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DETERMINANTS OF NOMINAL EXCHANGE RATE FLUCTUATIONS IN KENYA

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Abstract

This study examined determinants of nominal exchange rate fluctuations in Kenya using an Autoregressive Distributed Lag (ARDL) approach over the period 1993Q3 when Kenya authorized floating exchange rate to 2014Q4. The study examined the short and long-run determinants of nominal exchange rate fluctuations in Kenya. Dependent variable was nominal exchange rate while explanatory variables were money supply, foreign exchange reserves, current account balance, and interest rate differentials. Empirical results confirmed that money supply, foreign exchange reserves, interest rate differentials are significant determinants of nominal exchange rate in Kenya while current account balance is not significant determinant. The ARDL bounds test approach confirmed lung run relationship between nominal exchange rate and the explanatory variables. The error correction term was strongly significant and having the right sign (negative); this means that the estimated speed of adjustment to the long run equilibrium in response to the disequilibrium caused by the short run shocks of the previous period was 16 percent per quarter. Both ARDL long and error correction model were found to be robust because they passed all diagnostic tests such as serial correlation, heteroskedasticity and normality test. The CUSUM test confirmed the stability of both estimated models.

Keywords: Interest rate differential, Foreign exchange reserve, Nominal Exchange Rate, Current account balance, Autoregressive Distribution Lag

INTRODUCTION

Since the collapse of Breton Wood in 1973 many countries in the world adopted either floating exchange rate or fixed exchange rate system. Despite introducing reforms in order to stabilise their economies, many Africa countries still experience high volatility of their exchange rate. Nyahokwe and Ncwadi, (2013) stated that In June, 2001 the exchange rate between the US dollar and South African rand was eight, in December 2001 it was twelve. Within six months down the line, the Rand had depreciated 50% against the US dollar and many other currencies. African countries such as Ghana, Nigeria and Malawi have also experienced fluctuations in exchange rate (See Ajao and Igbekoyi, 2013; Insah and Chiaraah, 2013).

When Kenya got her independence in 1963 it adopted fixed exchange regime whereby the value of the Kenya Shilling was fixed to US Dollar at 7.14. In 1972 to 1992, the shilling was devalued by 351 percent according to Kiptui, (2008). In 1990 the government adopted a dual exchange rate system which lasted until October 1993 when Government allowed floating exchange regime. Since then Kenya Shilling has continued to depreciate in more gradual manner with foreign exchange rate being affected by various factors for example post election violence of 2007/2008, which caused exchange rate overshooting in 2011 from KES 83 to over KES 100 within a span of 6 months. Since then Kenya has been experiencing fluctuations of its nominal exchange rate. Figure 1.1 in Appendix I shows fluctuations of exchange rate witnessed in Kenya from October 1993 to September 2015.

Exchange rate turbulence which persisted in May 2015 forced Monetary Policy Committee to call unscheduled meetings to chart out a clear policy direction to tame the slide of the shilling which had apparently defied policy move despite various tools employed by the CBK to manage exchange rate volatility.The committee which is CBK's top monetary decision making organ meets once every two month (CBK website), to give a new monetary policy stance. MPC unscheduled meetings were seen to reflect the CBK’s concern at the possible effect of the shilling’s depreciation on inflation, which climbed to 7.3 per cent in June from 6.9 per cent in May (KNBS).

This study was motivated by the manner in which Kenya was experiencing massive depreciation of its currency in the year 2015, with economic experts having various views on to why the shilling was fluctuating from Ksh. 87 in January to 106 in September per US dollar which was approximately 18 percent.

Some of the arguments which stakeholders were discussing to be the cause of depreciation of KES were; an increase in current account deficits due to poor performance of tourism and agriculture. For instance tourism industry which was and still is one of the major leading foreign exchange earners had been heavily affected by the threat of terrorism. For

example the repeat attacks by Al Shabaab and travel advisories warnings issued by Britain, United States and Australia against visiting the Kenyan coast, a popular destination for tourists made the sector to dwindle as major source of foreign exchange. This reduced foreign exchange supply putting more pressure on shillings to depreciate.

Low price of Agriculture produce in world markets, for instance horticulture, coffee and tea which contribute about 25 per cent to the country's GDP according to the Kenya National Bureau of Statistics (KNBS) were severely affected. Kenya's horticulture sector lost market share and became less economically competitive due to rising production costs and poor food-safety compliance making flower importers shift their focus to India and Ethiopia for cheaper flowers in the wake of rising cost of production in Kenya according to Global Competitiveness Study by USAID.

Interest rate differential was another reason, for instance stronger performance of US economy in mid 2015 made the dollar appreciate against Kenya shillings after Federal Reserve reversed its monetary policy. Anticipation of such move attracted international investors to invest in U.S. leaving emerging markets such as Kenya affected by such move as they were less appealing to investors who were taking their capital to US because of higher interest rates.

This study tested and estimated some of the determinants of exchange rate such as money supply, foreign exchange reserve balance, interest rate differentials and current account balance. This would help both policy makers and investors to know the long and short time behavior of nominal exchange rate in Kenya.

Statement of the problem

Exchange rate has been unstable in Kenya with a rising trend. It has come up with pervasive effects and consequences for prices, wages, interest rates, production levels and employment opportunities. The motive of this study was influenced by the rate at which KES was depreciating in 2015 against USD with the highest rate of 106.035 on 07 September 2015, the highest rate ever witnessed in Kenya since independence. In 2011 Kenya experienced exchange rate overshooting from KES 83 to over KES 100 within span of 6 months and it has risen steadily to over KES 106 in September 2015. This caused a lot of debate among various stakeholders with no empirical verification being done to authenticate their points of view.

The consequence of exchange rate fluctuations was felt in the entire economy because the weaker shilling raised the cost of imports including petroleum products and machinery, thus piling inflationary pressure (KNBS). It was also expected that the volatility of exchange rate would affect our foreign debt repayment. For instance when Kenya government borrowed Eurobond the Shilling was trading at Ksh 88 to US dollar while it was at KES 106 in September

2015, thus increasing the burden of repaying of the debt and interest payments.These make exchange rate instability an important concern for economic growth in developing economies.

Kenya like any other African countries has scant empirical studies done on exchange rate determinants. Apart from Were et al, (2011) who used Vector error correction model approach to examine determinants of exchange rate, most of the empirical research done by Kiptui, (2007), Kiptui, (2008), Otuori (2013) and Musyoki et al, (2003) are focused on the adverse consequences of exchange rate volatilities on various parts of the domestic economy such as banking sector, exports and imports. This has created a research gap hence, there was need to test other variables which were not tested by Were et al, (2011).

This study used ARDL approach to analyse determinants of nominal exchange rate fluctuations in Kenya. The recent studies indicate that the ARDL approach to cointegration is preferable to other conventional cointegration approaches such as Engle-Granger, (1987) Johansen, (1991; 1995) and Johansen-Juselius, (1990) tests, because it is flexible and it can be applied when the variables are of different order of integration. Again, ARDL approach simultaneously provides the long run and short run estimates for empirical investigation. Dynamic Error Correction Model (ECM) can be derived from ARDL through a simple linear transformation according to Banerjee et al*,* (1993). And the ECM integrates the short-run dynamics with the long-run equilibrium without losing long-run information.

This study evaluated determinants of nominal exchange rate fluctuations in Kenya because empirical test done in different countries in the world produce contradictory results, hence this create another research gap. Therefore, there was need to estimate the nominal exchange rate determinants in Kenya hence the need of this study.

General Objective of the Study

To estimate determinants of nominal exchange rate fluctuations in Kenya.

Specific Objective

1. To estimate impact of money supply on nominal exchange rate in Kenya.
2. To estimate impact of Foreign exchanges reserve on nominal exchange rate in Kenya.
3. To estimate impact of interest rate differential on nominal exchange rate in Kenya.
4. To estimate impact of Current account balance on nominal exchange rate in Kenya.

Research hypotheses

1. (i) There is no relationship between money supply and nominal exchange rate in Kenya.

(ii) There is a relationship between money supply and nominal exchange rate in Kenya.

2. (i) There is no relationship between Foreign exchange reserves and nominal exchange rate in Kenya.

   (ii) There is a relationship between Foreign exchange reserves and nominal exchange rate in Kenya.

3. (i) There is no relationship between interest rate differential and nominal exchange rate in Kenya.

   (ii) There is a relationship between interest rate differential and nominal exchange rate in Kenya.

4. (i) There is no relationship between current account balance and nominal exchange rate in Kenya.

   (ii) There is a relationship between current account balance and nominal exchange rate in Kenya.

Justification of the Study

In Kenya, fluctuations of exchange rate caused economic policy debate involving citizens, policymakers, business community, academic researchers and business press with no empirical verification being done to authenticate their arguments. Exchange rate fluctuations made country's exports to be more expensive in world market making them less competitive which resulted into reduction of production level in the economy. For example, flower importers shift their focus to India and Ethiopia for cheaper flowers in the wake of rising cost of production in Kenya according to Global Competitiveness Study by USAID.

Secondly, the raise in exchange rate was expected to effect on foreign borrowing in two ways; one it would increase interest on foreign loan repayment. For example when Kenya government borrowed Eurobond the Shilling was trading at Ksh 88 to US dollar which was at KES 106 in September 2015 which would increase the burden of repaying of the debt.

Thirdly, depreciation exchange rate, for instance made fuel price to be high despite fuel price was decreasing in the world market, this was because fuel price largely depend on exchange rate. And when the price of fuel is high it affects all sectors of the economy resulting to high cost of living.

The findings of this study addressed the existing knowledge gap in literature of on various determinants of exchange rate in Kenya. These will assist policy makers and government agencies, investors, financial institutions and multinational companies to know, estimate and predict determinants of foreign exchange fluctuations in Kenya.

For examples, government agencies and policy makers will use the result to make reasonable monetary and fiscal policy to generate a faster and better economic development. Financial institutions and multinational companies will also use the finding of this study to make the suitable decisions in response to exchange rate change in order to reduce the losses caused by changes in exchange rate. The results of this study will benefit for foreign investors in making right investment in foreign exchange market and more so to predict the exchange rate trend in Kenya and make right investment. The findings also will assist other researchers to try to reach concrete agreement over determinants of the exchange rate which is still an inconclusive area and causing a lot of economic debate. Lastly this study added more updated empirical evidence to existing economic literature in Kenya.

Scope of the Study

The study was in line with general objective which was to investigate the main factors causing fluctuations of nominal exchange rate in Kenya, using quarterly data from October 1993Q3, when Kenya allowed floating exchange rate, to 2014Q4. This study used time series data and applies graphical methods and the Augmented Dickey Fuller (ADF) to test stationarity of variables, Autoregressive Distribution Lag (ARDL) was applied to estimate long run relationship between the nominal exchange rate and explanatory variables while Error Correlation Mechanism (ECM) was used to explain Short run dynamics relating to explanatory variable and nominal exchange rate.

Limitation

This study mainly focused on the macroeconomics influence and non macroeconomics factors which affect exchange rate were not included in the analysis. For instance Saeed et al (2012) stated that the coefficient of political stability was significant in exchange rate fluctuation.

LITERATURE REVIEW

Theoretical Review

Economists and financial experts are yet to agree on a single theory that defines the exchange rate. The theories of the exchange rate concept can be classified as traditional or modern, Musyoki en el (2012). 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 parity 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 added Musyoki en el (2012).

Keynesianism's theory of exchange rate

This was developed by Keynes (1936), he explained that exchange rate is decided by supply and demand between countries' currencies. Supply and demand of foreign currency is determined by BOP international balance of payments of goods and services and exchange rate depend on current account balance of payment which also dependence on a country national income.

Argy (1981) come up new Keynesianism's theory which presented that exchange rate is decided by supply and demand of foreign currencies and the current account balance is the main factor to determine supply and demand of foreign currencies. The different with the original one was that Argy (1981) considered that current account is affected by the national income, prices level in two countries and exchange rate itself. He concluded that the equilibrium exchange rate is determined by monetary policy, fiscal policy, foreign income, price level, interest rate and expectation rate in two countries.

Elasticity approach

Alexander (1951 and 1952) introduced the macroeconomics version of this theory as absorption Habib, (2001) from the national accounting identity:- derived the trade balance as differences between the total output produced and the absorption (sum of the consumption, investment and government expenditures) in economy. If absorption in an economy exceeds the output produced then there is a deficit in the trade balance and this put pressure on exchange rate to depreciate. The depreciation on the exchange rate can by reduced reduction of absorption (imports) and increase output (export) brings balance in trade flow. One implication of absorption is the twin deficits problem which links the internal deficits to external deficits.

Monetary approach

Mendel and Fleming (1962) used Keynesian IS – LM framework to introduce flow of capital along with trade in goods in an open economy Habib, (2001). In the model domestics and foreign interest rate differentials causes capital flows between countries. Interest rate arbitrage induces the flow of short liquid capital to earn higher return, Caves et al, (1990). Both fiscal policy and monetary policy have an effect on capital mobility. For example expansionary

monetary policy lowers the interest rate and depreciates the currency while fiscal expansionary policy increases interest rate and appreciates the currency in short run.

This approach to exchange rate assumes money market equilibrium and purchasing power hold, such that domestic and foreign supplies, output and interest rate differential are the main determinants of exchange rate, Caves et al (1990) in their model increase in domestic credit creation increase money supply and depreciate domestic currency.

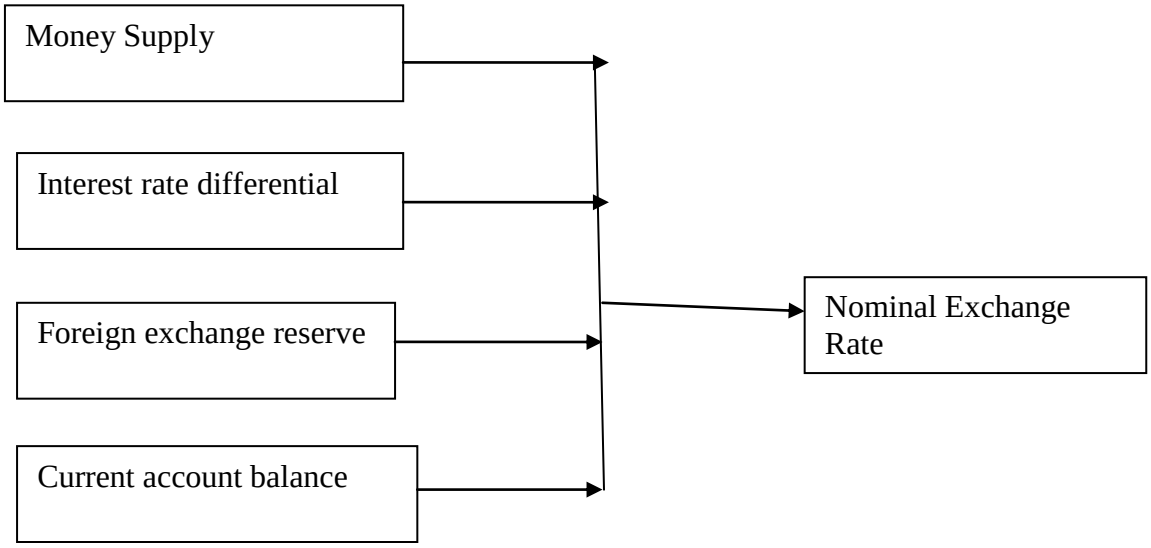
Portfolio balance approach

In portfolio balance model exchange rate is determined as an assets price Rodrique (1980). Agents hold domestics and foreign bonds dominated in foreign currency along with the money Habib, (2001). The composition of the portfolio of assets depends on the relative return on different assets. The model assumes interest parity hold and determines short run exchange rate and PPP give long run exchange rate. According to Habib, (2001), this model is first to explain volatility of exchange rate.

Conceptual Frame Work

According to Smyth (2004) conceptual frame work is structured from a set of broad ideas and theories that help a researcher to properly identify the problem they are looking at. From the above theories this study picked four explanatory variables which affect exchange rate and used them to form conceptual frame work as shown in figure 1 below.

Figure 1. Conceptual Framework



Money Supply

In the global monetarist approach developed by Johnson, (1972), he stated that the balance of payments of a country depends on monetary demand and supply in that country and the rest of the world. An increase in money demand and if the domestic's source component of money supply is not increased the monetary approach predicts that the country will experience exchange rate appreciation Frenkel and Johnson, (2013). He added that monetary authority will be compelled to purchase foreign exchange. A research done by Wilson, (2009) also support that increase in money supply cause a decrease in the ratio of currency, when he examined the effective exchange rate between USD and the weighted average trading pattern African. Hsien, (2009) also found the relative more real money aggregate increase real depreciation of Indonesia Rupian per USD. Saeed et al, (2012) also concluded that an increase in relative stock of money increases nominal exchange rate. However, they Jamal, (2005) and Zada, (2010) found that there was no statically significant relationship between money supply and exchange rate.

Interest rates differential

By manipulation of interest rate, central bank can exerts influence over both inflation and exchange rate Fane, (2000). Change in interest rate, for instance when there is higher interest rate relative to other countries this will attract foreign capital and cause exchange rate to raise. The opposite occur when there is low interest decrease exchange rate. Empirical test done by Macso – Fernandez et al, (2002) also found that an increase in the rate of differential exchange rate between Euro area and a broad would bring appreciation of Euro significantly. Ogun, (2012) and Zada, (2010) found the some result as opposed to Jamal, (2005) who found that they is no significant relationship between currency value of Korea and interest rate during Asia financial crisis.

Foreign exchange reserves

Foreign exchange reserves are assets held by central bank usually in various reserve currencies mostly in USD Fane, (2000). They are recorded in the balance of payment and located in capital account. Saeed et al, (2012) concluded that an increase in the relative balance of foreign exchange reserve would increase nominal rate, while Kriljenko and Habermeier, (2004) found contradictive result that adequacy of foreign exchange rate reserve was not strongly correlated exchange rate volatility.

Current account balance

Current account balance is the balance of trade between a country and its trading partners Fane, (2000). It reflects all payments between countries for goods, service and dividends. A deficit in this account show that a country is spending more on foreign trade than its earning. A negative balance of payment or a deficit in the current account shows that the country is importing or spending more on foreign trade than it exporting or earning from abroad. This means that the country requires more foreign currency than it receives from its exports. This excess demand for foreign currency lowers the country‘s exchange rate Taylor, (2001). Were et al (2011) also found that current account balance has a role to play in the determination of the exchange rate in Kenya.

Nominal Exchange Rate

Foreign exchange is the rate of exchange between domestic’s currency and foreign economy Hand, (2002). The exchange rate can either be nominal exchange rate, real exchange rate or effective exchange rate. Nominal exchange rate is the number of units of a domestic currency need to purchase a unit of a foreign currency or the number of foreign currency units need to purchase a unit of domestic currency Stein and Allen, (1997). They added that it is easily observe in the FOREX market. According to Sibanda, (2012) nominal exchange rate say little about export competitiveness of currency as it does not account for inflation differential between countries to measure the country’s export competiveness real exchange rate is often used Hand, (2002). Real exchange rate is the nominal rate adjusted for relative price ratio between countries. It measured the units of foreign currencies required to buy unit of domestic commodity.

Empirical Review

In the recent empirical research done by different researchers has tested and identified numerous variables (determinants) that effects of exchange rate. To discuss some of few empirical research done in recent past. To start with Wilson (2009) examined the effective exchange rate of USD and the weighted average trading partner of US. Founded that money supply was positively related to effective change rate which mean increase in money causes decline in the value of currency. Interest rate, government expenditure and deficits to GDP are negatively related with exchange rate. He used monetary approach and his results provide support for the long validly of the monetary approach to exchange rate. Deficits and outstanding debts financed domestically or foreign investors have an impact effect on exchange rate in the

long run but not in short run. Over the short run effective exchange rate is independent of debt and deficits.

Atif et al (2012) demonstrated the relationship between Australian exchange rate using economics and non economics determinants. Using quarterly and annual data over the period of 1975 to 2012, he suggested that Australia's trade components and macroeconomics indicators like net exports, GDP, and monetary play significant role in determining exchange rate. However, interest rate and inflation appear insignificant. The study also emphasized the pertinence of the unobserved effects such as political events and external shocks influence exchange rate. Engle Granger cointergration test exhibited long run relationship between exchange rate and variables estimated.

Saeed el al (2006) conducts a study to examine USD in term of PKR within the frame work of monetary approach using monthly data from January 1982 to April 2010. They used ARDL approach to cointergration and error correlation model to analysis their result. Variables they used were stock of money, foreign reserves and total debt of Pakistan relative to US and Political instability as a dummy variable. Empirical result confirmed that stock of money, debt and foreign reserve balance were significant determinants of exchange rate between PKR and USD. Political instability also had negative effect on value of domestic currency.

Rucha and Burange (2013) studied the determine factors of affecting the real exchange rate in India using quarterly data 1993Q1 to 2011Q4. The fundamental determinants considered were productivity differences, government expenditure, foreign institutional investments, inflations differential, terms of trade, foreign exchange reserves and net assets. ARDL bounds between the real exchange rate and these variables confirmed long run relationship between them.

Kamal (2013) investigated determinants of exchange rate for USD in term of Bangladeshi Taka using ARDL approach. He used monthly data from the January 1984 to April 2012. He found that exchange rate and macroeconomics variables affecting real exchange rate form a cointegrating vector. He observed that stock of money and increase in debt service burdens resulted in real depreciation of the currency while increase in foreign exchange rate appreciates currency. Political instability has a significant negative effect on the value of currency. He applied Augmented Dickey Fuller (ADF) test statinarity, Autoregressive distributive lag (ARDL) approach to co-integration to estimate the long run relationship between the nominal BDT/USD exchange rate and explanatory variables.

Zada (2010) studied the factors affecting exchange rate of Pakistan for the period 1979 to 2008. The study used multiple regression model in which exchange rate was taken as dependent variable while Inflation, interest rate, Foreign exchange reserves, trade balance,

money supply and Gross Domestic Product were the independent variables. The study showed that Inflation, interest rate and foreign exchange reserves strongly influence the exchange rate and remained significant at 1% level while other variables GDP, Money supply and trade deficit remained insignificant

Villavicencio and Bara (2006) explored the real exchange rate behavior in Mexico from 1960 to 2005 using Autoregressive Distribution Large (ARDL) model. Their study demonstrated that productivity differential proxies by real GDP per capital differential, higher interest rate and size of net foreign assets tend to appreciate the real exchange rate of Mexico.

In India context an ARDL model was applied by Kumar, (2010) for analysis determinant of real exchange rate in India following the Edwards, (1998) model the impact of productivity differential, government consumption, foreign exchange assets, term of trade and eternal openness are main determinants of real exchange rate of the rupee against the USD. He used quarterly data from 1997Q2 to 2009Q2 and found that productivity differential were significant and exert a negative effect on the real exchange rate, foreign exchange rate assets and term of trade were also significant and negatively correlated with real exchange rate.

In Africa, Insah and Chiaraah, (2013) determined the sources of exchange rate volatility in Ghana using the Autoregressive Distributed Lag (ARDL) Model and annual data from 1980 to 2012. The study suggested that government expenditure, domestic and external debts are major determinant of real exchange rate volatility.

Iyke and Odhiambo, (2015) identified the fundamental determinants of the long-run exchange rates in South Africa. They estimated the equilibrium real exchange rate for South Africa using a dataset covering the period 1975 to 2012. They conducted a cointegration test using the ARDL bounds-testing procedure. They found terms of trade, trade openness, government consumption, net foreign assets and real commodity prices to be the long-run determinants of the real exchange rate in South Africa.

There is scant empirical test done on the estimation of exchange rate determinants here in Kenya except, Were et al, (2011) did an investigation on exchange rate determination in Kenya using Vector error correction model approach to uncover the long run relationships. They found that current account balance has a role to play in the determination of the exchange rate. They result were a rise current account balance, higher domestic interest rates relative to foreign interest rates**,** as well as a rise in foreign price appreciated the exchange rate. Majority of the available empirical literatures on exchange rate in Kenya mostly investigate the adverse consequences of exchange rate volatilities on various parts of the domestic economy such as banking sector, exports and imports. For instance Otuori, (2013) conducted a study to investigate the determinant factors of exchange rates and their effects on the performance of

commercial banks in Kenya. He concluded that a rise in exchange-rate volatilities has been found to have negative consequences on the trade sector (i.e. exports and imports) of the local economy.

Kiptui, (2008) using ARDL cointergration techniques and error correction model, he investigated the impact of real exchange volatility on Kenya's exports. The results demonstrated the important of exchange rate as it have adverse effects on horticulture and tea in the long-run with elasticities. Another research by Kiptui, (2007) also in the same area found impact of real exchange on demand for demand of Kenya's major export categories. He used ARDL bounds testing approach to analyse the data. He suggested that the effects of the real exchange rate are more likely to be long-run in nature rather than short-term and that there could exit threshold levels at which exchange rate fluctuations harm exports.

Summary of the Literature Review

There is no agreement in the empirical research done in different countries on determinants of exchange rates fluctuations because in some cases there are contradicting results, (see Johnson, (1972),; Wilson, (2009),; and Hsien, (2009);, Frenkel and Johnson, (2013),; found that the exchange rate depends on money demand and supply, an increase in money demand predicts that the country will experience exchange rate appreciation. However, (Jamal, (2005) and Zada, (2010) found that there was no statically significant relationship between money supply and exchange rate.

Secondly, on interest rate differential in a country, empirical test done by Macso – Fernandez et al, (2002), Ogun, (2012) and Zada, (2010) confirmed this as opposed to Jamal, (2005) who found that there is no significant relationship.

Thirdly, on foreign exchange reserve, Saeed et al, (2012) concluded that an increase in the relative balance of foreign exchange reserve would increase nominal rate, while Kriljenko and Habermeier, (2004) find contradictive result that adequacy of foreign exchange rate reserve was not strongly correlated exchange rate volatility.

Lastly, on Current account balance a deficits as cause of depreciation of exchange rate:- Taylor, (2001) and Were et al, (2011) support this argument that current account balance plays a role in the determination of the exchange rate that a rise current account balance causes appreciation of the exchange rate.

Majority of empirical research done in Kenya investigate mostly the consequences of exchange rate volatilities therefore more investigation should be carried out to estimate the determinants of exchange rate in Kenya.

Research gaps

There is scant empirical analysis done on the estimation of exchange rate determinants here in Kenya apart from, Were et al (2011) who used Vector error correction model approach to examine determinants of exchange rate. Most of the empirical research done by Kiptui, (2007), Kiptui, (2008), Otuori, (2013) and Musyoki et al, (2003) focused on the adverse consequences of exchange rate volatilities on various parts of the domestic economy such as banking sector, exports and imports. Thus, there is need to test other variables which were not tested by Were et al (2011).

Secondly, there was also no consensus in the empirical research done in different countries on determinants of exchange rates fluctuations because in some cases there are contradictory results. Therefore, there was need to estimate and predict the exchange rate determinants in Kenya.

Lastly, this study used ARDL approach because it is flexible unlike other conventional cointegration approaches such as Engle-Granger, (1987), Johansen, (1991; 1995) and Johansen-Juselius, (1990) tests, because it can applied when the variables are of different order of integration irrespective of whether the underlying repressors are purely I(0), purely I(1) or fractionally cointegrated Pesaran and Pesaran (1997). Again ARDL approach can simultaneously provides the long run and short run estimates for empirical investigation. This technique can provides an efficient way to separately examine the long run and short run causal relationships, according to Bentzen and Engested, (2001). Dynamic Error Correction Model (ECM) can also be derived from ARDL through a simple linear transformation Banerjee et al. (1993). And the ECM integrates the short-run dynamics with the long-run equilibrium without losing long-run information.

RESEARCH METHODOLOGY

Research Design

Bryman, (2001), defined research design as the scheme, outline or plan that is used to generate answers to the research problem. Descriptive research design was used in this study. It was appropriated because of it is specific in nature and facts that it facilitate a general understanding and interpretation of the problem and described the state of affairs as it is in that particular time.

Data source

This study used data from central bank of Kenya and international financial statistics. The data was quarterly data from a period of third quarter 1993 to fourth quarter 2014 where data was available for analysis.

Data Processing and Analysis techniques

Babbie (2010) stated that data analysis is carried on the data collected in order to transform it to a form suitable for use in drawing conclusions that reflect ideas and theories that initiated the inquiry. In order to analysis the determinants of exchange rate in Kenya, graphical method and the Augmented Dickey Fuller (ADF) were used to test stationary of variables, Autoregressive Distribution Lag (ARDL) was applied to estimate long run relationship between the nominal exchange rate and explanatory variables. Error Correlation Mechanism (ECM) was used to estimate short run dynamics relating to macroeconomics variable and nominal exchange rate.

Model Specification

In this study the four explanatory variables that affect nominal exchange rate were presented in the equation (1) and ARDL approach to cointegration was used to estimate the relationship of variables using the OLS estimation as shown in the equation:

$NER_t = \alpha_0 + M2_t + (NIR_t - NIR_t^*) + FX_t + CAB_t + \varepsilon_t$ ……..…….. (1)

Where,

NER_t = Nominal Exchange Rate at time, t.

$M2_t$ = Money Supply at time, t.

NIR_t = Interest rate of Kenya at time, t

NIR_t^* = Interest rate of United States of America at time, t.

FX_t = Foreign Exchange Reserve at time, t.

CAB_t = current account balance at time, t.

εt = the error term at time, t.

α_0 = the intercept coefficient estimate, i.e. the value that would be taken by the dependent variable NER if the independent variables (M2, (NIR - NIR *), FX and CAB) took a value of zero.

Unit root testing

A series is said to be stationary if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the distance or lag between the two time periods, not on the time at which the covariance is calculated Gujarati, (2003). The unit root test is necessary for time series data because a regression carried out with non-stationary series gives spurious results Gujarati, (2003), i.e. if two variables are trending over time, regression could have a high R^2 even if the two are totally unrelated. In addition Brooks, (2008) added that use of non-stationary data also violates the standard assumptions for asymptotic analysis, meaning that the t ratios don't follow a t distribution while the F statistic does not follow the F distribution.

In this study, graphical methods, Augmented Dickey Fuller (ADF) test and Philips -Perron unit root test were used to detect the stationary of the variables. Graphical method was used to test stationarity at I(0) because it would be easy to make conclusion on the stationarity of the variables by looking at the graphs when variables were at I(0). This study also adopted Philips -Perron unit root test and the Augmented Dickey Fuller both at I(0) and (1) for more confirmatory test because the ADF assume no autocorrelation of the error term biases, hence its control ensures that the error term is a white noise according Wooldridge, (2003). Unlike the ADF, the PP method corrects for autocorrelation using non-parametric statistical methods without adding lagged difference terms Gujarati, (2003).

ARDL bound test approach for Cointegration

In this study cointegration was carried out to determine whether the independent and dependent variables were having a stationary linear combination in the long run. According to Dora, (2009) the purpose of a cointegration test is to examine whether variables in the system drift apart from each other and are individually stable I(1) in the short run. If these variables are cointegrated, they will be expected to form a stationary relationship in the long run.

Pesaran and et al, (2001) constructed ARDL model and applied the Bound test in a critical bound to examine the long-run equilibrium relationship among variables. The bounds test method cointegration has certain econometric advantages in comparison to other methods of cointegration which are the following: All variables of the model are assumed to be endogenous. Secondly, bounds test method for cointegration is being applied irrespective of the order of integration of the variable, either first order I (1) or I (0). Lastly both short-run and unbiased long-run coefficients of the model can be estimated simultaneously Harris and Sollis, (2003). The ARDL test is relatively more efficient in the case of small and finite sample data sizes.

Computing F-statistic

In this study existence of co-integration was tested by comparing the calculated value of conditional F-test compared with the critical value tabulated in Table CI (iii) of Pesaran et al. (2001). The Wald test (F-statistic) was computed to differentiate the long-run relationship between the concerned variables. The null and alternative hypotheses were as follows:

Null hypothesis $H_0 = \partial_1 = \partial_2 = \partial_3 = \partial_4 = \partial_5 = 0$ (no long-run relationship) i.e., there is no cointegration among the variables.

Alternative hypothesis $H_1 \neq \partial_1 \neq \partial_2 \neq \partial_3 \neq \partial_4 \neq \partial_5 \neq 0$ (a long-run relationship exists) i.e., there is cointegration among the variables.

According to Pesaran et al. (2001), for the cointegration test, the lower bound critical values assumed that the explanatory variables x_t are integrated of order zero, or I(0), while the upper bound critical values assumed that x_t are integrated of order one, or I(1). Therefore, If the F-statistic of ARDL bound testing was higher than the upper value, then the null hypothesis was to be rejected and conclusion was that was a long-run equilibrium relationship among variables (explanatory variables and dependent variable). On the other hand, if the F-statistic was lower than the lower value, then the null hypothesis was to be rejected hence there was no cointegration relationship among variables. However, if the computed F-statistic falls between the lower and upper bound values, then the result was inconclusive. Therefore, there was need to conduct the unit root test to ensure that none of the variables were integrated of order 2, because, in case of I (2) variables, ARDL procedures makes no sense.

Optimal Lag Length Selection

In this study the optimal number of lag length was important because the result of ARDL procedures is sensitive to the lag length in its estimation as indicated by Pesaran et al. (2001). This study used VAR model to establish optimal lag length by running equation (2) and the lag length criteria was to be carefully selected based on the Swartz-Bayesian information criteria (SBIC), the Akaike's information criteria (AIC), Final Prediction Error criteria (FPE), modified LR test statistics and the Hannan and Quinn information criteria as per according to Gujarati (2003). The Optimal lag length was to be recommended based on the lowest value of criteria and supported by the majority criteria (LR, FPE and AIC).

ARDL Model Specification

The ARDL approach to cointegration was used to estimate the relationship of variables using the OLS estimation of equation (2) as follows:

$$\Delta NER_t=\alpha_0+\sum\beta_{1i}\Delta NER_{t-i}+\sum\beta_{2i}\Delta M2_{t-i}+\sum\beta_{3i}\Delta NIR_{t-i}+\sum\beta_{4i}\Delta FX_{t-i}+\sum\beta_{5i}\Delta CAB_{t-i}+\partial_1 NER_{t-i}+\partial_2 M2_{t-i}+\partial_3 NIR_{t-i}+\partial_4 FX_{t-i}+\partial_5 CAB_{t-i}+\varepsilon_t \quad (2)$$

Where,

Δ denotes the first difference operator, the left-hand side is the nominal exchange rate. The expressions (β_1 –β_5) the right-hand side correspond to the short-run dynamics of the model. The remaining expressions with the summation sign (∂_1 – ∂_5) represent the long-run relationship.

Error correction models

This study was to obtain ECT from the long run coefficient of one lagged explanatory variables ($LNCAB_{t-i}$, $LNNIR_{t-i}$, $LNFX_{t-i}$ and $LNM2_{t-i}$) of equation (2) and divided by (multiplied by a negative sign) the coefficient of one lagged dependent variable ($LNNER_{t-1}$), i.e. Bardsen transformation (see Bardsen, 1989).

The ECT was to be lagged and the lagged (ECT_{t-i}) was to be estimated together with the short-run dynamics relationship between the independent and dependent variables with the following equation (3) model:

$$\Delta NER_t = \alpha_0 + \sum\beta_{1i}\Delta NER_{t-i} + \sum \beta_{2i}\Delta M2_{t-i} + \sum\beta_{3i} \Delta(NIR - NIR^*)_{t-i} + \sum\beta_{4i}\Delta FX_{t-i} + \sum\beta_{5i}\Delta CAB_{t-i} + \lambda ECT_{t-i} + u_t \quad \ldots\ldots 3$$

Where,

ECT_{t-i} was the lagged Error-Correction Term, the summation ($\beta_1 - \beta_5$) represent the coefficients for the short-run dynamics of the model's convergence to equilibrium and λ was parameter indicating the speed of adjustment back to long run equilibrium after short run shock. And was expected to have negative sign and significant for causality to exist in the long run equilibrium. The larger the error correction coefficient indicates faster adjustment back to long run equilibrium after short run shock.

The absolute value of adjustment parameter was supposed to lies between zero and negative one. Usually it ranges from -1 and 0. -1 signifies perfect and instantaneous convergence while 0 means no convergence after a shock in process.

Diagnostic Tests and Stability Test

It was important to analyse the robustness of each of the estimated models (i.e. long run and short run model) in this study in order to determine the extent to which estimated results could be relied on. The robustness of these models was tested by several diagnostic tests. The tests that were considered to be important in this study were; serial correlation, heteroskedasticity, normality and CUSUM test to examine the stability test of models.

Serial Correlation

One of the assumption of the ordinary least squares, states that the error terms are not supposed to be correlated with their previous values. The violation of this assumption entails that the coefficients obtained from a regression analysis may not be relied upon.

In this study, the Lagrange Multiplier (LM) test (i.e. Breusch-Godfrey LM test) was to be used to test for the presence of serial correlation. The LM test was to test the null hypothesis of no serial correlation against the alternative of auto-correlated residuals. If the p-value was to be more

than 5% significant level, the null hypothesis was to be accepted and thus confirmed there was no serial correlation of the error term.

Heteroscedasticity test

In a classical regression model the variance of the error terms is assumed to be constant, then it is said that homoscedasticity exist. In the event that the error terms do not have a constant variance, then heteroskedasticity exists.

In this study, the white test (Breusch-Pagan test for heteroskedasticity) was applied to the residuals of the model to find out if the variance of the error terms were constant. The null hypothesis of the error term was homoscedasticity and the alternative hypothesis of the error term of heteroscedasticity was to be tested. If the p-value was to be more than 5% significance level, then null hypothesis was to be accepted and thus confirming there was no heteroskedasticity of the error term and vice versa.

Normality Test

It also assumes that for linear regression model to be robust the residuals error terms are suppose to be normally distributed but Islam and Ahmed, (1999) and Takaendesa, (2006) said that the most important tests for the cointegration test are the serial correlation and the heteroscedasticity tests.

In this study, the Jarque Bera normality test was used to test normality of residuals. The null hypothesis of the residuals is normally distributed and alternative hypothesis that residuals are not normally distributed were to be tested. If the p-value was more than 5% significant level, the null hypothesis was to be accepted and thus confirmed that there was no heteroskedasticity of the error term and vice versa.

The stability test of models

According to literatures the commonly used tests for stability are the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMQ), both of which were introduced by Brown et al. (1975). Parameter stability is important since unstable parameters can result in model misspecification, Narayan and Smith, (2004).

In this study, the stability test was carried out by the cumulative sum of recursive residuals cumulative method (CUMSUM) to check the stability of long run ARDL model and Error Correction Model estimates.

To ascertain the appropriateness of the ARDL models and Error Correction Model, the stability tests the CUSUM was supposed to stay within 5% significance level and also should lie within the critical bounds for the estimates model to be stable.

RESEARCH FINDINGS AND DISCUSSION

Descriptive Statistics

Table 1: Descriptive statistics for the study variables

	LNNER	LNNIR	LNM2	LNCAB	LNFX
Mean	4.283	1.927	13.078	11.484	11.656
Median	4.325	2.097	12.902	11.800	11.788
Maximum	4.754	4.343	14.499	11.869	13.179
Minimum	3.777	-2.207	11.621	8.696	9.4948
Std. Dev.	0.1714	1.006	0.738	0.723	0.924
Skewness	-0.592	-1.039	0.226	-2.816	-0.351
Kurtosis	3.6765	5.591	2.202	10.759	1.984
Jarque-Bera	6.659	39.535	3.0171	329.416	5.463
Probability	0.036	0.000	0.221	0.000	0.065
Sum	368.299	165.757	1124.686	987.648	1002.439
Sum Sq. Dev.	2.498	85.999	46.254	44.447	72.672
Observations	86	86	86	86	86
Variation coeft	0.0400	0.522	0.056407	0.063	0.079

The table 1 shows that there is more variability in the LNNIR because of the higher standard deviation and smaller mean as compared to other dependent variables. It also, has the lowest statistics in terms of its mean and the minimum value as compared to other variables but it is not normally distributed according to JB. The opposite can be seen with LNM2.

Unit root testing

Testing for stationarity was important for this study to avoid spurious results and also to confirm the level of integration of the variables. Although the ARDL cointegration approach does not require unit root tests, this was conducted to ensure that none of the variables were integrated of order 2, because, in case of I (2) variables, ARDL procedures makes no sense. If a variable was found to be I(2), then the computed F-statistics, as produced by Pesaran et al. (2001) and Narayan (2005) can no longer be valid. In order to ensure the robustness of the results, this study used two tests for stationarity i.e. the graphical analysis, ADF and Phillip-Perron (PP) test.

Graphical Analysis

The graphical method was adopted in analysing the stationarity of the data in this study at I(0). The graphical results for stationarity test are presented in appendix II. From the analysis it is evident that LNFX, LNNER, LNM2 and LNCAB are trending upwards and also they are non stationary. While LNNIR shows a random walk that fluctuates around a mean, this may be due to the fact that, it was differentiated between KE NIR and US NIR. It was difficult to make conclusion on the stationarity of the variables by merely looking at the graphs when variables were differentiated at I(1). As a result, this study adopted the Augmented Dickey Fuller and the Phillip-Perron (PP) test for more confirmatory test both at I(0) and I(1).

Augmented Dickey Fuller Test

This study estimated stationarity using ADF with intercept and with trend and intercept, both at level and first difference level to check the order of integration of these variables. Results are presented table 2 and table 3.

Table 2: Results of ADF unit root test at Level

Variables	Intercept	P Value	Status	With Trend & intercept	P Value	Status
LNNER	-1.441218	0.5584	Non Stationary	-2.888063	0.1716	Non Stationary
LNFX	-1.171405	0.6836	Non Stationary	-3.670339	0.0299	Stationary
LNM2	-0.438591	0.8967	Non Stationary	-2.458891	0.3473	Non Stationary
LNNIR	-3.564384	0.0086	Stationary	-3.530235	0.0426	Stationary
LNCAB	18.98765	1.0000	Non Stationary	18.82800	1.0000	Non Stationary

Critical value for the ADF statistic with an intercept but not a trend = -2.9 at 95%
Critical value for the ADF statistic with an intercept and Trend= -3.5 at 95%

Table 3: Results of ADF unit root test at First Difference Level

Variables	intercept	P value	status	Intercept & Trend	P value	Status
LNNER	-8.141075	0.0000	Stationary	-8.123005	0.0000	Stationary
LNFX	-9.703788	0.0000	Stationary	-9.626260	0.0000	Stationary
LNM2	-4.706976	0.0002	Stationary	-8.893021	0.0000	Stationary
LNNIR	-7.195079	0.0000	Stationary	-7.188399	0.0000	Stationary
LNCAB	9.850877	1.0000	Non Stationary	6.100707	1.0000	Non Stationary

Critical value for the ADF statistic with an intercept but not a trend = -2.9 at 95%
Critical value for the ADF statistic with an intercept an Trend = -3.5 at 95 %

The results of the ADF show that all variables except LNNIR are non-stationary at levels with intercept. And also LNNIR and LNFX are only variables which are stationary at level with trend and with intercept. The LNNIR stationarity was attributed to the fact that, it had already been differentiated between KE NIR and US NIR. Again all variables a part from LNCAB were stationary at first difference level both with intercept and with trend and intercept.

This study therefore, concluded that all variables are stationary at first difference level while LNCAB is non stationary both at I(0) and I(1). Hence, this support the use of ARDL approach to cointegration was appropriate in this study to other conventional cointegration approaches such as Engle and Granger (1987), Johansen (1988) because of its applicability irrespective of whether the variables being integrated of order I(1) or I(0).

Philips -Perron unit root

This study estimated stationarity using PP test with intercept and with trend and intercept, both at level and first difference level to check the order of integration of these variables. Results are presented table 4 and table 5.

Table 4. Results of Philips -Perron unit root test at Level

Variables	Intercept	P Value	Status	With Trend & intercept	P Value	Status
LNNER	-1.428506	0.5647	Non Stationary	-3.056067	0.1237	Non Stationary
LNFX	-1.123543	0.7033	Non Stationary	-3.887631	0.0167	Stationary
LNM2	-0.445326	0.8955	Non Stationary	-1.466359	0.8335	Non Stationary
LNNIR	-3.254850	0.0202	Stationary	-3.124121	0.1075	Non Stationary
LNCAB	3.677493	1.0000	Non Stationary	1.381357	1.0000	Non Stationary

The results of the PP test on table 4. show that; at level with intercept all variables are non stationary part from LNNIR. And at levels with intercept and with trend all variables are non stationary a part from LNFX.

Table 5: Results of Philips -Perron unit root test at First Difference Level

Variables	Intercept	P Value	Status	Intercept & Trend	P value	Status
LNNER	-8.176041	0.0000	Stationary	-8.144462	0.0000	Stationary
LNFX	-10.74503	0.0001	Stationary	-10.60457	0.0000	Stationary
LNM2	-8.957375	0.0000	Stationary	-8.899049	0.0000	Stationary
LNNIR	-7.276207	0.0000	Stationary	-7.294936	0.0000	Stationary
LNCAB	-9.359609	0.0000	Stationary	-10.10869	0.0000	Stationary

The results of the PP test on table 5 show that all variables are stationary at first difference both with intercept at level and with intercept and with trend.

Optimal Lag Length Selection

The optimal number of lag length was important because the result of ARDL procedures is always sensitive to the lag length in its estimation as indicated by Pesaran et al. (2001). The lag length criteria in this study was carefully selected based on the Swartz-Bayesian information criteria (SBIC), the Akaike's information criteria (AIC), Final Prediction Error criteria (FPE), modified LR test statistics and the Hannan and Quinn information criteria as per Gujarati (2003).

Table 6: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-178.4733	NA	6.04e-05	4.474959	4.621710	4.533877
1	292.3944	872.8280	1.14e-09	-6.399865	-5.519358*	-6.046355*
2	314.3954	38.09921	1.24e-09	-6.326717	-4.712454	-5.678615
3	331.0595	26.82513	1.55e-09	-6.123402	-3.775384	-5.180709
4	370.5852	58.80657*	1.12e-09*	-6.477688*	-3.395914	-5.240403

This study used VAR model to establish optimal lag length by running equation (2) and result of respective lag length are shown in table 6 The Optimal lag length of 4 lag was recommended for this study because it was having lowest value criteria and supported by the majority criteria (LR, FPE and AIC).

ARDL Bounds tests for cointegration

For testing the existence of long run relationship between the dependent and explanatory variables, equation (2) was run by ordinary least squares (OLS). The Wald test (F-statistic) was

computed to differentiate the long-run relationship between the concerned variables (i.e. LNNER, LNCAB, LNFX, LNM2 and LNNIR). The computed F-statistic value was evaluated with the critical values tabulated in Table CI (iii) of Pesaran et al. (2001). The null hypothesis of no co-integration against alternative hypothesis of co-integration was tested and results represented in the table 7.

Table 7: Wald Test

Test Statistic	Value	df	Probability
F-statistic	5.500725	(5, 67)	0.0003
Chi-square	27.50362	5	0.0000

Critical value	Lower Bound Value	Upper Bound Value
1%	3.43	4. 60
5%	2.86	3.99
10%	2.57	3.66

The results indicated that there was evidence of cointegrating (the existence of a long-run) relationships between the LNNER and the other explanatory variables. The calculated F-statistic (5.51) was found to be greater than the upper bound critical value (3.99) at the 5 per cent level of significance at restricted intercept without trend. Thus, the null hypothesis of no cointegration was rejected, implying that there was a long run relationship amongst the variables.

ARDL Long Run Estimate

Since the selection of the lag length was important in estimating the ARDL (p, p,… p) model regression. A broader search analysis testing of the orders lag of length was done using AIC. In the first stage, this study estimated the general short and long-run models (which are not shown here) of equation (2) using the selected 4 lag length. In the second stage, variables which were not statistically significant in the long run were deleted in order to get parsimonious short and long-run models of ARDL model (4, 4, 2, 4, 1) based on Akaike information criterion with maximum recommended lag length of 4. The results of the parsimonious models are presented in table 8 below:

Table 8: ARDL (4, 4, 2, 4, 1) Model of Long run

Dependent Variable: D(LNNER)

Method: Least Squares

Sample (adjusted): 1994Q4 2014Q4

Included observations: 81 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.093542	0.472004	0.198180	0.8435
D(LNNER(-4))	-0.224207	0.116465	-1.925100	0.0583
D(LNCAB(-4))	-0.214218	0.105864	-2.023527	0.0468
D(LNFX(-2))	0.089679	0.047216	1.899344	0.0616
D(LNM2(-4))	-0.452051	0.167471	-2.699275	0.0087
D(LNNIR(-1))	0.002843	0.013364	0.212708	0.8322
LNNER(-1)	-0.185178	0.062912	-2.943445	0.0044
LNCAB(-1)	0.008262	0.016721	0.494122	0.6228
LNNIR(-1)	-0.019476	0.009328	-2.087855	0.0405
LNM2(-1)	0.097737	0.039795	2.456040	0.0165
LNFX(-1)	-0.053495	0.027616	-1.937105	0.0568
R-squared	0.295289	Mean dependent var		0.006735
Adjusted R-squared	0.194616	S.D. dependent var		0.062793
S.E. of regression	0.056352	Akaike info criterion		-2.788730
Sum squared resid	0.222292	Schwarz criterion		-2.463558
Log likelihood	123.9436	Hannan-Quinn criter.		-2.658267
F-statistic	2.933156	Durbin-Watson stat		1.838405
Prob(F-statistic)	0.003964			

The Parameter Estimates for Long Run Coefficient:

$LNNER_t = 0.0935 + 0.08262LNCAB_t - 0.01947LNNIR_t + 0.0977LNM2_t - 0.05349LNFX_t$

The results show that, in the long run, assuming other determinants remain unchanged: a percentage increment in LNCAB leads to around 0.8262 per cent increase of the nominal exchange rate, a percentage increment in LNNIR leads to around 0.0194 per cent decrease of nominal exchange rate, a percentage increment in LNM2 leads to around 0.0977 per cent increase of nominal exchange rate and lastly, a percentage increment in LNFX results in about 0.05349 per cent decrease of nominal exchange rate. All the variables included in the estimation of LNNER, apart from LNCAB, were found to be statistically significant.

The long-run model (Table 8) shows that all the variables were having the expected signs as predicted by economic theory. According to economic theory, increase in LNCAB and LNM2 decrease LNNER while increase in LNNIR and LNFX decreases LNNER.

The coefficient of multiple determination (R^2) measures the goodness of fit of the regression equation. This is, it gives the proportion or percentage of the total variation in the dependent variable Y explained by the (single) explanatory variable X Gujarati, (2004). The R^2 was found to be 0.295 approximately 30% showing that jointly all the explanatory variables account for 30 percent of the changes in the dependent variable. The adjusted R^2 of 0.1946 takes into account the degrees of freedom and was reflecting that up to 20 percent of the changes in the dependent variable was being explained in the model.

To test the predictive power of the model, the F-statistic confirmation was required. The F-statistic is closely related to R2 such that when R2 is equal to zero then the F-Statistic will be as well equal to zero, Gujarati (2004). The estimated parameters with respect to LNNER were equal to 2.933 and significant. This confirms that movements in estimated variables (explanatory variables) have a significant impact on LNNER.

Diagnostic Tests of long run model

The ARDL Long run Model was subjected to thorough diagnostics tests in order to determine its robustness. The model was tested for serial correlation, heteroscedasticity and normality. The stability of the model was confirmed using the CUSUM test.

Serial Correlation

The Breusch-Godfrey LM test with four lags length was performed in order to test null hypothesis of no serial correlation against alternative of serial correlation. The result is presented in the table 9.

Table 9: Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.879624	Prob. F(4,66)	0.4810
Obs*R-squared	4.099601	Prob. Chi-Square(4)	0.3927

With an F-statistic of 4.099 and a p-value of 0.393 which was more than 5% significant level, the null hypothesis was accepted and this confirmed that there was no serial correlation of the error term.

Heteroscedasticity test

The white test (Breusch-Pagan test for heteroskedasticity) was applied to the residuals of the model to find out if the variance of the error terms were constant. The null hypothesis of homoscedasticity of error term while the alternative hypothesis of heteroscedasticity of the error terms was tested and the results are reported in the Table 10.

Table 10: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.937199	Prob. F(10,70)	0.5052
Obs*R-squared	9.564219	Prob. Chi-Square(10)	0.4795
Scaled explained SS	50.27359	Prob. Chi-Square(10)	0.0000

The result shows that F-statistic of 9.564 and a p-value of 0.48 which was more than 5% significant level, the null hypothesis was accepted and this confirmed that there was no heteroskedasticity of the error term.

Normality Test

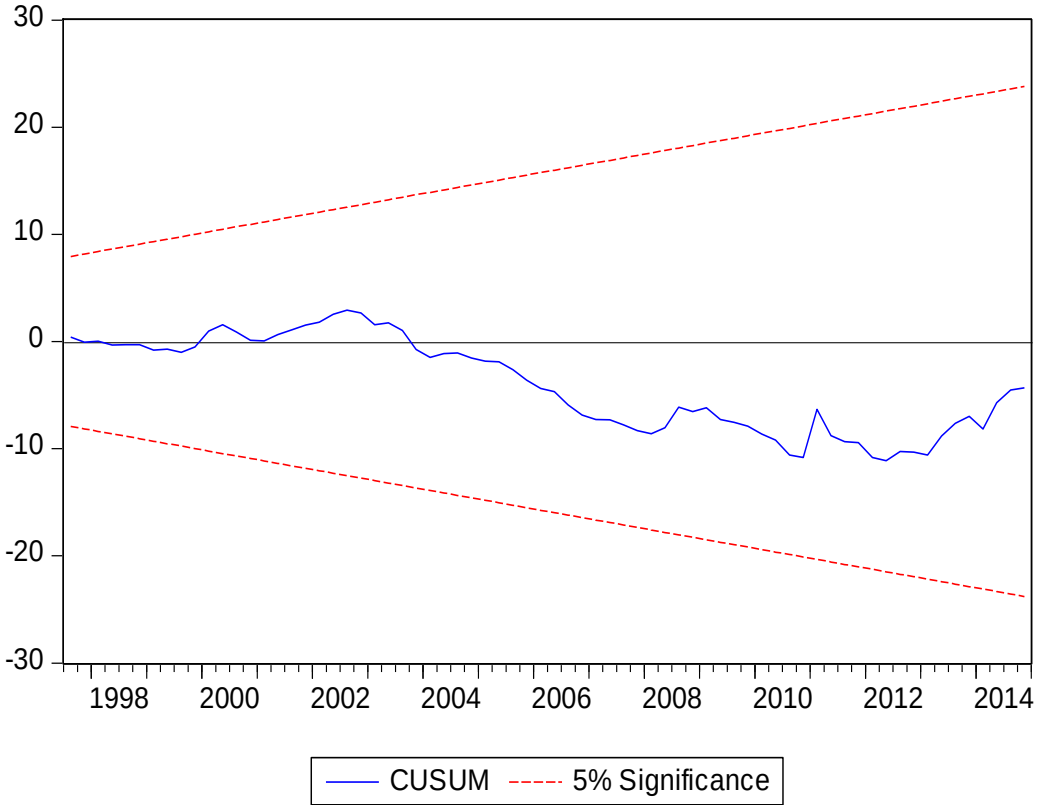
According to Islam and Ahmed (1999), and Takaendesa (2006) normality test was not most important tests after model has passed the serial correlation and the heteroscedasticity tests. However, the Jarque Bera normality test was used in this study to test normality of residuals. J-B test was based on the null that the residual was normally distributed against alternative hypothesis that residual was not normally distributed. The Jarque-Bera result indicates 3.156195(0.206367), thus confirming that the residual was normally distributed because P value was more than 5% significant level.

Stability Test

The stability of the parameters of the ARDL long run model was examined using the cumulative sum of the recursive residuals (CUSUM) tests proposed by Brown et al*.* (1975). The results of the stability tests are shown in Figures 2.

The results of Stability test show that the estimated ADRL long run model was dynamically and structurally stable because the CUSUM statistic stayed within the 5% critical bound.

Figures 2: The CUSUM Tests



Error Correction Model

Error Correction Term

This study first obtained ECT from the long run coefficient of one lagged explanatory variables ($LNCAB_{t-1}$, $LNNIR_{t-1}$, $LNFX_{t-1}$ and $LNM2_{t-1}$) of equation (2) estimated with a lag length of 4 divided by (multiplied by a negative sign) the coefficient of one lagged dependent variable ($LNNER_{t-1}$), i.e. Bardsen transformation (see Bardsen, 1989). The result obtained is show below:

ECT=LNNER(-1)-0.04300359*LNCAB(-1)+0.383292*LNFX(-1)+0.135102*LNNIR(-1)-0.67716*LNM2(-1)+0.27675

Error Correction Models

The ECT was lagged (ECT_{t-1}) and estimated with a lag length of 4 using equation (4). Variables which were not statistically significant were deleted in order to get parsimonious ARDL model (4, 4, 2, 4, 1). The result is presented in the table 11.

Table 11: Error Correction Model of the ARDL (4, 4, 2, 4,1)

Dependent Variable: DLNNER

Method: Least Squares

Sample (adjusted): 1994Q4 2014Q4

Included observations: 81 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.043544	0.014711	-2.960047	0.0041
D(LNNER(-4))	-0.181241	0.111599	-1.624036	0.1086
D(LNCAB(-4))	-0.206362	0.095717	-2.155951	0.0343
D(LNFX(-2))	0.062205	0.043608	1.426461	0.1579
D(LNM2(-4))	-0.359861	0.154140	-2.334634	0.0223
D(LNNIR(-1))	-0.023203	0.011917	-1.947124	0.0553
ECT(-1)	-0.159093	0.035890	-4.432853	0.0000
R-squared	0.313542	Mean dependent var		0.006735
Adjusted R-squared	0.257883	S.D. dependent var		0.062793
S.E. of regression	0.054094	Akaike info criterion		-2.913737
Sum squared resid	0.216535	Schwarz criterion		-2.706810
Log likelihood	125.0064	Hannan-Quinn criter.		-2.830715
F-statistic	5.633289	Durbin-Watson stat		2.185940
Prob(F-statistic)	0.000074			

The result shows ccoefficient for Error Correction Term is -0.15909 (0.000) and highly statistically significant and has correct sign (negative). The result supports evidence of cointegration relationship among variables in the model. Particularly, the estimated value of ECT_{t-1} is -0.159093, implying that the speed of adjustment to the long run equilibrium in response to the disequilibrium caused by the short run shocks of the previous period was 16 percent per. i.e. the coefficient of the feedback parameter was –0.159093, and this suggests that, LNNER exceed their long-run relationship with LNCAB, LNM2, LNNIR and LNFX, and they adjust at a rate of about 16 percent per quarter.

Diagnostic Tests of Short Run Model

The Short run Model was subjected to thorough diagnostics tests in order to determine its robustness. The model was tested for serial correlation, heteroscedasticity test and normality. It stability was confirmed by the CUSUM test.

Serial Correlation

The Breusch-Godfrey LM test with four lags was performed in order to test serial correlation. The null hypothesis of no serial correlation against alternative of serial correlation was tested and the results are reported in the table 12.

Table 12: Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.024201	Prob. F(4,70)	0.4009
Obs*R-squared	4.478482	Prob. Chi-Square(4)	0.3451

The results show that F-statistic of 4.48 and a p-value of 0.40 which was more than 5% significant level, thus the null hypothesis was accepted and this confirmed that there was no serial correlation of the error term.

Heteroscedasticity test

The white test (Breusch-Pagan test for heteroskedasticity) was applied to the residual of the short term model. The null hypothesis of the error term was homoscedasticity against the alternative hypothesis of the error terms are heteroscedasticity was tested and results are reported in the Table 13.

Table 13: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.086601	Prob. F(6,74)	0.3784
Obs*R-squared	6.558503	Prob. Chi-Square(6)	0.3636
Scaled explained SS	40.82666	Prob. Chi-Square(6)	0.0000

The result shows that F-statistic of 6.56 and a p-value of 0.38 which is more than 5% significant level, hence the null hypothesis was accepted, and this confirmed that there was no heteroskedasticity of the error term.

Normality Test

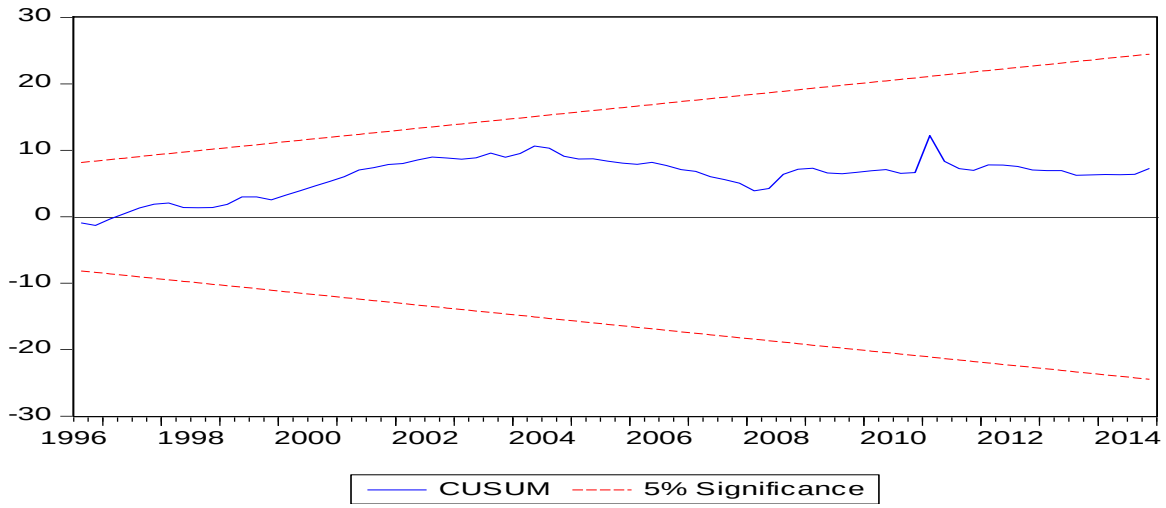
According to Islam and Ahmed (1999), and Takaendesa (2006) normality test is not the most important test after model has passed the serial correlation and the heteroscedasticity tests. However, the Jarque Bera normality test was used in this study to test normality of residuals. J-B test was based on the null hypothesis that the residuals are normally distributed against alternative that residual was not normally distributed. The Jarque-Bera result indicates that

1.818 (0.403) thus confirming the residual was normally distributed because P value was more than 5% significant level.

Stability Test

The stability of the parameters of the Error Term Model was examined using the cumulative sum of the recursive residuals (CUSUM). The results of the stability tests are shown in Figures 3. The model was found stable because the CUSUM statistic stay within the 5% critical bound as shown below.

Figures 3: The CUSUM Tests



SUMMARY

This study summarized the empirical findings as follows. First stationarity test of the variables was conducted using Augmented Dickey-Fuller (ADF) unit roots test and Philips -Perron unit root test. ADF test show that all variables are stationary at first difference level while LNCAB is non stationary both at I(0) and I(1). The results of the PP test show that all variables including LNCAB are stationary at first difference. Hence, this supports the use of ARDL approach to cointegration as appropriate in this study to other conventional cointegration approaches such as Engle and Granger (1987), Johansen (1988) because of its applicability irrespective of whether the variables are integrated of order I(1) or I(0)

Arising from this scenario the study employed ARDL model to estimate long run model using the VAR Lag Order Selection Criteria and adopted 4-period lag lengths. The empirical result of the hypotheses tested showed that: a percentage increment in LNCAB leads to around 0.8262 per cent increase of the nominal exchange rate, a percentage increment in LNNIR leads to around 0.0194 per cent decrease of nominal exchange rate, a percentage increment in LNM2

leads to around 0.0977 per cent increase of nominal exchange rate and lastly, a percentage increment in LNFX results in about 0.05349 per cent decrease of nominal exchange rate. All the variables included in the estimation of LNNER, apart from LNCAB, were found to be significant. The long-run model showed that all the variables were having the expected signs as predicted by economic theory. According to economic theory, increase in LNCAB and LNM2 decrease LNNER while increase in LNNIR and LNFX decreases LNNER. The ARDL long run model passed all the diagnostic tests such as normality, serial correlation and heteroscedasticity test. The CUSUM test confirmed the stability of the long-run relationship.

Lastly, the Short run model was consequently estimated with a lag length of 4 and variables which were not statistically significant were deleted in order to get parsimonious ARDL model (4, 4, 2, 4, 1). The error correction term was strongly significant and having the right sign (negative); this means the estimated speed of adjustment to the long run equilibrium in response to the disequilibrium caused by the short run shocks of the previous period was found to be 16 percent per quarter. The estimated Error Correction model passed all diagnostic tests and was stable as confirmed by the CUSUM test.

CONCLUSIONS

This study examined determinants of nominal exchange rate fluctuations in Kenya using an Autoregressive Distributed Lag (ARDL) approach over the period 1993Q3 when Kenya authorized floating exchange rate to 2014Q4. The study examined the short and long-run determinants of nominal exchange rate fluctuations in Kenya. Dependent variable was nominal exchange rate while explanatory variables were money supply, foreign exchange reserves, current account balance, and interest rate differential. Empirical results confirmed that money supply, foreign exchange reserves, interest rate differentials are significant determinants of the nominal exchange rate in Kenya while current account balance is not a significant determinant. The ARDL bounds test approach confirmed lung run relationship between nominal exchange rate and the explanatory variables. The error correction term was strongly significant and having the right sign (negative), this means that the estimated speed of adjustment to the long run equilibrium in response to the disequilibrium caused by the short run shocks of the previous period was found to be 16 percent per quarter. Both ARDL long run and error correction models were found to be robust because they passed all diagnostic tests such as serial correlation, heteroskedasticity and normality test. The CUSUM test confirmed the stability of both estimated models.

RECOMMENDATIONS

For Policy Making

The findings from this study have some implication for monetary and fiscal policy formulations in Kenya mostly in determining the nominal exchange rate in Kenya. The study proposes the following recommendations for the economy.

The study found that interest rates differential is a significant determinant of nominal exchange rate in the long run. This implies monetary policy is a crucial tool in maintaining stable exchange rate. Therefore there is room for the monetary authority to use interest rate policy to stabilize the exchange rate. Interest rate has implications for investment decisions making and international capital flows into Kenya, especially in globalised financial markets. Money supply is also significant determinant of nominal exchange rate. Excess money supply in the economy causes depreciation of exchange rate; therefore there is room for the monetary authority to pursue a monetary policy which can maintain stable exchange rates. Findings from this study show foreign exchange reserve is also one of the major determinants of nominal exchange rate in Kenya with significant effects. Therefore, this presents another monetary policy tool to stabilize the exchange rate. Lastly, findings from this study show that current account balance has the right sign but not significant determinant of nominal exchange rate in Kenya.

For Further Studies

This study employed the bounds testing (ARDL) approach to cointegration to examine determinants of exchange rate in Kenya. Although literature on exchange rate determination is wide, Kenya like many other African countries has attracted little research despite the fact that exchange rate remains one of the mostly discussed because of its implication on prices in developing countries. For more understanding of determinants of exchange rate, this study proposes that future studies may focus on the following areas;

i. It may interesting for a study that compares the impact of exchange rates on inflation because majority of developing countries have extensively carried out studies on exchange rates either focused on the impact of exchange rate volatility on trade or on growth.
ii. A study should also be conducted on relationship between exchange rates and stock prices in Kenya. The focus variables should be exchange rate, interest rate and stock prices and foreign direct investment.
iii. The relationship between the real exchange rate and economic growth in Kenya, the focus variables should be exchange rate, GDP, foreign direct investments and net foreign assets.

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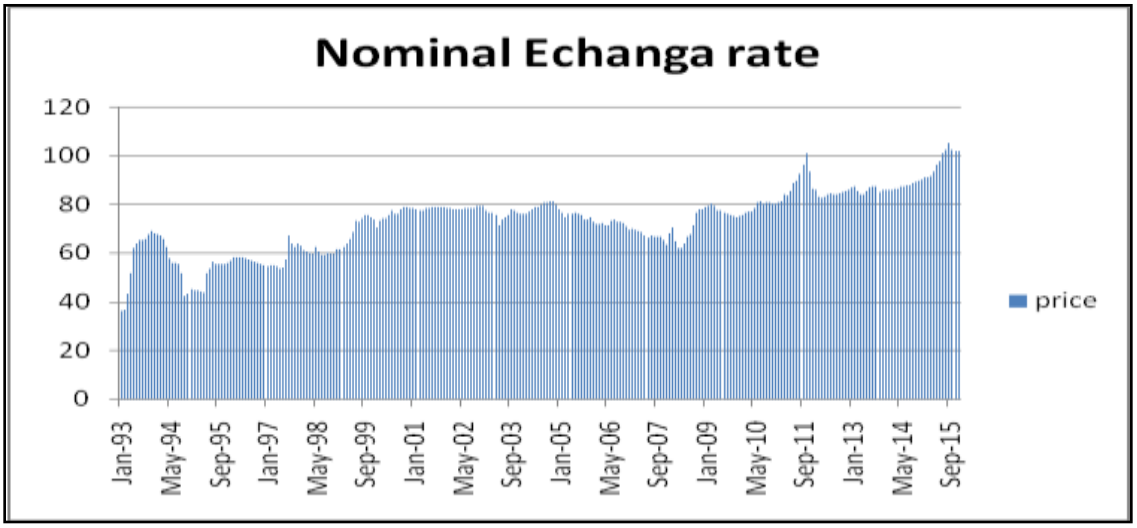
APPENDICES

APPENDIX I: Graph of Exchange Rate from Oct 1993 to Nov 2015.



APPENDIX II: Graphical method result of Stationarity