United Nations
Economic Commission for Africa

Exchange Rate Stability, Foreign Exchange Reserves, Monetary Policy and Expectations: The Case of Kenya

United Nations
Economic Commission for Africa

Exchange Rate Stability, Foreign Exchange Reserves, Monetary Policy and Expectations: The Case of Kenya

To order copies of ***Exchange Rate Stability, Foreign Exchange Reserves, Monetary Policy and Expectations: The Case of Kenya***, please contact:

Publications and Conference Management Section
Economic Commission for Africa
P.O. Box 3001
Addis Ababa, Ethiopia
Tel: +251 11 544-9900
Fax: +251 11 551-4416
E-mail: eca-info@un.org
Web: www.uneca.org

First printing June 2020

Designed and printed in Addis Ababa by the ECA Printing and Publishing Unit. ISO 14001:2015 certified.
Printed on chlorine free paper

Cover and inside photos: Shutterstock.com

Table of Contents

Acknowledgements ..... **v**

Abstract ..... **vi**

1. Introduction **1**

2. Literature review **3**
2.1 Purchasing power parity and interest rate parity **3**
2.2 Balance of Payments **4**
2.3 Exchange rate stability and other determinants of exchange rate **5**

3. Overview of exchange rate and monetary policy in Kenya **8**
3.1 Monetary policy in Kenya **9**
3.2 Exchange rate policy in Kenya **11**

4. Methodology **12**
4.1 Model Specifications **12**
i. Nominal and Real Exchange Rate Model **12**
ii. Foreign Exchange Reserves Model **14**

5. Estimation results and discussions **16**
5.1 Data Preliminaries **16**
5.2 Descriptive statistics **17**
5.3 Diagnostic tests **17**
5.4 Regression results **20**
i. Nominal exchange rate model 20
ii. Real exchange rate model 21
iii. Foreign exchange reserves model 23

6. Conclusions and policy implications **25**

References **27**

Liast of Figures

Figure I: Depreciation and devaluation in the nominal exchange rate: 2010–2017 2
Figure II: Exchange rate volatility in Kenya 8
Figure III: Trend of some selected variables of interest (2000m1–2017m12) 16

List of Tables

Table 1: Kenyan monetary performance indicators (2007–2016) 10
Table 2: Summary statistics 17
Table 3: Results for unit root test 18
Table 4: Test for multicollinearity 18
Table 5: Test for heteroskedasticity 19
Table 6: Model stability test 19
Table 7: ARDL results (dependent variable: nominal exchange rate) 20
Table 8: ARDL Results – Long run, short run and speed of adjustment (dependent variable: nominal exchange rate) 21
Table 9: ARDL results (dependent variable: real exchange rate) 22
Table 10: ARDL Results – Long run, short run and speed of adjustment (dependent variable: real exchange rate) 23
Table 11: ARDL Results (dependent variable: foreign exchange reserves) 24
Table 12: ARDL Results – Long run, short run and speed of adjustment (dependent variable: foreign exchange reserves) 24

Acknowledgements

This paper benefited from the overall guidance of Adam Elhiraika, Director, Macroeconomics and Governance Division at the Economic Commission for Africa. This paper was written by Khaled Hussein, Chief of Macroeconomic Analysis Section in the Macroeconomics and Governance Division, and Duncan O. Ouma, Economist Consultant in the Macroeconomic Analysis Section, Macroeconomics and Governance Division.

The paper also benefited from in-country consultations with Esman Morekwa *Nyamongo,* Leonard Kipyegon, Lydia Ndirangu, and Maureen Odongo from the Central Bank of Kenya; Livingstone Bumbe and Robert Osudi from the National Treasury, Kenya; Collins Omondi and Rosemary Bowen from the Kenya National Bureau of Statistics; Rose Ngugi and Benson Kiriga from the Kenya Institute for Public Policy Research and Analysis; Habil Olaka and Jared Osoro from the Kenya Bankers Association**;** Daniel N. Gachau, Nicasio Karani and Kelevilin Kimathi from Equity Bank, Kenya; Eva Murigu-Otieno, Betty Omuom and Makabelo Malumane from Standard Chartered Bank, Kenya.

Abstract

The objective of this study is twofold: first, to empirically investigate the impact of monetary policy instruments on nominal and real exchange rates; and, second, to assess the role of expectations, speculation and other macroeconomic fundamentals on nominal and real exchange rates. In addition, in the study, the determinants of foreign exchange reserves are reviewed, using a time series monthly data for the period 2000–2017. Several techniques are employed, including, in particular, autoregressive distributed lag models, which use the bound-testing technique. The analysis finds varying short-run and long-run relationships. The results have several policy implications. First, expectations and speculations are more significant factors in exchange rate movement than foreign reserves. Second, the interventions in the domestic goods market to control prices may not only be costly but they could also worsen exchange rate movements. Third, macroeconomic fundamentals play a significant role in the stability of the foreign exchange market. Fourth, central banks need to consistently assess and evaluate the effectiveness of the instruments used to achieve stability.

Keywords: Exchange rate; monetary policy; expectations; economic fundamentals; speculations; foreign exchange reserves.

1. Introduction

Real exchange rate is a key variable in the macroeconomic performance of a country. It can be used to measure a country's international competitiveness, growth and volume of trade, and therefore has a strong influence on economic performance. Exchange rate changes can lead to financial and balance-of-payment crises, but they can also support employment, output growth, economic development and accordingly, the quality of life in a country. Exchange rate provides macroeconomic linkage between the domestic economy and the rest of the world through the goods market and the asset market. Additionally, it provides microeconomic linkages that involve allocation of resources. A competitive real exchange rate draws resources into the traded goods sector, which is mirrored in the factor market by the reallocation of resources (Moosa and Bhatti, 2010). On the other hand, monetary policy is also a key component of any pro-growth economic system, especially in developing economies. A forward-looking independent monetary policy focuses not only on price stability, but also on other development goals in the context of the 2030 Agenda for Sustainable Development.

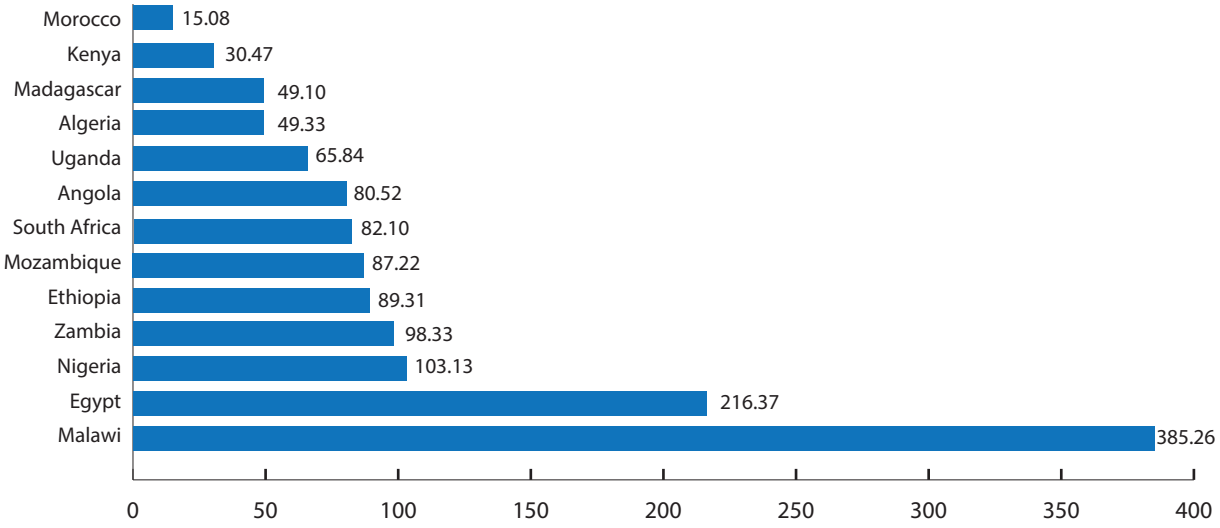
The exchange rates of developed and developing countries have fluctuated significantly over time, as many countries shift between various forms of exchange rate regimes. The trends have generated interest in exploring costs and benefits of different exchange rate arrangements, the factors that may account for the fluctuations, and the possible remedies. In particular, substantial fluctuations in nominal and real exchange rate values have raised interest as to whether exchange rates are driven in a systematic fashion by a small set of economic fundamentals identified by researchers (Boke and Doganay, 2014).

Given the role of the exchange rate in economic performance, exchange rate management and determination of an optimal and sustainable exchange rate arrangement have become one of major macroeconomic policy challenges facing many monetary authorities and central banks in Africa. The choice of exchange rate regime is determined by several factors, including, among them, the objectives pursued by the policymakers, the sources of shocks hitting the economy and the structural characteristics of the economy. Whichever regime is chosen, the authorities are presumed to adjust their macroeconomic policies (fiscal and monetary policies) to fit the chosen exchange rate policy. Governments use monetary policy to influence monetary aggregates, such as money supply, interest rates and exchange rate, with the aim of achieving macroeconomic policy targets, such as full employment, price stability, favourable balance of payment and economic growth.

Over the past two decades, African economies have been hit by exogenous and endogenous shocks. In response to these shocks, short, medium and long-term policies have been put in place, with instances of short-term policies dominating long-term strategies that could secure future stability. The debate on whether such monetary and exchange rate policy responses have been appropriate is ongoing. This debate narrows down to the role of central banks in providing appropriate coping strategies amid the shocks, and in aligning their strategies with the African transformative policy agenda (ECA and African Union, 2016).

Policy responses have been driven by the shocks themselves and the degree of exposure and policy flexibility in economies. The central banks must strike a balance between steering the economy through the shocks and confronting the looming threats resulting from the global shocks. Additionally, the central banks must confront and overcome possible conflicts between maintaining inflation-targeting regimes and intervening in foreign exchange markets to achieve price stability domestically.

Figure I: Depreciation and devaluation in the nominal exchange rate: 2010–2017



The currencies of most African countries in the past few years have experienced depreciation or devaluation. On average, the African countries' currencies depreciated by 18.77 per cent in 2015,[1] with Zambia leading at 40.30 per cent, followed by South Sudan (38.62 per cent).[2] The average exchange rate in Africa, as measured by the yearly local currency unit (LCU) per dollar, further depreciated by 2.94 per cent in 2016.[3] The depreciation across the continent is worth noting, not only because of its magnitude, but also because of its rapidness and the economic implications. With a relatively low level of foreign reserves (US$ 7.6 billion), Kenya appears to have achieved a more stable exchange rate compared to other countries across the continent with larger amounts of foreign reserves, such as Algeria ($113 billion), Libya ($63 billion), South Africa ($40 billion), Nigeria ($27 billion), Morocco ($23 billion), Angola ($23 billion) and Egypt ($20 billion).[4] The fluctuations in exchange rates across the continent can be attributed to domestic and external factors, including, among them, the domestic business and political environment, rising public debt, current account deficits, shocks in commodity prices, global market uncertainty and tightening monetary policy in advanced economies, among others.

The objective of this study is to conduct an empirical assessment of the role of monetary policy in exchange rate stability in Kenya. To do this, the following are investigated: the effect of the monetary policy instruments on nominal and real exchange rate; the role of expectations, speculations and other macroeconomic fundamentals on exchange rate stability; and the determinants of foreign exchange reserves in Kenya. The rest of the study is organized as follows: section 2 presents a literature review, while the overview of exchange rate and monetary policies in Kenya is presented in section 3. Study methodology and empirical findings are presented and discussed in sections 4 and 5, respectively. Finally, section 6 includes the conclusions and policy implications of the study.

1 The statistics are based on author's computations using data from the World Bank World Development Indicators database, 2018.
2 The other countries which experienced currency depreciation/devaluation of 20 per cent and above are Mozambique, Nigeria, Uganda, Algeria, Angola, Madagascar and the members of the West African Economic and Monetary Union (WAEMU). According to ECA (2017), this depreciation in most African countries was driven by low commodity prices and large fiscal and current account deficits. The Ethiopian birr and Ghanaian cedi were generally stable while the Kenyan shilling appreciated from the last quarter of 2015 to the middle of the second quarter of 2016.
3 This was also led by major depreciation/devaluation in a number of countries, including Mozambique (57.71 per cent), Malawi (43.81 per cent), Angola (36.31 per cent), Nigeria (31.72 per cent) and Zambia (19.47 per cent). The Ethiopian birr was devalued by 15 per cent in the last quarter of 2017.
4 The foreign reserves figures for 2016 were obtained from the IMF International Financial Statistics database in 2018. It is defined as total reserves excluding gold, foreign exchange and U.S. dollars.

2. Literature review

Many theories have been put forward to explain exchange rate behaviour. Models have been developed and modified by various economists over the years, including, among them, the purchasing power and interest rate parity approach; the balance of payment approach; the monetary models; the equilibrium and liquidity models; and the portfolio approach. Testing and comparing these models is well beyond the scope of this study. In this section, the theoretical background and modifications of some of these models and some empirical studies used to inform the theoretical framework and model specification for this study are reviewed.

2.1 Purchasing power parity and interest rate parity

The theory of purchasing power parity (PPP) states that change in the exchange rate between two currencies for any given time period is determined by change in the countries' relative price levels. It implies that the exchange rate between any two countries is in equilibrium when their domestic purchasing powers at that rate of exchange are equivalent. Accordingly, changes in price level are the main determinant of movements in the exchange rate (Otuori, 2013). The theory assumes that without transaction costs, identical goods would have similar prices in different markets, that is, the law of one price. Based on PPP, the percentage change in the exchange rate between two currencies is approximately equal to the difference in their respective countries' rate of inflation.

$$\%\Delta e = \%\Delta P^{d} - \%\Delta P^{f} \quad \text{.....1}$$

Where:

e – Exchange rate (between domestic currency and foreign currency)

P^{d} – Domestic price level

P^{f} – Foreign price level

As the concept of PPP is derived from the law of one price, it is subject to the same limitations of inflation rate, transport and other transaction costs. It is, however, an important and recurrent concept in international finance, which is used in a number of theories of exchange rate and balance of payments (Hallwood and McDonald, 2000). This theory implies that price differentials (terms of trade) between two trading partners is the main determinant of the exchange rate of the two currencies.

The theory of interest rate parity (IRP) suggests that the interest rate differential between two countries is equal to the differences between the two countries' spot exchange rate and forward exchange rate. This theory plays a critical role in exchange markets by connecting spot exchange rates, foreign exchange rate and interest rates. Interest rates, inflation and exchange rates are all highly correlated. It, therefore, implies that any changes in the interest rate by the monetary authority influence the countries' exchange rate and inflation rate (Alexius, 2001). This happens through the capital account of balance of payment. Higher interest rates attract capital inflows, raising the demand for domestic currency and the exchange rate. Interest rate parity can be stated in two ways: uncovered interest parity (UIP); and covered interest parity (CIP).

Uncovered interest parity holds that the differences between the current spot exchange rate and the expected future spot rate of two currencies reflect the differences in the interest rate on short-term assets denominated in the two currencies. It holds when the interest differential just equals the expected premi-

um or discount on foreign exchange. On the other hand, CIP refers to a condition in which the relationship between interest rates and the spot exchange rate and forward exchange rates between two countries are in equilibrium, leaving no room for interest arbitrage.

$$UIP: \quad (i^d - i^f) = (e^e - e)/e \quad \text{.....2}$$

$$CIP: \quad (i^d - i^f) = (e^f - e)/e \quad \text{.....3}$$

Where:

i^d *– Interest rate on the domestic currency denominated assets*

i^f *- Interest rate on the foreign currency denominated assets*

e – spot exchange rate

e^e *– expected future exchange rate*

e^f *– forward exchange rate*

Equation (2) assumes strong uncovered interest parity, which in reality does not exist because of the numerous frictions that can violate the no-arbitrage condition (Stavrakeva and Teng, 2015). The frictions are the inability of investors to borrow at the risk-free government bond rate, counterparty risk, and the value-at-risk constraints. The expected changes in exchange rate is given as:

$$E_t \Delta e_{t+1} = i_t^d - i_t^f + \delta_t \quad \text{.....4}$$

Where δ captures currency risk premium and the frictions, the realized changes in exchange rate becomes:

$$\Delta e_{t+1} = i_t^d - i_t^f + \delta_t + \Delta e_{t+1} - E_t \Delta e_{t+1} \quad \text{.....5}$$

Where $\Delta e_{t+1} - E_t \Delta e_{t+1}$ is an expectional error, which is assumed to have a mean of zero and to be uncorrelated with variables in the information set used to form exchange rate expectations in period t, Stavrakeva and Tang (2015) reviewed the conventional and unconventional measures of monetary policy as drivers of nominal exchange rates. They found that shocks in monetary policy and changes in the expectations about future monetary policy have a significant impact on exchange rate variations in some countries.

2.2 Balance of Payments

Developed by Krueger (1969), the theory of balance of payments, also known as the demand and supply theory of exchange rate, suggests that the exchange rate is determined through the balance of payments depending on the balance between demand and supply of foreign exchange in the exchange market. Credits in the balance of payments constitute the supply of foreign exchange made by the exporting countries. On the other hand, debits constitute the economy's demand for foreign exchange emanating from the importing countries. Any surplus or deficit realized in the balance of payments results in changes in the demand or in the supply of foreign exchange, which leads to fluctuations in the foreign exchange rate.

Favourable balance of payments raises a country's exchange rate above the long-run equilibrium exchange rate, which, in turn, reduces the country's competitiveness (Kanamori and Zhao, 2006). The theory, also

referred to as the general equilibrium theory of exchange rate, is, however, based on several unrealistic assumptions, including, among them, a contemporary integrated world market, limited holding of stocks and long lags in market information dissemination. With the advancement of technology, information on commodity and financial markets is shared almost in real time. It also assumes perfect competition with no government intervention in the foreign exchange market. Other limitations of the theory are that it fails to explain the determinants of the internal value of a currency; it considers the balance of payments as a fixed quantity; it ignores the connection between the rate of exchange and the internal price level; and the theory is indeterminate at a time. These assumptions are unrealistic in the real-world scenario.

2.3 Exchange rate stability and other determinants of exchange rate

The theories and models of exchange rate determination have identified several factors that are likely to determine the level and movement of exchange rates. Debate on the causes of exchange rate fluctuations rages on among scholars and policy analysts. This debate has dominated recent literature in international finance, owing to the effects of exchange rate fluctuations on the economies of developing countries, and the intensity and frequency at which the fluctuations (depreciation) have been experienced in these countries (Africa specifically) in recent years.

Many countries are holding very large amounts of foreign currency reserves, mainly the United States dollar. Countries hold the reserves for various reasons, including, among them, the ability to stabilize the exchange rate (monetary policy perspective), the need to caution the domestic economy from global or imported financial crises (financial stability considerations) and the need to ensure that sufficient funds are available to service the Treasury's foreign liabilities.

For instance, following the 1997 Asian financial crisis, the emerging Asian countries' accumulated foreign currency holdings were 40 per cent of the world's total foreign currency holdings, with China being the second and India the fifth largest holders of foreign currency worldwide (Hagiwara, 2005; Romero, 2006). Nevertheless, the debate on the benefits and costs of large holdings of international reserves is inconclusive.

Many African countries hold large amounts of reserves. The largest holders of foreign reserves have also experienced significant volatility (depreciation) of their exchange rates in recent years. For instance,[5] Algeria leads with $113 billion of foreign reserves, but the exchange rate has depreciated by 60 per cent in the past 10 years; Nigeria holds reserves of $40 billion and recorded a 102 per cent depreciation in the exchange rate in the past decade; and South Africa with reserves of $27 billion has experienced a 114 per cent loss in the value of its currency in the past decade. On the other hand, Kenya with foreign reserves amounting to only $7.6 billion has experienced a 51 per cent loss in the value of its currency. It is, therefore, important to examine why countries hold large amounts of reserves. Could these resources be used in a more productive manner that promotes economic growth and development (such as financing infrastructural development) rather than being kept idle as reserves?

According to Aizenmann and Marion (2003), supporters of large holdings of reserves argue that the opportunity cost of holding the foreign reserves is small compared with the economic consequences of sharp devaluation (or depreciation) of the currency that may occur in the absence of the reserves. Reserves are, therefore, held to influence the exchange rate of a currency and prevent devaluation or depreciation. This is done by purchasing and selling the country's own currency to affect its demand and supply, which, in turn, helps to maintain a stable value in international markets. This argument is valid for both emerging and developing economies, whose debt is mostly denominated in foreign currencies and would be greatly affected by such devaluation or depreciation. Devaluation also affects the cost of imported goods and raises inflation.

5 The figures are based on the data from World Development Indicators (2018).

It is, therefore, clear that there are benefits and costs to holding foreign reserves, however it is not known if holding of reserves is a sufficient insurance against the shocks, or the appropriate way of managing exchange rate volatility. Additionally, assessing the optimal amount of reserves to be held by a country's central bank and whether the amount of reserves held should vary with the exchange rate regimes require an empirical analysis. Many countries hold foreign reserves in excess of four months' imports value. Some of the variables that are likely to determine the level of foreign reserves held by countries are balance of payment (both current account balance and capital account balance); average propensity to import (scope of international trade); amount of public debt; amount of money in circulation; exchange rate volatility and exchange rate regime (Fischer, 2001; Aizenmann and Marion, 2003; Benediktsson and Palsson, 2005).

The literature on expectations of the exchange rate dynamics is also wide. Empirical evidence and theoretical discussion emphasize the impact of "news" on exchange rates movements (Devereux and Engel, 2008). The exchange rate acts as an asset price, and as such, it responds to news about future returns on assets. This implies that the exchange rate should be insulated against the impact of shocks to expectations of future market outcomes. Lin (1994) demonstrated that an increase in public debt leads to the depreciation of the real exchange rate or a currency for a country with higher capital elasticity of output, while it appreciates the real exchange rate of a currency for a country with lower capital elasticity of output. Vamos (2015) also found debt-GDP ratio to have a positive and significant effect on the exchange rate of 15 emerging economies in Central Europe. Similary, Azam (1997) found that debt problem and poor debt management policy led to devaluation of the CFA in the franc zone in January 1994.

Njuguna (1999) assessed whether the exchange rate was affected by monetary policy in Kenya between 1970 and 1995, and whether such effects (if they exist) are permanent or transitory. Carrying out causality tests and using quarterly data, the empirical results showed that the nominal exchange rate was determined by real income growth, inflation rate, growth in money supply, the real exchange rate cycles, and the monetary shocks. The results further revealed that there were feedback effects between monetary shocks and the cyclical movements of the real exchange and that the cyclical component appreciated the nominal exchange rate, while growth in money supply depreciated the nominal exchange rate.

It was concluded based on the study that the exchange rate policy was not supported by an appropriate monetary policy. This is because monetary shocks were found to affect the real exchange rate, and at the same time the exchange rate policy accommodated the monetary disequilibrium (to protect the foreign reserves). This should not be the case under a floating exchange rate regime in which monetary policy should be independent and the exchange rate should fluctuate to ensure equilibrium in the reserves.

Zettelmeyer (2000) empirically analysed the effect of monetary policy on the exchange rate of currencies for three small open economies, Australia, Canada and New Zealand, using daily data on interest rates and exchange rates for the period 1990–2000. Employing a vector autoregression-based model, focusing on the immediate responses, the exchange rate reaction to monetary policy as one of the important channels for monetary transmission was analysed as part of the study. Understanding this reaction also helps to discriminate between models of business cycles, which may have different implications about how monetary policy should be conducted. Additionally, the need to understand the role of monetary policy in stabilizing exchange rates, especially during and after financial and currency crises, is raised in the paper. The monetary policies include change of cash rate target, inflation targeting and interest rate targets. The central banks also adopt discretionary interventions in spot markets and options markets, and automatic rule interventions. Both OLS and IV regression results show that, on average, a contractionary monetary shock that increases the interest rate leads to appreciation of the local currencies. The results further imply that any given change in policy target has prompted a smaller reaction of the exchange rate.

Benavides and Capistran (2009) investigated the volatilities in interest rates and exchange rates under two monetary policy instruments in Mexico for the period 1998–2008. The two instruments were the non-bor-

rowed reserves requirements target and the interest rate target. Using the test of multiple structural changes, the results show volatility declined significantly as Banco de Mexico transited from a non-borrowing reserves requirement targeting to interest rate targeting. Additionally, using a bi-variate generalized autoregressive conditional heteroskedasticity (GARCH) model and causality tests, the authors found a bi-directional causality between interest rate and exchange rate volatillities during the non-borrowed reserves requirement targeting, and no causality during and after the transition. However, the actual determinants of the volatilities observed and documented were not identified in the study, nor why the changes in the volatilities would be associated with the two monetary policy instruments.

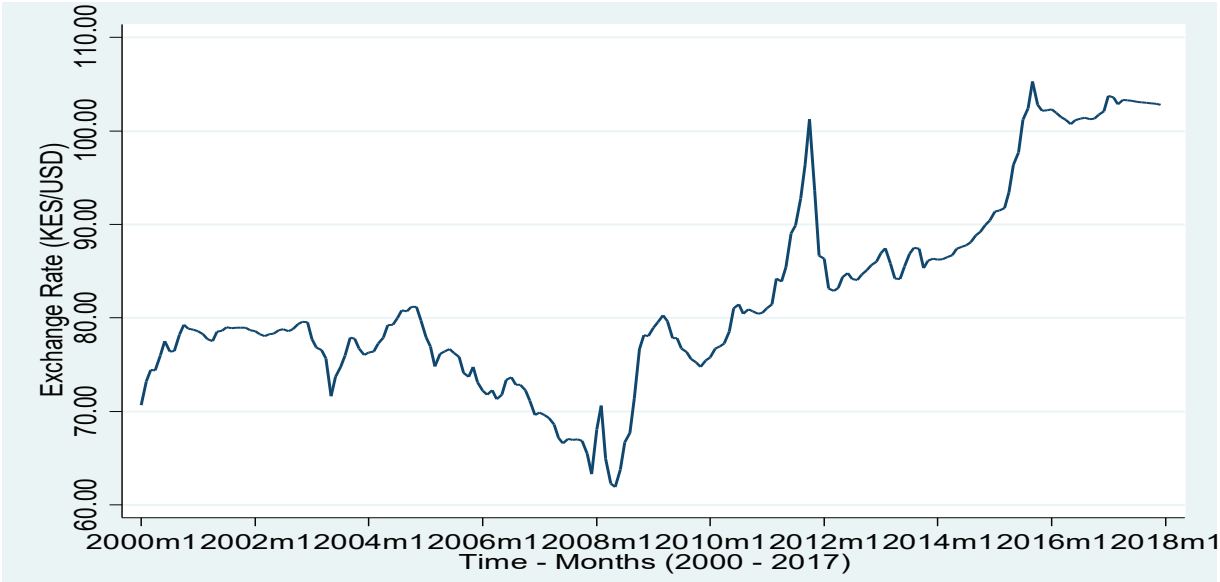
Alagidede and Ibrahim (2016) studied the causes of exchange rate volatility and its effects on economic growth in Ghana. The study was aimed at analysing the key drivers of the volatility and the channels of manifestation by an empirical approach. Using annual time series data for the period between 1980 and 2013, the authors estimated a GARCH model and showed that the drivers of exchange rate volatility vary in the short run and in the long run. In the short run, output is the most important driver of the fluctuations, while in the long run, volatility is significantly influenced by government expenditure, money supply growth and terms of trade shocks. The relationship between output and real exchange rate volatility is inverse, suggesting that decreases in output heighten volatility in real exchange rates. This implies that the interventions into short-run output fluctuations may be too costly and may not necessarily yield the intended benefits. Consequently, the optimal policy should be one that focuses on the source of the output fluctuations rather than intervening in the foreign exchange market.

3. Overview of exchange rate and monetary policy in Kenya

Kenya abandoned exchange rate controls in the early 1990s as part of reforms aimed at improving the investment environment and spurring economic growth (Ouma and Ihiu, 2018). The Kenyan shilling has remained relatively stable against the United States dollar and other major currencies for the last five years, with a slight general upward trend (depreciating by only about 15 per cent against the dollar).[6] However, the uncertainties surrounding the timing of the first interest rate increase in the United States following the tapering of quantitative easing led to a stronger dollar, undermining the stability of many emerging markets' and developing economies' financial markets. This caused volatility among most currencies of emerging markets' economies and currencies of frontier markets, including the Kenya shilling (K Sh). The shilling depreciated against the dollar in nominal terms from the first quarter of 2015 to the third quarter of 2015, peaking at K Sh 106.245 on 8 September 2015 (and monthly average of 105.27 Kenya shilling per dollar). However, it strengthened from the last quarter of 2015 before depreciating slightly again from July 2016. During this period, volatility increased as the local currency reacted to global and domestic developments (Central Bank of Kenya, 2016).

The volatility and depreciation was attributed to portfolio investors divesting from these markets for safe havens in developed economies' markets, from which returns were poised to rise with expected increases in interest rates. In Kenya, the local currency faced depreciation pressures from a strengthening dollar and high current-account deficits, reflecting the peak of capital equipment imports in 2014, weak exports receipts and increased foreign investors' outflows from the Nairobi Securities Exchange in the first half of 2015. The Central Bank of Kenya policy support through open market operations and existing foreign reserves of $7.6 billion (equivalent to 4.5 months of import cover) at the end of June 2015 together with the precautionary arrangements with the International Monetary Fund (IMF) of $1.5 billion continued to

Figure II: Exchange rate volatility in Kenya



Source: Based on Central Bank of Kenya (2018).

6 The statistics are based on author's computations using data from the World Bank World Development Indicators database, 2018.

provide adequate buffers against short-term shocks, restoring stability of the exchange rate from the end of 2015 through to the end of 2016.

The Central Bank of Kenya has downplayed the arguments about the inadequacy of its foreign exchange rate reserves to target the level and influence the direction of the exchange rate. Its position is that the bank's primary responsibility is to formulate and implement a monetary policy that achieves stability in the general price level, including the exchange rate, which is the price of the Kenya shilling. To achieve this stability, a combination of indirect monetary policy tools and/or instruments such as open market operations and statutory requirements are employed. Among these instruments are foreign exchange market operations. In a liberalized foreign exchange regime, the central bank only needs to allow the exchange rate to move in line with the fundamentals of the economy. Its participation in the foreign market is, therefore, limited to acquiring foreign exchange to service official debt, finance government imports, build foreign exchange reserves, and, in times of volatility, buy or sell foreign exchange to stabilize the market. Foreign exchange reserve becomes an indirect instrument of monetary policy (Central Bank of Kenya, 2013).

The experience of Kenya can be considered as a case of a flexible exchange rate regime producing expected results in macroeconomic performance, with the inflation rate largely within the monetary policy medium term target of 5 per cent (+/- 250 basis points) and the economy growing at an acceptable rate (above 5 per cent), though below the two-digit vision in the 2030 target. However, this was not the case at the offset of the adoption of the floating exchange rate regime. The exchange rate was floated in an environment of excess liquidity, and massive depreciation and high and accelerating inflation ensued. The mopping up process pushed the treasury bill rate up, and, because this is the benchmark for other interest rates, all other interest rates shot up to historic levels. The exchange rate of the Kenya shilling was devalued three times in 1993 (Njuguna, 1999).

3.1 Monetary policy in Kenya

Monetary policy affects the nominal exchange rate, which, in turn, affects inflation and output. A rise in the policy rate leads to an inflow of capital and appreciation of the domestic currency in nominal terms. This affects inflation as the domestic price of imported goods and the price of import-competing goods decline. For net importers of capital goods, the currency appreciation may also lead to a surge in private investment as the price of domestic investment goods also declines (Chavula and others, 2017).

The success of monetary policy depends on the operating economic environment, the institutional framework adopted, and the choice and mix of the instrument used. In Kenya, monetary policy is formulated by the monetary policy committee of the central bank, and is aimed primarily at achieving and maintaining overall inflation within the government target range as provided by the Cabinet Secretary for the National Treasury at the beginning of every fiscal year.[7] The Central Bank Rate (CBR) is the base for monetary policy operations. The monetary policy stance is then operationalized through various instruments including, among them, open market operations, changes in cash reserve requirements at the Central Bank of Kenya, foreign exchange market operations, and the Central Bank of Kenya standing facility (overnight discount window). To achieve the desired level of money supply, open market operations are conducted using repurchase agreements (repos), reverse repos, and term auction deposits. The implementation of monetary policy is then guided by the Central Bank of Kenya targets on the net international reserves and net domestic assets as the operational parameters (Central Bank of Kenya, 2017).

The Central Bank of Kenya works closely with the National Treasury to ensure coordination of monetary and fiscal policies for overall macroeconomic stability. The two institutions execute the government domestic

7 The Government through the Cabinet Secretary for the National Treasury provides the overall inflation target at the beginning of a fiscal year (FY). For FY 2016/17, the target was 5 per cent, with an allowable margin of 2.5 per cent on either side.

borrowing programme to support a stable yield curve and market stability. The Central Bank of Kenya also monitors the foreign exchange market in the light of the risks posed by increased uncertainties in the global financial markets. The foreign exchange reserves and the precautionary arrangements of IMF provide adequate buffers against short-term shocks. Additionally, the monetary policy measures in place are expected to moderate demand-driven inflationary pressures, while stability of the exchange rate is expected to moderate any possible effects of imported inflation on the price level. The Central Bank of Kenya also monitors any second-round effects on the rise in food prices on inflation.

Money supply (M1, M2 and M3) rose steadily from 2007 to 2016 (table 1). This growth could be attributed, for example, to domestic credit from the Central Bank of Kenya to the National Treasury; reduction in interest rates; and expansionary fiscal policy. Similarly, foreign exchange reserves also rose steadily from $3.3 billion in 2007 to $7.6 billion in 2016, while the exchange rate of the Kenya shilling depreciated by 51 per cent over the period, but with some fluctuations in between. The total domestic credit rose marginally from about 37.7 per cent of GDP in 2000 to 42.8 per cent in 2016. It fluctuated, however, between 2001 and 2009, reaching a minimum of 31.1 per cent in 2007.

The debt-GDP ratio worsened consistently during the same period, rising from 28.9 per cent in 2007 to 56.1 per cent in 2016. This can be attributed to the rising government budget deficit occasioned by a growing wage bill and increasing infrastructural expenditure. As much as debt may be seen as a stimulator of the domestic economy, massive public deficits and debts make countries less attractive to foreign investors.

Table 1: Kenyan monetary performance indicators (2007–2016)

YEAR	M11a	M22b	M33c	FER4d	TDC5e	INFL6f	TBR7g	PD-GDP8h	EXR9i	EXB10j
2007	373.3	666.9	775.9	3355.0	31.1	9.8	6.8	28.9	67.3	-10.1
2008	392.9	766.5	896.5	2878.5	33.9	26.2	7.7	31.4	69.2	-12.2
2009	442.2	898.1	1044.1	3849.0	35.6	9.2	7.4	36.7	77.4	-10.8
2010	577.2	1099.2	1277.5	4320.1	41.1	4.0	3.6	39.4	79.2	-12.9
2011	622.7	1254.0	1522.2	4264.4	41.7	14.0	8.7	45.1	88.8	-17.2
2012	710.7	1469.0	1741.3	5711.0	42.2	9.4	12.6	47.4	84.5	-13.3
2013	788.3	1632.8	2007.3	6598.2	43.8	5.7	8.9	51.9	86.1	-13.3
2014	936.4	1981.9	2336.4	7910.5	44.7	6.9	8.9	51.6	88.0	-14.7
2015	1015.7	2226.8	2666.7	7547.8	45.4	6.6	10.9	53.6	98.2	-11.1
2016	1308.9	2342.6	2764.5	7599.9	42.8	6.3	8.5	56.1	101.5	-8.8

1 a M1 is money supplied, measured in domestic currency (Kenya shillings) in billions, sourced from international financial statistics.
2 b M2 is money supplied, measured in domestic currency (Kenya shillings) in billions, sourced from international financial statistics.
3 c M3 is money supplied, measured in domestic currency (Kenya shillings) in billions, sourced from international financial statistics.
4 d FER is the total foreign exchange reserves minus gold comprise special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities. Gold holdings are excluded. Data are in current U.S. dollars, millions, sourced from the World Development Indicators.
5 e TDC is total domestic credit (as a percentage of GDP) provided by the financial sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net, sourced from World Development Indicators.
6 f INFL is inflation as measured by the consumer price index. It reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used, sourced from the World Development Indicators.
7 g TBR is the treasury bill rate, interest rates on treasury bills, per cent per annum, sourced from International Financial Statistics.
8 h PD-GDP is the total public debt to GDP ratio, per cent per annum, sourced from National Treasury, Kenya.
9 i EXR is official exchange rate determined by national authorities. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar), sourced from World Development Indicators.
10 j EXB is the external balance on goods and services, defined as the exports of goods and services minus imports of goods and services, sourced from World Development Indicators.

This is because large debts are associated with inflation rates (in Kenya, the inflation rate has remained low in the past couple of years). The country's external balance has remained in deficit for several years. Improvement in the balance of payment is associated with depreciation in the domestic currency, as demand shifts to the country's exports and domestic expenditure switches from imported to domestic products.

3.2 Exchange rate policy in Kenya

Many African countries have moved progressively through different systems of exchange rate arrangements; some shifting from a single currency peg to a weighted currency basket peg and then to a managed float or independently floating exchange rate regime. According to ECA (2008), the appropriate exchange rate regime for promoting pro-poor economic openness is one in which the government purposefully intervenes in the foreign exchange market with clear medium-term objectives of export promotion and exchange rate stability. This arrangement is preferable to "floating" regimes for a number of reasons: first, the view that economies have a unique, market-determined exchange rate that strikes the correct balance between tradable and non-tradable is incorrect in practice; and second, the practical goal of export promotion is achieved through devaluation, lowering the foreign currency price of a country's exports.

The main objective behind shifting exchange rate regimes is to find one that is optimal and sustainable. Experience in that regard is varied across African countries – ranging from a single currency peg to independently floating and monetary zone arrangements, such as the West African Economic and Monetary Union (WAEMU) and the Common Monetary Area (CMA) of Southern Africa. Many African countries are now moving towards liberalization of their exchange rate policy, and are removing many foreign exchange restrictions.

From the time of independence in the 1960s to the 1970s, Kenya maintained a fixed exchange rate, with the currency being overvalued at some point (Njuguna, 1999). This was coupled with exchange controls, domestic credit controls, interest rates controls and domestic prices controls that were ignited by the balance of payment crisis, which occurred in 1971–1972. As much as these controls had eased the inflationary pressure, they caused major distortions in the economy. In 1982, the country shifted to a flexible exchange rate regime. This included the flexible exchange rate regime with a crawling peg (1982–1990), and the dual and floating exchange rates in 1990. The country experienced a period of relatively lower inflation rates during the crawling peg regime, but the floating regime led to high inflation rates and a rise in interest rates. The low inflationary pressure during the crawling peg regime can be attributed to the foreign exchange import controls imposed by the government during that period.

The adoption of the floating exchange rate system came with several expectations. Some of the expected advantages included: smooth and continuous adjustment of the exchange rate in line with the forces of demand and supply in the foreign exchange market; balancing in the demand and supply of foreign exchange without shifting the level of foreign reserves; the freedom to pursue an independent monetary policy with no adverse effects on the balance of payments; and delink of the external imbalance movements from the reserve movements, as external balance would now follow exchange rate movements instead. This, however, was not the case. The exchange rate became volatile because of the disequilibrium in the money market, constraints in the economy's output and other misalignments in the macroeconomic fundamentals. The volatility imposed risks on both traders and investors (with dollar-denominated assets). The systematic devaluation of the official exchange rate led to a spiral of inflation, eroding the benefits of the floating exchange rate.

4. Methodology

4.1 Model Specifications

i. Nominal and Real Exchange Rate Model

The first objective of this study was to analyse the effect of monetary policy on the nominal and real exchange rate stability. Monetary policy is proxied by various instruments and/or tools, such as money supply, cash reserve requirements, central bank repo, interest rate differentials, price level differentials, foreign reserves and currency in circulation. The nominal exchange rate can be influenced by several other macroeconomic fundamentals and monetary shocks. These may include the following: balance of payment and terms of trade shocks; national output; public debt; and expectations (see Krueger, 1969; Kanamori and Zhao, 2006).

$$EXR = f(MS, CPID, TOTS, IRD, PD, GDP, FER, TDC, CIC, CRR, REPO, REM, FP, D1)$$

$$\therefore EXR_t = \beta_0 + \beta_1 MS_t + \beta_2 CPID_t + \beta_3 TOTS_t + \beta_4 IRD_t + \beta_5 PD_t + \beta_6 GDP_t + \beta_7 FER_t + \beta_8 TDC_t +$$

$$\beta_9 CIC_t + \beta_{10} CRR_t + \beta_{11} REPO_t + \beta_{12} REM_t + \beta_{13} FP + \beta_{14} D1_t + \varepsilon_t \quad \ldots\ldots 4$$

Where:

EXR – The nominal exchange rate

MS – Money supply

CPID – Consumer price index differential

TOTS – Terms of trade shocks

IRD – Interest rate differential

PD – Public debt

GDP – Gross domestic product (national output)

FER – Foreign exchange reserves

TDC – Total domestic credit

CIC – Currency in circulation

CRR – Cash reserves requirement

REPO – Central bank rate on short term lending to commercial banks

REM – Diaspora remittances

FP – Forward premium

D1 – Dummy for anti-speculation regulation (D1=1 for the period regulation was in force, D1=0 otherwise)

Following the works of Salemi (1980) and Frankel (1980), the forward premium is used as a measure of expectations. Forward premium measures the expected depreciation of currency in terms of foreign exchange. This framework can be used to test whether the forward premium on foreign exchange is a sufficient statistic for the prediction of the future depreciation of the currency in terms of foreign exchange. The forward premium on exchange rate is given as:

$$FP = \ln EXR^{F}_{t-1} - \ln EXR_{t}$$

Where: EXR^{F} - The forward exchange rate, given as:

$EXR^{F} = EXR\left[\frac{1+I^{D}}{1+I^{F}}\right]$ - The three-month interest rate in domestic currency

I^{F} - The three-month interest rate in foreign currency
EXR – Nominal exchange rate
FP measures the rational expectations of the percentage change in exchange rate.
To analyse both short-run and long-run relationships between exchange rate and various instruments of monetary policy and other determinants, equation (4) was estimated using the autoregressive distributed lag (ARDL) bound testing approach. ARDL has several advantages over the traditional cointegration models. These include: the estimates are consistent even if the variables do not have same level of integration; the estimates are unbiased even in the long run; and it also gives more efficient estimates in cases of data with small and finite sample (Harris and Sollis, 2003).
In addition, the ARDL model is appropriate modelling the relationship between economic variables in a single-equation time-series setup since the cointegration of non-stationary variables in ARDL is equivalent to an error-correction (EC) process. Additionally, the ARDL model has a re-parameterization in EC form (Engel and Granger, 1987; Hassler and Wolters, 2006). The existence of a long-run or cointegrating relationship can be tested based on the EC representation. It is also possible to perform a bounds test to draw conclusive inference without knowing whether the variables are I(0) or I(1), respectively (Pesaran, Shin, and Smith, 2001). The bounds testing procedure is popular and attractive compared with the other cointegration tests (Kripfganz and Schneider, 2016).

The ARDL model form of equation (4) is specified as follows: ARDL (p,q,...,q)model:

$$EXR_{t} = \alpha_{0} + \alpha_{1}t + \sum_{i=1}^{p}\Phi_{i}EXR_{t-i} + \sum_{i=0}^{q}\beta_{i}MS_{t-i} + \sum_{i=0}^{q}\varphi_{i}CPID_{t-i} + \sum_{i=0}^{q}\delta_{i}TOTS_{t-i} + \sum_{i=0}^{q}\psi_{i}IRD_{t-i} +$$

$$\sum_{i=0}^{q}\lambda_{i}PD_{t-i} + \sum_{i=0}^{q}\eta_{i}GDP_{t-i} + \sum_{i=0}^{q}\varpi_{i}FER_{t-i} + \sum_{i=0}^{q}\theta_{i}TDC_{t-i} + \sum_{i=0}^{q}\kappa_{i}CIC_{t-i} + \sum_{i=0}^{q}\pi_{i}CRR_{t-i}$$

$$+\sum_{i=0}^{q}\rho_{i}REPO_{t-i} + \sum_{i=0}^{q}\vartheta_{i}REM_{t-i} + \sum_{i=0}^{q}\tau_{i}FP_{t-i} + \sigma_{i}D1 + \varepsilon_{t} \quad \ldots\ldots 5$$

The optimal lag lengths p and q were determined using the Akaike information criterion (AIC). The lag lengths of the regressors (q) vary across the variables. The re-parameterization in conditional EC form of equation 5 would be as below (equation 6):

$$\Delta EXR_t = \alpha_0 + \alpha_1 t - \psi\begin{bmatrix} EXR_{t-1} - \zeta MS_t - \xi CPID_t - \omega TOTS_t - \upsilon IRD_t - \tau PD_t - \rho GDP_t - \\ \kappa FER_t - \lambda TDC_t - \chi CIC_t - \varpi CRR_t - \theta REPO_t - \nu REM_t - \Im FP_T - \hbar D1_t \end{bmatrix} +$$

$$\sum_{i=1}^{p-1}\Omega_{EXRi}\Delta EXR_{t-i} + \sum_{i=0}^{q-1}\beta_{MSi}\Delta MS_{t-i} + \sum_{i=0}^{q-1}\delta_{CPIDi}\Delta CPID_{t-i} + \sum_{i=0}^{q-1}\phi_{TOTSi}\Delta TOTS_{t-i} + \sum_{i=0}^{q-1}\eta_{IRDi}\Delta IRD_{t-i} + \sum_{i=0}^{q-1}\varphi_{PDi}\Delta PD_{t-i} +$$

$$\sum_{i=0}^{q-1}\gamma_{GDPi}\Delta GDP_{t-i} + \sum_{i=0}^{q-1}\pi_{FERi}\Delta FER_{t-i} + \sum_{i=0}^{q-1}\partial_{TDCi}\Delta TDC_{t-i} + \sum_{i=0}^{q-1}\ell_{CICi}\Delta CIC_{t-i} + \sum_{i=0}^{q-1}\vartheta_{CRRi}\Delta CRR_{t-i} + \sum_{i=0}^{q-1}o_{REPOi}\Delta REPO_{t-i} +$$

$$\sum_{i=0}^{q-1}\sigma_{REMi}\Delta REM_{t-i} + \sum_{i=0}^{q-1}\Theta_{FPi}\Delta FP_{t-i} + \lambda D1_t + \varepsilon_t \quad \ldots\ldots 6$$

Where:

ψ *- The speed of adjustment coefficient (The error correction term – ECT)*

$\zeta, \xi, \omega, \upsilon, \tau, \rho, \kappa, \lambda, \chi, \varpi, \theta, \nu, \hbar, \Im$ -

The long run coefficients

$\Omega, \beta, \delta, \phi, \eta, \varphi, \gamma, \pi, \partial, \ell, \vartheta, O, \lambda, \Theta, \sigma$

- The short run coefficients

To analyse the effect of monetary policy and other macroeconomic fundamentals on the real exchange rate stability, a similar ARDL model was specified and estimated following the same procedure.

The real exchange rate (REXR) is obtained as follows:

$$REXR = \frac{EXR \times CPI^*}{CPI}$$

Where:

EXR – The nominal exchange rate

CPI* - Foreign consumer price index (of the leading export destination)

CPI – Domestic consumer price index

ii. Foreign Exchange Reserves Model

The work of Fischer (2001), Aizenmann and Marion (2003), Benediktsson and Palsson (2005), Dash and Narayanan (2011) and Chowdhury, Uddin, and Islam (2014) are considered to analyse the determinants of foreign exchange reserves, which suggest that the amount of foreign reserves held by a country's central bank depends on the balance of payment, scope of international trade (average propensity to import), exchange rate, public debt, money supply, inflation rate, GDP and call money rate.

$$FER = f(CAB, KAB, API, EXR, PD, CMR, MS, INFL, GDP) \quad \ldots\ldots 7$$

Where:

FER – Foreign exchange reserves

EXR – Nominal exchange rate

CAB – Current account balance

KAB – Capital account balance

API – Average propensity to import (measured as import to GDP ratio)

PD – Public debt (measured as debt to GDP ratio)

CMR – Call money rate, given by the central bank rate on short term lending to brokers

MS – Money supply

INFL – Inflation rate

GDP – Gross domestic product

Equation (7) was also estimated under the ARDL approach using a similar procedure as described above. The ARDL form of equation (7) is specified as follows: ARDL (p,q,…,q) model:

$$FER_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \beta_i FER_{t-i} + \sum_{i=0}^{q} \chi_i CAB_{t-i} + \sum_{i=0}^{q} \delta_i KAB_{t-i} + \sum_{i=0}^{q} \phi_i API_{t-i} + \sum_{i=0}^{q} \varphi_i EXR_{t-i} + \sum_{i=0}^{q} \gamma_i PD_{t-i}$$

$$+ \sum_{i=0}^{q} \eta_i CMR_{t-i} + \sum_{i=0}^{q} \kappa_i MS_{t-i} + \sum_{i=0}^{q} \lambda_i INFL_{t-i} + \sum_{i=0}^{q} \nu_i GDP_{t-i} + \varepsilon_t \quad \ldots\ldots 8$$

The optimal lag lengths p and q were determined using the Akaike information criterion (AIC). The lag lengths of the regressors (q) vary across the variables. The re-parameterization in conditional EC form of equation 8 would be as below (equation 9):

$$\Delta FER_t = \alpha_0 + \alpha_1 t - \beta \begin{bmatrix} FER_{t-i} - \chi CAB_t - \delta KAB_t - \phi API_t - \varphi EXR_t - \\ \kappa PD_t - \lambda CMR_t - \mu MS_t - \nu INFL_t - \pi GDP_t \end{bmatrix} +$$

$$\sum_{i=1}^{p} \upsilon_{FERi} \Delta FER_{t-i} + \sum_{i=0}^{q} \tau_{CABi} \Delta CAB_{t-i} + \sum_{i=0}^{q} \pi_{KABi} \Delta KAB_{t-i} + \sum_{i=0}^{q} \rho_{APIi} \Delta API_{t-i} + \sum_{i=0}^{q} \theta_{EXRi} \Delta EXR_{t-i} +$$

$$\sum_{i=0}^{q} \gamma_{PDi} \Delta PD_{t-i} + \sum_{i=0}^{q} \eta_{CMRi} \Delta CMR_{t-i} + \sum_{i=0}^{q} \sigma_{MSi} \Delta MS_{t-i} + \sum_{i=0}^{q} \omega_{INFLi} \Delta INFL_{t-i} + \sum_{i=0}^{q} \varpi_{GDPi} \Delta GDP_{t-i} + \varepsilon_t \quad \ldots\ldots 9$$

Where:

β *- The speed of adjustment coefficient*
$\chi, \delta, \phi, \varphi, \kappa, \lambda, \mu, \nu, \pi$ *- The long-run coefficients*
$\upsilon, \tau, \pi, \rho, \theta, \gamma, \eta, \sigma, \omega, \varpi$, *- The short-run coefficients*

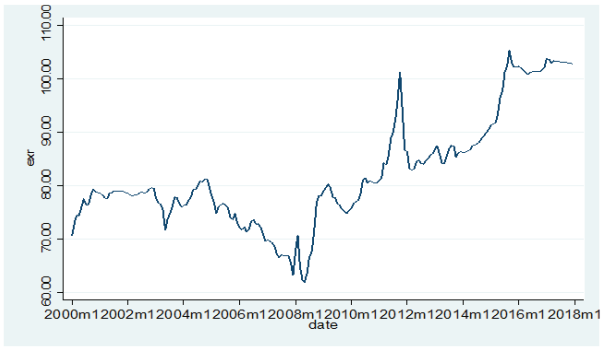
5. Estimation results and discussions

5.1 Data Preliminaries

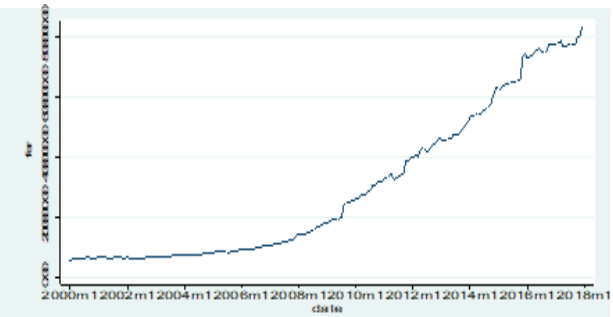
Figure II presents the time series plots of selected data variables over the period between January 2000 and December 2017 on a monthly basis. The exchange rate has an upward trend generally over the period, oscillating between a minimum of K Sh 61.9 per dollar and a maximum of K Sh 105.3 per dollar. The trend of foreign exchange reserves rises consistently (with minor fluctuations) over the period from about $0.6 billion in January 2000 to about $8.5 billion in December 2017. The current account balance is in deficit and tends to worsen over the period, though with fluctuations. The trends of interest rate differentials and the

Figure III: Trend of some selected variables of interest (2000m1–2017m12)

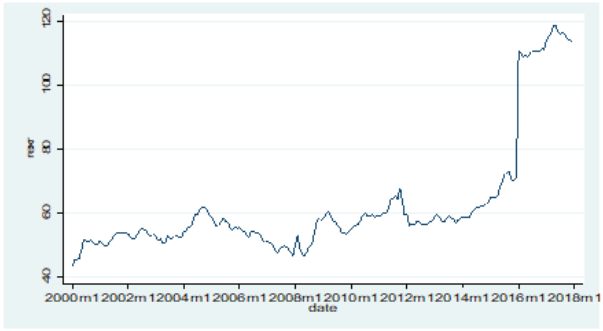
Exchange rate



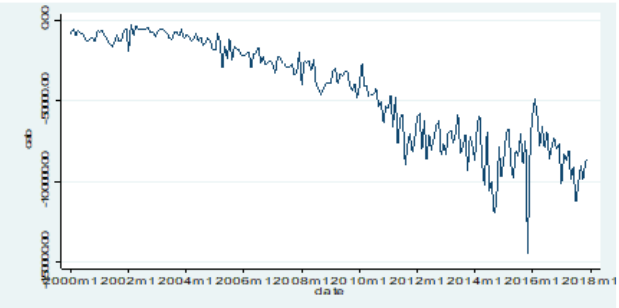
Foreign exchange reserves



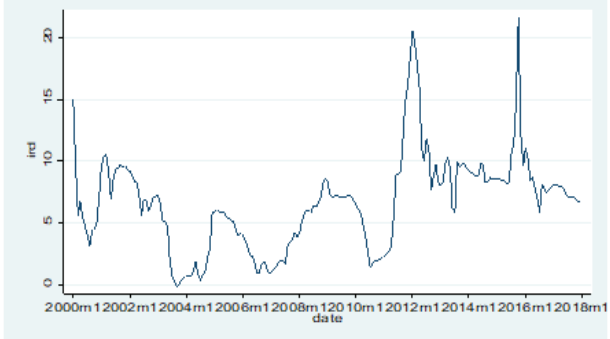
Real exchange rate



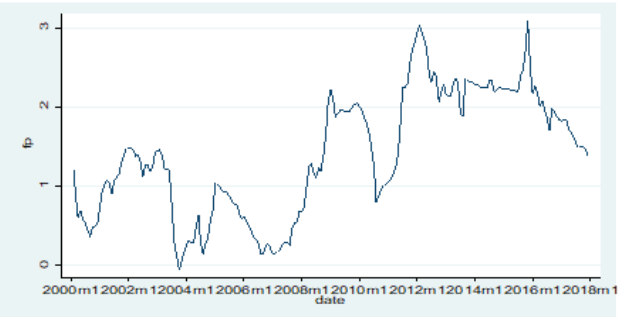
Current account balance



Interest rate differential



Forward premium



Source: Authors' computations using study data.

Table 2: Summary statistics

Variable	Descriptive statistics		
	Mean	Minimum	Maximum
Nominal exchange rate (EXR)	82.19686	61.899	105.275
Foreign exchange reserves (FER)	296,339.7	58,124.71	830,565.6
Interest rate differential (IRD)	6.650694	-.11	21.63
Terms of trade (TOTS)	.4676839	.2530575	.9596374
Repo (REPO)	7.427586	0	18.89
Cash ratio requirement (CRR)	6.387731	4.5	12
Inflation rate (INFL)	8.15781	1.221151	19.72
Total domestic credit (TDC)	1,203,189	326,792.1	3,198,285
Money supply (MS)	1,042,229	304,342.3	2,538,195
Deposit interest rate (DIR)	5.453426	1.96	10.38
Lending interest rate (LIR)	15.96509	11.97	25.39
Exports (EXP)	3,0278.09	9124	59,406
Imports (IMP)	74,034.12	13,899	165,573
Currency in circulation (CIC)	126,205.9	42,233	279,159
Real exchange rate (REXR)	62.45583	43.19091	118.7156
Consumer price index differential (CPID)	-33.43634	-75.22163	24.42508
Current account balance (CAB)	-43,885.8	-144,283.3	-2,534.15
Gross domestic product (GDP)	263496.1	181100.3	377873.7
Anti-speculation regulation (D1)	-	0	1
Forward premium (FP)	1.412536	-0.058375	3.100357
Diaspora remittances (REM)	83.93452	1	167
Public debt (PD)	3,843.204	28,196.700	312.600
Number of observations: 216			

forward premium remain unpredictable throughout the period. Real exchange rate is generally stable at an average of about K Sh 50 per dollar before experiencing a sharp rise at the beginning of 2016.

5.2 Descriptive statistics

In addition to the graphical illustrations, descriptive statistics were used to describe the basic features of the data used in the study. This gives the summary of the data in terms of the mean, minimum value, maximum value and the number of observations, as presented in table 2.

5.3 Diagnostic tests

To determine the appropriate models and estimation procedures, several diagnostic tests were performed, including unit root tests, test for multicollinearity, test for homoscedasticity and model stability tests. The optimal lag length for each variable was specified using the Akaike Information Criterion (AIC) in the ARDL framework. The lag length is automatically calculated by the system, but pegged at a maximum of 3. The number of lag length assumptions is considered sufficient to correct any serial correlation that may occur in the residual. Unit root test results are presented in table 3 Similarly, the results for multicollinearity, heteroskedasticity and stability tests are presented in tables 4, 5 and 6 respectively.

The unit root results based on the augmented version of the Dickey and Fuller (1979) test showed that most variables were non-stationary at levels, but become stationary upon first differencing. Interest rate differential, terms of trade shocks, diaspora remittances, call money rates, public debt and repo were however stationary at levels. This implies that all variables were either I(0) or I(1), which meets the precondition for estimating an ARDL bound model (Pesaran and Pesaran, 2009).

Table 3: Results for unit root test

H0: Unit root is present in the time series					
Variable	Levels		First difference		Verdict
	Z(t)-Statistic	***P-Value***	***Z(t)-Statistic***	***P-Value***	***I(d)***
Nominal exchange rate (EXR)	-0.430	0.9049	-10.684***	0.0000	*I(1)*
Foreign exchange reserves (FER)	3.533	1.000	-13.095***	0.0000	*I(1)*
Interest rate differential (IRD)	-3.187**	0.0207	-	-	*I(0)*
Terms of trade (TOTS)	-5.604***	0.0000	-	-	*I(0)*
Repo (REPO)	-4.461***	0.0002	-	-	*I(0)*
Cash ratio requirement (CRR)	-2.661	0.0811	-14.706***	0.0000	*I(1)*
Inflation rate (INFL)	-2.420	0.1361	-11.277***	0.0000	*I(1)*
Total domestic credit (TDC)	4.895	1.0000	-3.360***	0.0000	*I(1)*
Money supply (MS)	5.872	1.0000	-14.168***	0.0000	*I(1)*
Currency in circulation (CIC)	1.265	0.9964	-18.805***	0.0000	*I(1)*
Real exchange rate (REXR)	0.217	0.9732	-14.097***	0.0000	*I(1)*
Consumer price index differential (CPID)	-1.235	0.6582	-14.119***	0.0000	*I(1)*
Current account balance (CAB)	-2.927	0.4230	-24.847***	0.0000	*I(1)*
Gross domestic product (GDP)	1.210	0.9961	-16.569***	0.0000	*I(1)*
Forward premium (FP)	-1.416	0.5747	-10.565***	0.0000	*I(1)*
Diaspora remittances (REM)	-4.846***	0.0000	-	-	*I(0)*
Interest rate differential (IRD)	-2.568*	0.0997	-	-	*I(0)*
Public debt (PD)	-9.594***	0.000	-	-	*I(0)*
Call money rate (CMR)	-4.307***	0.0004	-	-	*I(0)*
Average propensity to import (API)	-2.724*	0.0699	-25.823***	0.0000	*I(1)*

***, ** and * denotes rejection of the null hypothesis at 1%, 5% and 10% significant level.

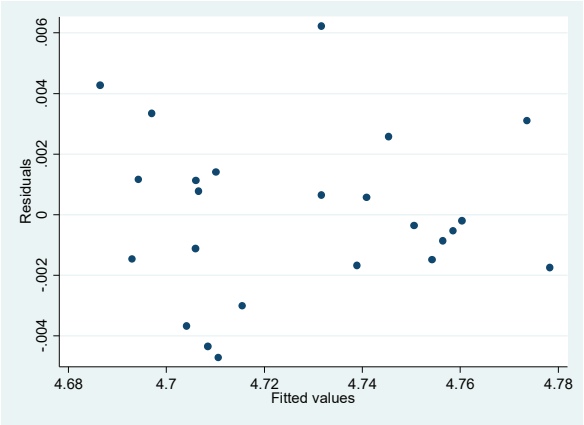
Table 4: Test for multicollinearity

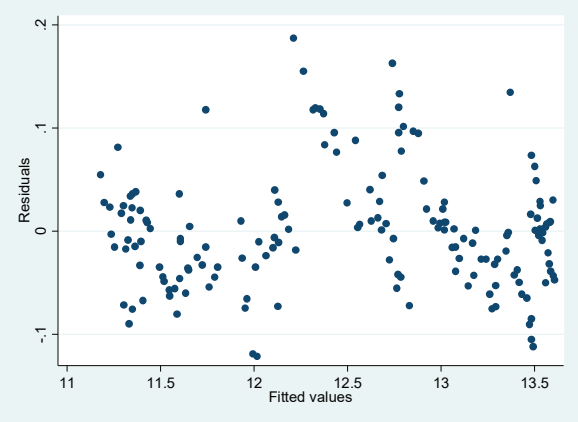
Exchange rate model			**Foreign exchange model**		
Variable	**VIF**	**1/VIF**	**Variable**	**VIF**	**1/VIF**
Foreign exchange reserves (FER)	1.24	0.8048	Nominal exchange rate (EXR)	1.03	0.9711
Interest rate differential (IRD)	2.55	0.4752	Inflation rate (INFL)	1.02	0.9819
Terms of trade (TOTS)	1.50	0.6665	Current account balance (CAB)	1.03	0.9674
Repo (REPO)	2.10	0.4752	Call money rate (CMR)	1.04	0.9581
Cash ratio requirement (CRR)	1.03	0.9662	Public debt (PD)	1.04	0.9633
Total domestic credit (TDC)	1.25	0.7975			
Consumer price index differential (CPID)	1.20	0.8350			
Gross domestic product (GDP)	1.05	0.9567			
Forward premium (FP)	1.19	0.8377			
Diaspora remittances (REM)	1.13	0.8888			
Mean VIF	1.40		Mean VIF	1.04	

In the presence of multicollinearity, the estimate of one independent variable's impact on the dependent variable, while controlling for the other independent variables, tends to be less precise than if the predictors are not correlated with one another. Additionally, multicollinearity tends to make the standard errors of the affected coefficients larger, which may lead to failure to reject a false null hypothesis. According to Gujarati (2003), any variable with variance inflation factor (VIF) of more than five is highly correlated with other exogenous variables and must, therefore, be dropped from the model. After dropping all the collinear variables (MS, CIC and API), the rest of the variables have VIF values below five and accordingly, there

Table 5: Test for heteroskedasticity

H0: Constant variance			
Exchange Rate Model		Foreign Exchange Reserves Model	
Chi2(1)	1.25	Chi2(1)	0.00
Prob>Chi2	0.2638	Prob>Chi2	0.9542





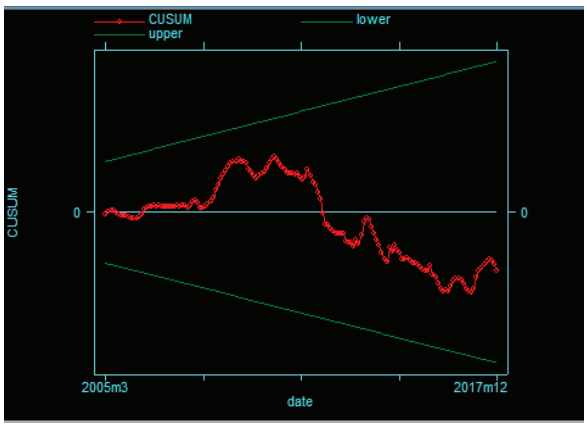
is no multicollinearity problem in the data sets. The mean VIF for the exchange rate model and foreign exchange reserves model are 1.40 and 1.04, respectively.

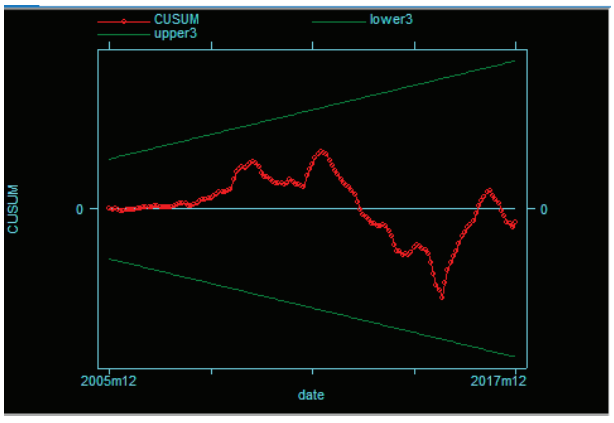
In the presence of heteroskedasticity, confidence intervals and hypotheses tests cannot be relied on. A Breusch-Pagan/Cook-Weisberg test for heteroskedasticity is performed. It tests the null hypothesis that the error variances are all equal versus the alternative that the error variances are a multiplicative function of one or more variables (Breusch and Pagan, 1979; Cook and Weisberg, 1983). The results presented in table 5 indicate the failure to reject the null hypothesis of constant variance, implying that the data set is homoscedastic. Additionally, the residual plots show formation of no particular pattern, implying the absence of heteroskedasticity in the data.

A model stability test is performed on the ARDL models estimated using the statistical test based on the recursive least squares, that is, cumulative sum (CUSUM). The graphs presented in table 6 show that both models are stable, with plot of CUSUM statistic being within the lower and upper limits at a 95 per cent lev-

Table 6: Model stability test

H0: Perfect parameter stability	
Exchange Rate Model	Foreign Exchange Reserves Model





el of confidence throughout the study period. This indicates failure to reject the null hypothesis of "perfect parameter stability" at a 5 per cent level of significance.

5.4 Regression results

Based on the diagnostic results presented in the previous section, ARDL models are specified for nominal exchange rate, real exchange rate and foreign exchange reserves and estimated using the bound test procedure. As exchange rate volatility is very high, monthly data are used with a maximum lag of 3. F-statistics are calculated for each model, as suggested by Perasan, Shin, and Smith (2001) and Kripfganz and Schneider (2016) for testing levels relationships.

i. Nominal exchange rate model

To estimate the short-run and long-run relationships between the nominal exchange rate and its various determinants, the ARDL model is estimated. Table 7 shows the results of the short-run dynamic coefficients, the long-run relationships and speed of adjustment (the error correction term - ECT) that is associated with the long-run relationships. The error correction coefficient is estimated at -0.1300, which is statistically significant at the 1 per cent level. ECT has the correct sign and is statistically significant implying relatively high speed of convergence of the nominal exchange rate to the long-run equilibrium exchange rate path. The regression fits reasonably well with an Adjusted R-Squared of 0.9871 (see table 7), despite a few insignificant coefficients.

The short-run and long-run coefficients indicate that the movement of the Kenyan nominal exchange rate is influenced equally by macroeconomic fundamentals and the monetary policy instruments almost in equal share. The coefficient of the anti-speculation regulation implemented by Central Bank of Kenya in 2011/2012 is statistically significant in the short run and in the long run, implying that the regulation plays an important role in the movement or stability of the nominal exchange rate in Kenya. Additionally, expectations are found to have a significant impact on the nominal exchange rate in the long run, even though the effect is relatively weak. Expectations and the exchange rate tend to move in the same direction, as the coefficients are found to be positive. These findings conform to those of Devereux and Engel (2008), which showed that the exchange rate acts as asset price and accordingly responds to news about future returns on the asset.

Table 7: ARDL results (dependent variable: nominal exchange rate)

VARIABLE	COEFFICIENT	P-VALUE
EXR – L1	1.1377***	0.000
EXR – L2	-0.4183***	0.000
EXR – L3	0.1456*	0.062
FER	-0.00002***	0.002
REM	0.0061	0.101
REPO	0.0650	0.291
REPO – L1	-0.2892***	0.000
TOTS	-4.4905*	0.052
CPID	-0.0045848	0.546
IRD	0.0051	0.450
FP	-0.8927	0.342
FP – L1	1.7949**	0.026
TDC	0.00001***	0.000
GDP	-0.00009**	0.044
D1	3.5697**	0.012
Constant	23.0699***	0.000
Prob. > F	594.81***	0.0000
Adj. R-squared	0.9871	

***, ** and * statistical significance at 1%, 5% and 10% significant level.

Table 8: ARDL Results – Long run, short run and speed of adjustment (dependent variable: nominal exchange rate)

	LONG-RUN COEFFICIENTS		SHORT-RUN COEFFICIENTS	
VARIABLE	COEFFICIENT	P-VALUE	COEFFICIENT	P-VALUE
EXR – L1	-	-	0.2563***	0.001
FER	-0.0002**	0.023	-0.00003***	0.001
REM	0.1101***	0.002	0.0059	0.113
REPO	-1.6943***	0.003	0.0674	0.271
TOTS	-3.3724*	0.092	-4.3851*	0.057
CPID	-0.03546	0.478	0.0046	0.498
IRD	0.6071	0.440	-0.0789	0.399
FP	7.8318*	0.072	-0.6182	0.523
TDC	0.00008***	0.001	0.00001***	0.000
GDP	-0.0005***	0.001	-0.00009**	0.043
D1	7.0338**	0.021	3.6090**	0.011
Constant	22.009***	0.000	22.009***	0.000
ECT (SPD_ADJ)	-0.1300***	0.000	-	-
R – Squared	0.4462		0.4462	
Adj. R - Squared	0.3604		0.3604	
BOUNDS TEST – F-stat	5.365***	0.000	5.365***	0.000

***, ** and * statistical significance at 1%, 5% and 10% significant level.

These results provide evidence of the short-run and long-run dynamics nexus that seems to exist between nominal exchange rate in Kenya and its main determinants. In the long run, the movement of the nominal exchange rate depends on the gross domestic product, foreign exchange reserves, diaspora remittances, terms of trade shocks, repo and total domestic credit, whereas interest rate differential and consumer price index differential do not influence the nominal exchange rate in the long run. The influence of terms of trade shocks in the long run is minimal since the coefficient is statistically significant only at the 10 per cent level. These findings are partly in agreement with those of Alagidede and Ibrahim (2016) who found a long-run relationship between output and the exchange rate in Ghana, even though the relationship was inverse.

On the other hand, the short-run estimates provide evidence of the existence of a relationship between the nominal exchange rate and its past period values, foreign reserves, terms of trade, total domestic credit and gross domestic product. The influence of foreign reserves, GDP and total domestic credit is negligible, however, in both the short and the long run, with the coefficients being almost equivalent to zero. The influence of diaspora remittances, repo, and interest rate differential remain statistically insignificant in the short run. Alagidede and Ibrahim (2016) also find evidence of a short-run relationship between terms of trade shocks and the exchange rate in Ghana by using a different analytical framework.

The F-statistics for the ARDL bounds test for the nominal exchange rate is 5.365, which is higher than the upper critical value of 4.078 at a 1 per cent level of significance. This implies the rejection of the null hypothesis of "no level relationship" between the variables in the ARDL irrespective of the order of integration. Accordingly, a level relationship between the nominal exchange rate and its determinants specified in the model exists.

ii. Real exchange rate model

To estimate the short- and long-run relationships between the real exchange rate and its various determinants, the ARDL model is estimated. Table 10 shows the results of the short-run dynamic coefficients, the long-run relationships and speed of adjustment. The error correction coefficient is estimated at -0.1597, which is statistically significant at the 1 per cent level. ECT has the correct sign and is statistically significant,

Table 9: ARDL results (dependent variable: real exchange rate)

Variable	Coefficient	P-Value
REXR – L1	1.1363***	0.000
REXR – L2	-0.2959***	0.000
FER	-0.00001**	0.046
REM	0.0033	0.259
REPO	0.0327	0.483
REPO – L1	-0.2199***	0.000
TOTS	-3.3865*	0.057
CPID	0.4595***	0.000
CPID – L1	-0.5201***	0.000
CPID – L2	0.1384***	0.000
IRD	0.0022	0.976
FP	-0.5329	0.474
FP – L1	0.0214	0.983
FP – L2	2.0655**	0.05
TDC	-0.00007***	0.000
GDP	-0.00008**	0.019
D1	2.8849***	0.007
Constant	19.8908***	0.000
Prob. > F	2862.09***	0.0000
Adj. R-squared	0.9879	

***, ** and * statistical significance at 1%, 5% and 10% significant level.

implying a high speed of convergence of the real exchange rate to the long-run equilibrium real exchange rate path. The regression fits reasonably well with an Adjusted R-Squared of 0.9879 (see table 9), despite a few insignificant coefficients. As in the case of nominal exchange rate, the short run and long run coefficients indicate that the movement of the Kenyan real exchange rate is influenced by a mixture of both macroeconomic fundamentals and the monetary policy instruments almost in equal share.

Additionally, speculations and expectations also play a role in the movement of real exchange rate in Kenya. The coefficient of the dummy representing the implementation of the anti-speculation regulation by the Central Bank of Kenya is highly significant in the short run and in the long run at 1 per cent and 5 per cent, respectively. Concurrently, the coefficient of forward premium, which is a proxy for expectations, is also statistically significant in the short run and the long run, at 10 per cent levels. This implies that the effect of expectations on the nominal exchange rate is stronger than on the real exchange rate in the short run, while the effect is weak in both cases in the long run.

The results further indicate that there exists short- and long-run dynamics nexus between the real exchange rate in Kenya and a number of its main determinants. In the long run, the movement of real exchange rate depends on gross domestic product, repo, diaspora remittances, total domestic credit, foreign reserves, terms of trade shocks, and consumer price index differential. The coefficients of GDP, foreign reserves and total domestic credit are too small implying negligible influence, whereas the interest rate differential does not influence the real exchange rate in the long run.

The short-run estimates show the existence of a relationship between the real exchange rate and its past period values, foreign exchange reserves, terms of trade shocks, consumer price index differential and its past values, total domestic credit, and gross domestic product. The influence of GDP, total domestic credit and foreign reserves are, however, weak in the short run, with the coefficients being too small (-0.00008,

Table 10: ARDL Results – Long run, short run and speed of adjustment (dependent variable: real exchange rate)

	Long-run coefficients		Short-run coefficients	
VARIABLE	COEFFICIENT	P-VALUE	COEFFICIENT	P-VALUE
REXR – L1	-	-	0.2959***	0.000
FER	-0.00008*	0.089	-0.00001**	0.046
REM	0.0644***	0.001	0.0032	0.259
REPO	-1.1726***	0.001	0.0326	0.483
TOTS	-2.1211*	0.072	-3.3865*	0.057
CPID	0.487***	0.000	0.4595***	0.000
CPID – L1	-	-	-0.1384***	0.000
IRD	0.0136	0.975	0.0022	0.976
FP	4.0094*	0.089	-0.5329	0.474
FP – L1	-	-	-1.1517*	0.070
TDC	0.00004***	0.000	0.00007***	0.000
GDP	-0.0003***	0.001	-0.00008**	0.019
D1	7.8418**	0.026	2.8848***	0.007
Constant	19.8908***	0.000	19.8908***	0.000
ECT (SPD_ADJ)	-0.1597***	0.000	-	-
R – Squared	0.9266		0.9266	
Adj. R – Squared	0.9139		0.9139	
BOUNDS TEST – *F-stat*	5.098***	0.001	5.098***	0.001

***, ** and * statistical significance at 1%, 5% and 10% significant level.

0.00007 and 0.00001, respectively). The influences of diaspora remittances, repo and interest rate differential on the real exchange rate remain statistically insignificant in the short run.

The F-statistics for the ARDL bounds test for real exchange rate is 5.098, which is highly significant at the 1 per cent level. This implies the rejection of the null hypothesis of "no level relationship" between the variables in the ARDL irrespective of the order of integration. Accordingly, there exists a level relationship between the real exchange rate and its determinants specified in the model.

iii. Foreign exchange reserves model

To estimate the short- and long-run relationships between foreign exchange reserves and their various determinants, the ARDL model is estimated. Table 11 shows the results of the short-run dynamic coefficients, the long-run relationships and the error correction term. The error correction coefficient is estimated at -0.0831, which is statistically significant at the 1 per cent level. The speed of adjustment coefficient has the correct negative sign and is statistically significant, implying a high speed of convergence of the foreign exchange reserves to the long-run equilibrium foreign exchange reserves path. The regression fits well with an Adjusted R-Squared of 0.9987 (see table 10), with only three insignificant coefficients. The short- and long-run coefficients indicate that the variations in the level of foreign reserves held by the Central Bank of Kenya depend mainly on the macroeconomic fundamentals. In the long run, the movement of foreign exchange reserves depends mainly on the current account balance, gross domestic product and nominal exchange rate. Inflation, public debt and call money rate do not influence the level of foreign exchange reserves in the long run.

The short-run estimates indicate existence of relationship between the foreign exchange reserves and the current account balance, public debt, and call money rate. The influence of inflation, the nominal exchange rate, GDP and capital account balance rate are statistically insignificant in the short run. As in the previous cases, the F-statistics for the ARDL bounds test for foreign exchange reserves is found to be statistically significant, implying the rejection of the null hypothesis of "no level relationship" between the variables in the

Table 11: ARDL Results (dependent variable: foreign exchange reserves)

VARIABLE	COEFFICIENT	P-VALUE
FER – L1	0.9050***	0.000
CAB	-0.2197***	0.000
KAB	0.0068	0.264
GDP	-1.7650	0.542
GDP – L1	4.7668*	0.090
EXR	-0.4261	0.382
EXR – L1	0.8269*	0.089
CMR	0.1317***	0.003
CMR – L1	-0.1948***	0.000
PD	0.0114	0.571
PD – L1	-0.0807***	0.001
INF	-0.0335*	0.080
Constant	-9.3947***	0.003
Prob. > F	7373.22***	0.000
Adj. R-squared	0.9987	

***, ** and * statistical significance at 1%, 5% and 10% significant level.

Table 12: ARDL Results – Long run, short run and speed of adjustment (dependent variable: foreign exchange reserves)

	Long-run coefficients		Short-run coefficients	
Variable	Coefficient	P-value	Coefficient	P-value
CAB	-2.5423***	0.005	-2.2114***	0.000
KAB	0.0850	0.258	0.0071	0.246
GDP	2.7908***	0.000	-2.2545	0.431
EXR	5.0493***	0.005	-0.4679	0.331
CMR	0.4178	0.194	0.1261***	0.004
CMR – L1	-	-	-0.0983**	0.022
CMR – L2	-	-	-0.1292***	0.002
PD	0.2410	0.686	0.0131	0.515
PD – L1			-0.0832**	0.015
PD – L2	-	-	-0.0616**	0.010
INF	-0.3260	0.113	-0.0271	0.141
Constant	-7.9854***	0.006	-7.9854***	0.006
ECT (SPD_ADJ)	-0.0831***	0.001	-	-
R – Squared	0.3207		0.3207	
Adj. R - Squared	0.2426		0.2426	
BOUNDS TEST – F-stat	3.989**	0.025	3.989**	0.025

***, ** and * statistical significance at 1%, 5% and 10% significant level.

ARDL, irrespective of the order of integration. Accordingly, a level relationship between foreign exchange reserves and some of its determinants specified in the model exists.

6. Conclusions and policy implications

In this study, the role of monetary policy in exchange rate stability in Kenya is empirically assessed. Specifically, the impact of monetary policy instruments on the nominal and real exchange rates; the role of expectations, speculations and other macroeconomic fundamentals on nominal and real exchange rate stability; and the determinants of foreign exchange reserves in Kenya are investigated. Expectations are proxied by the forward premium while speculations are captured by a dummy variable representing the implementation of the anti-speculation regulation by the Central Bank of Kenya. Using time series monthly data for the period between January 2000 and December 2017, ARDL models are estimated using the bounds testing technique to determine the effect of monetary policy and other variables on exchange rate and foreign reserves in Kenya. This methodology enabled the analysis of short-run dynamics and long-run effects of the independent variables, and the speed of adjustment of the dependent to the long-run equilibrium path.

The econometric results show interesting findings. First, they indicate that the level of foreign exchange reserves has a negligible impact on the nominal and real exchange rates in the short run and in the long run. Second, the results show that speculations and expectations play a significant role in the determination of the exchange rate in the short run and in the long run. The short-run impact of expectations on the nominal exchange rate is, however, insignificant.

Third, the other determinants of the nominal exchange rate path in the short run are previous levels of the exchange rate; terms of trade shocks; total domestic credit; and GDP, whereas the long-run determinants are diaspora remittances; repo; terms of trade shocks; total domestic credit; and GDP. On the other hand, the short-run determinants of the real exchange rate are previous levels of real exchange rate; the consumer price index differential; terms of trade shocks; total domestic credit; and GDP, whereas the long-run determinants are the consumer price index differential; terms of trade shocks; and total domestic credit.

Fourth, results show that there is a strong relationship between the current account balance and foreign exchange reserves held by the Central Bank of Kenya in both the short run and the long run. The other significant long-run determinants of foreign exchange reserves are GDP and the nominal exchange rate. The call money rate and public debt are found to have a short-run effect on the amount of foreign reserves stock. The results, however, show no short-run significant relationship between the nominal exchange rate and foreign exchange reserves. Finally, the results indicate a high speed of convergence for nominal and real exchange rate models, and a moderate speed of adjustment to the long-run equilibrium path for the foreign exchange reserves model.

These results have several policy implications. First, the notion that developing countries must hold large reserves of foreign exchange in order to ensure exchange rate stability needs to be re-examined. Given the opportunity cost of holding a large amount of reserves, central banks should consider other mechanisms for achieving and maintaining exchange rate stability other than holding an extensive amount of foreign reserves. Foreign reserves do not play as a significant role in exchange rate movements as expectations and speculations. Ensuring that expectations are managed and maintained in a stable manner will result in a stable exchange rate.

Alternatively, monetary authorities could consider policies or regulations that insulate the exchange rate against the effects of shocks to expectations about the future outcomes of the financial and foreign exchange markets. Concurrently, anti-speculation policies or regulations play an important role in achieving stability. This further shows that the exchange rate policy in Kenya is supported by an appropriate monetary policy regulation. However, this may not apply to all the monetary policy actions.

Second, the direct relationship between the consumer price index differential and real exchange rate depreciation both in the long and short run imply that interventions to the domestic good market in attempt to control prices may not only be costly, but it could also worsen the exchange rate movements. The central bank must, therefore, come up with optimal policy actions that address the causes to upward pressure on the domestic prices, rather than directly intervening on the foreign exchange market. At the same time, output is found to be directly related to nominal and real exchange rates in both the short run and in the long run. This implies that macroeconomic fundamentals play a role in exchange rate movement. Tackling issues related to growth and putting the economy on the path of accelerated and inclusive growth is likely to stabilize the foreign exchange market.

Third, the other macroeconomic fundamentals (terms of trade shocks, current account balance and GDP) are also found to play a significant role in the stability of the foreign exchange market. The coefficients of terms of trade shocks that have the correct negative sign are strongly significant in the short run for both the nominal and real exchange rate models. This implies that increased importation at the expense of exports continues to adversely affect the stability of the foreign exchange market. This calls for policies aimed at achieving structural transformation that would see the country move towards more production and improving the quality (and therefore the value) of exports. Export of cheap unprocessed products simultaneously with importing expensive manufactured products remains one of the sources of pressure on the domestic currency to depreciate. At the same time, the current account is found to have a strong and inverse effect on the foreign exchange reserves in both the short run and the long run. This implies that with a strong current account balance, the central bank would not need extensive foreign exchange reserves to ensure foreign exchange market stability.

Lastly, the results indicate that a number of monetary policy instruments have impact on either the exchange rate or foreign exchange reserves, while others do not. The nature of the impact (whether short run or long run) also varies. This implies that central banks need to consistently assess and evaluate the effectiveness of the instruments used to achieve stability from time to time. The results indicate that some instruments may not be effective at all, while others may not support or are not appropriate for the stability objective.

References

Aizenmann, J., and N. Marion (2003). The high demand for international reserves in the Far East: what's going on? NBER Working Paper Series, No. 9266. Available at https://www.nber.org/papers/w9266.pdf.

Alagidede, P., and M. Ibrahim (2016). On the causes and effects of exchange rate volatility on economic growth: evidence from Ghana. Journal of Africa Business, vol. 18, No. 2, pp. 169-193.

Alexius, A. (2001). Uncovered interest parity revisited. *Review of International Economics,* vol. 9, No. 3, pp. 505–517.

African Union (2017). *AU Roadmap on Harnessing Demographic Dividend through Investments in Youth*. Addis Ababa: African Union Commission.

Azam, J. (1997). Public debt and the exchange rate in the CFA franc zone. *Journal of African Economies,* vol. 6, No. 1, pp. 54–84.

Baldacci, E., and others (2008). Social spending, human capital, and growth in developing countries: implications for achieving the MDGs. IMF Working Paper No. 04/217, Washington, D.C.: IMF.

Benavides, G., and C. Capistrán (2009). A note on the volatilities of the interest rate and the exchange rate under different monetary policy instruments: Mexico 1998-2008. Banco de Mexico: Working Paper No. 2009-10. Available at

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.610.1580&rep=rep1&type=pdf.

Benediktsson, H. C., and S. Palsson (2005). Central bank foreign reserves. *Monetary Bulletin*, vol. 7, No. 3.

Boke, S. S., and S. M. Doganay (2014). Trade and real exchange rate: permanent and transitory components. Available at

https://pdfs.semanticscholar.org/0054/848dfcb6ce7a2131760b65d24f715eb0ab28.pdf?_ga=2.261333837.1169280714.1552035387-107648351.1551097490.

Breusch, T. S., and A. R. Pagan. A simple test for heteroscedasticity and random coefficient variation. *Econometrica*, vol. 47, No. 5, pp. 1287–1294.

Central Bank of Kenya (2013). The Central Bank of Kenya's Exchange Rate Policy. Available at https://www.centralbank.go.ke/images/docs/CBK%20Newsletter/The%20CBK%20Exchange%20rate%20policy.pdf.

_____(2016). *The Kenya Financial Sector Stability Report, 2015*. Nairobi.

_____(2017). *Eighteenth Bi-Annual Report of the Monetary Policy Committee*. Nairobi: Central Bank of Kenya.

Chavula, H. K., and others (2017). Monetary and other financial policies for Africa's structural transformation. In *Macroeconomic Policy Framework for Africa's Structural Transformation*, C. Lopes, A. Hamdok, and A. Elhiraika, eds. Addis Ababa: Palgrave Macmillan.

Chowdhury, N. M., M. J. Uddin, and M. S. Islam (2014). An econometric analysis of the determinants of foreign exchange reserves in Bangladesh. *Journal of World Economic Research,* vol. 3, No. 6, pp. 72–82.

Cook, R. D., and S. Weisberg. Diagnostics for heteroscedasticity in regression. *Biometrika*, vol. 70, No. 1, pp.1–10.

Dash, R., and K. Narayanan (2011). Determinants of foreign exchange reserves in India: a multivariate cointegration analysis. *Indian Economic Review,* vol. XXXXVI, No. 1, pp. 83– 107.

Davies, A. (2009). Human development and the optimal size of government. *The Journal of Socio-Economics,* vol. 38, No. 2, pp. 326–330.

De Grauwe, P. (1994). Exchange rates in search of fundamental variables. Center for Economic Policy Research: Discussion Papers, No. 1073. Available at

https://pdfs.semanticscholar.org/bcd0/578446870911cfc2e238dfa314fc6511f4f8.pdf.

Devereux, M. B., and C. Engel (2008). Expectations, real exchange rates, and monetary policy. European Central Bank and the International Monetary Fund Seminar. Available at https://www.frbsf.org/economic-research/files/devereux_engel.pdf.

Dickey, D., and W. Fuller (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, vol. 74, No. 366, pp. 427–431.

Dornbusch, R. (1976). Expectations and exchange dynamics. *The Journal of Political Economy,* vol. 84, No. 6, pp. 1161–1176.

Economic Commission for Africa (ECA) (2008). Macroeconomic convergence in East and Southern Africa, 1980–2007. Paper prepared for a workshop on macroeconomic policy convergence in Southern Africa, Pretoria, 23–26 September 2008. Available at http://repository.uneca.org/bitstream/handle/10855/3231/Bib.%2026557_I.pdf?sequence=1.

_____(2016). *Measuring Corruption in Africa: The International Dimension Matters. African Governance Report IV*. Addis Ababa: ECA.

Economic Commission for Africa (ECA) and African Union (2016). Monetary and exchange rate policy amid global economic slowdown. Caucus of African Central Bank Governors. Concept note for the ninth Joint Annual Meetings of the African Union Specialized Technical Committee on Finance, Monetary Affairs, Economic Planning and Integration and the Economic Commission for Africa Conference of African Ministers of Finance, Planning and Economics, Addis Ababa, 31 March–5 April 2016.

Engel, R. F., and C. W. Granger (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica,* vol. 55, No. 2, pp. 251–276.

Fischer, S. (2001). Opening remarks for IMF/World Bank International Reserves: Policy Issues Forum. Washington, D.C., 28 April 2001. Available at

https://www.imf.org/en/News/Articles/2015/09/28/04/53/sp042801.

Frankel, J. A. (1980). The forward exchange rate, expectations, and the demand for money: the German hyperinflation. *The American Economic Review,* vol. 70, No. 4, pp. 771–775.

Gujarati, D. N. (2003). *Basic Econometrics*. New York: McGraw Hill Book Co.

Gupta, S., B. Clements, and E. Tiongson (1998). Public spending on human development. *Finance and Development*, vol. 35, No 3.

Hagiwara, A. T. (2005). Foreign exchange reserves, exchange rate regimes and monetary policy: issues in Asia. ERD Working Paper Series, No. 61. Manila: Asian Development Bank.

Hallwood, C. P., and R. McDonald (2000). *International Money and Finance.* Oxford, UK: Blackwell Publishers.

Harris, R., and R. Sollis. *Applied Time Series Modelling and Forecasting*. West Sussex, U.K.: Wiley.

Hassler, U., and J. Wolters (2006). Autoregressive distributed lag models and cointegration. *Allgemeines Statistisches Archiv,* vol. 90, No. 1, pp. 59–74.

Hausman, J. (1978). Specification tests in econometrics. *Econometrica,* vol. 46, No. 6, pp.1251– 1271.

Husain, I., and others (2016). *Fostering Economic Growth, Equity and Resilience in Sub Saharan Africa: The Role of Family Planning*. Washington, D.C.:Population Reference Bureau.

Im, K. S., M. H. Pesaran, and Y. Shin (2003). Testing for unit roots in heterogeneous panels. *Journal of Economics,* vol. 115, No. 1, pp. 53–74.

Kanamori, T., and Z. Zhao (2006). The renminbi exchange rate revaluation: theory, practice and lessons from Japan. ADBI Policy Paper 9. Tokyo: Asian Development Bank Institute.

Kripfganz, S., and D. Schneider (2016). ARDL: stata module to estimate autoregressive distributed lag models. Stata Conference 18 – Chicago.

Krueger, A. (1969). Balance-of-payment theory. Journal of Economic Literature, vol. 7, No. 1, pp. 1–26.

Lin, S. (1994). Government debt and real exchange rate in an overlapping generations model. *Journal of Economic Integration,* vol. 9, No. 1, pp. 94–105.

Monan, Z. (2012). The Impact of Declining Demographic Dividend and Socioeconomic Transformation. 3 July. Available at https://www.chinausfocus.com/society-culture/the-impact-of-declining-demographic-dividend-and-socioeconomic-transformation.

Moosa, I. A., and R. H. Bhatti (2010). *The Theory and Empirics of Exchange Rates.* Singapore: World Scientific.

Njuguna, N. S. (1999). Monetary and exchange rate policy in Kenya. African Economic Research Consortium, RP 94. Available at

https://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/2233/RP%2094.pdf;jsessionid=EFE4E75578D89C1FCA979360AE088DE8?sequence=1.

Ouma, D., and E. Kihiu (2018). Exchange rate fluctuations and stock market performance in Nairobi Security Exchange, Kenya. *Journal of Emerging Issues in Economics, Business and Finance*, vol. 7, No.1, pp. 2400–2417.

Otuori, O. (2013). Influence of exchange rate determinants on the performance of commercial Banks in Kenya. *International Journal of Academic Research in Accounting, Finance, and Management Sciences,* vol. 6, No. 2, pp. 121–133.

Pesaran, M. H., and B. Pesaran (2009). *Time Series Econometrics: Using Microsoft 5.0*. Oxford, UK: University Press.

Pesaran, M. H., Y. Shin and R. Smith (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics,* vol. 16, No. 3, pp. 289–326.

Prasetyo, A. D., and A.N. Pudjono (2013). Measuring government expenditure efficiencies towards peace and human development. *The Asian Journal of Technology Management,* vol. 6, No. 2, pp. 82–91.

Romero, A. M. (2006). Comparative study: factors that affect foreign currency reserves in China and India. *The Park Place Economist,* vol. XIII.

Salemi, M. K. (1980). The forward exchange rate, expectations, and the demand for money – the German hyperinflation: comments. *American Economic Review,* vol. 70, No. 4, pp. 763–770.

Sarangi, N., and J. Bonin (2017). Fiscal policy on public social spending and human development in Arab countries. Economic and Social Commission for Western Asia Working Paper. Beirut: ESCWA.

Schultz, T. P. (1999). Health and schooling investments in Africa. *Journal of Economic Perspectives,* vol. 13, No. 3, pp.67–88.

Simwaka, K. (2010). Choice of exchange rate regimes for African countries: fixed or flexible exchange rate regimes? MPRA Paper, No. 23129. Available at https://mpra.ub.uni-muenchen.de/23129/1/Exchange_rate_management_BOOK_CHAPTER_June_2010.pdf.

Singh, S., and J. E. Darroch (2012). Adding it up: costs and benefits of contraceptive services estimates for 2012. Available at https://www.unfpa.org/sites/default/files/pub-pdf/AIU%20Paper%20-%20Estimates%20for%202012%20final.pdf.

Stavrakeva, V., and J. Tang (2015). Exchange rates and monetary policy. Federal Reserve Bank of Boston. Working Paper, No. 15 - 16. Available at

https://www.bostonfed.org/publications/research-department-working-paper/2015/exchange-rates-and-monetary-policy.aspx.

United Nations, Department of Economic and Social Affairs, Population Division (2017). World population prospects: key findings and advance tables – The 2017 revision. Working Paper No. ESA/P/WP/248.

United Nations Population Fund (UNFPA) (2017). *Worlds Apart: Reproductive Health and Rights in an Age of Inequality. State of World Population 2017*. Sales No. E.17.lll.H.1.

United Nations Population Fund (UNFPA), United Nations-Malawi, and African Institute for Development Policy (2016). *Harnessing the Demographic Dividend to Accelerate Socio-economic Transformation and Economic Development in Malawi*. Lilongwe: Ministry of Finance, Economic Planning and Development.

van der Merwe, E. J. (2003). The exchange rate regime and monetary arrangements in South Africa. Address at the International Monetary Convention. Madrid (14 May).

Vamos, I. (2015). Exchange rate and public debt in Central Europe. Available at file:///C:/Users/freelancers/Downloads/VAMOS.pdf.

Zettelmeyer, J. (2000). Impact of monetary policy on exchange rate: evidence from three small economies. *Journal of Monetary Economics*, vol. 51, No. 3, pp. 635–652.

Zulu, E. M. (2016). Enhancing the demographic dividend for socioeconomic transformation in Africa – the role of parliamentarians. Presented at 2016 NEAPACOH Annual Meeting. Kampala, 29 July. Available at

http://www.ppdafrica.org/docs/NEAPACOH2016/presentations/Enhancing_the_demographic_dividend.pdf.

Printed in Addis Ababa by the ECA Printing and Publishing Unit.
ISO 14001:2015 certified. Printed on CF (Chlorine Free Paper).