared	0.29	S.D. dependent variable	0.011
S.E. of regression	0.01	Sum squared residuals	0.003
Durbin-Watson stat	1.94		

The R² value of the model is 0.48. This means that 48% variability of the estimated value of CPI, (D(CPI)) is explained by the independent variables ER, IR, CPI, BOT and ITV. The adjusted R² is 0.29, meaning that the variation in the independent variables is 29% explained. The Sum of regression is 0.01. Durbin Watson stat is 1.94, meaning that there is no autocorrelation of the residuals as the value is approaching 2. The mean dependent variable (DCPI) is 0.008 with the standard deviation being 0.011. The sum squared of the residuals is at 0.003. This makes it the best model as it has the least sum of squared errors of prediction (SSE) value meaning that its mean square errors (MSE) value is also the smallest as all the models have a common number of parameters. The aim of any model is to reduce the MSE.

$$D(BOT) = C(53)*(ER(-1) - 0.58 *IR(-1) - 56.19*CPI(-1) + 24.50 *BOT(-1) - 278.14) + C(54)*(ITV(-1) - 0.022*IR(-1) + 0.21*CPI(-1) - 0.69*BOT(-1) - 7.34) + C(55) *D(ER(-1)) + C(56)*D(ER(-2)) + C(57)*D(ITV(-1)) + C(58)*D(ITV(-2))+ C(59)*D(IR(-1)) + C(60)*D(IR(-2)) + C(61)*D(CPI(-1)) + C(62)*D(CPI(-2)) + C(63)*D(BOT(-1)) + C(64) *D(BOT(-2)) + C(65)$$

R-squared	0.72	Mean dependent variable	0.01
Adjusted R-squared	0.62	S.D. dependent variable	0.21
S.E. of regression	0.13	Sum squared residuals	0.56
Durbin-Watson stat	2.25		

The R² value of the model is 0.72. This means that 72% variability of the estimated value of BOT, (D(BOT)) is explained by the independent variables ER, IR, CPI, BOT and ITV. The adjusted R² is 0.62, meaning that the variation in the independent variables is 62% explained. The Sum of regression is 0.13. Durbin Watson stat is 2.24, meaning that there is presence of negative autocorrelation of the residuals as the value is approaching 4. The mean dependent variable (DBOT) is 0.01 with the standard deviation being 0.21. The sum squared of the residuals is at 0.56.

4.5 Post Estimation Analysis

Post estimation analysis was carried out to examine the model robustness to show the relationship between interbank transaction volumes and exchange rates. Tabular method was used to test model stability.

Table 4.9: Roots Characteristics Polynomial

Root	Modulus
1	1
1.000000 - 2.44e-15i	1
1.000000 + 2.44e-15i	1
0.913118	0.913118
-0.349701 - 0.662535i	0.749162
-0.349701 + 0.662535i	0.749162
-0.72017	0.720168
0.522976 - 0.490141i	0.716758
0.522976 + 0.490141i	0.716758
0.320868 - 0.626479i	0.70387
0.320868 + 0.626479i	0.70387

0.155225 - 0.530845i	0.553075
0.155225 + 0.530845i	0.553075
-0.328712 - 0.052003i	0.3328
-0.328712 + 0.052003i	0.3328

results of table 4.12 above revealed that the model was stable since none of the modulus for the characteristics polynomial was greater than 1.

4.5.1 Granger Causality

Granger causality was carried out to examine causal link between exchange rate and interbank volume of transactions, interest rate, consumer price index and balance of trade.

Table 4.10: Granger Causality

Null Hypothesis:	F-Statistic	Prob.	Conclusion
ITV does not Granger Cause ER	0.18	0.84	
ER does not Granger Cause ITV	0.26	0.77	No Causality
IR does not Granger Cause ER	3.12	0.06	Unidimensional causality from ER to IR
CPI does not Granger Cause ER	0.33	0.72	
ER does not Granger Cause CPI	0.75	0.48	No Causality
BOT does not Granger Cause ER	0.25	0.78	
ER does not Granger Cause BOT	1.40	0.26	No Causality

IR does not Granger Cause			
ITV	0.20	0.82	
ITV does not Granger Cause IR	1.45	0.25	No causality
CPI does not Granger Cause ITV	1.73	0.19	
ITV does not Granger Cause CPI	0.17	0.84	No causality
BOT does not Granger Cause ITV	1.14	0.33	
ITV does not Granger Cause BOT	3.23	0.05	Unidimensional causality from ITV to BOT
CPI does not Granger Cause IR	1.30	0.28	
IR does not Granger Cause CPI	0.25	0.78	No Causality
BOT does not Granger Cause IR	0.40	0.67	
IR does not Granger Cause BOT	0.60	0.56	No Causality
BOT does not Granger Cause CPI	1.98	0.15	
CPI does not Granger Cause BOT	0.13	0.88	No Causality

Based on the data, there was no causality between interbank trading volume and exchange rate therefore we accept the null hypothesis: There was no causal relationship between interbank transaction volumes and exchange rate volatility of the Kenya Shilling against the US Dollar. In addition, it was also observed that there was no causality between CPI and ER, BOT and ER, ITV and IR, CPI and IR, BOT and IR, BOT and CPI. Further, there was unidimensional causality from exchange rate to interest rate and interbank trading volume and balance of trade.

4.5.2 Impulse Response

Cointegration of study findings was tested using impulse response and variance decomposition. Cholesky type one SD innovations was adopted as it assumes that historical behavior patterns of a variable will be repeated in future.

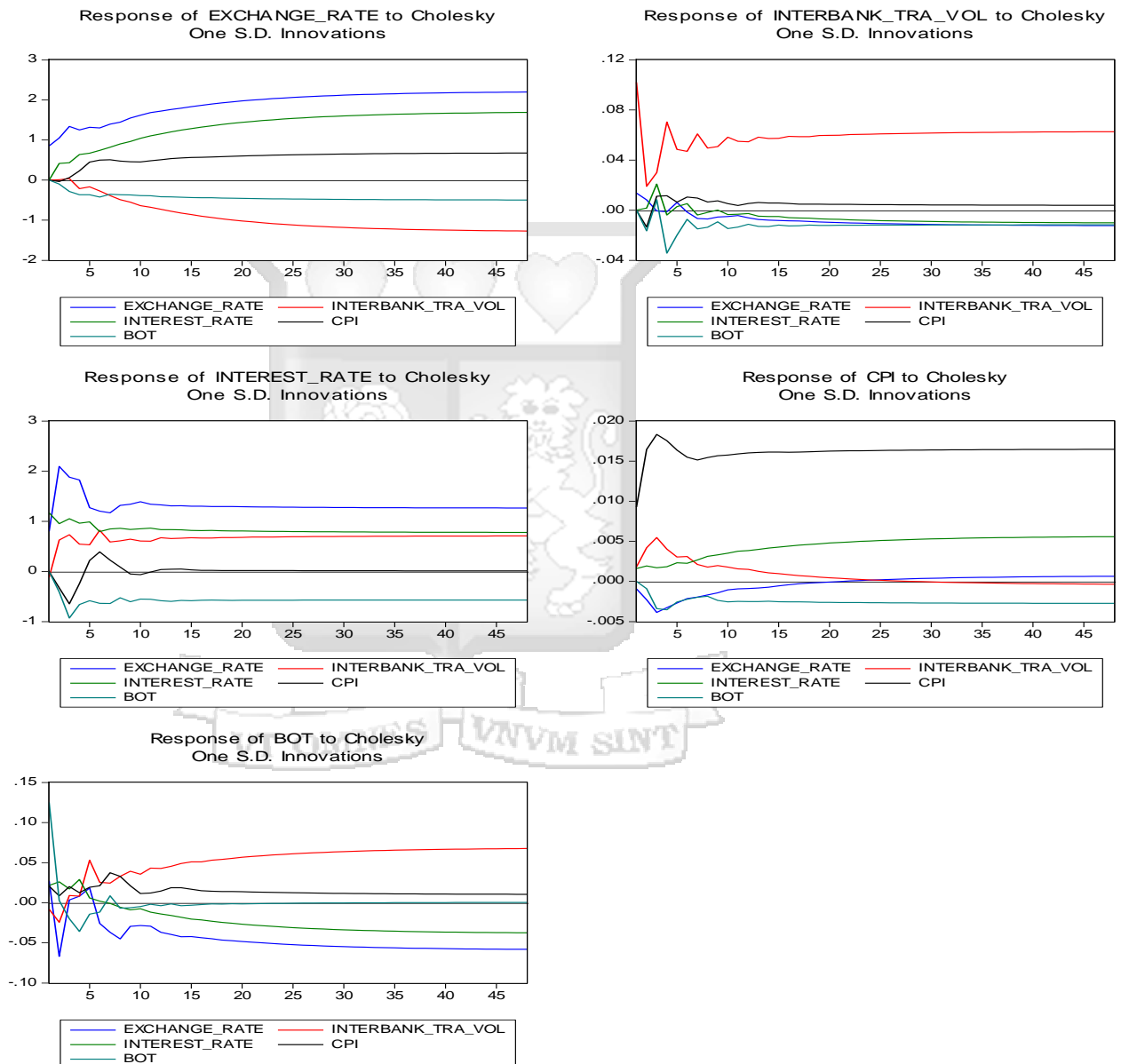


Figure 4.9: Impulse Response

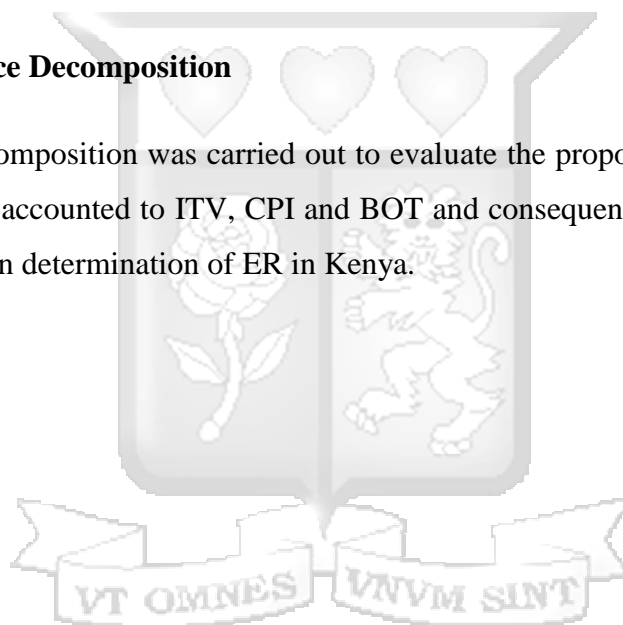
The pictorial presentation as shown in the charts in Figure 4.9 revealed that exchange rate responds to shocks of interbank transaction volume, interest rate, CPI and BOT. Exchange rate responded positively to interest rate and BOT and maintained positive

trend throughout the period under consideration. In contrast, it responded negatively to interbank transaction volumes and consumer price index.

The relationship between ER and ITV diverges in the long run, implying that as the Kenya Shilling exchange rate weakens the volumes decrease with time. This could be attributed to reduced economic activity due to the high prices of importing goods and services. During this period, most importers hold off purchasing foreign exchange due to the increase in price whereas exporters would receive more value for every unit of US Dollars received. This observation is supported by the response of Balance of Trade to the Kenya Shilling exchange rate, which reduces as the Kenya Shilling weakens against the US dollar. In contrast, the interest rates increase as the Kenya Shilling exchange rate weakens against the US Dollar.

4.5.3 Variance Decomposition

Variance decomposition was carried out to evaluate the proportions of shocks in ER that could be accounted to ITV, CPI and BOT and consequently examine their value contribution in determination of ER in Kenya.



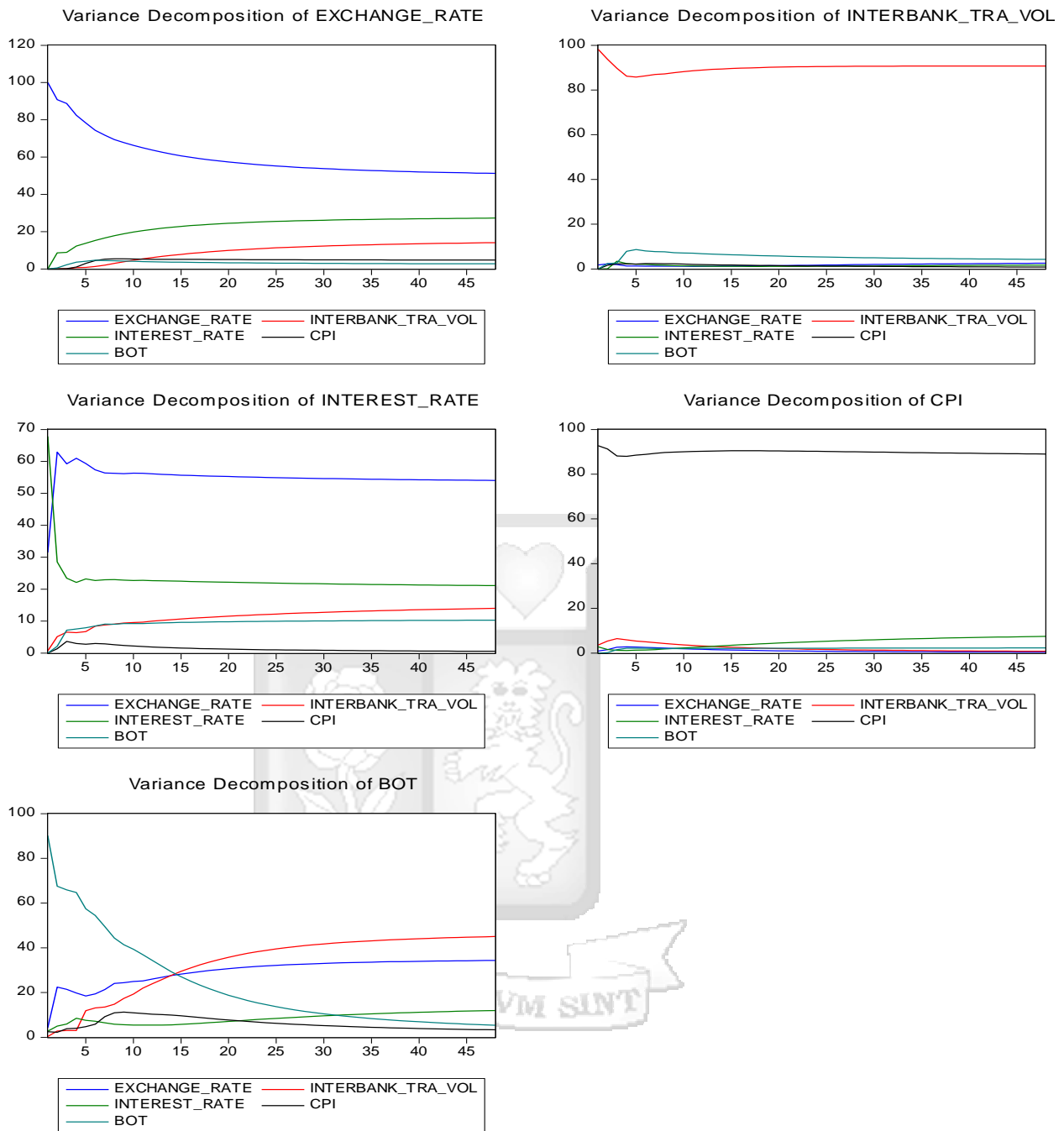


Figure 4.10: Variance Decomposition

Results shown in Figure 4.10 in the graph titled ‘variance decomposition of exchange rate’, revealed that ITV, IR, CPI and BOT affected the variance in exchange rate in the period under consideration. Variance in Exchange rate started at 100 and then followed a downward trend. On the other hand, variance due to ITV, IR, CPI and BOT commenced at zero and then increased within the same period under consideration. CPI and BOT had a minimal impact on the variance decomposition of

ER as opposed to ITV and IR. In addition, IR had a bigger effect compared on the variance of ER compared to ITV.

In the graph titled ‘variance decomposition of interest rates’, it revealed that IR is affected by ER, ITV, BOT and minimally by CPI. IR starts approximately at 65 and decreases, while ER starts at about 32 and increases. The variance in interest rates showed the inverse relationship between IR and ER which is consistent with the results of the regression analysis and with the study done by Kyule (2006), which concluded that there exists a negative relationship between the Kenya Shilling exchange rate volatility and interest rates.

The variance decomposition of BOT is affected by ER, ITV, CPI and IR. Variance in BOT starts above 80 and decreases to almost zero whereas ITV, CPI, IR and ER start at zero and proceed to rise indicating an inverse relationship. Variance decomposition of Interbank volumes is hardly affected by variance in ER, IR, CPI and BOT. Similarly, variance in ER, IR, ITV and BOT have a minimal impact on variance decomposition of CPI.

4.5.4 Regression Analysis

The study assumed the relationship between interbank volume of transactions and exchange rate, regression analysis was applied to test this relationship.

Table 4.11: Regression Analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob .
Interbank transaction				
Volume	3.419	1.971	1.735	0.09
Interest rate	0.525	0.148	3.547	0.00
CPI	49.884	3.876	12.871	0.00
BOT	-3.522	2.591	-1.360	0.18
		Mean	dependent	97.6
R-squared	0.79	variable		7
Adjusted R-squared	0.77	S.D.	dependent	6.58

		variable	
S.E. of regression	3.14	Akaike info criterion	5.21
Sum squared residuals	434.60	Schwarz criterion	5.36
		Hannan-Quinn	
Log likelihood	-120.99	criterion.	5.27
Durbin-Watson stat	0.26		

Results shown in Table 4.10 revealed 79% of the variation in exchange rate can be explained by interbank transaction volume, interest rate, CPI and BOT. Interest rate and CPI had positive and significant relationship with exchange rate. In addition, interbank trading volume had positive and insignificant relationship with exchange rate. In contrast, balance of trade had negative and not significant relationship with exchange rate.

Table 4.12: Correlation Analysis

	Exchange Rate	Interbank trading volume	Interest rate	CPI	BOT
Exchange rate	1				
Interbank trading volume	-0.03	1			
Interest Rate	0.85	-----	1		
CPI	0.62	0.77	-----	1	
BOT	0.86	0.27	-0.32	0.02	-----
	0.00	0.06	0.14	0.14	1
	-0.06	0.39	0.14	0.35	-----
	0.69	0.01	0.34	0.35	-----

Pearson correlation analysis was carried out to examine the strength of the relationship between independent and dependent variables. Results shown in Table 4.11 revealed positive and significant relationship between CPI and exchange rate. Interbank trading volume, interest rate and BOT had inverse and non-significant relationship with exchange rate.

On the effect of interbank trading volume, the Pearson correlation results showed a negative relationship between interbank trading volume and exchange rate volatility ($r=-0.03$, $p=0.85$). This implies that foreign exchange rate volatility and interbank trading volume are negatively related, with no significant correlation between the variables. This shows that foreign exchange rate volatility decreases with every increase in interbank trading volume and a unit change in interbank trading volume would lead to a 0.03 decrease in exchange rate volatility (Beta 0.85, $p>0.05$). The relationship between these two variables was not statistically significant at the 0.05 significance level.



CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This is the last chapter of this study on effect of interbank transaction volumes on exchange rate volatility. It summarises the findings and gives recommendations detailed herein.

5.2 Summary of Findings

5.2.1 What is the causal relationship between interbank transaction volumes and exchange rate volatility of the Kenya Shilling against the US Dollar?

The study finds that there is an inverse and non-significant relationship between interbank foreign exchange volumes and the Kenya Shilling exchange rate during the period in review. The study also revealed that there was no causality between Interbank trading volumes and the Kenya Shilling Exchange rate and the Kenya Shilling Exchange rate and Interbank Transaction volume. Therefore, we accepted the null hypothesis that is, there was no causal relationship between interbank transaction volumes and exchange rate volatility of the Kenya Shilling against the US dollar. This is not consistent with the study by Porarinsson (2009) who in examining the relationship between volume and volatility in the Icelandic Foreign Exchange market found that volumes had a significant impact on exchange rate volatility. Karpoff (1987) who in examining the relation between Price Changes and Trading Volume found that there was an asymmetric relationship between volume and volatility but was not the only plausible explanation. He argued that the price-volume relationship is strongest in markets or times where flow of information is most volatile.

5.2.2 What is the dynamic response of exchange rate to changes in interbank transaction volumes?

The results revealed that Exchange rate is impacted by interbank foreign exchange volumes but interest rates had a bigger impact. The relationship between interbank transaction volumes and exchange rate volatility diverge

with time, which means as the Kenya Shilling exchange rate weakens, the volumes decrease with time. This could be attributed to reduced economic activity due to the high prices of importing goods and services. This observation was supported by the response of Balance of Trade to the Kenya Shilling exchange rate, which improved as the Kenya Shilling weakens against the US dollar. This is in line with Bergen (2010), who argued that higher interest rates attract foreign capital and cause the exchange rate to rise and lower interest rates tend to decrease exchange. According to Mundell-Fleming model, an increase in interest rate is necessary to stabilize the exchange rate depreciation and to curb the inflationary pressure and thereby helps to avoid many adverse economic consequences (Reinhart, 2001). Duarte and Stockman (2002) also concurred with the view that interest rates are a factor for the changes in exchange rate and is the tool used by the central bank of a country to keep a check on any major currency fluctuation.

5.2.3 How do interbank transaction volumes influence exchange rate volatility of the Kenya Shilling against the US Dollar?

The results indicated that exchange rate volatility is affected by interbank transaction volumes but not as much as the impact of interest rates on exchange rate volatility. In addition, foreign exchange rate volatility and interbank trading volume are negatively related, with no significant correlation between the variables. This is consistent with Kyule (2016) who concluded that there exists a positive relationship coefficient between GDP and Kenya shillings volatility, and a negative relationship with interest rates, inflation and balance of payments. The study found that Interest rates influences Kenya shillings instability.

5.3 Policy Implications and Recommendations

The study recommends the government should facilitate local manufacturing and production, which reduce reliance on imports arising from increased consumption of local products in the economy. This also increases exports from surplus production, which are sold in other countries. The combined effect of these two results in an

improved balance of trade by reducing the deficit, which in turn strengthens the local currency in relation to foreign currencies.



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