REAL EFFECTIVE EXCHANGE RATE VOLATILITY AND ITS IMPACT ON SELECTED MACROECONOMIC PERFORMANCE INDICATORS IN KENYA

BY

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A THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ECONOMICS OF MASENO UNIVERSITY

DEPARTMENT OF ECONOMICS

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DECLARATION

Declaration by the Candidate

This thesis is my original Work and has not been presented for a degree in any other University. No part of this thesis may be reproduced without the permission of the Author and/or Maseno University.

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ACKNOWLEDGEMENT

ALL THE GLORY AND HONOUR BE TO OUR ALMIGHTY HEAVENLY FATHER THROUGH WHOM ALL THINGS ARE POSSIBLE.

The task of writing this thesis has been a challenging one – and even my study at a PhD level would not have amounted to anything had it not been for the sacrifice of various people. The following are therefore unreservedly thanked for their willingness to assist me in this regard and are gratefully acknowledged.

My heartfelt gratitude goes to my two supervisors Dr. Destaings Nyongesa (PhD) and Dr. Alphonce Odondo (PhD) for so many hours they devoted going through my entire manuscript with a fine-tooth comb and pointing out numerous shortcomings. I owe my very deep appreciation to the members of the faculty who included Prof.M.S.Mukras; Dr. Scholastica Achieng Odhiambo, PhD; Dr. Nelson Obange, PhD; Dr.Gedion Momanyi, PhD and Dr. Robert B.K. Mule, PhD for their availability, concern and support all the way. I thank my friends, Daniel Tuitoek and Josphat Kemboi for their support and encouragement.

I also wish to extend my gratitude to my colleagues in the struggle, the 2018 PhD – Economics class with whom we always tried to forge ahead even under extenuating circumstances. I am particularly grateful for the companionship and encouragement provided by Evans Kiganda and Reuben Rutto. Their assistance greatly improved my work.

Am truelly indebted to my beloved wife, Khatundi Fibi Nelima, for her love, care and unwavering support in the course of this study. She surely remained a living source of encouragement, especially at various instances of despair and stress, which enabled me to accomplish this task. I am as well indebted to my beloved son Victor and daughters Linna, Beryl, Stella and Veronica who have been a great source of inspiration.

I once again thank them all without implicating any of them for the stubbornness and deficiencies that may be discernible in this work. I strongly affirm that they remain entirely the author's and should not be attributed to any of the acknowledged persons.

DEDICATION

I dedicate this work to my dear wife, Fibi Nelima, my son Victor, my daughters Linnah, Beryl, Stella, Veronica and my grandchildren Leleti, Tatiana, Riche and Vladmira.

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ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey – Fuller
AERC	African Economic Research Consortium
AIC	Akaike Information Criterion
ARCH	Autoregressive Conditional Heteroscedasticity
CBK	Central Bank of Kenya
COMESA	Common Market for Eastern and Southern Africa
DF	Dickey–Fuller
EAC	East African Community
EU	European Union
ECM	Error Correction Model
EMU	European Monetary Union
ERS	Economic Recovery Strategy
FDI	Foreign Direct Investment
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
IMF	International Monetary Fund
IRF	Impulse Response Function
IV	Instrumental Variables
KPSS	Kwiatkowski- Phillips- Schmidt- Shin Test
MA	Moving Average
ML	Maximum Likelihood
NER	Nominal Exchange Rate
NEER	Nominal Effective Exchange Rate

NYSE	New York Stock Exchange
ODA	Official Development Assistance
OLS	Ordinary Least Squares
PP	Phillip – Perron
REER	Real Effective Exchange Rate
RER	Real Exchange Rate
SEM	Structural Equation Models
SSA	Sub-Saharan Africa
VAR	Vector Autoregressive
VDs	Variance Decompositions
VECM	Vector Error Correction Model
NAIRU	Non Accelerating Inflation Reasonable Unemployment

OPERATIONAL DEFINITION OF SIGNIFICANT TERMS

Exchange Rate: Is the rate at which Kenyan currency may be converted into a trading partner's currency. Among other things, the exchange rate determines how much the residents of Kenya pay for imported goods and services, and how much they receive as proceeds from exported goods and services.

Macroeconomic Performance: In the context of this study, this is measured by three indicators i.e. economic growth, foreign direct investment inflow, and current account balances. This was measured by economic growth rate (Barro and Sala-i-Martin, 2003)

Nominal Exchange Rate: Refers to the exchange rate of the Kenyan currency regarding another currency expressed in bilateral terms excluding inflationary effect.

Nominal Effective Exchange Rate: Is the rate of the Kenyan currency against a weighted composite basket of the Kenya's trading partner currencies.

Real Exchange Rate: Is expressed as the Nominal Exchange Rate of the Kenyan shilling adjusted for inflation.

Real Exchange Rate Volatility: Refers to short term fluctuations of the Kenya's RER about their longer term trends. It also entails short-term (monthly, weekly, or even hourly) fluctuations in the exchange rates as measured by their absolute percentage changes during a particular period (Beckman, Belke and Dobnik, 2011).

Real Effective Exchange Rate: Is the rate of the Kenyan currency against a weighted composite basket of the Kenya's trading partner currencies adjusted for inflation.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Being a developing small open economy, Kenya is prone to both external and internal shocks which can destabilize her economy. Kenya is confronted with the challenges of designing policies to spur economic growth, attract foreign direct investment, improve the balance of payments position, and at the same time mitigate against the effects arising from the implementation of both microeconomic and macroeconomic policies. These policies include fiscal policy, monetary policy and the exchange rate policy. Exchange rate policy is a determinant factor in the international transactions. Exchange rates and their rates of change overtime have been more volatile than the relative price levels and rates of inflation (Stokman, 1996). Exchange rate volatility has been witnessed in the Kenyan economy Since the adoption of flexible exchange rate in 1993 (CBK, 2002).

The impact of real effective exchange rate volatility on macroeconomic variables has become a subject of increasing debate in international macroeconomics and finance in the recent decades, in both developing and advanced countries. Advocates of fixed exchange rate argue that the exchange rate stability enhances cross-border trade and provides an attractive environment for the flow of international capital like foreign direct investment (FDI), and eventually stimulate economic growth in a developing country like Kenya. In their view, volatile and unpredictable fluctuations of the exchange rate may lead to many harmful macroeconomic consequences such as volatility of prices and output, deterioration of total exports as well as worsening of external competitiveness (Gylfason, 2000: Rose, 2000; Frankel & Rose, 2002; and De

Grauwe & Schnabl, 2004). On the other hand, proponents of floating exchange rate regime believe that exchange rate flexibility enhances automatic adjustments of the balance of payments in response to external shocks and positively influence the trade volume and economic growth (Friedman, 1953 ; Aseidu, 2001; and Aseidu, 2003).

The exchange rate is measured as a unit of domestic currency vis-à-vis a unit of the currency of Kenya's trading partners and is normally against the US Dollar. This is measured in real terms as the real effective exchange rate (REER) whereby the rate of one currency against a weighted composite basket of the country's trading partner currencies is adjusted for inflation. Kenya trades with many countries, hence, the need to focus on the composite basket of trading partner currencies. This is the most appropriate measure of the real exchange rate for a study of this nature given its ability to capture and measure the international competitiveness of countries. Moreover, it has been weighted by the level of trade and investment between the country in question and the rest of the world (Kiyota and Urata, 2004). This has the advantage of eliminating the bias of the sample towards actual investors when bilateral exchange rates are used.

Real Effective Exchange Rate (REER) volatility refers to short term fluctuations of the REER about their longer term trends (Frenkel and Goldstein, 1986). It also entails short-term (monthly, weekly, or even hourly) fluctuations in the exchange rates as measured by their absolute percentage changes during a particular period (Williamson *et al.*, 1985). Increased, REER volatility may lead to higher prices of internationally traded goods by causing traders to add a risk premium to cover unanticipated exchange rate fluctuations (McKinnon & Ohno, 1997; Mckinnon, 1963).

Like other developing countries that face the challenges of improving the balance of payments and stimulating economic growth, Kenya has adopted some different exchange rate regimes over the last five decades. From a fixed exchange rate regime up to 1982 to crawling peg during the period 1983 to 1993 before a floating exchange rate regime was adopted in 1993. Following the liberalization of the foreign exchange market, Kenya attained monetary independence to control inflationary pressures but lost the nominal anchor to tie down domestic prices, and thus globalization effects are transmitted directly into the country through exchange rate volatility (Kiptui & Kipyegon, 2008). External shocks require appropriate fiscal and monetary policies to prevent the emergence of unsustainable current account deficits, growing foreign debt burdens and steady losses of international competitiveness while at the same time keeping the domestic rate of inflation at low levels, conducting a strict monetary policy stance and maintaining positive real interest rates. This has been difficult in practice.

Throughout the economic adjustment agenda, exchange rate and trade reform occupy a core position. The real effective exchange rate, by its impact on international competiveness of an economy, assumes an overriding importance among the cohort of policy variables. The real effective exchange rate is an active source of discussions in Kenya where questions have arisen both in the policy arena as well as within the public domain revolving around the possible reasons for persistent appreciation of the shilling real exchange rate against key currencies(Kiptui & Kipyegon, 2008).

Also, Kenya's economy is now experiencing a sharp decrease in the foreign exchange reserves. Kenya adopted a unified and flexible exchange rate in the early 1990s, as part of a market-based reform program designed to improve the investment environment and stir up economic growth (Ndung'u, 2008). Since then, the exchange rate has witnessed continuous shocks and interventions. These changes in the exchange rate have been accompanied by considerable fluctuations in the Kenya's economic growth.

Economists have long known that poorly managed exchange rates can be disastrous for economic growth. Avoiding overvaluation of the currency is one of the most robust imperatives that can be gleaned from the diverse experiences with economic growth around the world (Rodrik, 2008).

The Kenyan economy has posted a mixture of patterns in terms of growth in real Gross Domestic Product (GDP) as depicted by peaks and troughs since independence. Kenya recorded an average growth rate of 6.5% in real GDP over the period 1964-1967 which was exceptional (CBK, 2002). However, this growth momentum was slowed down to below 4 percent during the early 1970s. The GDP growth rate averaged 8.2% in 1976 and 1977, (GOK, 1994) and Onyango (2014).

During the early 1980's, real GDP growth rate remained below 5 percent and fell to below 1 percent in 1984. However, there was an economic recovery in 1985-1986 when real GDP growth rate rose to 4.8 percent and 5.5 percent respectively. The GDP growth rate terribly slipped in the 1990's to a low of 0.2 percent in 1993.

The economy recorded its worst performance since independence in the year 2000 when the GDP growth rate recorded a -0.2 percent. After the economy registered a disappointing performance in the 1990's and early 2000, it resumed growth momentum again and there was a consistent increase in real GDP growth rate from the year 2002 thereby rising to a 7.0 percent in 2007 percent. However, this growth momentum was badly taken aback by the post-election violence of 2008 which led to a real GDP growth rate of 1.7 percent (CBK, 2009).

Economic Performance under the Economic Recovery Strategy (ERS) of 2003-2007 points to the fact that Kenya has a great potential. On average, real GDP expanded by

5.3 per cent over the period 2003-2007, which compares well with growth rates achieved by most reforming countries in sub-Saharan Africa

Kenya has high potential of increasing real GDP growth to double digit, thereby realizing a globally competitive and prosperous economy, as envisaged under the First Medium Term Plan, 2008-2012, a policy blueprint of the Kenya Vision 2030 (GOK, 2007). After experiencing moderately high growth rates during the 1960s and 1970s, Kenya's economic growth during the last three decades has far been below its potential. This trend is attributed to the steady losses of the country's international competitiveness.

The impact of exchange rate volatility on economic growth has received relatively little attention from both theoretical and empirical perspectives. Empirical evidence offers varied findings regarding the relationship between these variables. There is, however, no adequate information yet on whether real effective exchange rate volatilities have influenced the Kenyan economic growth, or whether any such influences have been negative or positive. This study tried to fill this gap.

The link between exchange rate volatility and FDI is regarded as one of the scanty areas in literature. Foreign direct investment provides potential growth attributes like technology, specialized skills, and access to the international market (McAleese, 2004). However, the host country must possess structures and mechanisms that can optimally absorb and retain these benefits, but not all emerging markets possess this capability (Borensztein, De Gregorio, & Lee, 1998).

Foreign direct investment has been (and is) regarded as one of the growth engines for countries with capital deficiency and technological backwardness. An investor looking for a possible market, resource-rich country, cheap labor and growth prospect and a country in frantic need of capital inflow, technological inflow, and technological spill over, job creation and employment is regarded as a perfect economic match. However, this relationship has never been smooth. It has been characterized as a hard relationship, difficult to realize at times. In addition to these factors, the collapse of the Bretton woods agreement introduced another worrisome factor to investors- a fluctuating and unpredictable exchange rate valuation due to unpredictable market forces, named-volatility.

The appriori results had suggested, among other things, that exchange rate volatility may be a source of worry by foreign investors in Kenya. Also, there may be a significant positive relationship between real FDI inflows and exchange rate volatility in Kenya. This implies that, depreciation of the Kenyan Shilling may increase real FDI inflows (Mwega & Ngugi, 2005.).

Throughout the 1970s Kenya had been one of the prime candidates for Transnational Countries (TNCs} in eastern and southern Africa with relatively better infrastructure, market growth and openness at a time when many other countries had closed regimes. In 1975 FDI inflow appeared to be $ 17million and sequentially rising to $ 78million in 1980. Later, Kenya experienced fluctuations in terms of attracting FDI. For instance, the mean annual flow of FDI into the country remained to be $60million in the 1970s falling to $30 million in between 1980-1990. However, FDI begun to rise in the beginning of the 21st century especially with the licensing of mobile phone ventures for Kenyan-foreign investors pushing further the mean annual FDI inflow to $41 million in 2000-2008.

The impact of exchange rate volatility on FDI, however, remains less explored. This study contributed to the gap in empirical investigation of the matter for the Kenyan economy. The study investigated the impact of real effective exchange rate volatility on foreign direct investments (FDI) in Kenya alongside other selected macroeconomic variables. The current account balance of a host country can be viewed as an indicator of the strength of its currency. A deteriorating current account balance is likely to lead to a depreciation of the host country's currency. It is possible that potential multinational investors view current account deficits negatively because such deficits may lead to inflation and exchange rate variations.

Theoretically, a current account deficit should cause the value of the local currency to fall. In this case, the value of imports into the importing country is higher than the value of exports sold to foreigners (Baharumshah, 2001). Hence, the demand for foreign currencies to buy these imports is higher than the demand for the local currency to buy the exports. Simple supply and demand analysis, therefore, suggests that the value of the local currency should fall.

Balance of payments deficits have been a common phenomenon in the Kenyan economy from the 1960s. The government has over the years enacted various policy measures aimed at remedying the situation; however the balance of payments situation does not seem to have improved despite this policy measures (Mwega & Ngugi, 2005.) . The deficit in the current account widened from a deficit of Ksh. 76.4 billion in the first quarter of 2011 to a deficit of 81.1 billion in the first quarter of 2012. The deterioration in the current account was mainly as a result of 20.8 per cent widening of the merchandise account deficit.

Kenya's overall balance of payments positions declined by US$ 220.7 million from a surplus of US$ 360million in May 2011 to a surplus of US$ 139 million in May 2012 (Stratlink, 2012). The deterioration was largely due to narrowing of the current account. The current account deficit nearly doubled to 13.1% of GDP. Imports grew by almost 20%, while exports increased by 10%, thus representing a net export of -10%.

Despite rapid economic growth experienced between 1963 and 1970, the current account balance of payments remained in deficit except in 1963, 1964, 1965, 1977, 1993, 2003, 2009, and 2010 when it recorded a surplus of US$ 10.1m, US$ 50.6m, US$ 0.5m, US$ 25.9m, US$ 124.5m, US$ 132.4m, US$ 9908.3m, and US$ 11404.95m respectively. The adjustments in balance of payments in Kenya appear to be complicated because the receipts and expenditures are mostly financial and seldom in real assets.

1.2 Statement of the Problem

The volatility of exchange rate describes uncertainty in international transactions both in goods and financial assets which affects a country's macro-economic performance. Kenya has witnessed fluctuations in foreign exchange market as exhibited by strong appreciations of the Kenyan Shilling between 2004 and 2007 of value 30.0% which is a major deviation from its past levels. Kenya's economic growth during the last three decades has far been below its potential. Kenya's real GDP growth rate between 1985-1995, 1996-2005 and 2006-2015 was 5%, -0.2% and 4% respectively, as compared to 6.8% on average during the 1960s and 1970s. Kenya has continuously experienced fluctuations in terms of attracting foreign direct investment; and the deficits in the current account balances have been a common phenomenon from the 1960s. Some scholars have attributed this trend to the volatility of the shilling. Previous literatures on this issue have generated mixed results on the relationship between Kenya's real effective exchange rate (REER) volatility and selected macro-economic performance indicators, and as such this study sort to resolve this controversy. This study investigated and mapped out the profile of Kenya's real effective exchange rate (REER) volatility for the period 1972 to 2015 by employing the GARCH technique and interrogated its impact on three Kenyan macroeconomic indicators, viz; real GDP growth rate, foreign direct investment inflows and current account balances to fill the gap.

1.3 Overall Objective of the Study

This study, in broad terms, empirically assessed the real effective exchange rate (REER) volatility and its impact on macroeconomic performance in Kenya.

1.4 Specific Objectives

1. To determine whether real effective exchange rate in Kenya has been volatile;

2. To establish the impact of real effective exchange rate volatility on real economic growth rate in Kenya;

3. To assess the impact of real effective exchange rate volatility on foreign direct investment inflows in Kenya;

4. To investigate the impact of real effective exchange rate volatility on current account balances in Kenya.

1.5 Research Hypotheses

$H_0 1$: The real effective exchange rate in Kenya has not been volatile.

$H_0 2$: Real Effective Exchange Rate volatility has no impact on real economic growth rate in Kenya;

$H_0 3$: Real Effective Exchange Rate volatility has no impact on foreign direct investment inflows in Kenya;

$H_0 4$: Real Effective Exchange Rate volatility has no impact on the current account balances in Kenya.

1.6 Scope of the Study

This study examined the impact of real effective exchange rate volatility on macro-economic performance in Kenya, focusing on three macroeconomic indicators, namely: Economic Growth, Foreign Direct Investment Inflows and Current Account Balances during the period 1972 to 2015. The study measured the volatility of real effective exchange rate (REER) using the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model and the Vector Autoregressive Model (VAR) to investigate the impact of real effective exchange rate volatility on real economic growth rate, foreign direct investment inflows and current account balances in Kenya.

1.7 Justification of the Study

A number of researchers have argued that real effective exchange rates are crucial not only for attaining sustained general economic performance and international competitiveness, but have a strong impact on resource allocation amongst different sectors of the economy, foreign trade flows and balance of payments, employment, structure of production and consumption and external debt crises (Edwards, 1988; Edwards & Savastano, 1999).

Recently, however, episodes of volatility increased, thereby posing challenges for macroeconomic management in Kenya (Kiptui & Kipyegon, 2008). Kenya, like other developing countries, has experienced a combination of exogenous shocks such as worsening terms of trade mainly on account of fluctuations in international commodity prices, oil price shocks and fluctuations in capital flows, which have created macroeconomic management policy challenges.

Therefore, understanding the impact of real effective exchange rate volatility on macroeconomic performance would help in guiding appropriate exchange rate policies that foster exports' competitiveness, attract foreign financial sources such as FDI, improving the balance of payments and stimulating real economic growth rate. This study aimed at examining the impact of exchange rate volatility on macroeconomic performance in Kenya whose findings certainly make a contribution on the exchange rate volatility – macroeconomic performance nexus debate.

The findings of this study also contribute to the position taken by the Mundell-Fleming-Dornbusch model; the IS-LM-BoP model; the risk aversion theory and the elasticity approach. The identified macroeconomic indicators were selected because they have a strong and direct bearing on Kenya's general economic performance and international competitiveness.

Furthermore, the current study has tried to resolve the lack of conclusive evidence and added to the body of knowledge on the subject matter. The relationship between a country's exchange rate and macroeconomic variables is a crucial issue from both the descriptive and policy prescription perspectives. As Edwards (1989), puts it, "it is not an overstatement to say that real exchange rate behavior now occupies a central role in policy evaluation and design". A country's exchange rate is an important determinant of the growth of the cross- border trading and it serves as a measure of its international competitiveness (Bah & Amusa, 2003). The findings of this study will, therefore, help in the formulation of appropriate fiscal and monetary policies so as to prevent the emergence of unsustainable current account deficits, growing foreign debt burdens and steady losses of international competitiveness.

The study findings will guide policy makers of Monetary Authorities like CBK, foreign trade experts, to formulate effective foreign trade policies that aim at increasing trade both in terms of volume and efficiency and therefore lowering REER volatility. This will improve the overall welfare of the citizens at large.

1.8 Theoretical Framework

1.8.1 Measuring Real Effective Exchange Rate Volatility

Theoretical models on measuring Real Effective Exchange Rate (REER) Volatility are mixed. Economists and financial experts are yet to agree on a single theory that defines the exchange rate. Hitherto, there are at least five competing theories of the exchange rate concept, which may either be classified as traditional or modern. The traditional theories are based on trade and financial flows, and purchasing power parity, and are important in explaining exchange rate movements in the long run. These theories are: the elasticity approach to exchange rate determination, the monetary approach to exchange rate determination, the portfolio balance approach to exchange rate determination, and the purchasing power theory of exchange rate determination. The modern theory, however, focuses on the importance of capital and international capital flows, and hence, explains the short run volatility of the exchange rates and their tendency to overshoot in the long run.

An alternative to the simple monetary model is a disequilibrium macroeconomic model that considers the differential speeds of adjustment in asset and goods markets. This leads us to the sticky-price monetary approach to the exchange rate. The most common Sticky-Price Monetary Model (SPMM) is the Dornbusch (1976) over- shooting model, which is basically an extension of the Mundell-Fleming model (Obstfeld and Rogoff, 1996; Donald, 1988). Hence this model is also known as the Mundell-Fleming-Dornbusch model.

In it, the nominal output prices are assumed to be sticky - they adjust slowly over time. The consequences for the short-run behavior of the exchange rate, given imperfect price flexibility, are to generate 'over – shooting'. That is, given an initial disturbance, the exchange rate first moves beyond its long run equilibrium level, and then in the longer run moves back. This provides an explanation of an empirical phenomenon which attracted much attention in the late 1970s and early 1980s.

This study was anchored on the Mundell-Fleming-Dornbusch model to measure real effective exchange rate volatility in Kenya for the period under study.

1.8.2 Exchange Rate Volatility and Economic Growth

To examine the impact of real effective exchange rate volatility on economic growth rate, this study employed the Mundell–Fleming model for a small open economy that is exposed to terms of trade shocks and hence international competitiveness. The Mundell–Fleming model also known as the IS-LM-BoP model (or IS-LM-BP model), is an economic model first set forth (independently) by Robert Mundell and Marcus Fleming. The model is an extension of the IS-LM Model. Whereas the traditional IS-

LM Model deals with the economy under autarky (or a closed economy), the Mundell–Fleming model describes a small open economy.

1.8.3 Exchange Rate Volatility and FDI

Theories explaining exchange rate volatility and foreign direct investment (FDI) may be broadly classified as production flexibility theory and risk aversion theory. According to the risk aversion theory, it claims that higher fluctuations in exchange rate lower the certainty equivalent of expected exchange rate, which in turn reduces FDI. This study was anchored on the risk aversion theory.

1.8.4 Exchange Rate Volatility and Current Account Balance

As for the relationship between real effective exchange rate volatility and current account balance, this study employed the elasticity approach. This idea is summarized in the Marshall-Lerner condition, which states that devaluation will have a positive effect on a country's balance of payments if the sum of the elasticities of demand for its exports and imports is greater than unity. The converse holds if it is less than unity. Dornbusch (1988) also noted that the relative impact of adjustments to the REER on the current account depends on the extent to which domestic demand can switch from tradables to non-tradables, as well as the domestic economy's ability to generate additional output to meet export demand.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Since the breakdown of the Bretton-Woods system of pegged exchange rates and the switch to floating exchange rates in the early 1970s, the effect of exchange rate volatility on economic performance has become a subject of interest for both policy makers and researchers. In this section, we briefly review the theoretical and empirical arguments on the impact of exchange rate volatility on three main macroeconomic variables namely; economic growth, trade, and foreign direct investment.

2.2 Theoretical Review

2.2.1 Measuring Real Effective Exchange Rate Volatility

The Dornbusch model has the mixed features of the Mundell-Fleming model and the monetary model, though it stems from the former and, is sometimes called the Mundell-Fleming-Dornbusch model. The Dornbusch model is prominently featured by the sticky price assumption and overshooting. The sticky price assumption suggests that prices are neither totally flexible nor totally fixed. With this assumption, the aggregate supply curve is flat in the short term, the slope of the aggregate supply curve gradually becomes steeper and steeper with the time horizon and the curve is vertical in the long run. In the short term, increases in output are induced by shifts in aggregate demand; in the medium term, increases in out-put are caused by shifts in aggregate demand or shifts in aggregate supply or both; and in the long run, only a shift in aggregate supply changes output. Other assumptions of the Dornbusch model include that the exchange rate is flexible, agents have perfect foresight and the Uncovered Interest Rate Parity (UIRP) holds. The real interest rate differential model by Frankel (1979) is introduced as an attempt to bridge the opposite results and conflicting policy implications often produced by the flexible monetary model and the Dornbusch model.

The model proposed by Dornbusch (1976) has three basic building blocks: uncovered interest rate parity and expectations, demand for money or the money market equilibrium and aggregate demand the goods market equilibrium. The model is for a small open economy, so the foreign interest rate is exogenous and the long-run equilibrium interest rate for the domestic interest rate.

The first relationship in the model is UIRP, that the expected change in the foreign exchange rate is equal to the interest rate differential between the domestic country and the foreign country. In the case of a small open economy, the expected change in the foreign exchange rate is equal to the difference between the prevailing domestic interest rate and its long-run equilibrium rate:

$$E_t(\Delta e_{t+1}) = r_t - r^* \qquad \text{2.1}$$

Where e_t = the exchange rate in logarithms, $\Delta(e_{t+1}) = e_{t+1} - e_t, r_t$ is the domestic interest rate, r^* and is the long-run equilibrium interest rate where a time sub-script is not relevant.

The second building block of the model, the demand for money equation, is the standard version:

$$m_t - p_t = \emptyset y_t - \curlywedge r_t \qquad \text{2.2}$$

Where m_t = demand for money, p_t is the price level, y_t is real income, and all are expressed in domestic variables and are in logarithms; and $\emptyset > 0$ and $\curlywedge > 0$ are coefficients representing the income elasticity of demand for money, and the interest rate semi-elasticity of money demand respectively.

The third element of the model is the price adjustment process through analyzing aggregate demand and excess demand If we leave this part out and let the A simpler way proceeds as follows. Aggregate demand is:

$$y_t^d = y^- + \delta[(e_t - p^* - p_t) - (\bar{e} + p^* - \bar{p})] - \partial(r_t - r^*) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.3$$

i.e., aggregate demand is its long-run equilibrium level plus the effects caused by the discrepancy between the real exchange rate and the long-run real exchange rate and the discrepancy between the prevailing interest rate and the long-run equilibrium interest rate. The price adjusts in proportion to the discrepancy between aggregate demand and its long-run equilibrium level.

First the long run equilibrium properties of the model are identical to those of the monetary approach (Asset Market Equilibrium lies at the center of the model) where the asset in question is money and, where the demand for money function is stable and the supply of money is determined by the monetary authorities (the Central Bank of the country). The economic interpretation of this is that as the exchange rate rises, aggregate demand rises as net exports respond to increased competitiveness. Thus is offset by a rising price level which reduces aggregate demand via two mechanisms. First, the increased price level reduces competitiveness and therefore net exports. Secondly, the increasing of the price level also has the effect of reducing the real money stock, therefore increasing the domestic interest rate (the 'Keynes effect') which also reduces aggregate demand.

The Dornbusch model is interesting for its properties of dynamic adjustment, once the crucial assumption is made that asset markets adjust more quickly than do goods markets and that in the short run, the price level is sticky, while goods prices are fixed in the short run and only adjust gradually in the long run. Thus, an increase in the money stock increases real income in the short run, both because of the fall in the interest rate and because of the (overshooting) the rise in the real exchange rate. In this guise, it is tempting to see the Dornbusch model as reconciliation between Mundel–Fleming as a short run exercise, and the monetary approach as the long run equilibrium to which it tends.

Despite its popularity, the Dornbusch model has methodological limitations when examined from micro-foundation perspective. First, the model lacks explicit choice-theoretical foundations, particularly concerning micro-foundations of aggregate supply (Obstfeld & Rogoff, 1996). Its specification of the price determination is ad hoc. The model also is ill-equipped to capture current account dynamics or the effects of government spending, since it does not account for private or government inter-temporal budget constraints (Obstfeld & Rogoff, 1996). In addition, it does not explicitly model the implicit bond market. Nevertheless, the model has played a dominant role in the literature on exchange rate dynamics and remains one of the basic building blocks of open economy macro-models.

2.2.2 Exchange Rate Volatility and Economic Growth

The Mundell–Fleming model portrays the short-run relationship between an economy's nominal exchange rate, interest rate, and output (in contrast to the closed-economy, IS-LM model focuses only on the relationship between the interest rate and output). The Mundell–Fleming model has been used to argue that an economy cannot simultaneously maintain a fixed ex-change rate, free capital movement, and an independent monetary policy. This principle is frequently called the "impossible trinity," "unholy trinity," "irreconcilable trinity," "inconsistent trinity" or the "Mundell–Fleming trilemma."

The equations of the Mundell-Fleming Model are as follows;

$$Y_t = C_t + I_t + G_t + NX_t \quad \text{………………………………………………..2.4}$$

The LM curve

$$\frac{M_t}{P_t} = L_t[i_t, Y_t] \quad \text{…………………………………………………………2.5}$$

$$BOP_t = CA_t + KA_t$$

……………………………………..……………………2.6

Where Y_t is GDP, C_t is consumption, I_t is physical investment, G_t is the government spending(an exogenous variable), M_t is the nominal money supply, P_t is the price level, i_t is the nominal interest rate, L_t is the liquidity preference(real money demand) and NX_t is the net exports.

Basic assumptions of the model are that: (i) Spot and forward exchange rates are identical, and the existing exchange rates are expected to persist indefinitely, (ii) Fixed money wage rate, unemployed resources and constant returns to scale are assumed. Thus domes-tic price level is kept constant, and the supply of domestic output is elastic, (iii) Taxes and saving increase with income, (iv) The balance of trade depends only on income and the exchange rate, (v) Capital mobility is perfect and all securities are perfect substitutes. Only risk neutral investors are in the system. The demand for money therefore depends only on income and the interest rate, and investment depends on the interest rate, (vi) The country under consideration is so small that the country cannot affect foreign incomes or the world level of interest rates.

2.2.3 Exchange Rate Volatility and FDI

The risk aversion theory assumes that there exist no hedging possibilities, firms are risk averse, and a higher proportion of revenues and expenditures are in foreign currency such that exchange rate volatility negatively impacts on the level of trade (Goldberg & Kolstad, 1995). An individual is risk averse if for any arbitrary risk prefers to be sure of the amount equal to the expected value of the risk.

$$u[w + E(z)] > E[u(w + z)] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.7$$

Where w is the initial wealth, E is the expectation operator and z, a random variable, be his risky prospect. A general measure of risk aversion is Pratt's risk premium $\pi(w, z)$ defined by the equation

$$u[w + E(Z) - r(w, z] = E[u(w + z)] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.8$$

The risk premium $\pi(w, z)$ depends both on w and on the distribution of z. $\pi(w, z)$ can be interpreted as the maximum amount, beyond the negative of the expected value of the risk itself, which an individual with wealth equal to w would pay to insure against the risk z.

The theoretical literature has its roots in Clark (1973), who contends that a risk averse firm facing increased exchange rate volatility will reduce its exports due to the uncertainty in its future profitability. Other models show that the negative relationship between exchange rate volatility and trade may not always hold under different conditions. For example, the presence of hedging instruments or accessibility to mature forward markets (Ethier 1973, Baron 1976, and Broll 1994) can alleviate the impact of exchange rate volatility on trade. On the other hand, an opposite (positive) relationship can exist when highly risk averse firms faced with volatile exchange rates increase their exports due to stronger income over substitution effects (De Grauwe 1987), and when high costs are involved in entering and exiting export markets (Franke 1991, and Sercu and Vanhulle 1992).

2.2.4 Exchange Rate Volatility and Current Account Balance

Two broad approaches are typically used to explain the impact of real exchange rate changes on the current account. The first, the elasticities approach, holds that an appreciation (depreciation) in the REER should result in higher (lower) levels of imported goods and services, and lower (higher) exports, given that imports would have become cheaper (more expensive) while exports would have become relatively more expensive (cheaper). The extent to which these changes may be realized will depend on the relative elasticities associated with export and import commodities. If, for example, a country relies heavily on imported intermediate inputs, i.e., there are no close substitutes; depreciation in the nominal exchange rate may not stimulate changes in imports, as the price elasticity of demand is low.

According to this approach, the success of devaluation in improving the balance of trade, and the rough it the balance of payment depends upon the demand elasticity of import and export of devolving country. An improvement in the balance of trade will depend upon whether the demand for import and export is elastic. Devaluation makes import of the devaluing country costlier than before and in case her demand for imports is elastic, a higher amount will be adversely the balance of payment of the devaluing country. However, if her demand for exports is elastic then with a fall in the prices of exports as a result of devaluation, the foreigners, which in turn will help in resting equilibrium in her demand for imports is elastic, and then the imports of the country will be significantly reduced by devaluing country.

Let $Ex^d Em^d =$ price elasticity of demand for exports and imports respectively

$Ex^s Em^s =$ price elasticity of supply for exports and imports respectively. Then according to Learners conditions, devaluation will increase a country's balance of trade, then

$$Ex^d = Em^d = Em^d > 1 \text{ gives infinite } Em^s \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.9$$

2.3 Review of Empirical Studies

2.3.1 Measurement of Real Exchange Rate and Real Effective Exchange Rate

As is commonly done in the empirical literature, the real exchange rate is proxied by the nominal exchange rate (E) multiplied by the relative prices of the domestic and foreign economies (P*/P).

This is given as:

$$R_t = \frac{E_t P_t^*}{P_t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.10$$

The task of deciding which measure of the exchange rate is the most appropriate is usually faced with two set of issues. According to Chinn (2002:5), the first is between the theoretically applied measures and the real world counterparts. The second one is between using the most appropriate measure conceptually and using a measure based on the most readily available data. In short, the translation from the real exchange rate theory to real- world data is not straight forward, due to the fact that, in most cases, there are usually problem in reconciling between what theory postulated and the available data to execute same. For instance, at the empirical level, due to the problem of getting data on the relative price of tradable goods to the price of non-tradable goods many authors continue to proxy the real exchange rate by nominal exchange rate adjusted for movements in the prices of foreign and domestic countries (Sundararajan, et. al., 1999:5; Jimoh, 2006:94; Jongwanich, 2009:14). That is as we have in equation 2.1 above.

Also, the empirical treatment of the real effective exchange rate typically abstract from how to measure exchange rates when countries engage in transactions with a number of partners. In such a case, equation 2.1 can be weighted to obtain the empirical measurement of real effective exchange rate. Real effective exchange rate is measured as below:

$$REER_t = \sum_{i=1}^{n} w_{it} \frac{E_{it} P_{it}^*}{P_t} \qquad \text{..........2.11}$$

Where, $REER_t$ is the real effective exchange rate at time t, E_t is the nominal exchange rate, P_t is the domestic price while P_t^* is the foreign price at time t respectively, w_{it} is the weight attached to each trade partner.

Using geometric weighted method, real effective exchange rates is measured as:

$$REER_t = \prod_{i=1}^{n} w_{it} \frac{E_{it} P_{it}^*}{P_t} \qquad \text{..........2.12}$$

The trade weight w_{it} of the trading partners is sum to 1(Chinn, 2006:122). The weight to be given to each bilateral rate is commonly based on the share of total imports, exports or total exports and imports. When data from only major trading partners are used for the computation, the weight to be given to the *ith* country's bilateral rate is computed as the country's total import and export to the domestic economy as a percentage of domestic country's total export and import from all the selected trading partners. The formula used for calculating the trade weights is given as follows:

$$w_{it} = \frac{M_{it} + X_{it}}{\sum_{i=1}^{n} X_{it} + \sum_{i=1}^{n} M_{it}} \quad \ldots\ldots 2.13$$

Where; w_{it} = time varying weight of country i in the overall trade volume of the country.

M_{it} = imports of home from country i at time t, X_{it} = exports of home to country i at time t

$\sum_{i=1}^{n} X_{it}$ = Exports of home to the n selected trading partners at time t and $\sum_{i=1}^{n} M_{it}$ = Imports of home to the n selected trading partners at time t

Other issues involved in the measurement of effective exchange rate include the choice of price index and the choice of trade partners among others. In practice, the choice of prices to employ usually depends on the relative price that best reflect the relative price of tradable goods to non-tradable goods. The indices available are: the consumer price index (CPI), the producer price index (PPI), the wholesale price index (WPI), the export price index (EPI) and the GDP deflator (Chinn, 2006:115). The most commonly used price series are consumer price index.

Although there are theoretical reasons to prefer other types of price index when measuring competitiveness (Koch, 1984:7), CPIs have the advantage of being timely and available for a wide range of countries over a long period of time. According to Chinn (2002:119), for the purposes of calculating the relative price of tradable goods, the preferred measure is the exchange rate deflated by PPIs or WPIs. One drawback of using these indices is that, there is considerably more variation in how these price series are constructed across countries, than for the corresponding CPIs (Chinn, 2002:7; 2006:120). Concerning the choice of countries to include and their relative weights, in principle, all countries that trade with a domestic country should be included. In practice, data limitations tend to restrict the number of countries that can be considered. The actual selection is determined by practical considerations, efforts are made to ensure that the currencies included account for a high proportion of total trade of the country in question (Chinn, 2006:123, Ibrahim and Ayodele, 2012).

2.3.2 Exchange Rate Volatility and Economic Growth

The relationship between exchange rate volatility and economic growth has received relatively little attention from both theoretical and empirical perspectives. This is because, the exchange rate is considered as nominal variable and not related to the long term real growth performance (Levy-Yeyati & Sturzenegger, 2003). Empirical evidence offers mixed findings regarding the impact of exchange rate volatility on growth. For example, Ghosh (1996) studied the growth performance under alternative regimes in 145 IMF-member countries and found that there are no significant differences in output growth across exchange rate regimes. They argued that pegged regimes increases investment and volatility of growth and employment but reduces productivity growth and inflation.

While examining the impact of exchange rate volatility for East Asian countries, McKinnon & Schnabl (2004); McKinnon & Ohno (1997); and Mckinnon (1963), argued that before the Asian crisis of 1997/98 the exchange rate stability contributed significantly to low inflation, sound fiscal position, high investment and boosted long-term growth.

Investigation of the impact of exchange rate volatility on economic growth on small open economies at the European Monetary Unity (EMU) periphery was conducted by Schnabl (2008). He estimated a panel data of 41 countries in the EMU periphery from 1994 to 2005. Volatility was captured as a yearly average of monthly percentage exchange rate. He performed both GLS and GMM and the results provided evidence that exchange rate volatility has a negative impact on economic growth. The study concludes that a stable exchange rate creates a stable milieu for the adjustment of asset and labour market hence fostering growth. By contrast, using panel estimations for more than 180 countries Edwards and Levy-Yeyati & Sturzenegger (2003) found evidence that countries with more flexible exchange rate grow faster. A study by Edwards (1988) found that floating exchange rate fosters economic growth. However, the current study had a different approach. This study focused on Kenya only, used the time series data set ranging from 1972-2015, employed GARCH model to derive the quarterly measure of volatility for REER and performed VAR.

The link between growth and exchange rate volatility was examined by Holland et al (2011) for a set of 82 advanced and emerging economies using a panel data set ranging from 1970 to 2009. They employed ARMA to derive the monthly volatility measure for RER. By estimating the dynamic panel data growth model, they found out that a more volatile RER has significant negative impact on economic growth and the results are more robust for different model specification. This study focused on Kenya only, used the time series data set ranging from 1972-2015 and employed GARCH model to derive the quarterly measure of volatility for REER not RER.

Azeez et al (2012) examined the effects of exchange rate volatility on macroeconomic performance in Nigeria for a period of 25 years ranging from 1986 to 2010. The study employed OLS and Johansen co integration estimation technique to test for the short and long run effect respectively. The ADF test reveals that all the variables were stationary. The result found that the RER volatility contributes positively to GDP in the long run. The current study examined the impact of REER volatility on macroeconomic performance in Kenya for a period of 44 years ranging from 1972 to 2015 by employing the VAR technique.

Rodrik (2009) postulated that an undervaluation of the real exchange rate encourages economic growth as it increases the share of the tradable sector to GDP. The author points out that the tradable sector is more vulnerable than the non-tradable sector because of institutional weaknesses and market failures, explaining why the tradable sector is too small in developing countries. Tradables are those goods and services (exportables and importables) whose price behavior is determined by the world market, while non-tradables are those goods and services produced and consumed domestically and which are not close substitutes to tradables. An undervaluation of the exchange rate is seen as a policy that would improve export competitiveness, encourage investment in the tradable sector and hence foster economic growth.

Other authors, viz, Levy-Yeyati & Sturzenegge,(2003) deny that expansion in the tradable sector would enhance economic growth. According to them, an undervaluation in exchange rate promotes savings that in turn encourage capital accumulation and hence promote economic growth. Another strand of literature postulates that large deviations of real exchange rates, from equilibrium, reduce growth. Aguirre *et al*. (2005), for instance, postulate that a real overvaluation of the exchange rate might lead to deficits in the current account balance and ultimately to a currency crisis while undervaluation provokes inflation and overheats the economy.

Large volatilities in exchange rates wrongly signal economic agents; factor inputs are wrongly allocated among competing ends and ultimately create an unstable milieu. Vieira and MacDonald (2000) examine the impact of real exchange rates misalignment on long run growth for ninety countries for the period 1980-2004 using two step Generalized Method of Moments (GMM) estimates and find that the coefficients for real exchange rate misalignment are positive for different models and samples, signifying that a more depreciated real exchange rate fosters long run growth whilst a more appreciated real exchange rate hampers long run growth. For countries with liberalized capital accounts, estimates show a robust negative relationship between exchange rate volatility and growth. The current study, however, examined the impact of real effective exchange rate on economic growth for Kenya alone for the period 1972-2015 using the VAR estimates.

Arratibel, *et al*. (2011) examine the impact of real exchange rate volatility on economic growth for a large sample of developing countries and the results reveal that real exchange rate volatility, by dampening productivity growth, reduces economic growth. In a similar vein, Aghion, Bacchetta, Ranciere, & Rogoff (2012) show that as developing countries develop their financial sector, the negative impact of real exchange rate volatility is less pronounced. Akinbobola & Oyetayo (2010) examine the impact of real exchange rate volatility on domestic output growth in Nigeria using data spanning the period 1986-2004. The authors find that the real exchange rate of Nigeria positively impacts on output growth after a considerable lag.

The few studies that have been undertaken in Kenya on the subject of exchange rate behavior have mainly focused on explaining the determinants of exchange rate behavior, with emphasis on the role of macroeconomic variables such as monetary policy shocks. For instance, (Were *et al*., 2002), analyzed factors that have influenced the exchange rate movements since the foreign exchange market was liberalized in 1993.

A related study by (Ndung'u, 2000) assessed whether the exchange rates in Kenya were affected by monetary policy and whether these effects were permanent or transitory. The study by Kiptoo (2007) focused on real exchange rate volatility and misalignment, and its impact on the Kenya's international trade, and investment. Sifunjo (2011) focused on chaos and non- linear dynamic approach to predicting exchange rates in Kenya. Even then, these studies including Ndung'u (1997; Ndung'u (2000); Kiptoo (2007); and Sifunjo (2011) did not deal with the impact of real effective exchange rate volatility on the Kenya's economic growth.

Musyoki *et al*., (2012) examined Real Exchange Rate (RER) Misalignment on economic growth in Kenya by using Johansen Cointegration, and Error Correction Model Technique to establish the factors that determine equilibrium real exchange rate, calculate the real exchange rate misalignment as the difference between equilibrium and actual real exchange rate. Generalized Method Moments (GMM) technique was used to assess the impact of the real exchange rate misalignment on economic growth for the period of January 1993 to December 2009. Monthly frequency data was used for the study. The results of the study on the extent of RER misalignment suggest that over the study period 1993-2009, Kenya's RER generally exhibited a depreciating trend, implying that in general, the country's economic growth deteriorated over the study period.

Onyango, (2014) identified the effect of exchange rate volatility on economic growth in Kenya. Using annual secondary time series data for the period 1980 to 2012, the study employed OLS estimation method to identify the effect of exchange rate volatility on GDP growth rate. The study found that exchange rate volatility positively impacts on GDP growth but is not significant in affecting GDP growth rate.

2.3.3 Exchange Rate Volatility and FDI.

The divided theoretical literature has motivated many empirical studies, which by and large remain inconclusive due to methodological reasons. Differences in country coverage, sample periods, model specifications, and estimation techniques, which have evolved along with the advancement in econometrics, make it difficult to establish a systematic relationship between exchange volatility and trade.

For example, using total export volume and a single equation time series method of cointegration and/or error correction model, Doroodian (1999) confirms the negative relationship between exchange rate volatility and exports in India, Malaysia, and the Republic of Korea; Doganlar (2002) finds the same in Indonesia,Malaysia, Pakistan, and the Republic of Korea; and Poon et al. (2005) find a long-run negative relationship in three of the East Asian countries they study (Japan, the Republic of Korea, and Singapore), and a positive relationship in two others (Indonesia and Thailand). More recent papers have employed panel data. Benassy-Quere and Lahreche-Revil (2003) use bilateral total export volume between 11 Asian and 23 Organisation for Economic Co-operation (OECD) countries in a gravity model setup. They find intra-Asia exchange rate volatility has no discernible impact on exports, but a negative relationship exists between Asia–OECD exchange rate volatility and exports. Meanwhile, Chit (2008) and Chit *et al.,* (2010) also use bilateral total export volume, but adopt a different panel model specification that reconfirms the negative relationship between exchange rate volatility and exports.

The link between exchange rate volatility and FDI is regarded as one of the scant areas in literature. Most of the empirical studies have focused on the level of the exchange rate (i.e. appreciation and depreciation) as a main determinant of FDI flow to the host countries. However, a few groups of these studies stressed the impact of volatility in attracting FDI or otherwise e.g. Dixit & Pindyck (1994); and Markusen1(995). Likewise, empirical evidence on the impact of exchange rate volatility on FDI inflow is mixed. For example, Stokman & Vlaar (1996) and Khan & Bamou (2005) argued that exchange rate volatility exerts a positive impact on FDI flow to the host countries. These findings are based on the argument that FDI is an export substitution. That is, an increase in exchange rate volatility in the host country induces a multinational firm to serve the host country via a local production facility rather than exports, thereby insulating against currency risk.

Another group of empirical studies stated that exchange rate volatility negatively affects the flow of foreign direct investment (Dixit & Pindyck, 1994). They claimed that a country with a high degree of exchange rate volatility will have a high degree of currency risk, which converts the flow of FDI to countries with more stable exchange rates.

One very important and original contribution of (Froot & Stein, 1991) is the attention given to the relationship between exchange rate volatility and FDI at the sectorally disaggregated level. Data covering 13 sectors between 1974 and 1987 were analyzed. They found that, in all the thirteen cases, the exchange rate had a negative sign, with 5 of this being statically significant. The strongest impact of the exchange rate was evident in the manufacturing industries, especially chemicals. Also, the study analyzed, FDI inflows in the US, UK and West Germany, Canada, and Japan. The empirical findings revealed that the estimated coefficients of the exchange rate were negative and statically significant for the US and West Germany. These results further imply that exchange rate depreciation also leads to greater FDI.

Alexander & Murphy (1975) were set to providing a formal theoretical and empirical basis for modeling the relationship between exchange rates and FDI, using US data. This study developed and provided a relatively comprehensive analysis of the effects of exchange rate changes on capital flows overtime. The internal rate of return theory for the purpose of comparing alternative investment returns was explored in the study. It represents a theoretical reasoning that suggests that exchange rate devaluation in the host economy increase FDI in such economy. Their results support the contention that US dollar devaluations induced FDI inflows into the economy.

A couple of other studies on the relationship between exchange rates and FDI were carried out during this same period. One of these, by (Logue and Willet, 1977) attempted to provide both theoretical and empirical evidence on this relationship in the case of the US, by employing the portfolio balance approach to FDI flows. It was established that devaluation of the dollar improved FDI inflows to the US economy. In a further comment, (Stevens, 1977) investigated the response to expectations concerning future exchange rates and concluded that a foreign firm expecting currency devaluation in a foreign country of interest would defer FDI until after the devaluation when it would be more profitable to do so.

By putting forth the hypothesis that an appreciation of the host currency would indeed increase FDI into the host currency, (Campa, 1993) differed completely from the earlier views of Kohlagen (19970; and Froot & Stein (1992b) . Instead of focusing on the price of foreign assets, as Froot & Stein, (1992a) did, Campa's study was more along the lines of a production-based theoretical approach. According to him, a firm's decision to invest abroad depended on its expectations regarding future profit streams. Therefore, an appreciation of the host currency increases expectations of future profitability regarding the home currency. To test this hypothesis, foreign investors entering the US in the 1980s were thoroughly examined. Findings revealed that an appreciation in the United States' exchange rate stimulated FDI.

A study by Kiyota & Urata (2004), is another significant study that examined the impact of exchange rate level on FDI at the sectoral level, with specific focus on the Japanese FDI to four machinery industries between 1978-1999. The study showed that real exchange rates had strong effects on FDI in industries; they found that, at the aggregate level, the movement in the exchange rate had a statistically significant impact on FDI. However, level industry results indicated different findings regarding the magnitude of the coefficients. In the case of FDI destination, the real exchange rate was found to have the same effects on FDI for all the East Asian countries and ten out of eleven cases in the Latin American Region. This emphasized that overvaluation of the host country's currency discouraged the Japanese FDI, thus stressing the need to maintain a stable exchange rate and avoid overvaluation to attract FDI.

Studies on the relationship between exchange rate volatility, on the one hand, and FDI, on the other, for SSA countries are very scanty. Mowatt & Zulu (1999) in a study of the Southern and Eastern African region, identified exchange rate as one of the barriers to FDI in Zimbabwe, Botswana, and Mozambique. Similarly, in a survey of Southern African countries, Khan and Bamou (2005) found that about 25% of the total firms surveyed identified exchange rate risk as an important determinant of FDI in the sub-region. However, these studies did not analyze the impact of real effective exchange rate volatility on FDI in these countries, as is the case for this study in Kenya.

An attempt was made by Bleaney & Greenaway (2001) to examine the impact of the level and volatility of real effective exchange rate on investment and growth for fourteen SSA countries. The study found that exchange rate volatility has a strong negative effect on investment. However, the focus of the study was on total investment, not FDI, as is the focus of this study.

Alaba (2003) is one of the very few studies that have attempted to bridge the gap on the exchange rate volatility-FDI nexus for SSA countries. The study aimed at determining the magnitude and direction of the effects of exchange rate movement and its volatility on FDI flows to agriculture and manufacturing sectors in Nigeria. Employing the GARCH measure of volatility, the error correction methodology was used for the empirical investigation in testing the effects of both the official and parallel market exchange rates on FDI flows to agriculture and manufacturing. While the results show that the official market exchange rate movement significantly reduces FDI inflows to agriculture, the same is, however, insignificant for the manufacturing FDI. For the volatility coefficients, official market exchange rate volatility was not found to be significant for FDI inflows to both manufacturing and agriculture. Conversely, the estimated parallel market exchange rate coefficients suggest that both systematic movements of the exchange rate and its volatility are significant for the flow of FDI to both agriculture and manufacturing in Nigeria with the parallel market rates, yielding both negative and positive signs for exchange rate volatility in the two sectors. The emerging conclusion was that while exchange rate volatility attracted investment in agriculture, it rather deterred FDI in the manufacturing sector, thus suggesting ambiguity on the effects of exchange rate movements and its volatility on FDI inflows in Nigeria for the period under study.

Ogunleye (2008) did an extensive work aimed at providing a comprehensive analysis of the exchange rate volatility-FDI nexus in SSA by examining nine countries in the region, with the countries cutting across different exchange rate and FDI policies and arrangements. Both country-specific time-series and panel models estimation techniques were employed. The study found that the exchange rate volatility generally constraints FDI inflows to SSA. This is equally established for both the CFA and non-CFA group of countries, though with varying degrees. In a series of country-specific studies commissioned by the African Economic Research Consortium (AERC), Ajayi (2004); Khan & Bamou (2005); and Mwega & Ngugi (2005) recognized the possible effect of exchange rate volatility on FDI, although, they did not explicitly examine the relationship empirically.

Another recent study based on the experiences of African economies is (Ogunleye, 2008). This study examines the effects of both the movement in the levels and volatility of exchange rate on FDI inflows in nine selected African countries. Consistent with the submission in (Mwega & Ngugi, 2005), the study finds that exchange rate depreciation induces FDI inflows while appreciation retards it. On the other hand, the impact of exchange rate movements on FDI is found to be significant only in countries with large FDI inflows.

It is noteworthy from this survey that studies exploring the relationship between exchange rate and FDI in SSA are very scarce. It was only in the recent study that (Mwega & Ngugi, 2006) considered the effects of the exchange rate level on FDI inflows in Kenya. The results showed that real exchange rate depreciation has a positive effect on FDI inflows in the country. This supports the proposition that exchange rate depreciation attracts FDI inflows to host economies: quite the opposite of the view represented by (Campa, 1993).

Ochieng (2013) and Anyango (2013) found a weak positive relationship between exchange rate fluctuations and FDI inflows in Kenya for the period 1981 to 2010. While investigating the determinants of FDI in Kenya covering the period 1970 to 1999, Muthoga (2009) found that the exchange rate is one of the determinants of FDI inflows in Kenya. However, there are inadequate studies that have interrogated the whole economy as opposed to specific sectoral approach. Besides, there are very few studies that have attempted to interrogate whether there is any relationship between these phenomena based on SSA countries' experience. A few studies that have attempted this enquiry either focused only on levels of exchange rate or public investment, without considering the possible endogeneity between exchange rate volatility and FDI.

In summary, there appears to be a lack of clear-cut direction on the effect of appreciation and depreciation in the host country's exchange rate on FDI inflows.

2.3.4 Exchange Rate Volatility and Current Account Balance

As for the link between exchange rate volatility and trade volume, the literature has provided extensive evidence since the collapse of Bretton-woods system of fixed exchange rate. This is because fluctuations in the exchange rate may negatively affect the competitiveness of the tradable goods and in turn reduce the volume of trade and worsen the balance of payments position of an economy.

On the empirical front, the evidence on the impact of exchange rate volatility on trade also failed to reach a consensus. A survey of previous literature on this issue yields negative and positive impacts as well as inconclusive results. Some studies have found that exchange rate volatility exerts a negative impact on trade volume (Lee and Saucier, 2007). Other empirical studies have found that exchange rate volatility has a positive effect on trade volume, McKenzie & Brooks (1997) and Carvallo & Kasman (2005), among others. Moreover, another group did not find any significant association between exchange rate volatility and trade (McKenzie & Brooks, 1997); (Carvallo & Kasman, 2005), among others, yet another group did not find any significant association between the variables. McKenzie (1998); McKenzie & Brooks (1997); Hondroyiannis, Swamy, Tavlas & Ulan (2008); Musyoki, *et al*., (2010); and Musyoki, *et al*., (2012) observed that the real exchange rate in Kenya experienced episodes of appreciations coupled with volatility in the 2005-2010 period. Studies like Were, *et al*., (2002); Kiptui (2007); and Chege, *et al.,* (2011)) found a negative relationship between the variables. Bonroy (2007) held that the effect could be positive, negative or zero depending on the export prices.

Balance of payments deficits have been a common phenomenon in the Kenyan economy from the 1960s. The government has over the years enacted various policy measures aimed at remedying the situation; however the balance of payments situation does not seem to have improved despite this policy measures (Mambo, 2012). The deterioration was largely due to narrowing of the current account. The foreign current account deficit, which is the sum of the balance of trade (export minus import of goods and services), net factor income (such as interest and dividends) and net transfer payments (such as foreign aid) has been widening and now ranks among the highest in the world.

Kenya's deficit is as per countries such as Greece and Swaziland – two countries with serious debt problems. In Swaziland, Africa's last absolute monarchy (Motsamai, (2011), a budget crunch has reached a critical stage with government struggling to maintain spending on essential areas (United Nations, 2012). However, the relationship between the real effective exchange rate and current account balances for the Kenyan economy has not been adequately investigated.

2.3.5 Exchange Rate Volatility and Macro-economic Performance

Arratibel *et.al*., (2009) analyzed the relation between nominal exchange rate volatility and several macroeconomic variables, namely real per output growth, excess credit, Foreign Direct Investment (FDI) and the current account balance, in the Central and Eastern European (CEE) Member States. Using panel estimations for the period between 1995 and 2008, they found that lower exchange rate volatility is associated with higher growth, higher stocks of FDI, higher current account deficits, and higher excess credit. The results were economically and statistically significant, and robust. In their study they used several control variables including, trade openness, Population growth, inflation and monetary freedom index. The current study however uses quarterly time series data for the period 1972q1 to 2015q4 for a single small open economy. Following Arratibel *et al.,* (2009), the current study excluded all the control variables and carried out bivariate analysis.

Empirical studies on the Kenyan macro-economy explaining the impact of shocks to real effective exchange rate movements on some selected macroeconomic indicators are scarce (Kiptui & Kipyegon, 2008). Pollin & Heintz (2007) called for a reassessment of monetary policy with a view to achieving a more depreciated shilling. The few studies that have been undertaken on the Kenyan economy have mainly concentrated on explaining the determinants of exchange rate behavior but not an empirical assessment of the relationship between REER volatility and macroeconomic performance. For instance, Were, *et al*., (2002) analyzed the factors that have influenced the exchange rate market since it was liberalized in 1993. A related study by Ndung'u (1997) assessed whether the exchange rates in Kenya were affected by monetary policy; and whether these effects were permanent or transitory. The study by Kiptoo (2007) focused on the real exchange rate volatility, and misalignment, and its impact on Kenya's international trade and investment. Sifunjo (2011) focused on chaos and non-linear dynamic approaches to predicting exchange rates in Kenya. Even then, these studies including (Ndung'u (2000); Ndung'u (2001); Kiptoo (2007); and Sifunjo (2011) did not deal with the impact of exchange rate volatility on the Kenya's macroeconomic performance as is the case in this study.

2.4 Summary

Therefore, a huge body of empirical studies has grown in recent decades on the association between exchange rate volatility and some macroeconomic indicators, such as economic growth, current account balance and FDI. Despite the extensive and diversified literature on this issue, the existing evidence is far from any consensus. This disagreement is attributed to the difference in models specification, sample period, methods of measuring exchange rate volatility and macroeconomic indicators considered.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section covers research design, data types and sources and data analysis techniques. It also deals with unit root tests, cointegration analysis, GARCH Modeling, and formulation of ECM model and ethical considerations.

3.2 Research Design

This study adopted the Quantitative Research Design. The study was concerned with empirically examining the impact of exchange rate volatility on macroeconomic performance in Kenya. It specifically intended to investigate the empirical relationship between some selected indicators of macroeconomic performance and the real effective exchange rate volatility in Kenya. The design enabled the researcher to arrive at conclusions about trends and effects of past phenomena aimed at explaining the present dynamic relationships.

3.3 Study Area

Located on the eastern part of the continent of Africa, Kenya is the 49^{th} largest country in the world with a total area of 580,335 square kilometers (World Factbook, 2014). Kenya became an independent state in 1963, after gaining its sovereignty from the United Kingdom. The population of Kenya stood at 43,013,341 (2012) and the nation has a density of 76 people per square kilometer. Kenya's GDP as per 2014 data stood at KES. 60,936,509,778.

According to the October 2015 Kenya Economic Update, Kenya is poised to be among the fastest growing economies in Eastern Africa. Besides, the 2016 Country Economic

Memorandum says that Kenya's growth prospects will depend a lot on Innovation, FDI, Oil and International competitiveness, among other indicators, in the long term.

3.4 Target Population

According to Ngechu (2004), a study population is a well-defined or specified set of members, group of things, households, firms, services, elements or events being investigated. Thus the population should fit a certain specification of the study and should be homogenous. The population of interest for this study comprised of the specific macroeconomic indicators. The selected indicators were REER, CAB, GDP Growth rate and FDI. The sampled period was 44 years spanning 1972 – 2015. This period was chosen based on the fact that Kenya started experiencing exchange rate volatility in 1972 soon after the first oil price crisis; a floating exchange rate regime was adopted in 1993 in Kenya, following the liberalization of the foreign exchange market. These variables were postulated to have a bearing on macroeconomic performance in Kenya.

3.5 Sampling Frame

Purposively, the study used secondary data which is readily available and maintained and harmonized by the CBK, KNBS, IMF and World Bank about Kenya's FDI inflows, Current Account balances, GDP growth rate, Inflation, Exports and Imports, Official exchange rate and the computation of the REER over the period under consideration, that is, 1972-2015.

3.6 Data Collection

3.6.1 Data Type and Sources

The quarterly data set covering the period 1972 - 2015 was selected because since 1972 the exchange rate has seen policy interventions (such as changes from fixed exchange rate to floating exchange rate regimes) in Kenya. Also, by the end of the 1970s, the country had started to suffer from unfavourable economic situations. Moreover, this period was dictated by the availability of data on the variables under investigation.

The data on REER included trade volume with major trading partners, real bilateral exchange rate, foreign price index calculated as the weighted CPI index and the domestic CPI. The other data included real GDP growth rate; Foreign Direct investment measured as a ratio of FDI inflow to GDP; The current account balance measured as a ratio of CAB to GDP (see Appendix I).

The quarterly data series was sourced from various issues of the Central Bank of Kenya (CBK), Kenya National Bureau of Statistics, International Monetary Fund (IMF), UNCTAD and World Bank's world development indicators. These data were posted to excel and transformed to quarterly values before being exported to EVIEWS for analysis.

3.7 Data Analysis

3.7.1 Real Effective Exchange Rate Volatility and Selected Macroeconomic Indicators

Measuring exchange rate volatility is one of the controversial issues in the recent economic literature. Several measures of volatility have been employed in the literature, including standard deviations and Autoregressive Conditional Heteroscedasticity (ARCH) techniques. The ARCH model has proven to be useful in studying the volatility of inflation [Coulson and Robins (1985)], the term structure of interest rates [Engle, Hendry and Trumbull (1985)], the volatility of stock market returns (Engle, Lilien and Robins, 1987), and the behavior of foreign exchange market (Domowitz and Hakkio (1985) and Bollerslev and Ghysels (1996) among others. However, methods based on standard deviation suffer from many shortcomings.

First, the standard deviation measures of exchange rate volatility ignore relevant information on the random process that generates the exchange rate volatility (Engle, 1982). Second, this method is arbitrary in choosing the order of the moving average and is noted for underestimating the effects of volatility on decisions (Pagan & Ullah, 1988). Furthermore, standard deviation measure of volatility is characterized by skewed distribution. Exchange rates are typified by volatility clustering, implying that future exchange rate changes are not independent of the past and current changes.

To this extend, the applicability of the findings of the various studies based on standard deviation may be in doubt. To correct for this apparent deficiencies, the ARCH was introduced by (Engle, 1982) and later modified by (Bollerslev, 1986) as the GARCH. Ever since, different variants of the ARCH and GARCH models have emerged. One of the asserted superiority of the ARCH and its variants over the standard deviation measures is their ability to distinguish between predictable and unpredictable elements in the real exchange rate formation process, and are, therefore not prone to overstating volatility (Arize, Osang, and Slottje, 2000), This study employed the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model to measure the real effective exchange rate (REER) volatility.

3.7.1.1 Model Specification for the Real Effective Exchange Rate Volatility

To overcome the methodological deficiencies of standard deviation methods, the study used the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) developed by (Bollerslev, 1986) The advantage of the GARCH method over the standard deviation measures is their ability to discriminate between predictable and unpredictable elements in the exchange rate formation process, and therefore, they serve as accurate measures of volatility (Arize *et al.*, 2000 and Darrat & Hakim, 2000). Musyoki et al (2012) noted that GARCH (1,1) is the most widely used specification in Autoregressive Conditional Heteroscedasticity (ARCH) family.

The proposed study investigated the relationship between exchange rate volatility and macroeconomic performance in Kenya, focusing on some selected macroeconomic indicators, namely; economic growth, foreign direct investment, and current account balances during the period 1972q1–2015q4. The study measured the real effective exchange rate (REER) volatility using the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model. The Vector Autoregressive (VAR) Model was used to establish the impact of exchange rate volatility on those selected macroeconomic indicators.

Therefore, the conditional variance of GARCH model could be specified as follows:

$$lnREER_t = \boldsymbol{\alpha}_o + \boldsymbol{\alpha}_1 ln\ REER_{t-1} + e_t\ ;\text{where } e_t \sim (0, h_t) \ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

$$h_t = \boldsymbol{\alpha} + \beta e^2_{t-1} + \gamma h_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

This equation means that the conditional variance is a function of three terms: the mean, denoted by $\boldsymbol{\alpha}$; that is information about volatility from the previous period, measured as the lag of the squared residual from the mean equation e^2_{t-1} (the ARCH term), and the variance of previous period's forecast error; denoted h_{t-1} (the GARCH term). Accordingly, the GARCH (1, 1) conditional variance on quarterly real effective exchange rate (REER) over the period l972-2015 was estimated.

3.7.1.2 Model Specification for the Impact of REER Volatility on GDP

To investigate the impact of exchange rate volatility on macroeconomic performance, the study focused on the impact of exchange rate volatility on three key macroeconomic indicators. These are Real GDP growth, FDI inflows, and current account balance (CAB), which are assumed to reflect the macroeconomic performance. Each macroeconomic variable under investigation was considered as a dependent variable and was explained by REER volatility.

To assess, the impact of the real effective exchange rate volatility on output growth, the following (Arratibel *et al*., 2009) model was used :

$$Y_{it} = \alpha i + \delta X_t + \beta EX_t + \mathcal{E}_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3)$$

where Y_t is the real GDP growth for country *i* at time *t*. The vector X includes a set of control variables affecting growth: i) the ratio of investment to GDP; ii) the fiscal deficit, in per cent of GDP; iii) (the log of) openness; and iv) population growth. This model was estimated to answer hypothesis one.

The impact of the real effective exchange rate volatility on real output growth was examined through the estimation of the following model which is a modification of equation 3.4:

$$Y_t = \delta EV_t + \varepsilon_t \text{ ....} (3.4)$$

For all the $\varepsilon_t \sim IId\ (0, \square^2{}_\varepsilon)$

Where: Y_t is the real GDP growth at time t. EV_t is the volatility of real effective exchange rate at time t, and ε_t is the error term at time t. All variables were expressed in logarithm form, except real GDP growth that beared negative signs in some years. These variables were also selected based on previous studies on the effect of exchange rate volatility on growth (Arratibel *et al*., 2009). The impact of exchange rate volatility on real GDP growth rate can be either positive or negative as the empirical literature provides mixed findings.

3.7.1.3 Model Specification for the Impact of REER Volatility on FDI inflows

To test whether exchange rate volatility has a positive or negative effect on FDI, (Arratibel *et al*., 2009) model, as specified in the following equation, was modified:

$$InFDI_{it} = \alpha i + \delta X_{it} + \beta EX_{it} + \varepsilon_{it} \text{ ....} (3.5)$$

The dependent variable is the (log of the) stock of inward FDI in country *i* at time *t*. The vector X includes a set of control variables which are found in the literature to be robust determinants of FDI: i) (the log of) the level of real GDP; ii) (the log of) the level of real GDP per capita; iii) (the log of) openness, defined as the GDP's share of exports plus imports; iv) openness; v) unit labor costs.

For the purpose of this study, the (Arratibel *et al*., 2009) model specified above (Eqn. 3.5) was modified into equation 3.6 which was then estimated:

$$FDI_t = \delta EV_t + \varepsilon_t \quad \text{………………………………………………………….…… (3.6)}$$

For all the $\varepsilon_t \sim IId\ (0, \delta^2)$

Where: FDI_t is the ratio of FDI inflow to GDP at time t; EV_t is the REER volatility at time t, and ε_t is the stochastic error term at time t.

In literature, a huge set of explanatory variables have been predicted as significant variables that attract FDI inflows into the host country. However, for the purpose of this study, we focused on the impact of REER on FDI inflow for the case of Kenya. All variables were expressed in logarithm form. The sign of real effective exchange rate volatility is inconclusive as most of the empirical studies offered mixed results.

3.7.1.4 Model Specification for the Impact of REER Volatility on Current Account Balance

In order to test for a significant relation between exchange rate volatility and the current account balance, we estimate the following equation:

$$\frac{CA}{Y}t = \alpha_1 + \delta X_t + \beta EX_t + \varepsilon_t$$

……………………….…………………………..(3.7)

where the dependent variable is the ratio of the current account balance to GDP for country i at time t. The vector X includes a set of control variables affecting saving and investment. In particular, following the literature on the determinants of current account balance, they included the following variables: i) relative income (to the EU15); ii) relative income squared; iii) GDP growth); iii) FDI inflows; iv) Inflation; v) credit-to-GDP (financial deepening); vi) public deficit; vii) Openness viii) and capital controls.

Therefore as for the impact of exchange rate volatility on current account balance, the analysis followed (Arratibel *et al*., 2009) model (equation 3.7) by making some adjustments to suit the current study. Therefore, the adjusted estimatable current account equation is specified as follows:

$CA_t = \delta EV_t + \varepsilon_t$ ……………………………………………………………………(3.8)

For all the $\varepsilon_t \sim IId\ (0, \delta^2)$;

Where CA_t is the current account balance at time t; EV_t is REER volatility at time t and ε_t is the error term at time t. All variables in the model were used in logarithm form, except current account balance that bears negative signs in some years. According to economic theory, the impact of real effective exchange rate volatility on current account balance would be either negative or positive.

3.7.2 Integration properties (Unit root tests)

A time series variable has the property of stationarity when it possesses a finite mean, variance and autocovariance function that are all independent of time. Analogously, a non-stationary series possesses a time dependent mean or autocovariance function. A stochastic time series is said to be integrated of order *d* if the series requires differencing *d* times in order to achieve stationarity (Engle and Granger 1987).

Thus the time series X_t is said to be integrated of order one, denoted $X_t \sim I(1)$, if its level series X_t is nonstationary but its first-differenced series ΔX_t is stationary, that is, $\Delta X_t \sim I(0)$. Note that by stationarity we mean covariance or weak stationarity, meaning the property that a time series variable possesses a finite mean, variance, and autocovariance function that are all independent of time (Nyongesa, 2013).

The Classical Econometric Theory assumes that observed data are usually stationary in nature, whereby means and variances are constant overtime. However, the estimates of time series econometric models and historical records of economic forecasting invalidate such assumptions. Hence, as is common in time series analysis, before estimating regression models, all series require to be tested for unit root to avoid spurious regression.

The existence of unit root(s) of each variable was tested by using Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) tests for a unit root in line with the econometric techniques. The PP test has an advantage over the ADF test as it gives robust estimates when the series has serial correlation and time dependent heteroscedasticity, and there is a structural break (Nyongesa, 2013). Since the unit root tests are sensitive to the lag length, the study used the Akaike Information Criterion (AIC) to select the optimal lag length. The study utilized the quarterly time series data covering the period 1972-2015.

Based on the unit root results, evidence of cointegration among the variables was examined using the Augmented Dickey Fuller (ADF) test as advanced by (Engle & Granger, 1987). If the variables are cointegrated then, we have the long run information on exchange rate volatility. Therefore, an Error Correction Model (ECM) is estimated. This model provided useful estimates of short run dynamics and long run relationships in the macroeconomic performance indicators.

In principle, it is important to test the order of integration of each variable in the model, to establish whether it is non-stationary and how many times the variable needs to be differenced to derive stationary series. There are several ways of testing for the presence of unit root. The emphasis here is on using the Augmented Dickey-Fuller, and Phillip-Perron approaches to testing the null hypothesis that a series does contain a unit root (i.e. it is non-stationary) against the alternative of stationarity.

3.7.2.1 The Augmented Dickey-Fuller (ADF) Test

To illustrate the use of the Dickey-Fuller test, consider first an Autoregressive process of order one, AR (1) process.

$$Y_t = \mu + \rho y_{t-1} + \varepsilon_t \quad (3.9)$$

Where; μ and ρ are parameters and ε is assumed to be white noise. Y_t is a stationary series if $-1 < \rho < 1$. If $\rho = 1$, Y_t is a non-stationary series that exhibit a random walk with drift, μ. The hypothesis of stationary series can be evaluated by testing whether the absolute value of ρ is strictly less than 1. Dickey Fuller (DF) test takes the unit root as the null hypothesis H_o: $\rho = 1$ tested against the one sided alternative H_1: $\rho < 1$.

The test was carried out by estimating an equation with y_{t-1} subtracted from both sides of the equation (3.9), such that:

$$\Delta Y_t = \mu + \Upsilon y_{t-1} + \varepsilon_t \quad (3.10)$$

Where $\Upsilon = \rho$-1 and the null and alternative hypotheses are H_o: $\Upsilon = 0$ and H_1: $\Upsilon < 0$, respectively. The test was carried out by performing a t-test on estimated Υ. The t-statistics under the null hypothesis of unit root does not have conventional t-distribution. If the series is correlated at higher order lags, the assumption of white noise disturbance is violated (Dickey and Fuller 1979, 1981).

The Augmented Dickey Fuller (ADF) test makes a parametric correction for higher order correlation by assuming that the Y_t series follows an Autoregressive process of a higher order than one AR (ρ) and adjusting the test methodology. The ADF approach controls for higher order correlation by adding lagged difference terms of the dependent variable to the right hand side of the regression, such that:

$$\Delta Y_t = \alpha + \beta y_{t-1} + \delta t + \zeta_1 \Delta y_{t-1} + \zeta_2 \Delta y_{t-2} + \cdots + \zeta_k \Delta y_{t-k} + \varepsilon_t \quad \ldots\ldots\ldots\ldots (3.11)$$

This augmented specification is then used to test the hypothesis that, H_o: Y = 0 and H_1: Y <0.

An important result obtained by Dickey and Fuller (1979) is that asymptotic distribution of the t-statistic on Y is independent of the number of lagged first differences included in the ADF regression. Moreover, while the parametric assumption that y_t follows an Autoregressive (AR) process may seem restrictive. Said and Dickey (1984) demonstrated that the ADF test remains valid even when the series has a moving average (MA) component provided that enough lagged difference terms are used to augment the regression.

3.7.2.2 The Phillip-Perron (PP) Test

Phillips and Perron (1988) propose a non-parametric method of controlling for higher-order serial correlation in a series. The test regression for the Pillips-Perron (PP) test is the AR (1) process:

$$\Delta y_t = \alpha + \Upsilon\, y_{t-1} + \varepsilon_t. \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.12)$$

While the ADF test corrects for higher order serial correlation by adding lagged differenced terms on the right-hand side, the PP test makes a correction to the t-statistic of the Υ coefficient from the AR(1) regression to account for the serial correlation in ε_t (Phillips and Perron, 1988).

The correction is nonparametric since an estimate of the spectrum of ε_t at frequency zero is used that is robust to heteroskedasticity and autocorrelation of unknown form. The asymptotic distribution of the PP t-statistic is the same as the ADF t- statistic. As with the ADF, test one has to specify whether to include a constant, a constant and a linear trend, or neither in the test regression. For the PP test, the truncation lag q for the Newey- West correction is specified (that is, the number of periods of serial correlation to include).

3.7.2.3 The Kwiatkowski, Philips, Schmidt and Shin test

The alternative test introduced in 1992 by Kwiatkowski, Phillips, Schmidt and Shin, and called henceforth KPSS test has a null of stationarity of a series around either the mean or a linear trend; and the alternative assumes that a series is non-stationary due to the presence of a unit root. In this respect, it is innovative in comparison with the earlier Dickey-Fuller test, or Perron type tests, in which null hypothesis assumes presence of a unit root.

In the KPSS model, series of observations is represented as a sum of three components: deterministic trend, a random walk, and a stationary error term. The model has the following form:

$$y_t = \xi_t + r_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.13)$$

Where; $r_t = r_{t-1} + u_t$; y_t, $t = 1,2\ldots, t$ denotes a series of observations of variable of interest, t - deterministic trend, r_t is random walk process, ε_t - error term of the first equation, by assumption is stationary. u_t - denotes an error term of the second equation and by assumption is a series of identically distributed independent random variables of expected value equal to zero and constant variation $\hat{\sigma}_u^2$. By assumption, an initial value r_0 of the second equation in (3.13) is a constant; and it corresponds to an intercept.

The null hypothesis of stationarity is equivalent to the assumption that the variance $\hat{\sigma}_u^2$ of the random walk process r_t in equation (3.13), equals zero. In case when $\xi=0$, the null means that y_t is stationary around r_0. If $\xi\neq0$, then the null means y_t is stationary around a linear trend. If the variance $\hat{\sigma}_u^2$ is greater than zero, then y_t is non-stationary (as sum of a trend and random walk), due to the presence of a unit root.

Subtracting y_t from both sides of the first equation in equation (3.13) we obtain:

$$\Delta y_t = \xi + u_t + \Delta\varepsilon_t = \xi + w_t \quad \text{.......} \quad (3.14)$$

Where w_t, due to assumption that ε_t and u_t are independently identically distributed random variables, is generated by an autoregressive process AR (1), (see Kwiatkowski *et al.*, 1992): $w_t=v_t+\Theta v_{t-1}$. Hence the KPSS model may be expressed in the following form:

$$y_t = \xi + \beta y_{t-1} + w_t \quad \text{.......} \quad (3.15)$$

Where $w_t = v_t + \theta v_{t-1}$, $\beta=1$

This equation expresses an interesting relationship between KPSS test and DF test checks $\beta=1$ on assumption that $\theta=0$; where θ is a nuisance parameter. Kwiatkowski *et al*. (1992) assume that β is a nuisance parameter, and test whether $\theta=1$, assuming that $\beta=0$. They introduce one-side Langrage Multiplier test a null hypothesis $\sigma_u^2=0$ with assumption that u_t have a normal distribution and ε_t are identically distributed independent random variables with zero expected value and a constant variance σ_ε^2.

The analysis concerning the KPSS test, due to its form and to the way of formulating null and alternative hypotheses, should be used jointly with unit root test, e.g. the DF or augmented DF test. Comparison of results of the KPSS test with those of unit root test improves quality of inference; (Amano, 1992). Testing both unit root hypothesis and the stationarity hypotheses helps to distinguish the series which appear to be stationary, from those which have a unit root, and those, for which the information contained in the data is not sufficient to confirm whether series is stationary or non-stationary due to the presence of a unit root.

3.7.2.4 Cointegration Analysis

Despite non-stationarity of the variables, there may exist a linear combination among the set of non-stationary variables, which is stationary, such that the variables are stationary (Engle and Granger, 1987). If this is the case, then the variables are said to be cointegrating, implying that there is a long-run relationship between them such that they can be estimated in levels even if they are singly non-stationary. Failing to account for this long run relationship, results in the misspecification of the model. Thus, differencing the variables to be stationary is not a solution since it removes from them Long-run properties.

Identification and estimation of cointegrating variables can be carried out using either Engle-Granger two-step procedure or Johansen procedure. Engle and Granger (1987) have produced the cointegration technique that incorporates both short run dynamics emanating from first order differences and common long run trend movements among variables. In this study the Engle-Granger two-step procedure is used to test for cointegration.

After establishing the order of integration, the next step was to establish whether the non-stationary variables are cointegrated. According to Engle and Granger (1987), individual time series could be non-stationary, but their linear combinations can be stationary if the variables are integrated of the same order. This is because equilibrium forces tend to keep such series together in the long-run. As such, the variables are said to be cointegrated and error-correction terms exist to account for the short – term deviations from the long-run equilibrium relationship implied by the cointegration. Furthermore, the differencing of non-stationary variables to achieve stationarity leads to loss of some long-run properties.

To test for cointegration among the non-stationary series can be carried out using either Engel – Granger two – step procedure or Johansen procedure. A more superior multivariate technique developed by (Johansen, 1988) and applied in (Johansen and Juselius, 1990) was used. Engle and Granger (1987) advocate ADF tests of the following kind:

$$\Delta \varepsilon_t = \mu\varepsilon_{t-1} + \Sigma\mu_i\Delta\varepsilon_{t-1} + \mu + \delta_t + s_t \quad \ldots\ldots (3.16)$$

Where $s_t \sim$ NIID $(0, \sigma^2)$. The residual based on ADF test for cointegration assumes that all the variables in the Ordinary Least Square (OLS) equation are all integrated of order one (1) such that the cointegration test gears to establish whether the error term is integrated of order one $\varepsilon_t \sim 1(1)$ against the alternative that is integrated of order zero $\varepsilon_t \sim 1(0)$. If some of the variables are in fact integrated of order two $1(2)$, then cointegration is still possible if the *1*(2) series cointegrates down to *1*(1) variable to cointegrate potentially with other *1*(1) variables.

3.7.2.5 Error Correction Model (ECM)

If the variables are cointegrated, estimating the equation in first difference results in the loss of valuable information on the long run relationship between the levels of the variables. For example, if;

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \varepsilon_t \quad \ldots\ldots (3.17)$$

Where ε_t is the error term, then;

$$Y_t - Y_{t-1} = \beta_1 (X_{1t} - X_{1t-1}) + \beta_2 (X_{2t} - X_{2t-1}) + \mu_t \quad \ldots\ldots (3.18)$$

Thus, if equation (3.17) is estimated instead of equation (3.18), according to Engle and Granger (1987), then the information about β_0 is lost. Thus, equation (3.18) focuses purely on the short run relationship between Y and X. Hence, it is likely to provide a poor forecast for even a few periods ahead if a long run relationship exists but is ignored. Furthermore, the first differenced equation (3.18), will result in auto correlated error term if the relationship in equation (3.17) exists; and, if disturbance term ε_t is non autocorrelated then, the disturbance term μ_t in equation (3.18) is of simple moving average form such that it is auto correlated.

Therefore, first differencing is an unsatisfactory method of dealing with the spurious problem. The appropriate method is to use Error Correction Model (ECM) that results in equations with first differenced and hence stationary dependent variables but avoid the problem of failing to make use of any long run information in the data. The result of cointegration test enables us to formulate an ECM. ECM relates short run changes in the dependent variable Yt to short run changes in the explanatory variables (the 3.6.3 Techniques of Analysis

3.7.3.1 Measuring Real Effective Exchange Rate

The real exchange rate (RER) was obtained by adjusting nominal exchange rate (NER) with inflation differential between domestic economy, and foreign trading partner's economies. The derivation of the RER, therefore, requires that the data of the NER, domestic inflation and foreign inflation be obtained. Since the Kenyan shilling appreciated against some currencies and depreciated against others during the study period, the nominal effective exchange rate (NEER) is constructed.

The NEER was delivered by weighting the bilateral shilling exchange rate against its trading partners currencies using the value of Kenya 'trade (imports plus exports) with its respective trading partners. The data required to derive the NEER is the Kenya's bilateral exchange rates with respective trading partners. Since some of the data on bilateral exchange rates are originally expressed regarding United States (US) dollars, cross rates were obtained, so as to have all bilateral exchange rates expressed regarding Kenya shilling per foreign currency.

The calculation of NEER was achieved through the arithmetic mean approach that involves summing up the trade weighted bilateral exchange rates as shown in Equation 3.19 below.

$$NEER = \sum_{it}^{n} ER_{it} * W_{it} \qquad (3.19)$$

Where ER_{it} is Kenya's bilateral exchange rate index with country ***i*** at time ***t*** while W_{it} is the bilateral trade weight for Kenya's i^{th} trading partner at time t. Each bilateral exchange rate index (ER_{it}) in Equation 3.19 is computed as follows:

$$ER_{it} = \left[\frac{NER_C}{NER_{t=0}}\right] * 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.20)$$

Where, the NERc is an index of Kenya shilling exchange rate per unit of trading partner's currency in the base period (2007) while $NER_{t=0}$ is the index of Kenyan shilling exchange rate per unit of trading partner currency in the current period/ year. The choice of 2007 as the base year is rationalized regarding relative stability of the economy and low volatility in the domestic, foreign exchange market during the year. Kenya's Gross Domestic Product (GDP) growth rate during this period was 7.1%, the highest rate ever achieved during the 1972-2015-study period.

The year 2007 also enjoyed macroeconomic stability, with an inflation rate that were not only low but also stable while the current account balance, as well as fiscal deficits, were considered to have been at sustainable levels. Each monthly bilateral trade weight in equation (3.19) was computed as a ratio of total trade (exports plus imports for each trading partner to the ratio of total trade (pus export imports) for all Kenya's trading partners. The formula to be used in deriving the trade weights is:

$$w_{it} = \left[\frac{\sum(X_{it} + m_{it})}{\sum(X_t + m_t)}\right] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.21)$$

Where X_{it} is the total value of Kenyan 's exports to i^{th} trading partner at time t. M_t is the total value of imports from Kenya's i^{th} trading partner also in time t**.** X_t are Kenya's total exports to all trading partners at time t, and M_t are total imports to all trading partners at time ***t***. In this study i=1,2……,n. Where n is the total number of Kenyan's trading partners which in this study will be 140. The NEER is obtained by combining equation 3.20 and equation 3.21 using the following formula:

$$NEER_t = \sum_{it}^{n} ER_t * W_t \quad \text{.......................................} (3.22)$$

Where ER_t is the bilateral exchange rate (equation 3.22) and W_t is the bilateral trade weight, n is the total number of countries which is 50. Based on equation 3.22 a decline in NEER represents an appreciation while an increase represents a depreciation of the NEER. This is because in the calculation of the NEER index, the base year (2007) exchange rate is taken as the denominator while the current exchange rate is taken as the numerator.

In order to obtain the real effective exchange rate (REER), the NEER was adjusted by the relative price indices of Kenya and the weighted average price indices of Kenya's trading partners. In an equation form, this is expressed as:

$$REER_t = NEER_t \left[\frac{P_{wt}}{P_{dt}}\right] \text{.......................................} (3.23)$$

Where P_{dt} is the price level in Kenya proxied by consumer price index (CPI) at time ***t*** and $PW_t$is the weighted average price level of Kenya's trading partner countries proxied by weighting CPI at time *t*. The price level of Kenya's trading partner countries is obtained by adding all the trade weighted price levels proxied by CPI of Kenya trading partners.

This is shown in an equation form as follows:

$$P_{wt} = \sum_{it}^{n} P_{it} * W_t \text{.......................................} (3.24)$$

Where P_{it} is the price level of Kenya's i^{th} trading partner country's peroxied by CPI at time *t*. W_{it} is the trade weight of Kenya's i^{th} trading partner country at time *t*. These weights are the same as those in the derivation of REER.

3.7.3.2 Generalized Autoregressive Conditional Heteroscedasticity (GARCH)

Since its "discovery" by (Engle, 1982), ARCH modeling has become a growth industry, with all kinds of variations on the original model. One that has become popular is the generalized autoregressive (GARCH) model, originally modified by (Bollerslev, 1986) as the GARCH. The simplest GARCH model is the GARCH (1, 1) model, which can be written as:

$$\delta_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \mu_2 \sigma_{t-1}^2 \quad \text{……} \quad (3.25)$$

Which says that the conditional variance of μ at time *t* depends not only on the squared error term in the previous time period as in ARCH (1) but also on its conditional variance in the previous time period? This model can be generalized to a GARCH (*p*, *q*) model in which there are p lagged terms of the squared error term and q terms of the lagged conditional variances. We will not pursue the technical details of these models, as they are involved, except to point out that a GARCH (1,1) model is equivalent to an ARCH (2) model and a GARCH (*p*, *q*) model is equivalent to an ARCH (*p* + *q*) model.

Financial time series, such as stock prices, exchange rates, inflation rates, etc. often exhibit the phenomenon of volatility clustering, that is, periods in which their prices show wide swings for an extended time period followed by periods in which there is relative calm. As (Franses, 2002) notes:

> Since such (Financial time series) data reflect the result of trading among buyers and sellers at, for example, stock markets, various sources of news and other exogenous economic events may have an impact on the time series pattern of asset prices. Given that news can lead to various interpretations, and also given that specific economic events like an oil crisis can last for some time, we often observe that large positive and large negative observations in financial time series tend to appear in clusters.

Knowledge of volatility is of crucial importance in many areas. For example, considerable macro econometric work has been done in studying the variability of inflation over time. For some decision makers, inflation in itself may not be bad, but its variability is bad because it makes financial planning difficult.

The same is true of importers, exporters, and traders in foreign markets for variability in the exchange rates mean huge losses or profits. Investors in the stock market are obviously interested in the volatility of stock prices, for high volatility could mean huge losses or gains and hence greater uncertainty. In volatile markets it is difficult for companies to raise capital in the capital markets.

3.7.3.3 Vector Autoregressive (VAR) model

The Variance Decompositions (VDs) and Impulse Response Function (IRF) analysis were used to examine the dynamic relationship between exchange rate volatility and macroeconomic variables. The VDs approach identifies the proportion of the movements in the variable under study that are due to their shocks and shocks to the other variables. On the other hand, IRFs traces out the effect of a one standard deviation shock to the orthogonalized residuals of the equation on current and future values of the endogenous variables, thus, impulse responses measure the responsiveness of the dependent variables in the VAR to shocks to each of the variables. The analysis was conducted using unrestricted VAR model with four endogenous variables, including economic growth, FD1, current account balance and exchange rate volatility.

It is worth mentioning that, the forecast error variance decompositions (VDs) and the impulse-response functions (IRFs) are derived from the vector autoregressive model (VAR). Precisely, VDs and IRFs are the transformation of VAR model into its moving average (MA) representation (Sims, 1980). However, the main challenge of employing VDs and IRFs analysis is the selection of the order of the variables in the VAR system. This is because orthogonalisation involves the assignment of contemporaneous correlation only to specific series.

Specifically, the first variable in the ordering is not contemporaneously affected by shocks to the other variables, but shocks to the first one do affect the other variables in the system: the second variable affects the other variables contemporaneously (except the first one), but it is not contemporaneously affected by them; and so on. Therefore, this follows Sims (1980) work that suggested starting with the most exogenous variable in the system and ending with the most endogenous one.

The Vector autoregressive (VAR) is an econometric model used to capture the linear interdependencies among multiple time series. VAR models generalize the univariate autoregressive model (AR model) by allowing for more than one evolving variable. All variables in a VAR are treated symmetrically in a structural sense (although the estimated quantitative response coefficients will not in general be the same); each variable has an equation explaining its evolution based on its own lags and the lags of the other model variables. VAR modeling does not require as much knowledge about the forces influencing a variable as do structural models with simultaneous equations: the only prior knowledge required is a list of variables which can be hypothesized to affect each other intertemporally.

A VAR model describes the evolution of a set of k variables (called endogenous variables) over the same sample period (t = 1… T) as a linear function of their past values. The variables are collected in a k x 1 Vector y_t, which has as the i^{th} element, $y_{i,t}$, the observation at time "t" of the i^{th} variable. For example, if the i^{th} variable is GDP, then $y_{i,t}$ is the value of GDP at time t.

A p^{th} - order *VAR*, denoted VAR (p), is

$$\gamma_t = c + A_1\gamma_{t-1} + A_2\gamma_{t-2} + \ldots + A_p\gamma_{t-p} + \ell_t \qquad (3.26)$$

Where the i – periods back observation γ_{t-1} is called the I^{th} - *lag* of y, c is a k x 1 vector of constants (intercepts), A_1 is a time-invariant k x k matrix and ℓ_t is a k x 1 vector of error terms satisfying thr following assumptions;

i). $E(e_t) = 0$ every error term has mean zero;

ii). $E(e_t e'_t) = \Omega$ the contemporaneous covariance matrix of error terms is Ω (a k x k positive-semidefinite matrix);

iii). $E(e_t e'_{t-k})$ = constant for any non-zero k there is no correlation across time; in particular, no serial correlation in individual error terms.

A p^{th} – order VAR is also called a VAR with *p* lags. The process of choosing the maximum lag *p* in the VAR model requires special attention because inference is dependent on correctness of the selected lag order.

Order of integration of the variables: All variables have to be of the same order of integration. The following cases are distinct:

- All the variables are $I(0)$ (stationary): one is in the standard case, that is a VAR model in levels.
- All the variables are $I(1)$ (non-stationary) with $d > 0$:
    - The variables are cointegrated: the error correction term has to be included in the VAR. The model becomes a Vector Error Correction Model (VECM), which can be seen as a restricted VAR.
    - The variables are not cointegrated: the variables have first to be differenced d times and one has a VAR in difference.

Table 3.1: Prior Expectations

VARIABLE	MEASUREMENT	APPROPRIATE EXPECTATION
REER Volatility	Standard Deviation (Variance)	+ve / -ve
GDP Growth rate	Percentage	-ve
FDI Inflow	Ksh. Million	-ve
CAB	Ksh. Million	-ve

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This section of the thesis presents descriptive statistics, unit root tests with and without structural breaks, results on GARCH, cointegration test and results of VAR.

4.2 Descriptive Statistics

The first step of the analysis was to compute the descriptive statistics reported in Table 4.1. This was done in order to get a general view of the individual variables and to identify outliers. The GDP growth rate recorded a maximum of 17.08, a minimum of -0.8 and a mean of 4.3157. This meant that on average the GDP had been growing consistently during the study period. Foreign direct investment inflow as a percentage of GDP reported a mean of 0.6177 with a maximum of 2.53 and a minimum of 0 while the current account balance as a percentage of GDP registered a mean of -6.1650 with a maximum of 0.888 and a minimum of -18.68. This implied that FDI inflows were above the 0.5 index.

The real effective exchange rate recorded a maximum of 128.0377, a minimum of 91.2429 and an average of 102.4101. This meant that the real exchange rate was very volatile. It recorded the highest fluctuation of 128 meaning that the Kenyan currency depreciated in relation to the World's major currencies during the study period. The null hypothesis of Jarque-Bera test states that "the data is not normally distributed". This null hypothesis was rejected for all univariate time series variables under study.

Table 4.1 also presents the results of normality test. Results indicated that GDP was normally distributed as per Jarque-Bera test statistic of 406.8657 (p – value 0.0000 < 0.05). FDI also was normally distributed with Jarque-Bera statistic of 279.5347 with p

– value of 0.0000 < 0.05. CAB was also normally distributed with Jarque-Bera test statistics of 816.1841 with p – value 0.0002 < 0.05. REER was also normally distributed with 270.2337 as Jarque-Bera statistic and p – value 0.0000 < 0.05.

Table 4.2: Descriptive Statistics

Variable	Mean	Std.Dev	Minimum	Maximum	Skewness	Kurtosis	Jarque-Bera	Probability
REER	102.410	6.4440	91.2429	128.0377	1.8212	7.8568	270.2337	0.0000
GDP	4.3157	3.1167	-0.8	17.08	0.0000	0.0000	406.8657	0.0000
FDI	0.6177	0.5581	0.0	2.53	0.0000	0.0001	279.5347	0.0000
CAB	-6.1650	4.8034	-18.68	0.888	0.0000	0.1729	816.1841	0.0002

Source: Author's Survey, 2018

The plot of REER is presented in Figure 4.1. It shows that REER was trending during the period under study. This is in line with economic theory (Lutkepohl, 2005).

Figure 4. 1: Time series plot for Real Effective Exchange Rate

Source: Author's Survey, 2018

Time series plot for GDP is presented in Figure 4.2 which shows that GDP was trended and was increasing over time. This implies that there was deterministic long run growth rate of the real economy (Enders, 2015). This finding was in agreement with prior study by Rothman (1998).

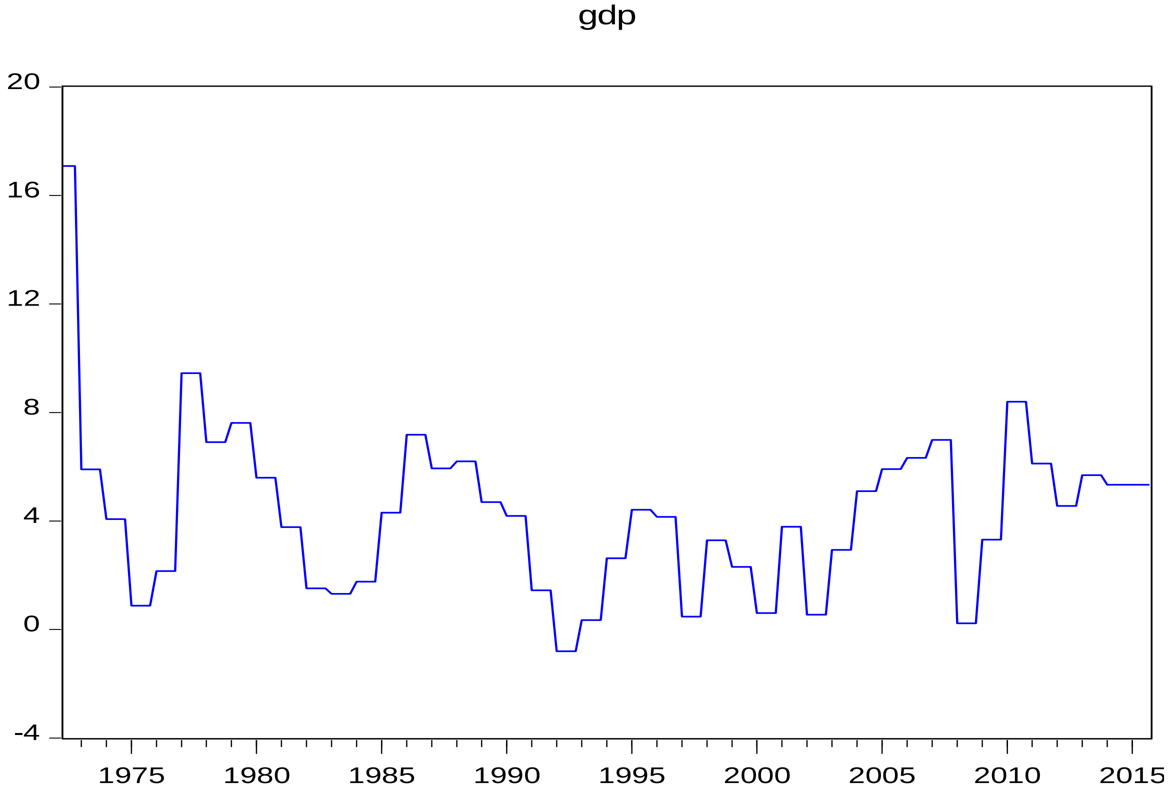

Figure 4. 2: Time series plot for real GDP growth rate

Source: Author's Survey, 2018

The plot of FDI is presented in Figure 4.3. It indicates that there was a white noise process. This is in line with the economic theory which shows that FDI is an exogenous variable.

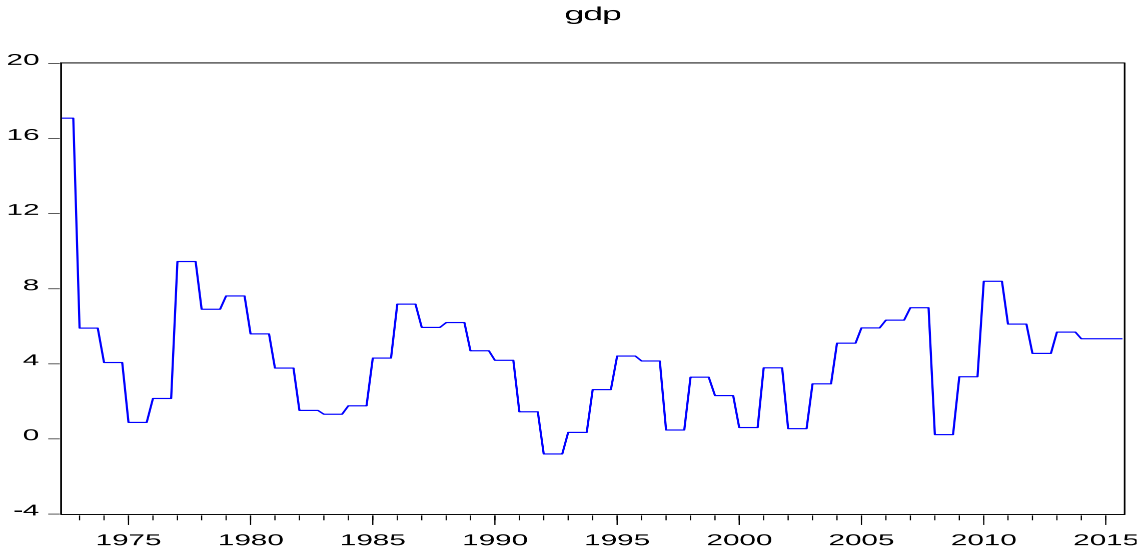

Figure 4. 3: Time series plot for Foreign Direct Investment (% of GDP

Source: Author's Survey, 2018

The plot of CAB presented in Figure 4.4 showed that it was trended and was increasing over time, during the period under consideration.

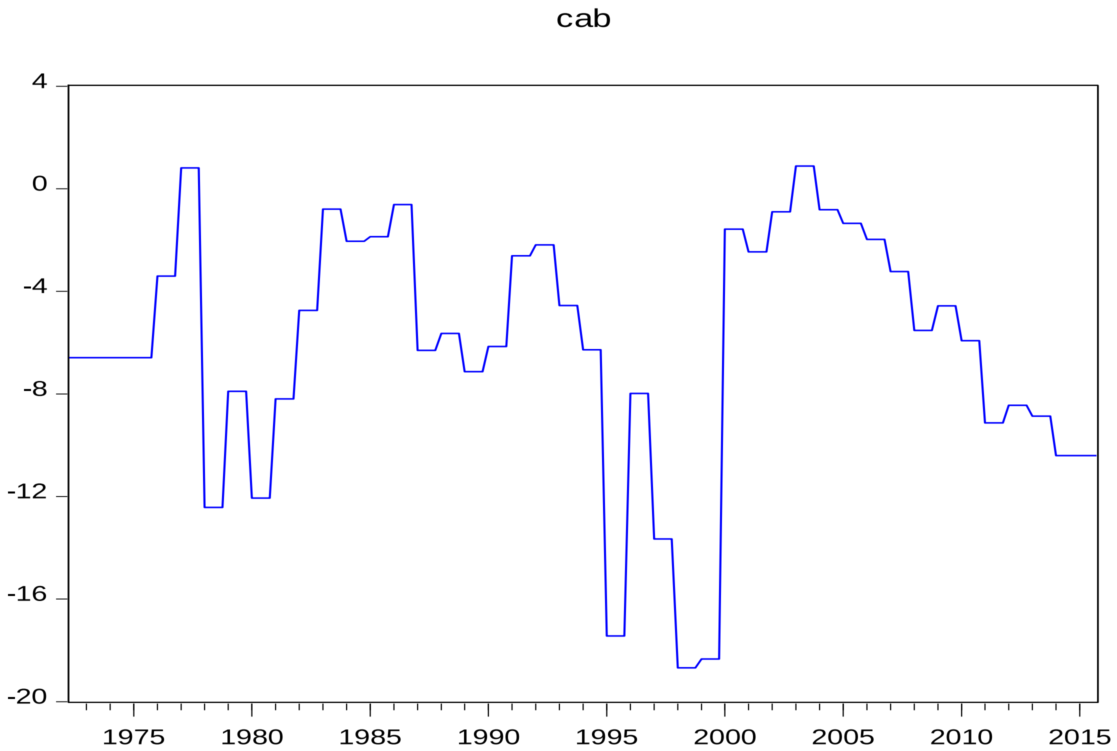

Figure 4. 4: Time series plot for Current Account Balance (% of GDP)

Source: Author's Survey, 2018

4.3Correlation Analysis

After the time series variables were plotted, it was necessary to perform correlation analysis. This was done to measure the strength of association and establish the bivariate association that existed among the study variables. Results for correlation analysis are presented in Table 4.2. The sample period is 1972q1 to 2015q4. Results showed that real effective exchange rate (REER) is significantly and positively correlated with economic growth (GDP) with a p-value of 0.000848 and a Correlation Coefficient of 0.241110 at 5% level of significance. REER recorded a significant and positive association with foreign direct investment inflow (FDI) with a p-value of 0.000184 and a Correlation Coefficient of 0.291485 at 5% level of significance. REER showed a negative and strong association with the current account balance (CAB) with a p-value of 0.000 and a Correlation Coefficient of -0.128759 at 5% level of significance.

Table 4. 3: Correlation Matrix

Covariance Correlation	REER	GDP	FDI	CAB
REER				
	1.000000			
GDP	0.000848**			
	(0.241110)	1.000000		
FDI	0.000184**	0.160852		
	(0.291485)	(0.093002)	1.000000	
CAB	6.98E-07	0.000701	0.000104	

(-0.128759)	(-0.047125)	(-0.039163)	1.000000

** Indicate the association is significant; values in parentheses are Spearman's Correlation Coefficient.

Source: Author's, Survey, 2018

4.4 Test for Multivariate Normality

Having established the correlation levels that existed among the variables, it was necessary to test for multivariate normality. The results of Doornik-Hansen test presented in Table 4.3 showed that the variables followed normal distribution and hence tests like z – distribution and t – distribution were suitable for the analysis. The χ^2 (14df) = 345.230; Prob. > χ^2 = 0.000. This showed that the study variables were multivariate normal therefore inferences can be drawn by applying parametric tests such as t-statistics; and F-Statistics.

Table 4. 4: Results of Doornik-Hansen test for Multivariate Normality

Type of Test	Df	χ^2	Pob > χ^2
Doornik-Hansen	14	345.230	0.000

Source: Author's Survey, 2018

4.5 Unit Root Tests without Structural Breaks

Having established the multivariate normality among variables, unit root tests were done on each of the individual time series and results are presented in Tables 4.4 and 4.5

4.5.1 Augmented Dickey-Fuller Unit Root Test

Results of Augmented Dickey-Fuller presented in Table 4.4 showed that economic growth rate was integrated of order zero *I(0)* at levels while all the other variables were integrated of order one *I(1)*. Current account balance (CAB) was integrated of order zero when the test was done with intercept. The existence of stationarity in GDP at levels is an indication that GDP was oscillating up and down, thus the economic growth rate was unstable and struggling to grow steadily during the period under study. This is a main feature in most developing countries as alluded to by Cashin and Dermott (1998).

The results of unit root tests are presented in Tables 4.4 and 4.5. The results of Augmented Dickey-Fuller rejected the presence of unit root in economic growth at levels with a p-value of $0.0015 < 0.05$. Unit root was present in real exchange rate volatility, foreign direct investment and current account balance with the p – values of 0.2504, 0.3764 and 0.0637 all > 0.05. The critical values for Augmented Dickey-Fuller test were -3.628 at 1%, -2.950 at 5% and -2.608 at 10%.

When variables were first differenced results showed that they became stationary. The Mackinnon p-values were 0.0233 and all were less than 0.05 Therefore, as per Augmented Dickey-Fuller test, it was concluded that the study variables were integrated of order one denoted by *I(1)*. GDP was differenced despite the fact that it was *I(0)* because time series procedures requires that the variables under analysis should be integrated of the same order (Greene 2012; Enders 2005; Hamilton 1994 and Lutkepohl 2005). Other studies have also shown that macroeconomic time series variables are normally integrated of order one (Greene, 2012).

Table 4. 5: Results of Augmented-Dickey-Fuller Unit Root Test

Variable	Intercept		Intercept and Trend		None		Remark
	T – Stat	Prob	T – Stat	Prob	T – Stat	Prob	
				Level			
REER	-2.6278	0.0893	-2.6230	0.2707	-1.0867	0.2504	
GDP	-4.7808	0.0001	-4.6386	0.0012	-3.2013	0.0015	*I(0)*
FDI	-2.6153	0.0913	-2.5135	0.3213	-0.7812	0.3764	
CAB	-3.1926	0.0221	-3.2089	0.0861	-1.8335	0.0637	
				First Difference			
REER	-13.1175	0.0000	-13.1042	0.0000	-13.1530	0.0000	*I(1)*
GDP	-13.1408	0.0000	-13.2146	0.0000	-13.1530	0.0000	*I(1)*
FDI	-9.1428	0.0000	-9.1592	0.0000	-9.1607	0.0000	*I(1)*
CAB	-13.1161	0.0000	-13.0832	0.0000	-13.1530	0.0000	*I(1)*

*Mackinnon p – values 0.0233

Source: Author's Survey, 2018

4.5.2 Results of Phillips-Perron Unit Root Test

Monte Carlo simulation has shown that the power of the ADF test is very low (Im and Lee, 2009). Therefore, in practice it is recommended that researchers should use more than one unit root test in order to compare the performances and facilitate robustness. The ADF test is unable to distinguish clearly between non-stationary and stationary series with a higher degree of autocorrelation and is quite sensitive to breaks (Im and Lee, 2009). To overcome this limitation, the semi-parametric Phillips-Perron test, which gives robust estimates when the series has serial correlation and time dependent heteroskedasticity, was used to supplement the ADF test.

Results of Phillips-Perron are presented in Table 4.5. Results showed that economic growth rate was stationary at levels, thereby agreeing with Augmented Dickey-Fuller test results. However, it disagreed with Dickey-Fuller by showing that FDI was stationary yet ADF showed that FDI had unit root.

The results of Philip-Perron rejected the presence of unit root in real effective exchange rate, economic growth, foreign direct investment and current account balance when all of them were first differenced, thereby conforming with the ADF results. The Mackinnon p – values were 0.0196 and all were less than 0.05. The critical values for Philip-Perron test were also -3.628 at 1%, -2.950 at 5% and -2.608 at 10%.

The Augmented Dickey-Fuller and Phillips-Perron Unit Root Tests, also referred to as the first generation tests (classical tests) cannot distinguish between unit root and near unit root stationary processes (Nyongesa, 2013). The power of the tests is low if the process is stationary but with a root close to the non-stationary boundary. The tests are poor at deciding, for example, whether $\varphi = 1$ or $\varphi = 0.95$, especially with small sample sizes (Greene, 2012).

In general, the ADF and PP tests have very low power against *I(0)* alternatives that are close to being *I(1)*. Since these tests cannot distinguish between unit root and near unit root stationary processes, the study employed the second generation unit root tests, which included Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test of Kwiatkowski *et al.,* (1992) and Elliot-Rothenberg-Stock unit root test proposed by Elliot, Rothenberg and Stock (1996).

Table 4. 6: Results of Phillips-Perron Unit Root Test

Variable	Intercept		Intercept and Trend		None		Remark
	T - Stat	Prob	T – Stat	Prob	T – Stat	Prob	
			Level				
REER	-2.7238	0.0720	-2.7585	0.2149	-1.0867	0.2504	
GDP	-4.7809	0.0001	-4.6386	0.0012	-3.2013	0.0015	*I(0)*
FDI	-4.2898	0.0006	-4.2797	0.0042	-2.8885	0.0040	*I(0)*
CAB	-3.2633	0.0181	-3.2758	0.0737	-1.6910	0.0859	
			First Difference				
REER	-13.1175	0.0000	-13.1042	0.0000	-13.1530	0.0000	*I(1)*
GDP	-13.1408	0.0000	-13.2150	0.0000	-13.1530	0.0000	*I(1)*
FDI	-25.2947	0.0000	-27.2643	0.0000	-24.6334	0.0000	*I(1)*
CBA	-13.6060	0.0000	-13.5993	0.0000	-13.6508	0.0000	*I(1)*

*Mackinnon p – values 0.0196

Source: Author’s Survey, 2018

4.5.3 KPSS and Elliot-Rothenberg-Stock Test

Results of KPSS unit root tests are presented in Table 4.6. Results were estimated with Newey-West Bandwidth automatic selection using Bartlett Kernel. The aim of this test is to remove deterministic trend of the series in order to make it stationary. Results indicated that economic growth rate was stationary supporting the findings of first generation unit root tests presented in section 4.5.1 and 4.5.2. Similarly results of Elliot-Rothenberg-Stock that were estimated with Schwarz Information Criteria (SIC) showed that economic growth rate was stationary also supporting first generation unit root test. The results of first difference series showed that the variables became stationary.

Table 4. 7: Results of KPSS and Elliot-Rothenberg-Stock Test

	Kwiatkowiski-Phillips-Schmidt Shin Test		Elliot-Rothenberg-Stock Test		
	Intercept	Intercept with Tend	Intercept	Intercept with Trend	Remark
			Level		
REER	0.4749	0.1218	4.8292	7.7434	
GDP	0.2466	0.1936	20.1283	20.5984	*I(0)*
FDI	0.1055	0.1061	2.7640	6.8451	
CAB	0.0730	0.0640	1.3932	4.9563	
			First Difference		
REER	0.4154	0.0308	0.2784	1.0372	*I(1)*
GDP	0.1656	0.0496	0.2788	1.0442	*I(1)*
FDI	0.2631	0.2462	9.1196	34.6336	*I(1)*
CAB	0.0544	0.0459	0.2784	1.0357	*I(1)*

Source: Author's Survey, 2018

Therefore it was concluded that the study variables were integrated of order one, denoted by *I(1)*. This supports prior empirical studies (Nyongesa, 2013; Lutkepohl, 2005; Hamilton, 1994; Enders, 2015 among others) and econometrics theory that indicates that macroeconomic variables are generally not stationary at levels but become stationary on first differencing (Greene, 2012; Cameron and Trivedi, 2005; Baum, 2005; Gujarati, 2012 and Wooldridge, 2012).

4.6 Unit Root Tests with Structural Breaks

The next step of the analysis was testing for unit root with structural breaks and results are presented in Table 4.7. Clemente-Montanes-Reyes identified two significant structural breaks in economic growth (Figure 4.5). The first significant structural break was in 1980q2 (p - value 0.000 < 0.05). It was associated with spill-over effects of oil crisis of 1979. Positive and significant structural break in economic growth occurred in 2004q2 (p - value 0.000 < 0.05).

Table 4.8: Unit Root Test with Structural Breaks

Variable	Breaks	Coef	T-Stat	P-Value	Year
REER	*D1*	-2.1547	-12.120	0.000	1998q2
	D2	1.9216	9.413	0.000	2005q2
GDP	*D1*	-1.6761	-6.713	0.000	1980q2
	D2	2.2682	4.610	0.000	2004q2
FDI	*D1*	-0.4197	-3.509	0.001	1980q2
	D2	0.1574	1.666	0.098	1993q2
CAB	*D2*	-17.0785	-7.845	0.000	1995q2
	D2	8.5708	9.195	0.000	2000q2

Source: Author’s Survey, 2018

This was attributed to the successful implementation of Economic Recovery Strategy for Wealth and Employment Creation 2003-2007, (GoK, 2003) which was implemented by the new Government regime as from 2003 to 2007, that succeeded in reversing the economic decline of the past two decades in Kenya. This is confirmed by the following OECD (2004).

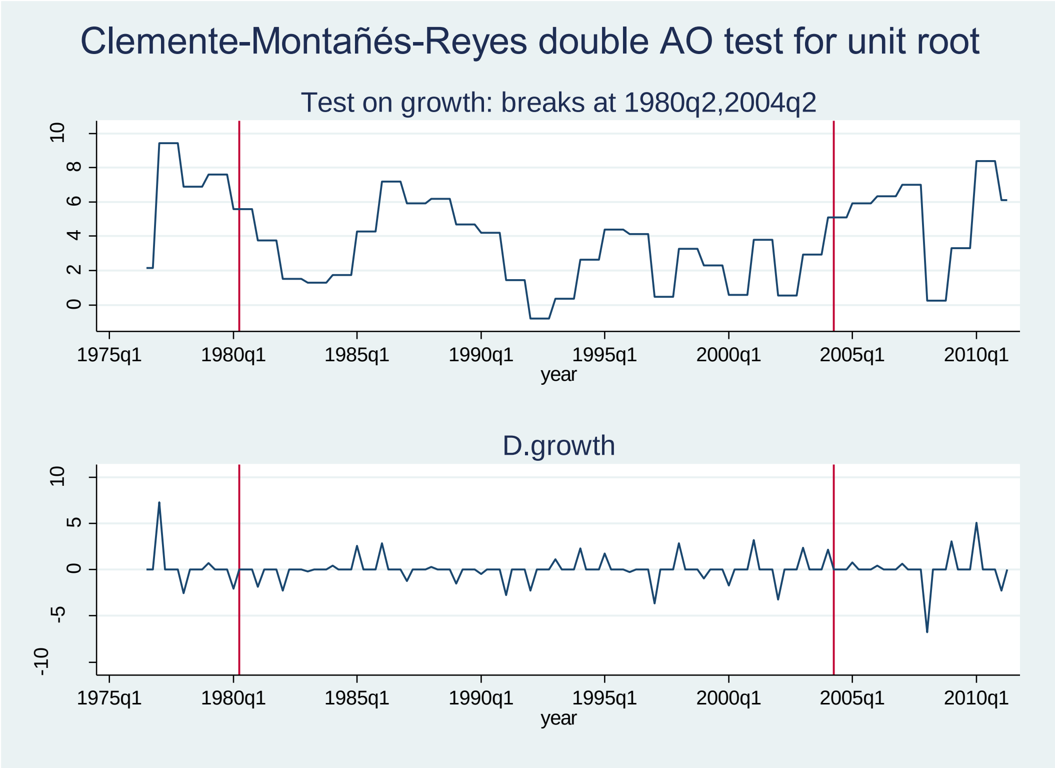

Figure 4. 5: Plots of Structural Breaks of GDP Growth Rate

Source: Author's Survey, 2018

The results for structural breaks for FDI are also shown in Figure 4.6. Foreign direct investment had first significant structural break in 1980q2. This structural break was positive and significant (p – value 0.001 < 0.05). This was as a result of the spillover effect of the oil crisis of 1978/79 that raised exchange rates, which in turn, raised the overall food prices in the country (Economic Survey, 1981). The second break on foreign direct investment occurred in 1993q2. This structural break was negative and significant (p – value 0.098 > 0.05). This is explained by the uncertainties that characterized the first multiparty elections of 1992 and the CBK's excessive accommodation of failed financial institutions (Tuitoek, 2014).

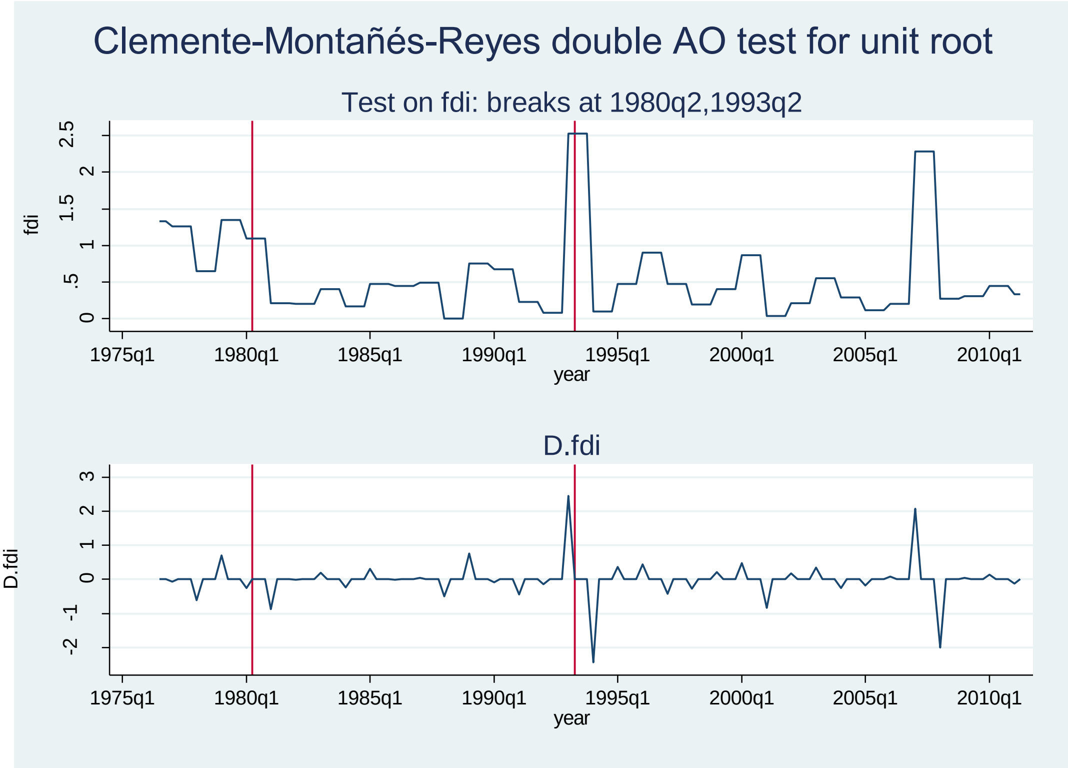

Figure 4. 6: Plots of Structural Breaks of FDI Inflow

Source: Author's Survey, 2018

The results for structural breaks for CAB are also shown in Figure 4.7. Current account balance had first significant structural break in 1995q2. This structural break was positive and significant (p – value 0.000 < 0.05). This was attributed to trade liberalization and implementation of floating exchange rate regime (Tuitoek 2014). Another positive and significant structural break for CAB (p – value 0.000 < 0.05) occurred in 2000q2. This was attributed to Foreign Trade and Balance of Payments (BOP), which continued to be favorable for last several years, received a jolt during the first eight months of the FY2002/03, with the imposition of quantitative restrictions and procedural difficulties on four items of export to India under the renewed Trade Treaty (GoK, 2003).

This is further attributed to poor growth performance in 2002 and 2003 that was accompanied by deteriorating economic fundamentals including a huge domestic debt, a worsening fiscal deficit and rising inflation (AfDB/OECD, 2004).

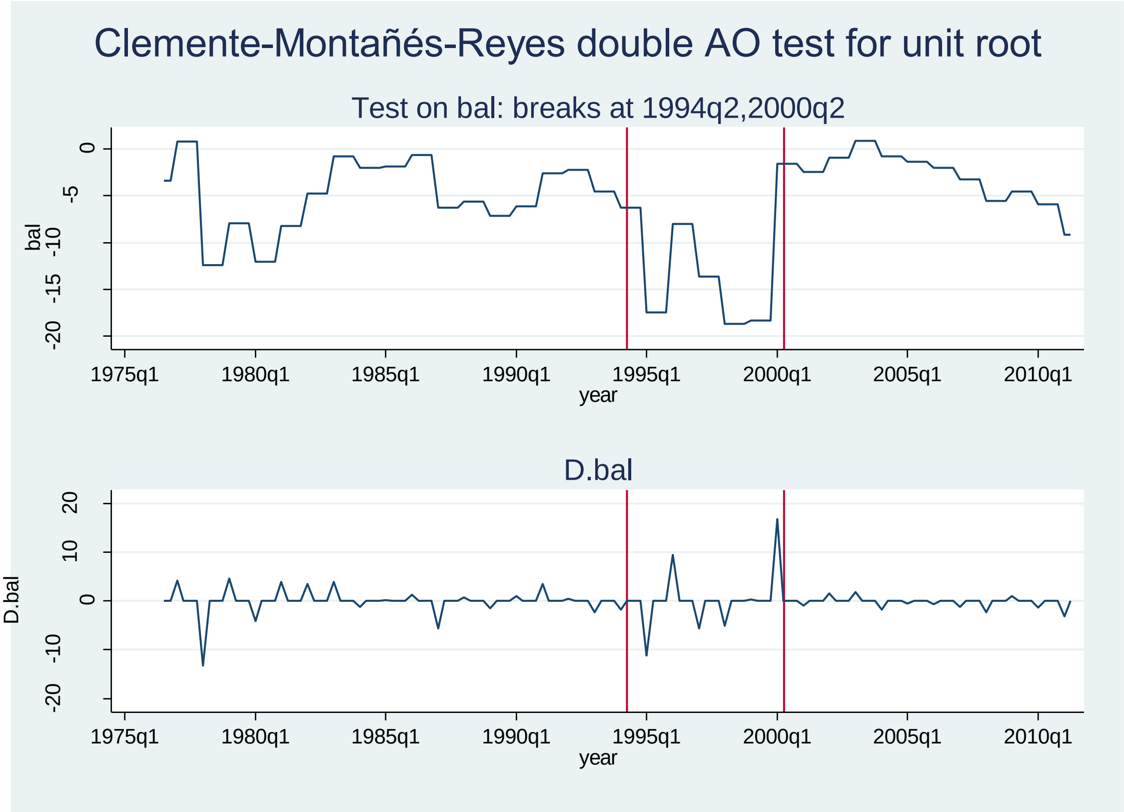

Figure 4. 7: Plots of Structural Breaks of Current Account Balance

Source: Author's Survey, 2018

The results for structural breaks for REER are also shown in Figure 4.8. Real effective exchange rate had first significant structural break in 1998q2. This structural break was positive and significant (p – value $0.000 < 0.05$). Another positive and significant structural break for REER (p – value $0.000 < 0.05$) occurred in 2005q2. This was explained by increased trade as a result of increased manufactured exports to COMESA countries and USA under Africa Growth Opportunities Act ((AGOA) (AfDB/OECD, 2006).

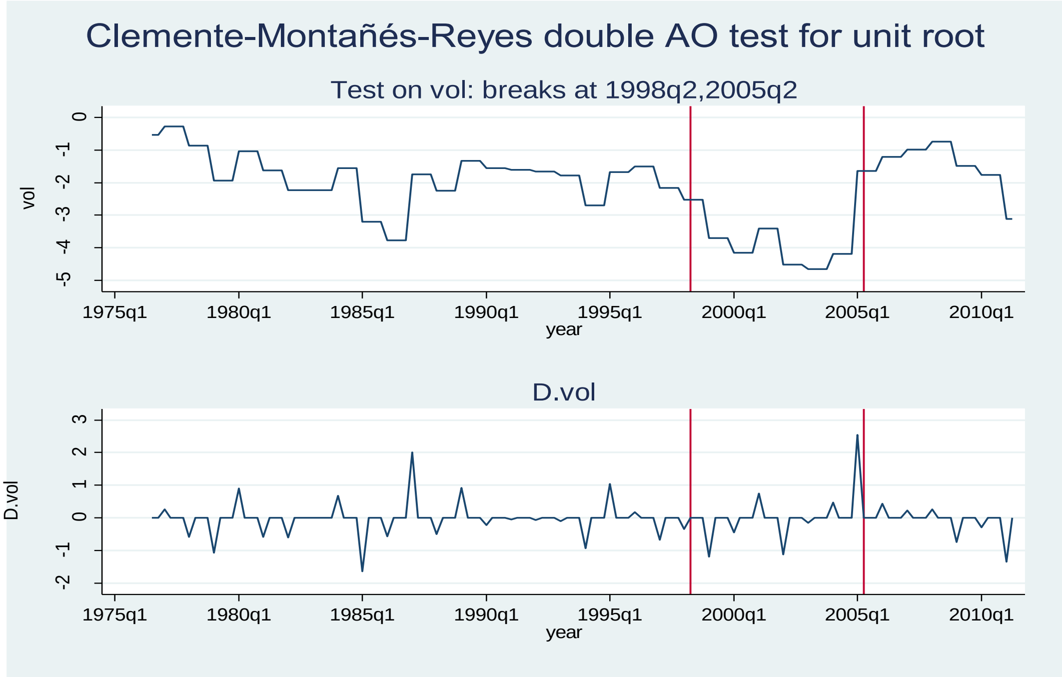

Figure 4. 8: Plots of Structural Breaks of REER

Source: Author's Survey, 2018

4.7 Cointegration Analysis

4.7.1 Johansen's Cointegration Test

Having established that the individual time series were integrated of order one, (*I* (1)), it then became necessary to check whether the variables were cointegrated. As explained earlier that even if there is no economic reason to suspect the variables to be cointegrated, it is important to ascertain that the GDP growth rate, the foreign direct investment inflow, current account balances and the real effective exchange rate are not cointegrated to justify the appropriateness of the structural VAR, or else, the VAR model should be replaced by an error correction representation.

To determine Johansen's cointegration test, there was need to estimate appropriate lag length and to estimate unrestricted VAR model. The log likelihood object provided a general, open-ended tool for estimation of a broad class of specification by maximizing likelihood function with respect to parameters of the model. In this regard the study used AIC lag specification procedure. There are several techniques for estimating cointegrating relationships. Of these techniques, the Johansen (1988) and Johansen and Juselius (1990) maximum-likelihood test procedure is the most efficient as it tests for the existence of a third cointegrating vector.

This procedure gives two likelihood ratio tests for the number of cointegrating vectors: (i) the *maximal eigen value test*, which tests the null hypothesis that there are at least r cointegrating vectors, as against the alternative that there is r+1, and (ii) the *trace-test*, where the alternative hypothesis is that the number of cointegrating vectors is equal to or less than r+1. As for the implementation of the Johansen's procedure, the optimal lag length in the VAR system need to be determined.

The lag length of the chosen VAR was 2. Our procedure for choosing the optimal lag length was based on the Akaike, Schwarz and Hannan-Quinn information criteria as well as the liquidity ratio test (AIC, SC, HQ, and LR, respectively). Tables 4.8 through to Table 4.12 present cointegration test results based on Johansen's maximum-likelihood procedure. Test results indicate that there is no evidence of cointegration among the four variables under consideration.

To determine the relationship that existed among the study variables for the study period, the current study used Johansen and Juselius (1990) cointegration technique. This technique was chosen because it is applicable where we have multivariate relationships as opposed to Engle-Granger technique that applies to bivariate relationships (Lutkepohl, 2005; Hamilton, 1994). This analytical technique also has advantages over other cointegration methods because it does not suffer from a normalization problem and is robust to departures from normality (Gonzalo, 1994; and

Nyongesa, 2013). It also supports other superior properties in relation to other techniques (Gonzalo, 1994; and Nyongesa, 2013).

The optimality of the Johansen-Juselius (1990) has been shown by Phillips (1991) in terms of symmetry, unbiasedness and efficiency property (Daly, 1996; and Nyongesa, 2013). This involved estimation of cointegration relationship between economic growth, foreign direct investment inflow, current account balances and real effective exchange rate volatility. The determination of Johansen cointegration procedure involve use of two test statistics, first, trace statistics and second, maximum eigenvalue statistics (Cameron and Trivedi, 2005). The coefficient of cointegration relationships are reported in Tables 4.8 and table 4.9.

Table 4. 9: Unrestricted Cointegration Rank Test (Trace)

Sample (adjusted): 1973Q2 2015Q4
Included observations: 171 after adjustments
Trend assumption: Linear deterministic trend
Series: REER GDP FDI CAB
Lags interval (in first differences): 1 to 4

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.127306	58.14534	47.85613	0.0040
At most 1 *	0.098862	34.86014	29.79707	0.0120
At most 2 *	0.057670	17.05966	15.49471	0.0288
At most 3 *	0.039560	6.902263	3.841466	0.0086

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's Survey, 2018

Table 4. 10: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.127306	23.28520	27.58434	0.1616
At most 1	0.098862	17.80048	21.13162	0.1375
At most 2	0.057670	10.15740	14.26460	0.2018
At most 3 *	0.039560	6.902263	3.841466	0.0086

Max-eigenvalue test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

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

Source: Author's Survey, 2018

While the existence of a cointegration relationship between macroeconomic variables and real effective exchange rate is a necessary condition to sustain macroeconomic performance, it is not an adequate condition. For besides it, the slope coefficients obtained from the equations derived from the series should also be equal to 1, so as to stipulate clearly that macroeconomic performance is indeed sustainable. Otherwise, failure to fulfill the second condition (sufficient condition), then the sustainability of macroeconomic performance is considered with doubt. As for the case under study, the results showed that the cointegrating coefficients were not significantly equal to 1. Thus, the null hypothesis of $\beta = 1$ was rejected. It is therefore concluded that macroeconomic performance in Kenya is not on a stable path and may not be sustained in the long run unless the real effective exchange rate volatility is fixed.

The results of unrestricted adjustment coefficients are presented in Table 4.10. The results showed that the adjustment coefficients of REER Volatility were all negative and significant (p – value 0.000123 for GDP < 0.05; p – value 0.005946 for FDI < 0.05

and p – value 0.000226 for CAB < 0.05). This was a clear indication that REER Volatility is principle determinant of GDP growth rate, FDI Inflows and CAB in the long run.

Table 4. 11: Unrestricted Adjustment Coefficients

Unrestricted Adjustment Coefficients (alpha):

D(VREER)	4.15E-05	5.09E-05	-5.28E-05	5.51E-05
D(GDP)	-0.013220	-0.350025	-0.050316	0.108569
D(FDI)	-0.100210	0.010344	0.010214	0.039040
D(CAB)	-0.464239	-0.081501	-0.331331	-0.169338

1 Cointegrating Equation(s):		Log likelihood	401.0313

Normalized cointegrating coefficients (standard error in parentheses)

REER	GDP	FDI	CAB
1.000000	-0.000123	-0.005946	-0.000226
	(0.00021)	(0.00123)	(0.00011)

Adjustment coefficients (standard error in parentheses)

D(REER)	-0.019080
	(0.01504)
D(GDP)	6.084953
	(46.8094)
D(FDI)	46.12543
	(12.3563)
D(CAB)	213.6832
	(76.0165)

Source: Author’s Survey, 2018

Table 4.12: Unrestricted Adjustment Coefficients

Unrestricted Adjustment Coefficients (alpha):

2 Cointegrating Equation(s):		Log likelihood	409.9316
Normalized cointegrating coefficients (standard error in parentheses)			
REER	GDP	FDI	CAB
1.000000	0.000000	-0.006404	-0.000254
		(0.00130)	(0.00012)
0.000000	1.000000	-3.728089	-0.226185
		(1.63833)	(0.15348)
Adjustment coefficients (standard error in parentheses)			
D(REER)	-0.029597	2.52E-05	
	(0.01635)	(1.5E-05)	
D(GDP)	78.36285	-0.157521	
	(49.2778)	(0.04410)	
D(FDI)	43.98948	-0.001039	
	(13.5361)	(0.01211)	
D(CAB)	230.5127	-0.062778	
	(83.2492)	(0.07450)	

Source: Author’s Survey, 2018

Table 4. 13: Unrestricted Adjustment Coefficients

Unrestricted Adjustment Coefficients (alpha):

3 Cointegrating Equation(s):	Log likelihood	415.0103	
Normalized cointegrating coefficients (standard error in parentheses)			
REER	GDP	FDI	CAB
1.000000	0.000000	0.000000	0.000126
			(8.8E-05)
0.000000	1.000000	0.000000	-0.004718
			(0.13640)
0.000000	0.000000	1.000000	0.059405
			(0.02465)
Adjustment coefficients (standard error in parentheses)			
D(REER)	-0.079963	2.13E-05	0.000121
	(0.03465)	(1.5E-05)	(9.0E-05)
D(GDP)	30.40254	-0.161164	0.109063
	(105.251)	(0.04462)	(0.27310)
D(FDI)	53.72540	-0.000299	-0.282632
	(28.9229)	(0.01226)	(0.07505)
(CAB)	-85.30438	-0.086768	-1.086475
	(175.604)	(0.07445)	(0.45565)

Source: Author's Survey, 2018

4.7.2 Specification Lag Order Selection and Estimation

Having tested for unit root the next step was to select the optimum lag length and results are presented in Table 4.13. Before we estimate the VAR model we have to decide on the maximum lag length, K. This is an empirical question. There were 176 observations in all. Including too many lags will consume degrees of freedom and too few lags will lead to model specification errors, not to mention introducing the possibility of multicollinearity (Gujarati, 2004).

One practical problem in the estimation of VAR models relates to the number of variables to be included in the model and the maximum lag length to be applied (Greene, 2012). Different lag orders can critically influence the substantive interpretation of the estimates, especially when the differences are large enough. Therefore, selection of the correct lag order for each VAR was the first and vital step in this study. The lag order is selected by some pre-specified criterion and is based on in the construction of VAR estimates. To decide on this, Final Error Prediction, Akaike Information Criterion (AIC), the Schwarz Information Criterion (SIC), the Hannan-Quinn Criterion (HQC) and the general-to-specific sequential Likelihood Ratio test (LR) were used. The sample period used by selection order criterion was 1973q1 to 2015q4 after lagging. Therefore, the number of observations is 172. The endogenous variables were economic growth, real effective exchange rate, foreign direct investment and current account balance.

It was necessary to determine the optimum number of lag lengths because using more lags consume degrees of freedom and using too few lags introduces correlation (Gujarati, 2013). Results indicated that optimum lag length was one. All information criteria selected lag length of one (1) indicated by (*) in Table 4.13.

Table 4.14: Selection of Optimum Lag Length

Lag	LL	LR	DF	P	FPE	AIC	HQIC	SBIC
0	-2421.16				72804.1	28.2228	28.2673	28.3326
1	-1696.14	1450*	36	0.000	24.1426*	20.211*	20.5228*	20.9795*
2	-1689.66	12.974	36	1.000	34.0768	20.5541	21.1333	21.9815
3	-1680.73	17.845	36	0.995	46.8602	20.869	21.7154	22.9551
4	-1667.03	27.418	36	0.847	61.1528	21.1282	22.2419	23.8731

Source: Author's Survey, 2018

4.7.3 Vector Autoregressive Model

The VAR model, being an alternative to the "incredible identification restrictions" in structural models, is an econometrics model that is employed to cater for the evolution and interdependencies between multivariate time series by generalizing the univariate AR models (Greene, 2012). An equation for each variable explains its evolution based on its own lags and the lags of all other variables in the model (Hamilton, 1994). The use of VAR model is a theory-free method of estimating dynamic economic relationships among macroeconomic variables (Sims, 1980).

Following Sims (1980), all the variables were treated as endogenous. Therefore, real GDP growth rate, foreign direct investment inflow as a percentage of GDP and current account balances as a percentage of GDP were clear endogenous variables. REER Volatility was also treated as endogenous variable despite the fact that it is influenced by external factors in order to utilise the essence of VAR Model as stated by Sims (1980) that all macroeconomic variables are jointly determined. The results of the VAR models are presented in Table 4.14. The results of Multivariate VAR Model indicated that the independent variables account for 87% of the variations in the dependent variables on average (Table 4.14).

4.7.3.1 GDP Growth rate equation

The results of Multivariate VAR Model are presented in Table 4.14. The results showed that REER volatility had a positive and significant effect on the current GDP with a t-statistic of 11.7715 > 1.96. The coefficient was 0.941227 showing that for a one unit change in REER volatility GDP growth rate was expected to increase by 0.941227. The lagged value of GDP growth rate had a positive and significant effect on the current value of GDP growth rate with the coefficient of 0.931024 (t-statistic of 11.6606 > 1.96).

The results showed that for one-unit increase in the lagged value of GDP growth rate, the current value of GDP growth rate was expected to increase by 0.931024 units. This is because the previous value of GDP growth rate forms the basis of the current level GDP growth rate. The VAR model results showed that the lagged value of both FDI and CAB have positive and significant effect on the current GDP growth rate with coefficients of 7.149472 (t – statistic = 2.25913 > 1.96) and 0.845873 (t – statistic = 10.7515 > 1.96) respectively.

4.7.3.2 REER Equation

Results showed that lagged GDP had a positive and significant effect on changes in REER t-statistics of 10.9934 > 1.96. The lagged coefficient of GDP was 0.858225 indicating that a one-unit change in lagged value of GDP growth rate causes REER volatility to change by 0.858225 units. This implied that GDP growth rate had a significant effect on REER volatility which is in line with macroeconomic theory. It is also important to note that economic fluctuations (business cycles) are cyclical in nature causing REER volatility. The other covariates were not significant (Table 4.14).

4.7.3.3 FDI Equation

The results indicated that the lagged value of REER volatility had an insignificant effect on FDI inflows. The coefficient was 28.83278, showing that a unit change in *REER(-1)* volatility will cause FDI inflows to increase by 28.83278 units. *REER(-2)* also had positive and insignificant effect on FDI inflows and showed that if *REER(-2)* increases by one unit, then FDI inflows increases by 12.39717 units. Results of the FDI Equation revealed that lagged values of FDI had a positive and significant effect on the current FDI as indicated by t-statistic of 10.2284 > 1.96 and the coefficient of 0.905137. This showed that if lagged value of FDI increases by one unit, current FDI inflows will increase by 0.905137 units. The covariates for GDP growth rate, REER volatility and CAB were all not significant in the FDI equation (Table 4.14).

4.7.3.4 CAB Equation

Further, lagged value of REER volatility did not have a significant effect on CAB.. Similarly, REER(-2) had a positive and insignificant effect on CAB. As for the CAB Equation, the results revealed that lagged values of CAB had a positive and significant effect on the current CAB as indicated by t-statistic of 10.2868 > 1.96. These results further indicated that a one-unit increase in Lagged value of CAB leads to 0.910147 increase in current level of CAB (Table 4.14). This shows that univariate time series variables under consideration were related.

Table 4: 15: Results of Vector Autoregressive Model

Vector Autoregressive Estimates
Sample (adjusted): 1972Q3 2015Q4
Included observations: 174 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	GDP	REER	FDI	CAB
GDP(-1)	0.931024	0.858225	0.004267	-0.027800
	(0.07984)	(0.07807)	(0.02002)	(0.12297)
	[11.6606]	[10.9934]	[0.21320]	[-0.22607]
GDP(-2)	1.09E-05	-0.045363	-0.004266	-0.052571
	(2.2E-05)	(0.07470)	(0.01915)	(0.11766)
	[0.50497]	[-0.60730]	[-0.22278]	[-0.44681]
REER(-1)	0.941227	-0.905030	28.83278	120.1098
	(0.07996)	(277.000)	(71.0183)	(436.314)
	[11.7715]	[-0.00327]	[0.40599]	[0.27528]
REER(-2)	-0.024198	-24.29463	12.39717	-152.7023
	(0.07933)	(274.820)	(70.4592)	(432.879)
	[-0.30503]	[-0.08840]	[0.17595]	[-0.35276]
FDI(-1)	7.149472	0.078408	0.905137	-0.143543
	(3.16470)	(0.30687)	(0.08849)	(0.48336)
	[2.25913]	[0.25551]	[10.2284]	[-0.29697]
FDI(-2)	1.59E-05	-0.067290	-0.155099	-0.150332
	(8.9E-05)	(0.30744)	(0.07882)	(0.48425)
	[0.17939]	[-0.21888]	[-1.96773]	[-0.31044]
CAB(-1)	0.845873	-0.012652	-0.001286	0.910147
	(0.07868)	(0.05069)	(0.01300)	(0.08848)
	[10.7515]	[-0.24960]	[-0.09896]	[10.2868]
CAB(-2)	7.76E-06	0.032596	-0.002245	-0.058059
	(1.5E-05)	(0.05098)	(0.01307)	(0.08030)
	[0.52712]	[0.63938]	[-0.17174]	[-0.72302]
Constant	-0.000177	0.790778	0.259831	-0.343415
	(0.00012)	(0.40716)	(0.10439)	(0.64133)
	[-1.50498]	[1.94219]	[2.48907]	[-0.53547]
R-squared	0.869820	0.747654	0.581415	0.787492
Adj. R-squared	0.863508	0.735419	0.561120	0.777189
Sum sq. resids	2.88E-05	345.8008	22.73034	857.9535
S.E. equation	0.000418	1.447675	0.371160	2.280289
F-statistic	137.8092	61.10808	28.64820	76.43039
Log likelihood	1111.499	-306.6476	-69.81946	-385.7033
Akaike AIC	-12.67241	3.628133	0.905971	4.536820
Schwarz SC	-12.50901	3.791532	1.069370	4.700219
Mean dependent	-0.002074	4.168966	0.621379	-6.160126
S.D. dependent	0.001131	2.814439	0.560258	4.830829

Determinant resid covariance (dof adj.)	2.39E-07
Determinant resid covariance	1.93E-07
Log likelihood	357.3769
Akaike information criterion	-3.693988
Schwarz criterion	-3.040390

Source: Author's Survey, 2018

4.8 Diagnostic Tests and Model Checking

There are normally a large number of parameters that are involved in the unrestricted VAR models which usually give rise to imprecise estimators (Diebold, 2018). It is therefore more appropriate to limit the dimensionality of the parameter space by imposing some restrictions (Diebold, 2018). The restrictions may be derived from non-sample information such as economic theory and from statistical procedures.

Therefore, it is vital to observe the stability of the model and confirm whether the residuals stand by the assumptions of the model. Post-estimations tests were conducted for the models so as to confirm the validity and stability of the estimates. The tests and their findings are discussed below.

4.8.1 Stability Test

In chapter three, it was stated that stability is an important feature of the *VAR (p)* – process. Thus, VAR generates stationary time series with time-invariant means, variances and covariance structure. This study tried to analyze the reverse roots of characteristic polynomial by carrying out a VAR stability condition check test as indicated in equation 3.30 in chapter three. The results in Tables 4.8 and 4.9 show that the moduli of the eigenvalues are actually less than one. The stability condition of VAR is confirmed by Figure 4.9 whose results indicate that no root lies outside the unit circle.

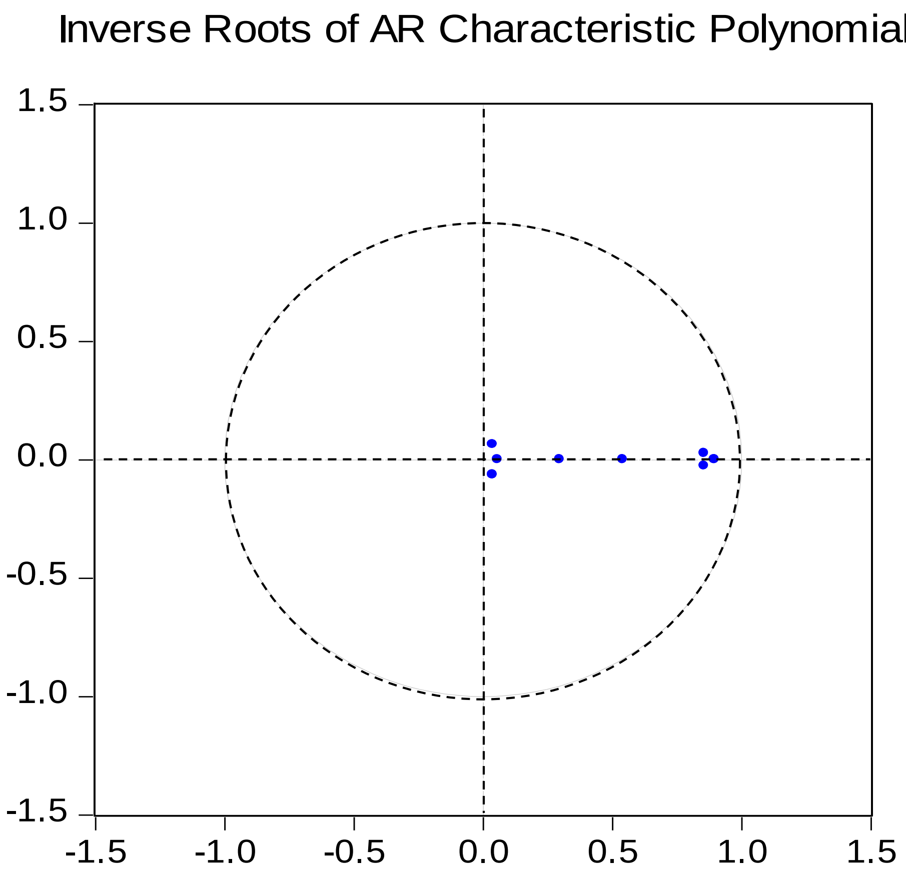

Figure 4. 9: Roots of the Companion Matrix

Source: Author's Survey, 2018

4.8.2 Normality Test

Although the validity of many of the statistical procedures in view of VAR models is not strictly dependent on normality, departure from the normality assumption may give a hint to the improvement of the model. However, it should be noted that normal distribution of errors is vital especially when there is need to make interpretations depending on the estimated econometric equation. This study plotted the residuals for the four models in order to determine whether the residuals are stationary or not. Figure 4.10 indicates that the residuals are indeed stationary (white noise processes) implying that the estimated parameters are valid.

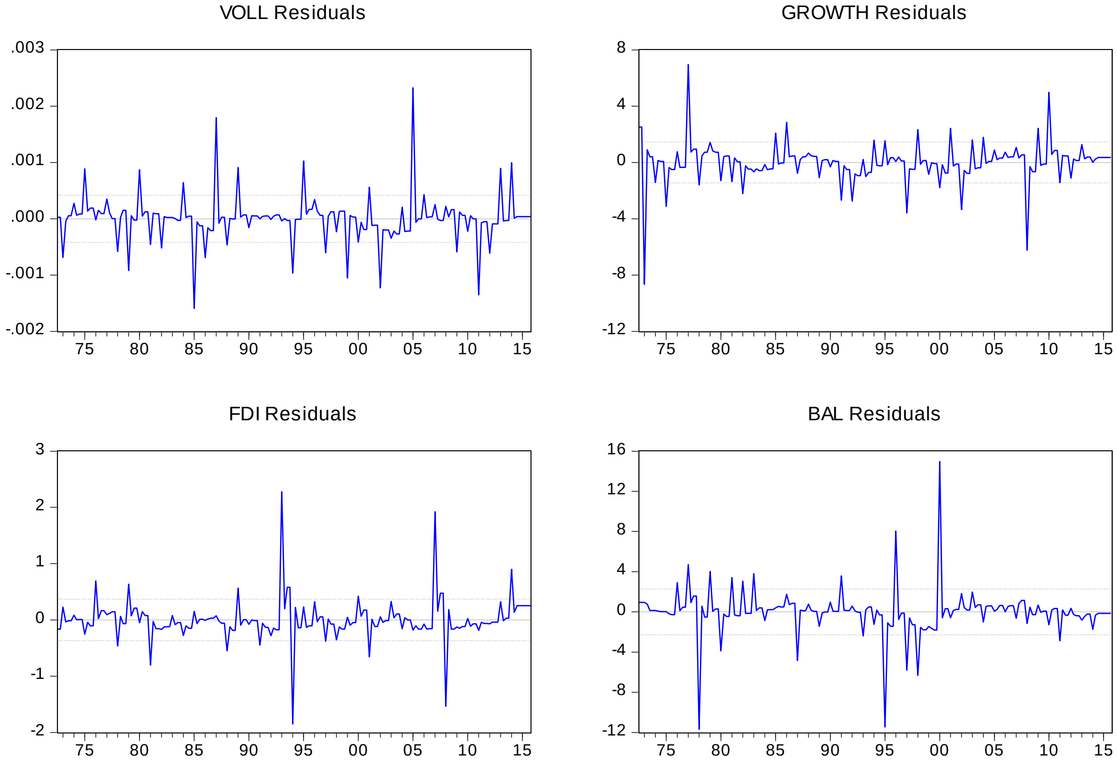

Figure 4. 10: Plot of the Residuals of the VAR Model

Source: Author's Survey, 2018

Having determined that the residuals are indeed stationary from the plots in Figure 4.10, a Jarque-Bera test for normality was also carried out on the residuals of the VAR models. This was meant to confirm the above results. A multivariate version of the Jarque-Bera test was conducted using the residuals that were standardized by a Cholesky Decomposition of the variance-covariance matrix for the centered residuals. The results of the Jarque-Bera test are presented in Table 4.15. The results confirmed that the errors in the models are normally distributed. The p-values were all 0.000 < 0.05.

Table 4. 16: VAR Residual Normality Tests

VAR Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)

Null Hypothesis: residuals are multivariate normal

Sample: 1972Q1 2015Q4

Included observations: 174

Component	Skewness	Chi-sq	Df	Prob.
1	0.901049	23.54478	1	0.0000
2	-0.900753	23.52933	1	0.0000
3	1.370624	54.47970	1	0.0000
4	0.095624	0.265176	1	0.6066
Joint		101.8190	4	0.0000

Component	Kurtosis	Chi-sq	Df	Prob.
1	12.68632	680.2293	1	0.0000
2	15.34596	1105.064	1	0.0000
3	19.82538	2052.428	1	0.0000
4	21.88603	2585.945	1	0.0000
Joint		6423.667	4	0.0000

Component	Jarque-Bera	Df	Prob.
1	703.7741	2	0.0000
2	1128.593	2	0.0000
3	2106.908	2	0.0000
4	2586.211	2	0.0000
Joint	6525.486	8	0.0000

Source: Author’s Survey, 2018

4.8.3 Serial Correlation Test

The Breusch-Godfrey LM (Lagrange-Multiplier) test and Portmanteau Test for Autocorrelations were used to test for the presence of serial correlation in the models. Table 4.16 and 4.17 show the results which confirmed that there was no autocorrelation in the models. The Breusch-Godfrey LM test and Portmanteau Test indicated that there was no residual serial correlation at the stated lag order Q-stat was 0.352242 and 3.9221945 at lag one and two respectively. For the Portmanteau Test the values were 0.862681 and 16.07181 respectively.

Table 4. 17: VAR Residual Serial Correlation LM Test

VAR Residual Portmanteau Tests for Autocorrelations
Null Hypothesis: no residual autocorrelations up to lag h
Sample: 1972Q1 2015Q4
Included observations: 174

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	Df
1	0.352242	NA*	0.354278	NA*	NA*
2	3.921945	NA*	3.965489	NA*	NA*
3	8.541855	0.9311	8.666451	0.9265	16
4	71.00581	0.0001	72.60014	0.0001	32
5	73.24583	0.0109	74.90644	0.0078	48
6	74.64509	0.1707	76.35568	0.1385	64
7	75.49870	0.6216	77.24506	0.5665	80
8	140.1378	0.0022	144.9993	0.0009	96

*The test is valid only for lags larger than the VAR lag order.
df is degrees of freedom for (approximate) chi-square distribution

Source: Author’s, 2018

Table 4. 18: VAR Residual Portmanteau Tests for Autocorrelations

VAR Residual Portmanteau Tests for Autocorrelations

Null Hypothesis: no residual autocorrelations up to lag h

Sample: 1972Q1 2015Q4

Included observations: 174

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	Df
1	0.862681	NA*	0.867667	NA*	NA*
2	16.07181	NA*	16.25364	NA*	NA*
3	30.37709	0.9831	30.80989	0.9804	49
4	308.5471	0.0000	315.5251	0.0000	98
5	317.5812	0.0000	324.8265	0.0000	147
6	332.5945	0.0000	340.3759	0.0000	196
7	340.2910	0.0001	348.3950	0.0000	245
8	614.2207	0.0000	635.5261	0.0000	294

*The test is valid only for lags larger than the VAR lag order.
df is degrees of freedom for (approximate) chi-square distribution

Source: Author's Survey, 2018

4.8.4 Heteroskedasticity Test

Table 4.18 presents the results for the Lagrange-Multiplier (LM) test for heteroskedasticity which also supports the null hypothesis of no heteroskedasticity in the four Models. The p-value was $0.0147 < 0.05$ and $0.0238 < 0.05$.

Table 4. 19: VAR Residual Heteroskedasticity Tests

Joint test:

Chi-sq	Df	Prob.
611.6017	784	1.0000

Individual components:

Dependent	R-squared	F(28,145)	Prob.	Chi-sq(28)	Prob.
res1*res1	0.256709	1.788515	0.0147	44.66740	0.0238
res2*res2	0.156674	0.962081	0.5260	27.26130	0.5041
res3*res3	0.164333	1.018363	0.4490	28.59401	0.4333
res4*res4	0.055982	0.307097	0.9997	9.740801	0.9995
res5*res5	0.109849	0.639062	0.9171	19.11376	0.8946
res6*res6	0.076681	0.430074	0.9946	13.34241	0.9912
res7*res7	0.206792	1.350071	0.1304	35.98180	0.1431
res2*res1	0.132862	0.793455	0.7590	23.11798	0.7271
res3*res1	0.221527	1.473646	0.0740	38.54571	0.0885
res3*res2	0.189198	1.208406	0.2340	32.92051	0.2387
res4*res1	0.118364	0.695246	0.8695	20.59526	0.8418
res4*res2	0.080123	0.451062	0.9921	13.94137	0.9876
res4*res3	0.139008	0.836084	0.7028	24.18736	0.6716
res5*res1	0.154702	0.947753	0.5462	26.91810	0.5227
res5*res2	0.122455	0.722633	0.8419	21.30720	0.8123
res5*res3	0.172432	1.079010	0.3716	30.00324	0.3631
res5*res4	0.102230	0.589687	0.9485	17.78795	0.9314
res6*res1	0.144615	0.875508	0.6484	25.16293	0.6190
res6*res2	0.085146	0.481971	0.9869	14.81536	0.9803
res6*res3	0.187112	1.192011	0.2492	32.55744	0.2524
res6*res4	0.049757	0.271160	0.9999	8.657648	0.9998
res6*res5	0.112510	0.656506	0.9036	19.57678	0.8794
res7*res1	0.177304	1.116062	0.3281	30.85085	0.3237
res7*res2	0.143018	0.864230	0.6641	24.88514	0.6341
res7*res3	0.191372	1.225572	0.2189	33.29868	0.2249
res7*res4	0.156920	0.963875	0.5235	27.30414	0.5017
res7*res5	0.088171	0.500751	0.9828	15.34175	0.9746
res7*res6	0.125592	0.743802	0.8187	21.85298	0.7881

Source: Author’s Survey, 2018

4.8.5 Lag Exclusion Wald Test

At this point, a null hypothesis about the non-significance of a given lag in the model was tested. The Wald statistic and the p-values for the joint significance is reported – separately for each equation and jointly for the entire model for every lag. Table 4.19 presents the results which indicate that all lags are significant p – values were all 0.000 < 0.05.

Table 4. 20: VAR Lag Exclusion Wald Tests

VAR Lag Exclusion Wald Tests

Sample: 1972Q1 2015Q4

Included observations: 174

Chi-squared test statistics for lag exclusion:

Numbers in [ ] are p-values

	REER	GDP	FDI	CAB	Joint
Lag 1	146.5695	124.8061	122.4667	141.9561	536.3433
	[0.000000]	[0.000000]	[0.000000]	[0.000000]	[0.000000]
Lag 2	0.773256	0.886473	4.246142	1.027104	6.738993
	[0.941997]	[0.926493]	[0.373718]	[0.905659]	[0.977970]
Df	4	4	4	4	16

Source: Author's Survey, 2018

4.9 VAR Granger Causality/Block Exogeneity Tests

Granger causality is basically meant to test the relationship between past values of the macroeconomic variables and their current values. The VAR *(1,1)* model was estimated since it satisfies the stability condition and has the optimal lag length as indicated in section 4.7.1.1. The causality tests results are reported in Table 4.20.

The results indicate that the null hypothesis that REER volatility does not Granger cause real GDP growth rate is rejected at 5% significance level, therefore showing that REER volatility Granger caused GDP. However, the effect was not significant (p – value 0.9717 > 0.05). This is in support of Rodrik (2008), Bhalla (2007), Gala (2007) and Gluzemann (2007) who found that the relative price of tradables to non-tradables (the real exchange rate) seems to play a role in the economic growth process.

The hypothesis that REER volatility does not Granger cause FDI inflows was also rejected. It was concluded the REER volatility precedes or Granger caused FDI inflow although the effect was insignificant (p – value = 0.3238 > 0.05). Results further showed that the null hypothesis that REER volatility does not Granger cause real CAB is rejected at 5% significance level, thereby implying that REER volatility Granger caused CAB but in an insignificant manner (p – value = 0.9314 > 0.05). The block Exogeneity test indicated that REER volatility, GDP growth rate and FDI inflows Granger caused CAB.

Theoretical analyses of the relationship between higher exchange-rate volatility and international trade transactions have been conducted by Hooper & Kohlhagen (1978) and some other economists who hold the view that exchange rate volatility is the source of exchange rate risks and has certain implications on the volume of international competitiveness, consequently on the current account balances.

Table 4. 21: VAR Granger Causality/Block Exogeneity Tests

VAR Granger Causality/Block Exogeneity Wald Tests
Sample: 1972Q1 2015Q4
Included observations: 174

Dependent variable: REER

Excluded	Chi-sq	df	Prob.
GDP	0.812433	2	0.6662
FDI	0.461361	2	0.7940
CAB	2.516539	2	0.2841
All	3.692410	6	0.7182

Dependent variable: GDP

Excluded	Chi-sq	df	Prob.
REER	0.057506	2	0.9717
FDI	0.067413	2	0.9669
CAB	0.897012	2	0.6386
All	1.070611	6	0.9828

Dependent variable: FDI

Excluded	Chi-sq	df	Prob.
REER	2.255378	2	0.3238
GDP	0.051097	2	0.9748
CAB	0.333180	2	0.8465
All	2.911793	6	0.8198

Dependent variable: CAB

Excluded	Chi-sq	df	Prob.
REER	0.142213	2	0.9314
GDP	1.798060	2	0.4070
FDI	0.693758	2	0.7069
All	3.273623	6	0.7738

Source: Author’s Survey, 2018

4.8 Interpretation and Discussion of VAR estimates and Test of Hypotheses

4.8.1 Volatility of Real Effective Exchange Rate

The study sought to determine the volatility of real effective exchange rate in Kenya. To achieve this objective, the first hypothesis stated that real effective exchange rate in Kenya has not been volatile. The GARCH model was estimated since it was feasible and has remained the workhorse for estimation of real effective exchange rate volatility.

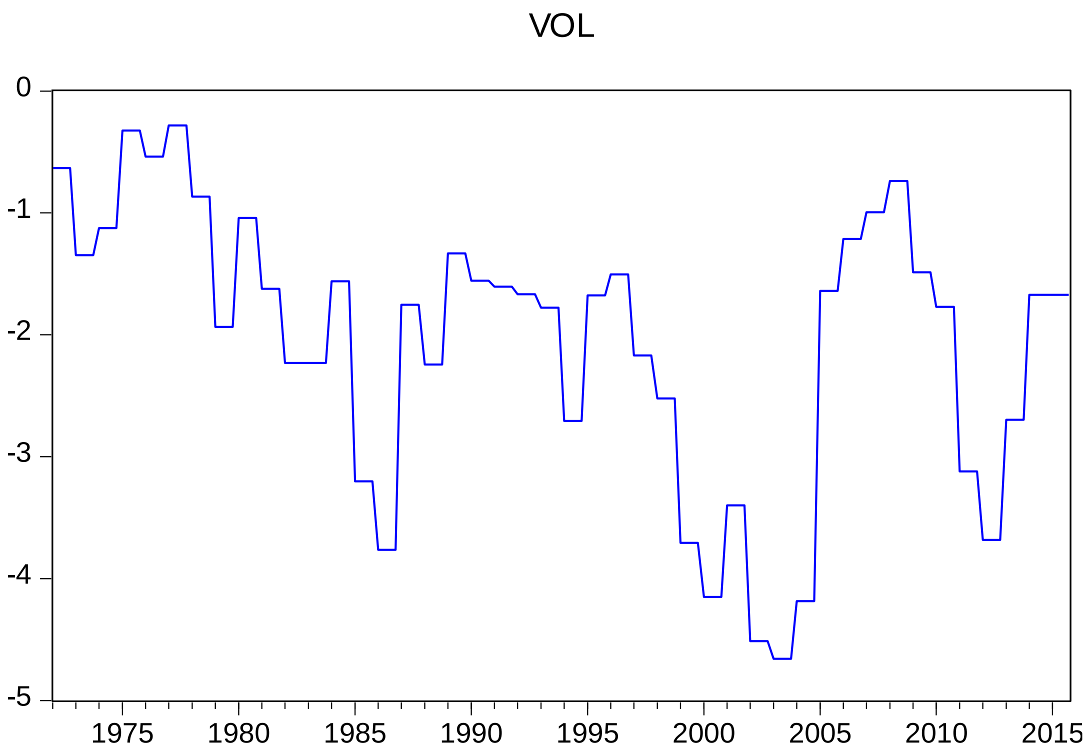

Figure 4. 11: Plot of REER Volatility in Kenya

Source: Author's Survey, 2018

The generalized ARCH (p,q) model – called GARCH(p,,q) – allows for both autoregressive and moving average components in the heteroskedastic variance. If we set p=0 and q=1, it is clear that the first-order ARCH model given by (3.31) is simply a GARCH (1,1) model. Similarly, if all values of β_1 equal zero, the GARCH (p,q) model is equivalent to an ARCH(q) model. The benefits of the GARCH model should be clear; a high-order ARCH model may have a more parsimonious GARCH representation that is much easier to identify and estimate (Enders, 2015). This is particularly true since all coefficients in (3.31) must be positive. Clearly, the more parsimonious model will entail fewer coefficient restrictions. Moreover, to ensure that the variance is finite, all characteristic roots of (3.10) must lie inside a unit cycle and imply that the process is stable (Enders, 2015).

The key feature of GARCH models is that the conditional variance of the disturbance of the (y_t) sequence acts like an ARMA process. Hence, it is to be expected that the residuals from a fitted ARMA model should display this characteristic pattern (Tsay, 2005).

Results of real effective exchange rate are presented in Table 4.21. Results indicated that the GARCH (1,1,1) selected by AIC and BIC model fitted the data very well. R-Square was 0.8642756 indicating that the model explained 86.43 percent of the variations in REER volatility, log likelihood was also a large number 92.34 > 30. The coefficient or the GARCH model was 0.9255271 meaning that for one unit change in the lagged REER volatility the current level of REER volatility was expected to change by 0.9255271. The results reported a p – value of 0.0000 < 0.05 and t – statistic of 32.90 > 1.96. Based on these results, the first null hypothesis that real effective exchange rate in Kenya has not been volatile is rejected. It is concluded that real effective exchange rate in Kenya was volatile (p – value 0.000 < 0.05) within the period under consideration (1972q1 – 2015q4).

Table 4. 22: GARCH Results on Real Effective Exchange Rate

Sample Period				1973q1 - 2015q4
Number of observations				172
Log likelihood				-92.341568
R-squared				.8642756
Adjusted R-squared				.86347722
Root MSE				41635337
Variable	Coef.	Std. Error	t – Value	P> |t|
REER L1	0.9255271	0.0281299	32.90	0.000*
Constant	-0.1612711	0.0666751	-2.42	0.017*
AIC	188.6831			
BIC	194.9781			

Source; Author's Survey, 2018

4.9 Real Effective Exchange Rate Volatility and Selected Macroeconomic Variables

The results of Bivariate VAR Model showed that REER explained 74% of the variations in GDP (Table 4.22). Further, Bivariate VAR Model indicated that REER volatility accounted for 58% of the variations in FDI (Table 4.23). The results also showed that REER volatility explained 78% of the variations in CAB (Table 4.24).

Results of VAR for REER and GDP are presented in Table 4.22. Results of Model 1 that shows economic growth as a dependent variable showed that coefficient of lagged value of economic growth was positive (0.8636) and was significant with a t – statistic of 11.2770 > 1.96 indicating that for a 1 per cent change in the lagged GDP, the current GDP was expected to increase by 0.8636 per cent. In model two, the lagged value of REER was positive and significant indicating that the lagged value of REER had a persistent effect on the current REER and on the current GDP. Based on the results, the second null hypothesis that real effective exchange rate volatility has no impact on economic growth in Kenya is rejected.

Results of bi-variate VAR model indicated that the lagged value of REER (-1) and REER (-2) had an effect on GDP. The first effect was positive and the second was negative and insignificant. The results further documents that when REER (-1) changes by one unit, GDP was expected to increase by 44.44524 units. In the case of REER (-2) a unit increase in REER(-2) was expected to reduce GDP by 74.65220 units. These results conform to the conclusions of multivariate VAR model regression analysis which showed that REER(-1) volatility had a positive effect on GDP growth rate and that REER(-2) had a negative effect on GDP growth rate. Based on these results the second hypothesis that REER volatility had no impact on GDP growth rate was rejected. These Findings are in line with the theory that REER volatility negates economic growth.

Table 4. 23: VAR Results of GDP and REER

Vector Autoregressive Estimates
Sample (adjusted): 1972Q3 2015Q4
Included observations: 174 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	1 GDP	2 REER
GDP(-1)	0.863620	1.09E-06
	(0.07658)	(2.2E-05)
	[11.2770]	[0.04910]
GDP(-2)	-0.049906	8.06E-06
	(0.07325)	(2.1E-05)
	[-0.68131]	[0.37903]
REER(-1)	44.44524	0.955283
	(265.898)	(0.07722)
	[0.16715]	[12.3708]
REER(-2)	-74.65220	-0.036766
	(264.409)	(0.07679)
	[-0.28234]	[-0.47880]
Constant	0.663027	-0.000214
	(0.31189)	(9.1E-05)
	[2.12585]	[-2.35780]
R-squared	0.746234	0.867488
Adj. R-squared	0.740228	0.864352
Sum sq. resids	347.7471	2.93E-05
S.E. equation	1.434460	0.000417
F-statistic	124.2419	276.5894
Log likelihood	-307.1359	1109.955
Akaike AIC	3.587769	-12.70063
Schwarz SC	3.678546	-12.60985
Mean dependent	4.168966	-0.002074
S.D. dependent	2.814439	0.001131
Determinant resid covariance (dof adj.)		3.54E-07
Determinant resid covariance		3.34E-07
Log likelihood		803.6898
Akaike information criterion		-9.122871
Schwarz criterion		-8.941316

Source; Author’s Survey, 2018

Results of VAR for REER and FDI are presented in Table 4.23. Results of Model 1 that has FDI as a dependent variable showed that the coefficients of both lagged values were significant determinants of current FDI. The first lag was positive and significant with coefficient of 0.8489 and t-statistics of 11.1191 > 1.96. The second lagged value, however, was negative and significant. In model 2, the lagged value of REER i.e REER(-1) was positive and insignificant. So to the second lagged value, REER(-2). Results indicate that, if REER(-1) volatility increases by one unit FDI inflows were expected to increase by 26.66405 units, while in the case of REER(-2) a change of one unit was expected to increase FDI inflows by 15.69045 units. These results are also in line with the conclusions of multivariate VAR model regression analysis. Therefore, based on these findings the third null hypothesis that REER volatility has no impact on FDI in Kenya was rejected. These findings support prior studies by Ochieng (2013 and Anyango (2013) but contradicts Muthoga (2009).

Table 4. 24: VAR Results of FDI and REER

Vector Autoregressive Estimates
Sample (adjusted): 1972Q3 2015Q4
Included observations: 174 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	FDI	REER
FDI(-1)	0.848874	2.29E-05
	(0.07634)	(8.7E-05)
	[11.1191]	[0.26409]
FDI(-2)	-0.157450	2.07E-05
	(0.07682)	(8.7E-05)
	[-2.04967]	[0.23695]
REER(-1)	26.66405	0.955814
	(67.9363)	(0.07715)
	[0.39249]	[12.3892]
REER(-2)	15.69045	-0.037426
	(67.5230)	(0.07668)
	[0.23237]	[-0.48808]
Constant	0.283059	-0.000201
	(0.07813)	(8.9E-05)
	[3.62284]	[-2.26657]
R-squared	0.580482	0.867266
Adj. R-squared	0.570552	0.864124
Sum Sq. Resids	22.78105	2.94E-05
S.E. equation	0.367150	0.000417
F-statistic	58.46072	276.0552
Log likelihood	-70.01333	1109.809
Akaike AIC	0.862222	-12.69895
Schwarz SC	0.953000	-12.60818
Mean dependent	0.621379	-0.002074
S.D. dependent	0.560258	0.001131
Determinant resid covariance (dof adj.)		2.32E-08
Determinant resid covariance		2.19E-08
Log likelihood		1040.578
Akaike information criterion		-11.84572
Schwarz criterion		-11.66417

Source; Author’s Survey, 2018

Results of VAR for REER and CAB are presented in Table 4.24. Results of Model 1 that has CAB as a dependent variable showed that coefficient of lagged value of CAB was positive (0.9387) and was significant with a t – statistic of 11.9912 > 1.96. Also in model 2 with REER as a dependent variable, the results showed that REER (-1) volatility had positive and insignificant effect on CAB. It indicated that when REER (-1) volatility changes by one unit then CAB was expected to increase by 0.056066 units. In the case of REER (-2), results were negative and insignificant. It also showed that if REER (-2) volatility increases by one unit CAB was expected to deteriorate by -0.181993 units. These results conform to the conclusions of multivariate VAR model regression analysis. Based on these results, the fourth null hypothesis that REER volatility had no impact on CAB in Kenya was rejected. These results support prior results by McKenzie and Brooks (1997).

Table 4. 25: VAR Results of CAB and REER

Vector Autoregressive Estimates
Sample (adjusted): 1972Q3 2015Q4
Included observations: 174 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	1 CAB	2 REER
CAB(-1)	0.938726	0.002223
	(0.07828)	(0.01429)
	[11.9912]	[0.15550]
CAB(-2)	-0.064091	0.008361
	(0.07882)	(0.01439)
	[-0.81312]	[0.58103]
REER(-1)	0.056066	0.948668
	(0.42902)	(0.07833)
	[0.13068]	[12.1116]
REER(-2)	-0.181993	-0.018990
	(0.42664)	(0.07789)
	[-0.42657]	[-0.24380]
Constant	-0.001049	-8.65E-05
	(0.00045)	(8.2E-05)
	[-2.32621]	[-1.05012]
R-squared	0.784221	0.868805
Adj. R-squared	0.779114	0.865700
Sum sq. residuals	0.000871	2.90E-05
S.E. equation	0.002270	0.000415
F-statistic	153.5524	279.7901
Log likelihood	814.9170	1110.824
Akaike AIC	-9.309391	-12.71062
Schwarz SC	-9.218614	-12.61984
Mean dependent	-0.006160	-0.002074
S.D. dependent	0.004831	0.001131
Determinant resid covariance (dof adj.)		8.52E-13
Determinant resid covariance		8.04E-13
Log likelihood		1929.109
Akaike information criterion		-22.05872
Schwarz criterion		-21.87717

Source; Author’s Survey, 2018

4.10 Variance Decomposition

Variance decomposition shows the contribution of each shock to the n-period-ahead forecast error of the variable. It typically shows the proportion of the forecast error variance which can be attributed to its own shocks and the innovations that emanate from other variables in the model. The results of variance decomposition for real effective exchange rate are reported in Table 4.25.

From the results it is seen that REER is 100 per cent explained by its own innovations in the first period, but its explanatory power declines over time to 93.7 per cent during the 10-th period. It is also clear that the decline is persistent and reduces marginally. Real effective exchange rate is explained by innovations of GDP growth rate, FDI inflow and CAB in the proportion of approximate mean of 0.42%, 0.67% and 1.70% for each series respectively, that is, economic growth rate, foreign direct investment inflow and current account balances have a significantly weak influence over the ten period time horizon.

Table 4. 26: Variance Decomposition of REER

		Variance Decomposition of REER:			
Period	S.E.	REER	GDP	FDI	CAB
1	0.000418	100.0000	0.000000	0.000000	0.000000
2	0.000574	99.94756	0.000227	0.037482	0.014736
3	0.000678	99.54139	0.053117	0.196251	0.209242
4	0.000756	98.80389	0.180308	0.422707	0.593099
5	0.000817	97.89138	0.339281	0.647568	1.121766
6	0.000866	96.91193	0.497266	0.837670	1.753131
7	0.000907	95.92543	0.637031	0.985802	2.451736
8	0.000940	94.96360	0.751859	1.096083	3.188456
9	0.000968	94.04353	0.840991	1.175852	3.939628
10	0.000991	93.17470	0.906686	1.232304	4.686305

Source: Author’s Survey, 2018

From Table 4.26, since economic growth is largely determined by its own values (99.15 per cent in the first period – 98.03 per cent during the 10-th period), there is an indication that there is persistence in the rate of economic growth which also explains the structural conditions of the Kenyan economy. Through the variance decomposition, there is a noticeable very weak contribution of the REER, FDI and CAB shocks on GDP. This contribution is approximately less than 1% both in the short and in the long term since the economic growth does not last long.

Table 4. 27: Variance Decomposition of GDP

		Variance Decomposition of GDP:			
Period	S.E.	REER	GDP	FDI	CAB
1	1.447675	0.853864	99.14614	0.000000	0.000000
2	1.910411	0.903234	99.05828	0.016907	0.021576
3	2.158806	0.846059	99.09682	0.029970	0.027146
4	2.305452	0.783887	99.07851	0.037141	0.100464
5	2.395480	0.734250	98.98702	0.039981	0.238751
6	2.451883	0.700915	98.83733	0.040373	0.421381
7	2.487697	0.683714	98.64985	0.039763	0.626678
8	2.510697	0.680805	98.44381	0.039055	0.836329
9	2.525644	0.689608	98.23497	0.038710	1.036710
10	2.535493	0.707338	98.03486	0.038892	1.218907

Source: Author's Survey, 2018

The results of variance decomposition for foreign direct investment inflow as a percentage of GDP are indicated in Table 4.27. The results reveal that FDI is 97.19 per cent explained by its own innovations in the first period which then declines to 91.42 percent during the 10-th period. Whereas REER accounts for approximately 5% of FDI, GDP and CAB have a significantly weak explanatory power of less than 2%.

Table 4. 28: Variance Decomposition of FDI (% of GDP)

		Variance Decomposition of FDI:			
Period	S.E.	REER	GDP	FDI	CAB
1	0.371160	1.029398	1.779001	97.19160	0.000000
2	0.487491	1.449577	1.997437	96.54956	0.003424
3	0.531932	2.104925	2.033693	95.82340	0.037978
4	0.549373	2.857770	2.024966	95.01891	0.098358
5	0.557148	3.612344	2.012991	94.21448	0.160180
6	0.561379	4.312727	2.005279	93.47470	0.207298
7	0.564156	4.934746	2.002110	92.82736	0.235784
8	0.566215	5.473115	2.002981	92.27493	0.248979
9	0.567843	5.931787	2.007215	91.80840	0.252599
10	0.569173	6.318524	2.013897	91.41555	0.252028

Source: Author's Survey, 2018

Finally, the results of variance decomposition for current account balance as a percentage of GDP are reported in Table 4.28. The results indicate that CAB is 94.61 per cent explained by its own innovations in the first period and this explanatory power declines to 91.67 per cent during the 10-th period. The CAB is approximately 4% explained by REER, but GDP and FDI have a significantly weak explanatory power of less than 2% over the 10-period time horizon.

Table 4. 29: Variance Decomposition of Current Account Balance (% of GDP)

Variance Decomposition of CAB:					
Period	S.E.	REER	GDP	FDI	CAB
1	2.280289	3.476403	0.136174	1.781017	94.60641
2	3.105457	3.179473	0.083492	1.512640	95.22439
3	3.606576	3.271382	0.139623	1.196047	95.39295
4	3.948105	3.471639	0.368530	0.998098	95.16173
5	4.193380	3.705961	0.711751	0.901430	94.68086
6	4.374212	3.947921	1.110618	0.864106	94.07736
7	4.509374	4.185185	1.523231	0.856835	93.43475
8	4.611121	4.411003	1.922775	0.863310	92.80291
9	4.687972	4.621488	2.293394	0.875233	92.20989
10	4.746090	4.814509	2.626741	0.888582	91.67017
Cholesky Ordering: REER GDP FDI CAB					

Source: Author's Survey, 2018

4.11 Impulse Response Functions

These impulses are derived using a recursive VAR model, in which Cholesky one-standard deviation shocks are applied and the response is estimated over a period of ten years following the initial occurrence of the shocks. The impulse response function of VAR is to analyze dynamic effects of the system when the model received the impulse. In our four dimensional VAR (2) model, the study worked out the response between these variables. Results of the impulse response analysis are presented in Tables 4.29 – 4.32 and Figure 4.12 which illustrates the response of real effective exchange rate volatility to one standard deviation innovation in each of the macroeconomic performance indicators and also the response macroeconomic performance indicators to one standard deviation innovation in real effective exchange rate volatility and one standard deviation innovation in each of the other macroeconomic variables.

Table 4. 30: Results of Impulse Response of GDP

	Accumulated Response of GDP:			
Period	GDP	FDI	CAB	REER
1	0.001546	0.000000	0.000000	0.000000
2	0.003051	0.000100	8.33E-06	-3.04E-05
3	0.004524	0.000280	2.31E-05	-8.50E-05
4	0.005996	0.000613	7.93E-05	-0.000172
5	0.007473	0.001052	0.000167	-0.000281
6	0.008958	0.001561	0.000278	-0.000403
7	0.010451	0.002103	0.000400	-0.000530
8	0.011948	0.002653	0.000528	-0.000658
9	0.013447	0.003199	0.000655	-0.000784
10	0.014948	0.003737	0.000781	-0.000909

Source: Author’s Survey, 2018

Table 4. 31: Results of Impulse Response of FDI

	Accumulated Response of FDI:			
Period	GDP	FDI	CAB	REER
1	7.75E-05	0.000366	0.000000	0.000000
2	0.000177	0.000675	-5.15E-06	1.70E-05
3	0.000293	0.000939	-1.44E-05	4.74E-05
4	0.000410	0.001115	-4.74E-05	9.68E-05
5	0.000525	0.001229	-9.85E-05	0.000159
6	0.000634	0.001303	-0.000163	0.000228
7	0.000740	0.001357	-0.000235	0.000301
8	0.000843	0.001407	-0.000309	0.000374
9	0.000944	0.001458	-0.000384	0.000446
10	0.001045	0.001515	-0.000457	0.000517

Source: Author’s Survey, 2018

Table 4. 32: Results of Impulse Response of CAB

	Accumulated Response of CAB:			
Period	GDP	FDI	CAB	REER
1	0.000129	0.000257	0.002363	0.000000
2	0.000284	0.000442	0.004720	2.09E-05
3	0.000459	0.000572	0.007070	5.84E-05
4	0.000635	0.000590	0.009391	0.000120
5	0.000808	0.000530	0.011689	0.000197
6	0.000975	0.000418	0.013970	0.000284
7	0.001137	0.000282	0.016242	0.000375
8	0.001295	0.000139	0.018510	0.000466
9	0.001451	-7.84E-07	0.020778	0.000557
10	0.001607	-0.000135	0.023048	0.000646

Source: Author's Survey, 2018

Table 4. 33: Results of Impulse Response of REER

	Accumulated Response of REER:			
Period	GDP	FDI	CAB	REER
1	3.17E-05	4.52E-05	-9.33E-05	0.000418
2	5.67E-05	0.000107	-0.000185	0.000830
3	7.66E-05	0.000183	-0.000276	0.001238
4	9.62E-05	0.000285	-0.000360	0.001641
5	0.000117	0.000404	-0.000438	0.002041
6	0.000139	0.000536	-0.000512	0.002437
7	0.000162	0.000673	-0.000584	0.002834
8	0.000186	0.000812	-0.000656	0.003229
9	0.000210	0.000951	-0.000727	0.003626
10	0.000234	0.001087	-0.000799	0.004022

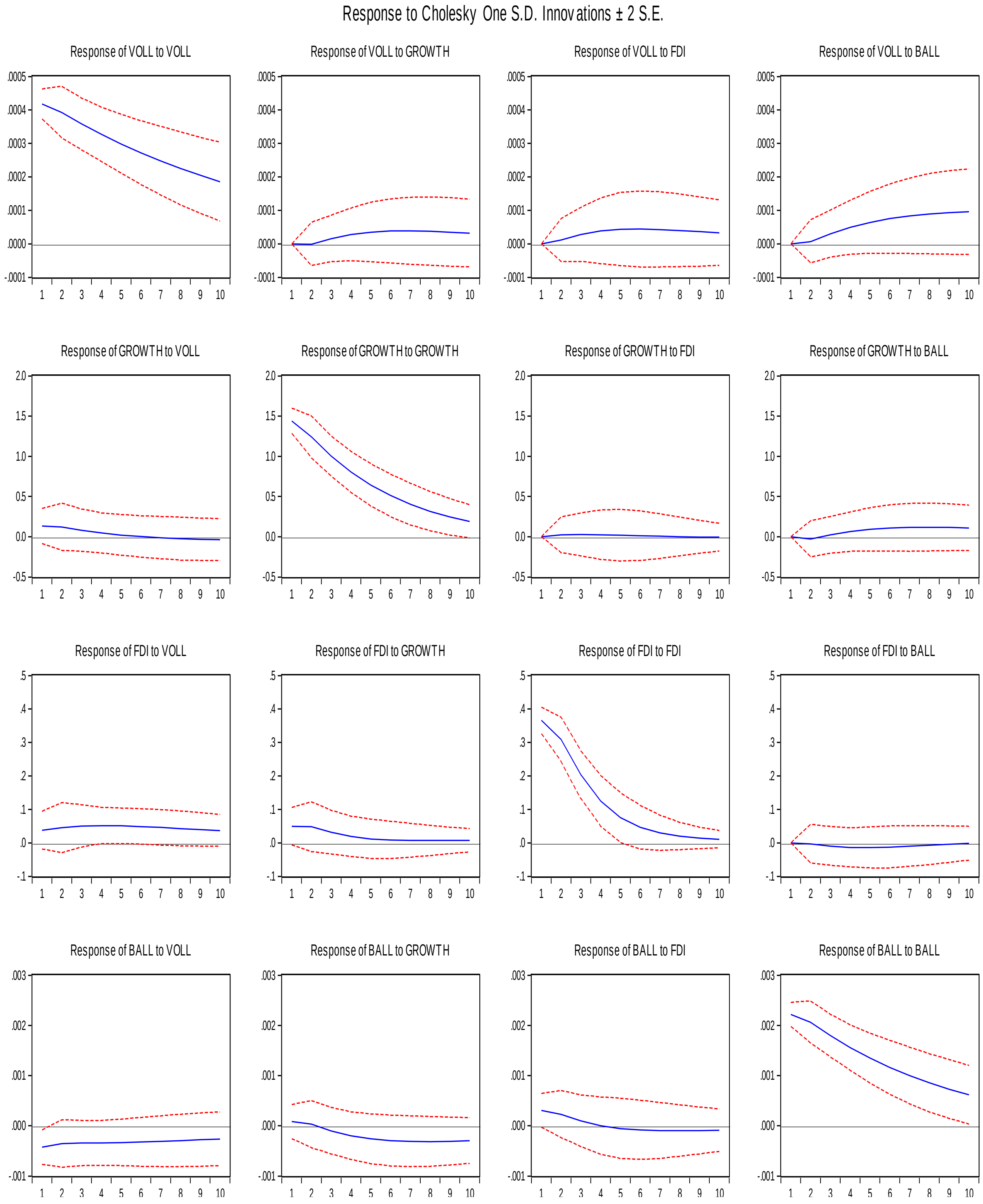

Figure 4. 12: Impulse Response Functions

Source: Author's Survey, 2018

4.12 Interpretation and Discussion of Impulse Response Results

Response of REER Volatility to REER Volatility: Panel 1 of Figure 4.12 indicates the reaction of REER volatility due to one standard deviation of unanticipated positive shock to itself – a steady decline in Kenya's REER volatility. The dashed line shows that the positive shock to REER volatility is transmitted almost completely to REER itself. There is a revelation of a persistently sharp decline in REER volatility. Asymptotically, it will converge to the equilibrium in the long run.

The study also sought to investigate the response of the other macroeconomic variables (GDP, FDI and CAB) to a shock on REER. The results are reported in Panels 5 – 16 of Figure 4.12 showing a great impact on the series. The time paths of the response coefficients do not generally converge to zero. This implies that a positive shock from the REER volatility generates an immediate significant impact on the macroeconomic variables under study. This reveals that REER volatility showed a negligible transitory shock to the macroeconomic variables in Kenya.

Response of REER Volatility to GDP and FDI: Panel 2 and 3 of Figure 4.12 shows the reaction of REER volatility due to one standard deviation of unanticipated shock to GDP and FDI. The dashed lines in the two panels become parallel to equilibrium after the 2nd year and into the long run. This verifies the stability of the model.

Response of REER Volatility to CAB: Initially, REER volatility was at equilibrium, and then started rising gently in response to the exogenous shock of CAB. It continues rising gently into the long run as revealed by Panel 4 of Figure 4.12. The shock dies after four quarters. `

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of findings contained in the thesis. First, there is a summary of the main findings of the study; secondly, based on the summarized findings, conclusions are drawn. Thirdly, based on the summarized findings and conclusions, recommendations are then outlined and suggestions for further research is hinted.

5.2 Summary of Findings

This study examined the real effective exchange rate volatility and its impact on macroeconomic performance proxied by GDP, FDI and CAB in Kenya between 1972Q1 and 2015Q4. This was achieved by estimating the GARCH Model to determine exchange rate volatility, VAR model, Granger causality, block Exogeneity test, Johansen-Juselius maximum likelihood cointegration approach, variance decomposition and Impulse response functions to investigate the possible impact of REER volatility on some selected macro-economic performance indicators.

The results of the unit root tests indicate that all the variables were integrated of order one $I(1)$. The test for volatility conducted using the GARCH model showed that there is persistent volatility in the Kenyan shilling's real effective exchange rate with that of the trading partners' currencies for the period under consideration. This result is in consonance with the findings of Nsofor (2017), Bala and Asemota (2013), Musyoki *et al.,* (2012), and Otieno (2014). Therefore, the real effective exchange rate in Kenya has been volatile during the study period.

The results of VAR model indicated a positive and insignificant effect of real effective exchange rate volatility on GDP growth rate in Kenya. This result contradicted the findings of Musyoki *et al.,* (2012), Doukas *et al,.* (2003), Kiyota and Urata (2004), Bala and Asemota (2013), Ping HUA (2011) and Nsofor (2017) who also found persistence volatility in exchange rate with negative and significant coefficient on economic growth rate.

The findings of the study also reveal a positive, yet insignificant impact of real effective exchange rate volatility on foreign direct investment in Kenya for the period under study. These results are in support of the findings of Dhakal (2010) who found that exchange rate volatility has a favorable effect on foreign direct investment in East Asian Countries. However, these results contradict the findings of Jayasekara (2013) who found that exchange rate volatility has a negative effect on foreign direct investment in Sri Lanka.

It also emerged that real effective exchange rate volatility has a positive and insignificant impact on current account balances for the period under consideration. These results disagree with Lee & Saucier (2007); Were, *et al*., (2002); Kiptui (2007); and Chege, *et al.,* (2011) who found a negative relationship between exchange rate volatility and trade in Asia and Kenya respectively.

Results indicate that, real exchange rate volatility insignificantly affected GDP growth rate, FDI inflows and CAB at 5 percent level of significance. Results of the cointegration analysis using Johansen test found the trace statistic for both models to be larger than the critical, with a maximum rank of zero (0). This implied that cointegration was not present and that there were no cointegrated equations, in ether bi-directional or uni-directional relationship.

This meant that the dependent and independent variables did not move closely to achieve equilibrium in the long-run among the variables of imports and exports models. Results further showed that increased exchange rate volatility (uncertainty) has adverse effects in the long-run on macroeconomic performance. The results further show that, long-run parameter estimates of the models are consistent with economic theory.

In an earlier study Musyoki, Pokhariyal and Pundo (2012) found that RER was very volatility for the entire study period in Kenya. They also found that Kenya's REER generally exhibited an appreciating and volatile trend, implying that in general, the country's international competitiveness deteriorated over the study period. Further the results of this study agree with their finding that the RER Volatility reflected a negative impact on economic growth of Kenya.

5.3 Conclusions

As articulated by Thapa (2002), exchange rate is one of the important candidates for conduct of prudent intermediate monetary policy target and its selection presupposes the investigation of empirical relationship between the REER and the macroeconomic activities. A priori relationship between the REER and macroeconomic activities is considered to be strong for a small open economy such as Kenya.

The conclusion drawn from the results of this study is that despite the adoption and implementation of a liberalized exchange rate regime in Kenya, success has not been achieved as expected in restoring equilibrium in the REER, CAB, FDI inflows and moderate and maintains a steady GDP growth rate. The results indicated that Kenya has experienced more pronounced episodes of REER volatility, implying deterioration in the country's international competitiveness. This is in line with the findings of Kiptoo (2009) for the case of most COMESA countries.

From the findings it is also concluded that real effective exchange rate was volatile throughout the sampled period. Lagged values of economic growth, current account balance, foreign direct investment, current real effective exchange rate and lagged values of real effective exchange rate volatility affected current values of economic growth, foreign direct investment inflows and current account balances hence macroeconomic performance in Kenya during the study period.

5.4 Policy Implications

The findings of this study exhibit some important implications for policymakers in Kenya and other developing countries of similar characteristics and stage of development. The findings indicate that REER volatility is a persistent feature of the Kenyan economy and that policy interventions are useful in addressing or containing the adverse shocks to the economy from REER volatility.

The findings of the volatile REER imply that, regular and persistent REER volatility may trigger financial crisis in the long run. In other words, the REER volatility path may be used as an indicator to predict financial crises and international competitiveness. Therefore, the policy implication arising from this analysis is that Kenya should implement policy measures to correct her unsustainable external imbalances in the long run as to the country’s economic growth rate.

There is need to apply the appropriate macroeconomic policy mix in the short run to mitigate the cyclical and short-term shocks that arise from REER volatility. However, to ensure that there is external stability in the long run, policies regarding structural improvement, such as export competitiveness enhancement, second stage import substitution and research and development, should be undertaken.

The key policy implication of the findings about the REER volatility is that prudent management of the exchange rate policy must be pursued. This will help reduce the exchange rate volatility associated with major trading partners. There is need to focus on the terms of trade in order to have a more significant positive impact on the current account balances. On the other hand, inflation should be contained to levels that are productive without adversely affecting the economic growth rate and current account balances.

5.5 Recommendations

In light of these results, it is recommended that Kenya should maintain its market determined exchange rate and implement a monetary policy aimed at confining inflation to levels that are at par or lower than those of Kenya's trading partners. It should also undertake further macroeconomic, institutional and structural reforms as well as export promotion and diversification in order to reduce the adverse effect of REER volatility and thus improve its international competitiveness hence improving on the current account balances and attract foreign direct investment. In particular, the following recommendations are made based on the results obtained in this study:

Enhance an entrenched macroeconomic stability in the country through the pursuit of appropriate monetary and fiscal policies. Given that a country's exchange rate policy is one of the components of the overall economic policy, its effectiveness will, in many ways, depend on the efficiency of the macroeconomic policy environment. The government and monetary authorities should design policies and programs that will enhance the stability of a shilling in relation to other currencies especially that of the US Dollars, the Euro and the Sterling Pound. The Kenya government and the Central Bank of Kenya in particular should therefore endeavor to pursue relevant monetary and fiscal policies to attain and maintain low and stable single-digit inflation rate, which promotes export competitiveness.

Public expenditure should be reduced so as to mitigate domestic borrowing which has tended to put an upward pressure on the level of interest rates and caused REER volatility. Other measures include addressing structural factors within the banking system, such as reducing their operational costs, which caused an upsurge in interest rates.

Pursue export diversification strategy as a deliberate growth strategy to enable the economy to insulate itself from the sharp and unexpected changes in terms of trade and, by extension, stabilize domestic incomes and employment. This would entail devising strategies to facilitate diversification of the country’s export base in order to avoid a situation in which when one major export commodity experiences sharp decline in prices, and then the country's terms of trade significantly change, leading to a further significant REER volatility shocks. Similarly, efforts should be made to implement most of the government’s laudable programs like economic diversification, away from Agriculture and Tourism, so as to stimulate Kenya’s domestic economy.

Creation of a conducive investment environment which would attract foreign direct investments (FDI) inflows through medium term policy measures**:** FDI is a more effective means of dealing with short-term capital and financial inflows. Such policy measures would ameliorate the extent of REER appreciation. It would also limit sudden and often wider REER volatility during periods of instability in Kenya whose foreign exchange markets are characterized by capital and financial flows that are usually of short-term nature;

The government should regulate international trade to control current account balances. This is because current account deficits had negative effect on economic growth. This may be done by the use of tariffs and promotion of export and contraction of imports, thereby improving current account balances.

5.6 Contribution of the study

The study makes some important contributions to both theory and practice of macroeconomics. It is particularly a significant response to calls by researchers for studies focusing on macro econometrics and international competitiveness. Specific contributions are as outlined in the following sections.

5.6.1 Contribution of the study to economic theory

The findings of this study would be of importance to the academicians since it contributes to knowledge by empirically testing the economic theories that relate to the REER volatility in the developing world by using a more robust econometric methodology, thereby contributing to the existing literature. The study employed GARCH which is a robust measure of uncertainty and VAR model which is the workhorse of modern time series analysis that often yield reliable results. The study confirms the Dornbusch’s influential Overshooting Model that aims to explain why floating exchange rates have high variances. The study appears to be among the first in-depth country analysis for Kenya using the REER volatility – macroeconomic performance nexus.

5.6.2 Contribution of the study to policy maker

The REER volatility and its impact on macroeconomic performance are of importance to the public and policy makers in trying to curb the macroeconomic imbalances and in detecting a country's level of international competitiveness. This would further enable the country to use the appropriate policy mix in trying to control the exchange rate fluctuations in order to avoid macroeconomic imbalances.

Additionally, a better understanding of the behavior of the exchange rate may assist policy makers in assessing whether policies aimed at attaining domestic economic objectives are compatible with a sustainable external position. Results from this study therefore provide critical inputs to the formulation of a policy framework that would assist in reducing the impact of exchange rate shocks to an economy.

Based on the findings above, a number of policy implications can be drawn in view of the relationship between exchange rate volatility and macroeconomic performance in Kenya. First and foremost, reducing exchange rate volatility is quite crucial to mitigate its impact on FDI inflows, output growth and current account balances deficits. A lot more attention should be paid to factors that stimulate exchange rate fluctuations like high inflation and budget deficit. Thus, policymakers should consider adopting inflation targeting as a strategy in addition to the autonomy of the monetary policy. Furthermore, authorities should try to avoid systematic currency devaluations in order to maintain the exchange rate volatility at a rate that allows adjustment of the current account balances in particular and the balance of payments in general.

The economy requires an effective exchange rate policy in order to prevent the unfavorable impact of declining foreign reserves. Therefore, an encouraging exchange rate should be offered for foreign transactions and transfers to attract inflows of foreign capital such as foreign direct investment inflow and migrants' remittances. In addition, diversification of the economy should be considered as a top priority within the development agenda. In this respect, managing a competitive exchange rate would be a crucial tool to further enhance macroeconomic performance. Moreover, trade cooperation with neighboring countries in the region like the East African Community (EAC) would be helpful in increasing foreign earnings, particularly in the short run.

5.7 Limitations of the Study

In conducting this study, a number of difficulties were encountered. The most pressing challenge was that of data inconsistency from various sources. Macroeconomic data were obtained from different sources which give varying values for a given macro-variable. This means that the same variables for the model may give different results when sources of data are different. Although the reliability of data cannot be guaranteed, results are valid for any analytical purposes, in the best of circumstances.

5.8 Suggestions for Further Research

Drawing from the scope and limitations of the current study, the following areas are suggested for further studies;

First, similar study should be done by using panel data techniques to cover many countries such as the regional economic trading blocks, for instance, to cover COMESA countries or even the Sub Saharan African countries.

Second, another study could be conducted by trying to capture other variables that in theory ought to influence macroeconomic performance.

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APPENDICES

APPENDIX 1: DEFINITIONS AND SOURCES OF DATA TO BE USED IN THE STUDY

Variable	Definition	Source
EV	Is the real effective exchange rate volatility measured by the ARCH model. The data on REER was obtained from the CBK which was calculated using the following formula: $REER_t = \frac{\sum^{q}_{t=1} w_{it} e_{it} p_{it}}{p_t}$ Where **w_{it}** is the trade weight corresponding to each trading partner; **e_{it}** is the real bilateral exchange rate; **p_{it}** is the foreign price index calculated as the weighted CPI index; **p_t** is domestic CPI for Kenya. The main trade partners of Kenya.	CBK and IMF
GDP	Annual real GDP growth rate	Kenya Bureau of statistics
FDI	Foreign Direct investment measured as a ratio of FDI inflow to GDP	IMF,UNCTAD and Kenya Bureau of Statistics
CA	The ratio of current account balance to GDP	CBK

APPENDIX 2: DATA USED IN THE STUDY

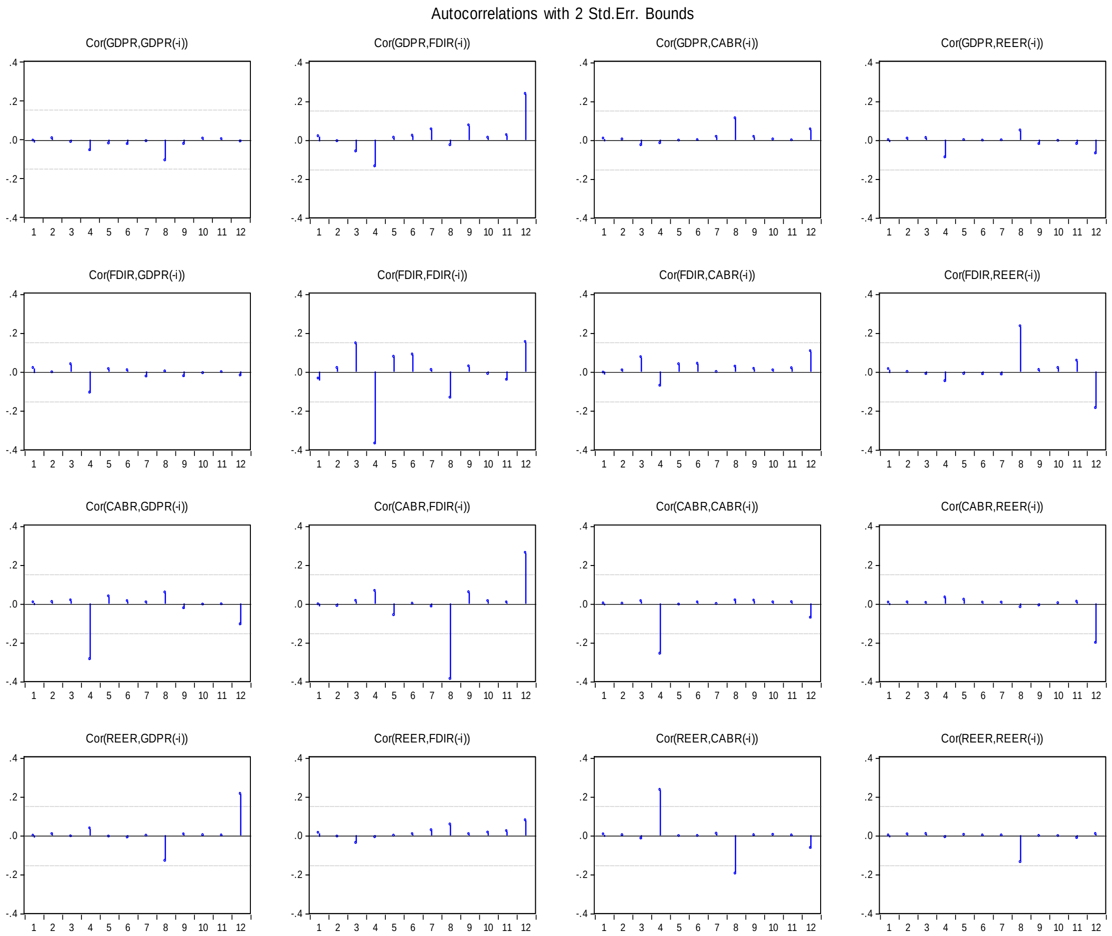
QUARTER	CAB	FDI	GDP	REER
1972q1	-6.593	0.3	17.08	103.1179
1972q2	-6.593	0.3	17.08	102.9186
1972q3	-6.593	0.3	17.08	102.7654
1972q4	-6.593	0.3	17.08	102.6581
1973q1	-6.593	0.69	5.9	102.5969
1973q2	-6.593	0.69	5.9	102.5816
1973q3	-6.593	0.69	5.9	102.6124
1973q4	-6.593	0.69	5.9	102.6891
1974q1	-6.593	0.79	4.07	102.8505
1974q2	-6.593	0.79	4.07	103.0038
1974q3	-6.593	0.79	4.07	103.1877
1974q4	-6.593	0.79	4.07	103.4021
1975q1	-6.593	0.53	0.88	104.183
1975q2	-6.593	0.53	0.88	104.2442
1975q3	-6.593	0.53	0.88	104.1216
1975q4	-6.593	0.53	0.88	103.8152
1976q1	-3.411	1.33	2.15	103.1625
1976q2	-3.411	1.33	2.15	102.5534
1976q3	-3.411	1.33	2.15	101.8254
1976q4	-3.411	1.33	2.15	100.9786
1977q1	0.817	1.26	9.45	95.13534
1977q2	0.817	1.26	9.45	96.00181
1977q3	0.817	1.26	9.45	98.70043
1977q4	0.817	1.26	9.45	103.2312
1978q1	-12.43	0.65	6.91	117.9072
1978q2	-12.43	0.65	6.91	122.7771
1978q3	-12.43	0.65	6.91	126.1539
1978q4	-12.43	0.65	6.91	128.0377
1979q1	-7.904	1.35	7.62	126.6095
1979q2	-7.904	1.35	7.62	126.2348
1979q3	-7.904	1.35	7.62	125.0947
1979q4	-7.904	1.35	7.62	123.1891
1980q1	-12.061	1.09	5.59	117.7576
1980q2	-12.061	1.09	5.59	115.4254
1980q3	-12.061	1.09	5.59	113.4319
1980q4	-12.061	1.09	5.59	111.7771
1981q1	-8.193	0.21	3.77	111.2574
1981q2	-8.193	0.21	3.77	109.9616
1981q3	-8.193	0.21	3.77	108.6861
1981q4	-8.193	0.21	3.77	107.4309
1982q1	-4.747	0.2	1.51	106.1959
1982q2	-4.747	0.2	1.51	104.9811

1982q3	-4.747	0.2	1.51	103.7866
1982q4	-4.747	0.2	1.51	102.6124
1983q1	-0.79	0.4	1.31	102.0562
1983q2	-0.79	0.4	1.31	100.8624
1983q3	-0.79	0.4	1.31	99.92809
1983q4	-0.79	0.4	1.31	99.25336
1984q1	-2.049	0.17	1.76	98.83816
1984q2	-2.049	0.17	1.76	98.68249
1984q3	-2.049	0.17	1.76	98.78637
1984q4	-2.049	0.17	1.76	99.14978
1985q1	-1.875	0.47	4.3	100.2475
1985q2	-1.875	0.47	4.3	100.9401
1985q3	-1.875	0.47	4.3	101.7023
1985q4	-1.875	0.47	4.3	102.5342
1986q1	-0.621	0.45	7.18	103.9771
1986q2	-0.621	0.45	7.18	104.7317
1986q3	-0.621	0.45	7.18	105.3393
1986q4	-0.621	0.45	7.18	105.8
1987q1	-6.299	0.49	5.94	106.3098
1987q2	-6.299	0.49	5.94	106.3982
1987q3	-6.299	0.49	5.94	106.2612
1987q4	-6.299	0.49	5.94	105.8988
1988q1	-5.641	0	6.2	104.7304
1988q2	-5.641	0	6.2	104.1496
1988q3	-5.641	0	6.2	103.5756
1988q4	-5.641	0	6.2	103.0084
1989q1	-7.128	0.75	4.69	101.5623
1989q2	-7.128	0.75	4.69	101.3633
1989q3	-7.128	0.75	4.69	101.5255
1989q4	-7.128	0.75	4.69	102.049
1990q1	-6.149	0.67	4.19	104.9783
1990q2	-6.149	0.67	4.19	105.4065
1990q3	-6.149	0.67	4.19	105.3781
1990q4	-6.149	0.67	4.19	104.8932
1991q1	-2.617	0.23	1.44	103.9517
1991q2	-2.617	0.23	1.44	102.5536
1991q3	-2.617	0.23	1.44	100.699
1991q4	-2.617	0.23	1.44	98.38778
1992q1	-2.195	0.08	-0.8	102.197
1992q2	-2.195	0.08	-0.8	102.7555
1992q3	-2.195	0.08	-0.8	103.2253
1992q4	-2.195	0.08	-0.8	103.6063
1993q1	-4.553	2.53	0.35	103.8985
1993q2	-4.553	2.53	0.35	104.102
1993q3	-4.553	2.53	0.35	104.2168

1993q4	-4.553	2.53	0.35	104.2428
1994q1	-6.28	0.1	2.63	103.4892
1994q2	-6.28	0.1	2.63	103.614
1994q3	-6.28	0.1	2.63	103.9264
1994q4	-6.28	0.1	2.63	104.4263
1995q1	-17.446	0.47	4.41	106.0799
1995q2	-17.446	0.47	4.41	106.5686
1995q3	-17.446	0.47	4.41	106.8583
1995q4	-17.446	0.47	4.41	106.9492
1996q1	-7.979	0.9	4.15	107.1181
1996q2	-7.979	0.9	4.15	106.7004
1996q3	-7.979	0.9	4.15	105.9732
1996q4	-7.979	0.9	4.15	104.9363
1997q1	-13.653	0.47	0.47	101.9528
1997q2	-13.653	0.47	0.47	100.9515
1997q3	-13.653	0.47	0.47	100.2953
1997q4	-13.653	0.47	0.47	99.98441
1998q1	-18.68	0.19	3.29	101.3612
1998q2	-18.68	0.19	3.29	101.2036
1998q3	-18.68	0.19	3.29	100.8542
1998q4	-18.68	0.19	3.29	100.313
1999q1	-18.341	0.4	2.31	99.47719
1999q2	-18.341	0.4	2.31	98.59346
1999q3	-18.341	0.4	2.31	97.55904
1999q4	-18.341	0.4	2.31	96.37391
2000q1	-1.569	0.87	0.6	93.87774
2000q2	-1.569	0.87	0.6	92.85536
2000q3	-1.569	0.87	0.6	92.14641
2000q4	-1.569	0.87	0.6	91.75089
2001q1	-2.466	0.04	3.78	91.66882
2001q2	-2.466	0.04	3.78	91.90018
2001q3	-2.466	0.04	3.78	92.44498
2001q4	-2.466	0.04	3.78	93.30322
2002q1	-0.895	0.21	0.55	91.24289
2002q2	-0.895	0.21	0.55	93.10368
2002q3	-0.895	0.21	0.55	94.7613
2002q4	-0.895	0.21	0.55	96.21573
2003q1	0.888	0.55	2.93	97.46698
2003q2	0.888	0.55	2.93	98.51505
2003q3	0.888	0.55	2.93	99.35993
2003q4	0.888	0.55	2.93	100.0016
2004q1	-0.819	0.29	5.1	100.2985
2004q2	-0.819	0.29	5.1	100.5905
2004q3	-0.819	0.29	5.1	100.736
2004q4	-0.819	0.29	5.1	100.735

2005q1	-1.347	0.11	5.91	100.1886
2005q2	-1.347	0.11	5.91	100.0541
2005q3	-1.347	0.11	5.91	99.93279
2005q4	-1.347	0.11	5.91	99.82451
2006q1	-1.976	0.2	6.33	99.59519
2006q2	-1.976	0.2	6.33	99.56671
2006q3	-1.976	0.2	6.33	99.60496
2006q4	-1.976	0.2	6.33	99.70994
2007q1	-3.229	2.28	6.99	99.94483
2007q2	-3.229	2.28	6.99	100.158
2007q3	-3.229	2.28	6.99	100.4126
2007q4	-3.229	2.28	6.99	100.7086
2008q1	-5.523	0.27	0.23	101.3296
2008q2	-5.523	0.27	0.23	101.5952
2008q3	-5.523	0.27	0.23	101.7888
2008q4	-5.523	0.27	0.23	101.9105
2009q1	-4.561	0.31	3.31	102.2964
2009q2	-4.561	0.31	3.31	102.1397
2009q3	-4.561	0.31	3.31	101.7767
2009q4	-4.561	0.31	3.31	101.2072
2010q1	-5.922	0.45	8.4	99.51895
2010q2	-5.922	0.45	8.4	98.90172
2010q3	-5.922	0.45	8.4	98.44308
2010q4	-5.922	0.45	8.4	98.14304
2011q1	-9.13	0.33	6.11	98.00159
2011q2	-9.13	0.33	6.11	98.01873
2011q3	-9.13	0.33	6.11	98.19447
2011q4	-9.13	0.33	6.11	98.5288
2012q1	-8.441	0.32	4.55	95.07171
2012q2	-8.441	0.32	4.55	95.05129
2012q3	-8.441	0.32	4.55	95.16319
2012q4	-8.441	0.32	4.55	95.40741
2013q1	-8.869	0.68	5.69	95.78396
2013q2	-8.869	0.68	5.69	96.29284
2013q3	-8.869	0.68	5.69	96.93404
2013q4	-8.869	0.68	5.69	97.70756
2014q1	-10.403	1.55	5.33	99.95885
2014q2	-10.403	1.55	5.33	100.4589
2014q3	-10.403	1.55	5.33	100.553
2014q4	-10.403	1.55	5.33	100.2413
2015q1	-10.403	1.55	5.33	99.52375
2015q2	-10.403	1.55	5.33	98.40035
2015q3	-10.403	1.55	5.33	96.8711
2015q4	-10.403	1.55	5.33	94.936

APPENDIX 3: PLOT OF RESIDUALS OF AUTOCORRELATION FUNCTIONS



Source: Author's, 2018

APPENDIX 4: JOHANSEN'S CO INTEGRATION TESTS

Unrestricted Cointegration Rank Test (Normalized)

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GDP	FDI	CAB	REER
-56.59595	-2736.644	-104.2121	460.2871
-447.8901	347.4077	48.81167	206.4934
72.40479	-469.8259	92.04575	953.1768
53.80591	-956.9858	199.0191	-232.3484

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	1.32E-05	0.000350	-5.03E-05	0.000109
D(FDI)	0.000100	-1.03E-05	1.02E-05	3.90E-05
D(CAB)	0.000464	8.15E-05	-0.000331	-0.000169
D(REER)	-4.15E-05	-5.09E-05	-5.28E-05	5.51E-05

Source; Author's, 2017

First Normalized Cointegrating Coefficients

1 Cointegrating Equation(s):		Log likelihood	3944.710
Normalized cointegrating coefficients (standard error in parentheses)			
GDP	FDI	CAB	REER
1.000000	48.35407	1.841335	-8.132863
	(11.0387)	(0.92610)	(4.09509)
Adjustment coefficients (standard error in parentheses)			
D(GDP)	-0.000748		
	(0.00576)		
D(FDI)	-0.005671		
	(0.00152)		
D(CAB)	-0.026274		
	(0.00935)		
D(REER)	0.002346		
	(0.00185)		

Source; Author's, 2017

First and Second Normalized Cointegrating Coefficients

2 Cointegrating Equation(s):		Log likelihood	3953.610
Normalized cointegrating coefficients (standard error in parentheses)			
GDP	FDI	CAB	REER
1.000000	0.000000	-0.078190	-0.582158
		(0.13302)	(0.52906)
0.000000	1.000000	0.039697	-0.156154
		(0.01896)	(0.07543)
Adjustment coefficients (standard error in parentheses)			
D(GDP)	-0.157521	0.085423	
	(0.04410)	(0.26946)	
D(FDI)	-0.001039	-0.277833	
	(0.01211)	(0.07402)	
D(CAB)	-0.062778	-1.242142	
	(0.07450)	(0.45522)	
D(REER)	0.025157	0.095748	
	(0.01463)	(0.08941)	

Source; Author's, 2017

First, Second and Third Normalized Cointegrating Coefficients

3 Cointegrating Equation(s):		Log likelihood	3958.689
Normalized cointegrating coefficients (standard error in parentheses)			
GDP	FDI	CAB	REER
1.000000	0.000000	0.000000	0.037381
			(0.54607)
0.000000	1.000000	0.000000	-0.470696
			(0.12652)
0.000000	0.000000	1.000000	7.923506
			(2.78555)
Adjustment coefficients (standard error in parentheses)			
D(GDP)	-0.161164	0.109063	0.011076
	(0.04462)	(0.27310)	(0.01438)
D(FDI)	-0.000299	-0.282632	-0.010008
	(0.01226)	(0.07505)	(0.00395)
D(CAB)	-0.086768	-1.086475	-0.074899
	(0.07445)	(0.45565)	(0.02399)
D(REER)	0.021331	0.120574	-0.003030
	(0.01469)	(0.08990)	(0.00473)

Source; Author's, 2017

APPENDIX 5: MAP OF KENYA