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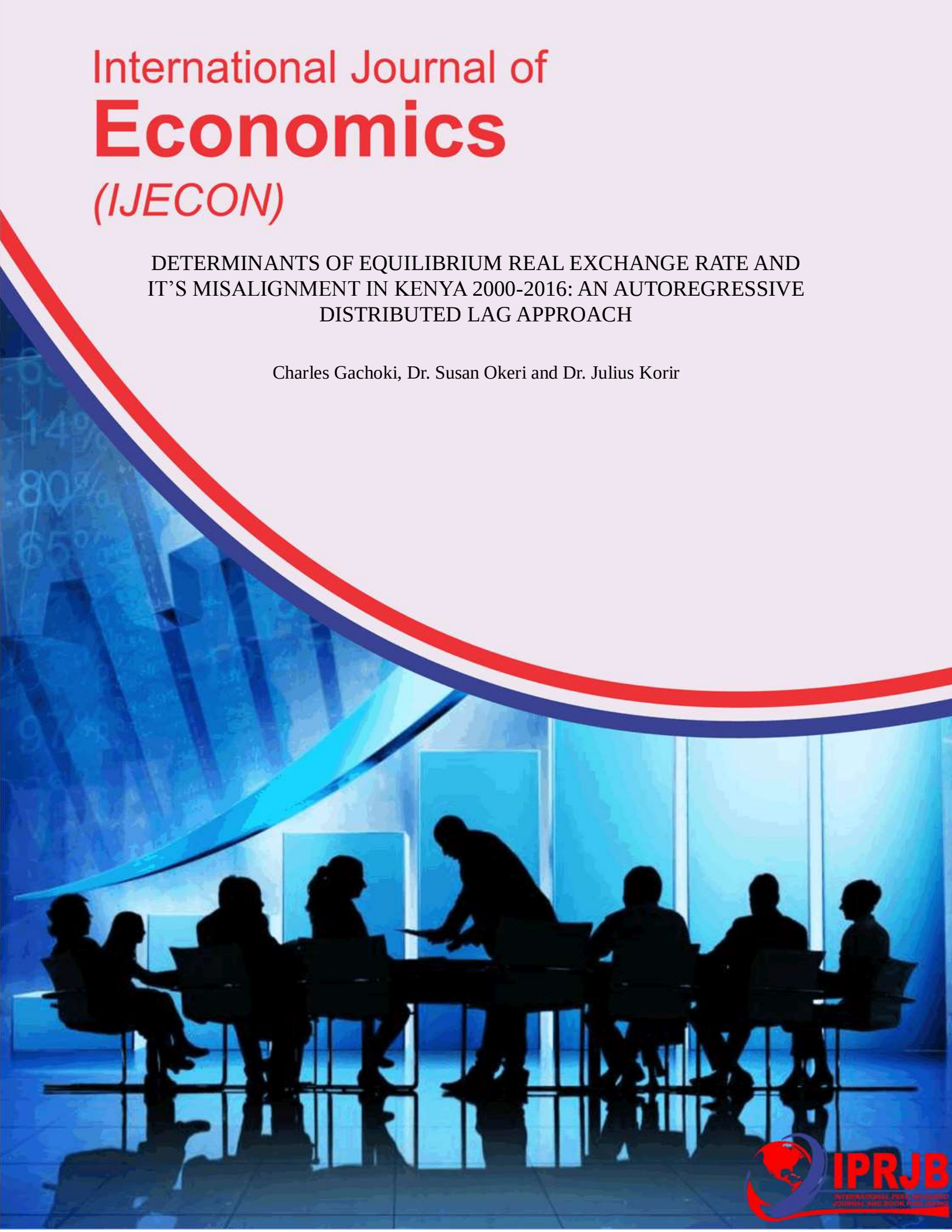

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DETERMINANTS OF EQUILIBRIUM REAL EXCHANGE RATE AND IT'S MISALIGNMENT IN KENYA 2000-2016: AN AUTOREGRESSIVE DISTRIBUTED LAG APPROACH

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Abstract

Purpose: This paper investigates the determinants of Kenya's real exchange rate and determine the real exchange rate and its misalignment from the long run equilibrium level using quarterly data covering 2000 – 2016.

Methodology The Behavioral Equilibrium Exchange Rate approach to determine the extent of exchange rate misalignment is adopted. The study adopted a dynamic Auto Regressive Distributed Lag bounds testing modeling approach.

Findings: The estimation results show that, net foreign assets, productivity, world oil prices, trade openness and terms of trade influence Kenya's long-run real exchange rate. However, government expenditure, and tax revenue were found to have no effect on the real exchange rate. The study results show that the real exchange rate is driven by the economic fundamentals and in terms of misalignment the exchange rate is overvalued to a maximum of 5.9 percent and undervalued up to 5.2 percent but overally the magnitude varies across the period of study. The Shilling is on average undervalued.

Unique contribution to theory, practice and policy: Kenya's exchange rate is closely aligned to its long run fundamentals and the adoption of the floating exchange rate regime achieved one of the intended purpose namely reduction of exchange rate misalignment associated with overvaluation. The monetary authority should ensure the exchange rate remains stable and within the 6 percent range while ensuring the particular fundamentals that can lead to overvaluation are monitored.

Keywords: *Misalignment, Dynamic, Fundamentals*

1.0 INTRODUCTION

1.1 Background

A country's exchange rate is the rate at which the domestic currency exchanges for a foreign currency over time and with respect to the different inflation rates. The exchange rate is a key variable in international trade due to the expectations that trade reacts to its movements (Hlatywayo & Sitima, 2014). Studying the exchange rate is key to understanding the differentiated trade patterns of world economies because, and prudent management of trade and exchange rate policies have been associated with faster growth in developing countries particularly in East Asia. However, equilibrium real exchange rate is an unobservable variable that is dependent on several macroeconomic variables, many of which are endogenously determined within the economy. An exchange rate misalignment is the unobservable gap between the exchange rate and its equilibrium level (Edwards, 1997).

An exchange rate is considered overvalued/undervalued if it appreciates/depreciates over or under its equilibrium path, respectively. The two conditions are described as misalignment. An ideal or equilibrium RER is the one that would prevail when the economy is simultaneously in internal and external balance. While it is common for the actual exchange rate to depart from the equilibrium level in the short and medium run due to short run frictions and adjustment costs, certain deviations from the equilibrium level can persistent through time leading to misalignments. A stable exchange rate is therefore an important factor in improving a country's trade (Toulaboe, 2009). There is consensus however, that variance of the real exchange rate with respect to its long run level results in substantial welfare loss, sends incorrect signals to economic agents, and leads in economic instability. Sidek, (2011) suggests that the starting point is to estimate the exchange rate misalignment. An exchange rate overvaluation is considered a bigger threat than an undervalued exchange rate in the economy. An overvalued exchange rate undermines export through loss of competitiveness by reducing the incentives of the importing country to import. If this situation persists, exports decrease relative to imports.

According to the Juthathip, (2009) despite the important role of exchange rate, there is limited empirical studies in developing countries. The exchange rate of both the developed and developing countries have exhibited significant fluctuations over time and has generated interest in exploring factors that may account for these fluctuations. A persistent exchange rate overvaluation is regarded as a precursor to a crisis and also reflects unsustainable macroeconomic policies in the economy. On the other hand, a persistent undervaluation could bottle the economy to overheating, which exerts pressure on domestic prices and misallocation of resources between tradable and non-tradable

sectors. According to Rodric (2008) a carefully crafted exchange rate undervaluation such as in China, Taiwan, Tanzania and Uganda seem to have cushioned the economies against the weak institutions constraint. Although most countries outside the Sub-Saharan Africa have dealt well with overvaluation, generally the exchange rate is usually overvalued due to inappropriate and inconsistent policies.

A World Bank, (2010) study indicates that while a stable undervalued exchange rate is a viable policy for economic growth in developing countries maintaining the policy long enough can have negative repercussions and therefore is not a sufficient condition. The objective therefore should be to keep the exchange rate as close as possible to its equilibrium level. The experience from the high performing East Asian "success stories" countries shows that a sound exchange rate induced competitiveness is one of the "winning strategies" in an export oriented world. Further, these countries launched their successful economic development by avoiding overvaluation of the exchange rate. Their economic status however, contrast sharply with countries in the Sub-Saharan Africa who have not been able to sustain the growth of trade and therefore forms a basis of investigation.

1.2 Kenya's Exchange Rate

In the 1990s, Kenya liberalized the goods, financial, and the foreign exchange markets. The movement from a fixed to a floating exchange rate regime was gradual starting with a fixed exchange rate regime at independence 1963-1982, a crawling peg from 1983-1993, and eventually adopted in 1993 a floating regime. According to Ndung'u, (1999) the exchange rate controls were instituted to address the balance of payment crisis of 1971/72 and to conserve foreign exchange. The implementation of the crawling peg between 1982 and 1990 was followed by a dual exchange rate that lasted up to 1993, when the exchange rate misalignment necessitated abandonment of the official exchange rate. Figure 1. illustrates the trend of Kenya's exchange rate between January 2000 and 2016.

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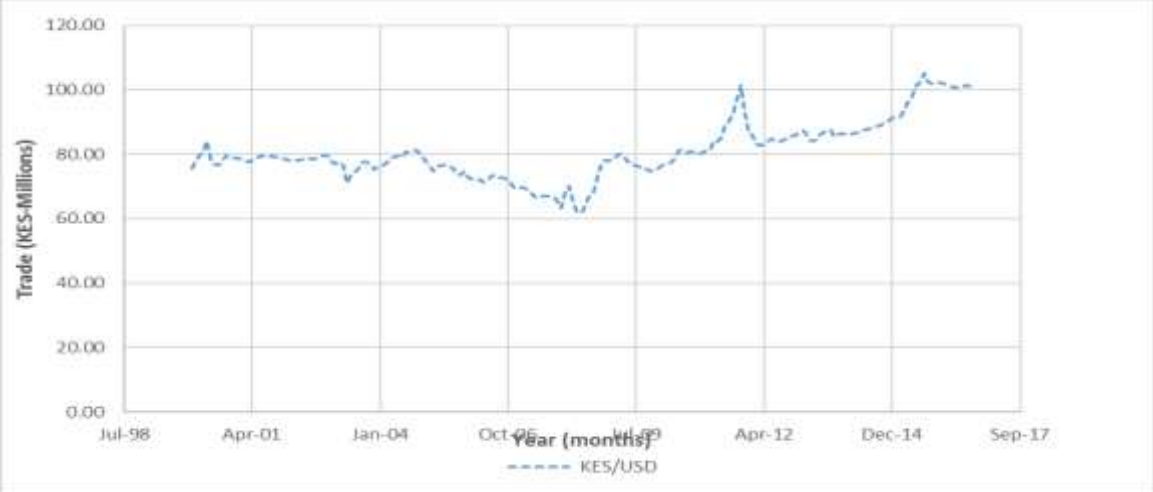

Figure 1. Kenya's Exchange Rate Trend

Source: Author's compilation using data from Central Bank of Kenya statistics (2000-2016)

The Kenya shilling stabilized between 2000 and 2004 at around 80 KES/USD, followed by an appreciation of 14.5percent from an average of 82.56 KES/USD in 2004 to 70.53 KES/USD in 2007. This appreciation of the Shilling during 2004-2007 was attributed to the NARC government which increased export earnings through search for new export markets, and generally improved macroeconomic environment. This appreciation was followed by a depreciation from 2008 onwards attributed to the global 2007/08 financial crisis. Other researchers such as Kiptui, (2008) have observed that Kenya's exchange rate was misaligned with varying degrees.

1.3 Equilibrium Exchange Rate Measurement

The RER and Arbitrage Approaches: the most dominant arbitrage conditions are Uncovered Interest Parity (UIP) and Purchasing Power Parity (PPP). The most common starting point of evaluating RER movements is the arbitrage conditions particularly those associated with risk-adjusted UIP. This condition equates ex-ante risks adjusted nominal rate of return on domestic and foreign currency assets. However, UIP is helps only in clarifying the adjustment path of the RER back to equilibrium by tying down the rate of change of RER but not its level. Some of the problems of UIP approach include the unavailability of future exchange rate values and even when they are estimated they are not sufficiently estimated; and the inability to predict exchange rate movements. While the possible failure in observing UIP is the shift in the equilibrium exchange rate, PPP suggests that equilibrium RER should be constant. The theory argues that the prices of the same goods and services in different countries should be the same, if expressed in one

currency. Therefore, the nominal exchange rate should be equal to the ratio of the prices of goods and services in the two countries. In practice however, PPP does not hold particularly in a situation where any of the assumptions is violated. PPP has been applied by among others Coudert & Couharde, (2008), and Musyoki, Pokhariyal & Pundo, (2012).

Short Run Approaches: the most commonly used short run approach is the Behavioral Equilibrium Exchange Rate (BEER) which uses a modelling technique that captures RER movements over time. BEER largely captures empirically short run equilibrium dynamics and the future exchange rates are assumed to be related to the Long run fundamentals measured to their foreign counterparts. Although the underpinning equation is of real interest differentials, the inclusion of a small set of economic fundamentals has been criticized as adhoc. This method has been applied by (Kiptui & Ndirangu, 2015, and Ali, Ajibola, Omotosho, Adetoba & Adeleke, 2015) among others.

Medium term approaches: The Fundamental Equilibrium Exchange Rate (FEER) is the most popular in this category and attempts to correct some of the problems associated with BEER. It is defined as a method of calculating RER consistent with medium term macroeconomic equilibrium. The calculations are either full scale macro econometric models or partial equilibrium models. The latter is the most common where the net trade, profits and dividends interactions are specified and the trend current account is computed by assuming that RER is at its actual level but home and abroad output at is at trend. The difference between the trend current account and actual current account is therefore the result of cyclical factors. The FEER therefore is calculated as the RER that reconciles the trend current account. The main weakness of FEER is that it is not possible in the short run to involve neutrality and therefore the forces at work will matter but such dynamics may not be available depending on the model used to calculate the FEER. This approach is developed solely in terms of flow equilibrium and therefore does not take into account long run stock equilibrium making it unsuitable for this study. This approach has been used by Olimov & Sirajiddinov, (2008), and Imam & Minou, (2011).

Long run approaches: these are approaches that allow RER to vary even in the long term and include the Permanent Equilibrium Exchange Rate (PEER) and the Natural Real Exchange Rate (NATREX). The distinct approach here is the PEER which is derived from the direct BEER estimates and some of the studies that have used it include Kiptoo, (2007), Palic, Dumicic & Sprajacek, (2014), and Chen & McDonald (2012). PEER decomposes the underlying components as either permanent or transitory unlike the BEER. Since the prevailing rates of fundamentals in the BEER and FEER may arguably deviate from long run characteristics, it is of importance to estimate their behavior in the long run. The equilibrium obtained from such estimates is the PEER and the difference

between the actual RER and the real PEER is called total misalignment. This study will adopt the PEER which has been fronted as more superior since it has attempted to correct the shortcomings of the other approaches and most importantly it distinguishes the permanent and transitory effects of the economic fundamentals. It also refines the exchange rate level by calibrating the BEER at equilibrium values.

1.4 Statement of the Problem

Real exchange rate misalignment as defined by Edwards (1989) refers to a situation where the real exchange rate diverges from its long-run equilibrium, though the equilibrium rate is not actually observed. the Kenya shilling has had swings in different episodes: stabilized at around 80 KES/USD between 2000 and 2004; an appreciation of 14.5% between 2004 and 2007; and a depreciation from 2008 onwards attributed to the global 2007/08 financial crisis. Studies by (Kiptui and kipyegon 2008, Kiptui & Ndirangu 2015) have found the exchange rate to be misaligned in varying degrees between 2000 and 2012. The misalignment has been blamed for the worsening of Kenya's trade balance (Musyoki, Pokariyal & Pundo 2012).

The main objective of this paper is to empirically determine the equilibrium level of Kenya's real exchange rate. Specifically, the study tries to explore: the constituent parts of the long run equilibrium RER; whether Kenya's real exchange rate is misaligned with respect the long run equilibrium level and if so calculate the degree of misalignment.

2.0 THEORETICAL LITERATURE REVIEW

2.1 The Monetary Theory

This approach was chiefly fronted in the early 1970s almost the same time the J-Curve theory emerged by Harry Johnson and Jacob Frenkel. The Monetary theory proposes that a deficit in the balance of payments is uniquely a monetary phenomenon instigated by too much money supply. Devaluation should therefore be understood in a monetary context. Therefore, a devaluation affects the balance of payments only if it affects the real money supply. By increasing domestic prices, devaluation increases the balance of payment resulting to reduced real money supply. However, any further increases in the nominal money supply that reestablish the original disequilibrium neutralizes any exchange rate devaluation resulting to ambiguous net effect on trade balance in the long-run. When a country devalues its currency, the real value of the money supply decreases due to the increase in prices of traded commodities and services measured in the domestic prices. In a functional form, this can be presented thus:

$$\frac{M^s}{p} = M^d(Y, E) \qquad 2.1$$

Where M^s is the nominal money supply, M^d is money demand, Y is income (output), and E is the nominal exchange rate. A devaluation in the exchange rate E leads to a rise in the traded goods and services prices hence depressing the real value of cash balance. This process ultimately causes spending reduction so as to restore the real value of money holdings. The reduction in consumption leads to a decline in absorption and an improvement in the trade balance. A growth in money supply improves the level of real balances hence, individuals expect a rise in their wealth, increases the level of expenditures relative to income and a deterioration in the trade balance. This therefore means that trade balance is affected negatively by money supply. The adverse result may not be perceived in instances such as: First, the nominal money balance may comprise only a small portion of total wealth; Second, money may not be perceived by the private sector as net wealth; and third, the reaction of expenditures to changes in wealth could be so small. The most important consequence of the Monetary Approach is that in the event monetary authorities increase money supply after devaluation in response to new money demand, the devaluation effect is significant. This monetary theory is considered well-grounded theoretically hence has considerable empirical support. The key characteristic of the monetary model is that exchange rate is expressed as the discount value of the future economic fundamentals and makes it suitable for this study.

2.2 Empirical Literature Review

Juthathip, (2009) examined the equilibrium RER and misalignment in developing Asian countries between 1995 and 2008 using the BEER method and quarterly data. The variables used were: Net Foreign Assets, productivity or Harrod-Balassa-Samuelson effect, Terms of Trade and degree of openness. The results showed that in the build-up of the 1997/98 crisis, the RER was persistently overvalued and that misalignment depressed exports. The BEER approach has been considered a better approach since it recognizes a set of real macroeconomic fundamentals as the drivers of equilibrium RER and therefore was utilized in this study.

Sidek, (2011) divided a sample (1991Q1-2008Q3) into a high and low misalignment regime respectively. The exchange rate misalignment was estimated using a BEER approach by incorporating government expenditure, net foreign assets, productivity, and trade openness as the economic fundamentals. The computed misalignment was incorporated alongside foreign income, and relative prices in a standard export demand equation using an autoregressive framework and estimated using least squares. The study concluded that any misalignment below 8.88 percent has no statistical significance on exports. This study used this threshold to assess the effect of exchange misalignment.

Musyoki, Pokhariyal & Pundo, (2012) sought to determine the real exchange rate misalignment in Kenya, using the Johansen Cointegration and error correction technique for the period between 1993 and 2009. The variables used were terms of trade, government expenditure, net capital, and financial inflows, trade openness, and a measure of productivity as the independent variables. The authors found that more often the actual RER was above its long run level and that the competitiveness of country's goods weakened during this period. Considering that the liberalization of the foreign exchange market took place in 1993, there is a likelihood of lag effects in the results of this study. The effects of the crawling were still being felt in the economy. This study used the same variables but corrected for this bias by using a sample which is not influenced by the lag effect.

Ibrahim, (2014) examined the effects of real exchange rate misalignment on imports and exports in Nigeria between the year 1960 and 2013. The study used the behavioural equilibrium exchange rate (BEER) technique to estimate the equilibrium real exchange rate. To analyse the effect of exchange rate misalignment on imports and exports, a single equation cointegration method was used. The study found that Nigeria's real effective exchange rate was above its equilibrium level between 1960 and 1985 and below between 1986 and 2013.

Jordaan and Eita, (2015) estimated the RER misalignment and its impact on economic competitiveness of South Africa using quarterly data for the period 1990-2011. The variables considered were RER, openness, terms of trade, government consumption and real national income using an intertemporal general equilibrium model. The impact on economic performance was estimated using a multivariate cointegration and vector auto regression. The findings of the study revealed that RER misalignment had a negative impact on economic performance.

Lugaiyamu, (2015) investigated the relationship between real exchange rate and tax revenue, government consumption, foreign income, and oil in Tanzania using granger-causality for the period 1987-2012. The author found no long run equilibrium relationship between real exchange rate and its structural determinants considered. However, the study concluded that there was mixed significant short run effects. Hill, Griffiths and Lim (2011) indicate that regression with I(1) variables is acceptable only when those variables are cointegrated, in order to avoid of spurious results. This study therefore derived the short-run and long-run effects by estimating the variables in first difference.

Kiptui and Ndirangu, (2015) using quarterly data sample ranging from 2000 to 2014, studied Kenya's real exchange rate misalignment using the BEER approach. The results

of the estimated vector error correction model (VECM) showed that the equilibrium RER is closely associated to its long run equilibrium level. The BEER approach has several advantages over other variant exchange rate determination approaches. First, BEER approach has the potential to capture all the fundamental movements of the exchange rates; second, by using time series in a single equation the BEER technique is highly tractable; and third, the exchange rate misalignment values produced using BEER are free from normative elements. The BEER approach was therefore found to be the most appropriate technique to estimate equilibrium exchange rate.

3.0 METHODOLOGY

3.1 Theoretical Framework

3.1.1 The Monetary Theory of Exchange Rate Determination

Based on the monetary theory of exchange rate determination, this study will adopt Kim (2008) simple monetary model by utilizing four behavioral equations:

$m_t - p_t = \gamma y_t - \theta i_t$ domestic money market equilibrium 3.1

$m_t^* - p_t^* = \gamma y_t^* - \theta i_t^*$ foreign money market equilibrium 3.2

$s_t = p_t - p_t^*$ purchasing power parity (PPP) 3.3

$i_t - i_t^* = E_t s_{t+1} - s_t$ uncovered interest rate parity (UIP) 3.4

Where:

m_t and m_t^* is the domestic and foreign money supply, p_t and p_t^* is the domestic and foreign price levels, $y_t$and $y_t^*$is the domestic and foreign incomes, i_t and i_t^* represent domestic and foreign interest rates and s_t is the nominal exchange rate all in natural log. $E_t s_{t+1}$ is the expectation of s_{t+1} at time t, γ is the income elasticity of demand, and θ is the interest semi elasticity to money demand.

Combining 3.1 and 3.2:

$s_t = m_t - m_t^* - \gamma(y_t - y_t^*) + \theta(i_t - i_t^*)$ 3.5

Let $f_t = m_t - m_t^* - \gamma(y_t - y_t^*)$ be the economic fundamentals consisting of domestic and foreign countries. Substituting UIP and PPP into 3.5

$s_t = f_t + \theta(E_t s_{t+1} - s_t)$ 3.6

$s_t - f_t = \theta(E_t s_{t+1} - s_t)$ 3.7

Under the rational expectations hypothesis with no bubble solutions the fundamental solution for s_t becomes: $s_t = \frac{1}{1+\emptyset} E_t \left[\sum_{j=0}^{\infty} \left(\frac{\emptyset}{1+\emptyset}\right)^j f_{t+j}\right]$ 3.8

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Equation 3.8 is a solution that relates the exchange rate to the sum of expected future fundamentals discounted to the present using a constant discount rate. By assuming that economic fundamentals series f_t follows a driftless random walk process I(1). Then $s_t \sim I(1)$, $\Delta s_t \sim I(0)$. Since $E_t s_{t+1} = s_{t+1} + v_t$, where v_t is a white noise forecasting error. The exchange rate and fundamentals must therefore be cointegrated. Rearranging:

$$\Delta s_{t+1} = \beta_0 + \beta_1 z_t + \varepsilon_t \quad 3.9$$

Where z_t are the economic fundamentals.

This is the foundational model applied in performing exchange rate forecasts based on the monetary approach. The BEER approach assumes that the unobservable expectation of the real exchange rate $E_t(S_{t+1})$ is determined only by long-run economic fundamentals z_t. Following Clark & McDonald, (1999), the BEER values produces more refined values called the Permanent Equilibrium Exchange Rate (PEER). This calibration is important because policy makers are interested in the long run (permanent) values while traders are interested in the transitory values. The relationship can be expressed in a simplified form as: $q^{reer} = f(Z_t)$ 3.10

According to Clark and McDonald, (1999), researchers use a small set of macroeconomic fundamentals to illuminate real exchange rate changes. These variables have been adopted due their wide use by researchers such as (Chen & Mcdonald, 2012; Kiptui & Ndirangu, 2015; Palic, Dumičić & Šprajaček, 2014). The terms of trade (tot) is the export to import prices ratio and is associated with a country's current account and balance of payments. Supposing a country's exports price rises above its imports prices, there is an improvement of the country's terms of trade. This leads to a rise in demand of the country's currency hence its real exchange rate appreciates. A country's degree of trade openness (open) by reducing tariffs quotas increase, reduces the price of domestic goods with an income and substitution effect. The intertemporal and intra-temporal substitution effect pushes demand towards imported goods, hence an increase in the price of tradables. This follow-on trade balance deterioration depreciates the real exchange rate. However, there is uncertainty on the income effect non-traded goods caused by trade openness. Empirical literature shows that the income effect of trade openness is dominated by the substitution effect. Productivity differentials effect (Prod) is likely to prevail owing to variations in traded and non-traded sectors productivity. Naturally, the traded sector is inclined to have rises in productivity relative to the non-traded sector, leading to an increase in the traded sector goods alongside wage rises. On the other hand, prices in the non-traded sector increase owing to increased demand hence the real exchange rate appreciation.

Any rise in the ration of government expenditure to GDP (Gov) can lead to a government

debt monetisation and reflect negatively if foreign investors foresee debt defaulting. Consequently, foreign investors may reduce ownership of the country's currency denominated securities resulting to a depreciation of the country's real exchange rate. On the other hand, a contractionary fiscal policy that enhances the net foreign assets position permanently may appreciate real exchange rate (Chen & McDonald, 2012). Based on the stock-flow consistent model of Clark & McDonald, (1999) the link between the real exchange rate and the economic fundamentals can be expressed as:

$$reer^* = f(tot, prod, gov, open) \quad 3.11$$

3.2 Empirical Model Specification

3.2.1 Determining Kenya's Exchange Rate Misalignment

To derive exchange rate misalignment, two steps were followed: first was the computation of equilibrium RER based on the theoretical framework developed in equation 3.11:

$$reer_t^* = f(tot_t, prod_t, gov_t, open_t, nfa_t) \quad 3.12$$

Where the degree of openness (open) is expected to cause a depreciation and therefore the expected sign is negative; in situations where there is relatively higher government expenditure (gov) on traded goods there results a real exchange rate depreciation as a result of the ensuing current account deficit; the Balassa –Samuelson productivity (prod) arise owing to the productivity variances in the traded and non-traded sectors. Relative to the non-traded sector, the traded sector tends to experience increases in productivity leading growth in traded goods and subsequently wages increases. The increase in income causes prices to rise due to higher demand thus causing an appreciation of the real exchange rate positive; Edwards, (1997) notes how the terms of trade (tot) affect the exchange rate is determined by whether the income effect dominates the substitution effect and therefore the expected sign is ambiguous; the current account is affected by the level of Net Foreign Assets (nfa) in two opposing ways. one, a high NFA can lead an economy into trade deficits for a longer term and still remain solvent, possibly leading to a adverse association between NFA and the current account. On the other hand, economies with high NFA benefit from higher net foreign income flows, which tend to create a positive association between NFA and current account balances. *Apriori* therefore the expected sign is ambiguous.

From literature reviewed in chapter Two, two additional variables that were explained as having potential effect on real exchange rate were added in equation (3.19). These variables were real taxes (tar), and real oil prices (oil). An increase in real tax revenue (tar) lowers private sector expenditure on home-produced products in turn reducing the

relative price of domestic goods leading to a real depreciation of the currency holding other factors constant. The expected sign is therefore negative. According to Lugaiyamu, (2015), the real price of oil and the real exchange rate should have a positive correlation theoretically. Since domestic residents cannot substitute oil imports with domestically produced sources of energy, an increase in the real price of oil reduces the disposable income, a fall in demand for domestic goods, a fall in the price level and a rise in the value of the real exchange rate. The expected sign is therefore positive.

$$reer_t^* = f(tot_t, prod_t, gov_t, open_t, nfa_t, tar_t, Oil) \quad 3.13$$

According to economic theory the economic fundamentals being considered are known to be affected by both by prevailing and past values and therefore a dynamic model is preferred. Nkoro and Uko, (2016) indicate that in such situations where variables are affected by past as well as present values an Autoregressive Distribute Lag (ARDL) model is appropriate. This is because ARDL enables inclusion of unrestricted lags of the regressors in a regression function which corrects for finite lag models that fail to assign correctly on the independent variables. Therefore, ARDL model was preferred for all the objectives. In case of a short sample and use of macro-economic variables which are known to be integrated of different orders Nkoro and Uko, (2016) recommends ARDL model. Further, the ARDL model gives short-run dynamics (traditional ARDL) and long run relationship simultaneously. Considering the first objective, the ARDL model was specified as:

$$reer_t^* = \beta_{0j} \sum_{j=1}^{K} tot_{t-j} + \beta_{1j} \sum_{j=0}^{K} prod_{t-j} + \beta_{2j} \sum_{j=0}^{K} gov_{t-j} + \beta_{3j} \sum_{j=0}^{K} open_{t-j} + \beta_{4j} \sum_{j=0}^{K} nfa_{t-j} + \beta_{5j} \sum_{j=0}^{K} tar_{t-j} + \beta_{6j} \sum_{j=0}^{K} oil_{t-j} + \varepsilon_t \quad 3.14$$

Where the coefficients to be estimated are denoted as β, and K is the maximum lagged observations.

The second step involved computation of the exchange rate misalignment (Mis) which followed Mwega (2014):

$$Mis = \frac{(ERER - REER)}{REER} * 100 \quad 3.15$$

Where ERER is the equilibrium real exchange rate.

Testing of time series properties of data was carried out using the stationarity and cointegration tests. The model preferred was ARDL owing to its advantages and appropriateness with the kind of data used. According to Nkoro and Uko, (2016) ARDL

has several advantages over other cointegration techniques. First, it does not require all the variables in consideration to be integrated of the same order meaning the variables can be I(1), I(0) or fractionally integrated. Second, it is more efficient relatively in situations of small and finite samples. The third advantage is that the long run model estimates obtained using ARDL are unbiased. Fourth both the long run and short run dynamics can be obtained while testing for cointegration. Finally, the modelling technique is preferred because it allows the various variables to have different lags and these lags are important since they make the model dynamic. Following Bustaman & Jayanthakumaran, (2007), ARDL involves two stages. The first stage involves establishment of the long run relationship. Once the long run relationship is established, an ARDL model is estimated using the optimal lags. Cointegration between variables in all the objectives was tested using Least Squares method and calculating the F-statistics for the joint significance of the lagged levels. A bounds test is therefore conducted on each objective and is presented before the short run and long run results are discussed. Prior to adoption of the results a variety of diagnostic and stability tests were performed to avoid spurious regression. Detailed analysis and estimation results are expounded in the subsequent section.

3.2.2 Time Series Properties Test

3.2.2.1 Stationarity Test

A majority of economic time series variables such as exchange rates, and macroeconomic aggregates such as real GDP are characterized by non-stationarity in their mean. According to Sims, Stock & Watson, (1990) such data produces statistics without a standard distribution and perhaps spurious regression results. Stationarity test was carried out using the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test was used since it eliminates possible low power against stationary near unit root processes associated with ADF and PP tests. While ADF test has low power there exists no single uniformly powerful unit root test. The test is founded on the notion that some time series is stationary around a deterministic trend which can be calculated by summing the deterministic trend, random walk and stationary random error such that:

$$y_t = \beta t + r_t + \varepsilon_t \qquad 3.16$$

Where y_t and t=1, 2…….T, βt represents the deterministic trend, r_t is a random walk and ε_t is the stationary random error.

$$r_t = r_{t-1} + \mu_t \qquad 3.17$$

According to Kwiatkowski, Schmidt and Shin, (1992), the first value r_0 is the intercept

since it is assumed to be fixed. The behavior of the series depend on the variance μ_t, σ_μ^2 such that if the variance is equal to zero r_t is constant and y_t is trend stationary. If the variance is greater than zero then r_t is a random walk and y_t is non stationary. Under the null hypothesis if β=0, y_t is stationary around r_0. The computed test statistics are evaluated against the critical KPSS values such that If the statistic is more (less) than the critical value given by KPSS the null hypothesis is rejected (not rejected).

3.2.2.2 Cointegration Test

According to Engel and Granger, (1987) cointegration checks for a long-run relationship between two or more-time series. A test for cointegration therefore should be considered as a pre-test to avoid spurious regression results. From literature, there exists cointegration between the real exchange rate and most macroeconomic variables. For instance, cointegration has been found between effective exchange rates and, exports and imports of emerging countries. In order to implement the ARDL bound test approach the model (3.14) can be augmented as follows:

$$\Delta reer_j = c + \sum_{i=1}^{p} \propto_i \Delta reer_{t-i} + \sum_{i=1}^{p} \partial_i \Delta tot_{t-i} + \sum_{i=1}^{p} \sigma_i \Delta prod_{t-i} + \sum_{i=1}^{p} \delta_i \Delta gov_{t-i} + \sum_{i=1}^{p} \gamma_i \Delta open_{t-i} + \sum_{i=1}^{p} \eta_i \Delta nfa_{t-i} + \sum_{i=1}^{p} \theta_i \Delta tar_{t-i} + \sum_{i=1}^{p} \mu_i \Delta oil_{t-i} + \lambda_1 reer_{t-1} + \lambda_2 tot_{t-1} + \lambda_3 prod_{t-1} + \lambda_4 gov_{t-1} + \lambda_5 open_{t-1} + \lambda_6 nfa_{t-1} + \lambda_7 tar_{t-1} + \lambda_8 oil_{t-1} + \varepsilon_t \quad 3.18$$

Cointegration between the variables in model (3.18) was tested by calculating the F-statistic for the joint significance of the lagged variables by use of least squares method. Pesaran *et al.,* (2001) provides two sets of adjusted critical value bound as I(0) and I(1) as lower and upper bound respectively. If the F statistic falls below the lower bound then the null hypothesis of no cointegration cannot be rejected regardless of whether the variables are I(0), I(1) or mutually cointegrated. If the F statistic is greater than the upper bound, then the null hypothesis is rejected and the verdict is inconclusive if the F statistics lies between the lower and upper bound.

3.2.3 Diagnostic and Stability Tests

Since the study utilized ARDL approach, various diagnostic tests were conducted to ensure consistent and unbiased regression results. These diagnostic tests include normality test using Jarque Bera statistics, serial correlation Breuch-Godfrey Lagrange Multiplier (LM) test, autoregressive conditional heteroskedasticity (ARCH) test, model specification RESET test, and parameter constancy CUSUM test.

4.0 EMPIRICAL FINDINGS

4.1 Time Series Properties

The main reason for determining stationarity or non-stationarity of data before running regression analysis is to eliminate the danger of finding significant regression results from unrelated data if non stationary data series is utilized in regression analysis. Non-stationary variables in regression models may yield spurious results such that the *R*-square values and *t*-statistics no longer follow the normal distributions and can be wildly inflated. That is, if non stationary time series are used in a regression model, the results may show a significant relationship where none exists.

4.1.1 Unit Root Tests

The study utilized time series data and therefore the need to establish the stationarity or non-stationarity of the data. The Kwiatkowski Phillips, Schmidt and Shin (KPSS) was used since it eliminates possible low power against stationary near unit root processes associated with ADF and PP tests. The results of the stationarity test results are presented in Appendix 1. The results show that some variables were stationary at level while some were stationary at first difference. Real effective exchange rate, terms of trade, net foreign assets, productivity, tax revenue, world oil prices, and trade openness, were stationary at first difference while government expenditure was stationary at level. From Table A17 the variables were integrated of order one I(1) and order zero I(0). None of the variables was integrated of order two I(2). This complimented the use of ARDL as the preferred modelling technique since it does not require variables to be integrated of the same order.

4.1.2 Cointegration Analysis

According to Engel and Granger (1987), cointegration means that, while individual time series can be nonstationary, a linear combination of two or more series can be stationary. That is, a long run relationship exists among non-stationary time series. Cointegration tests effectively test the stationarity of the residuals such that two variables are said to be cointegrated if the residuals are stationary, and are not cointegrated if the residuals are nonstationary, and any regression relationship between the two variables is said to be spurious. ARDL bounds test was considered most appropriate method to test for cointegration since variables were integrated of order zero I(0) and integrated of order one I(I). According to Pesaran *et al*., (2001), cointegration exists when the F statistic exceeds the upper bound. However, when the F statistic is below the lower bound, then there is no cointegration. In the case where the F statistics lies between the two limits, then the test is inconclusive. The bounds test results for all the models used are summarized in Table A16. The computed F-statistics were compared with the critical value bound at the optimal lags (k) according to Pesaran *et al*., (2001). It was

established that cointegration existed in all the objectives since the F statistics exceeded the upper bound, indicating a run relationship existed among the variables.

4.2 Diagnostic and Stability Tests

Various diagnostic and stability tests were carried out on the estimated models. The test results are discussed in sections 4.2.1 and 4.2.2.

4.2.1 Normality, Serial Correlation, and Heteroskedasticity Tests

A normality test of the data is a prerequisite in many statistical tests because normal data is an underlying assumption in parametric testing. According to Das & Imon, (2016), non-normality in the observations renders the associated *t* and *F* statistics generally invalid in finite samples. The Jarque-Bera test was used to test for normality in this study. The test is based on the null hypothesis H_0: JB=0 for normality and H_A: JB$\neq 0$ for non normality. A rejection of the null hypothesis implied that the residuals are not normally distributed. From the normality test histograms the results are sumarised and annexed in tables A2, A7, A9, A11, A13, and A15, the P values of the Jarque-Bera statistics are greater than 0.05. The null hypothesis that the residuals are normally distributed could therefore not be rejected at 5 percent level significance hence the series is normally distributed. The F and t tests could be utilized for hypothesis testing since the have a normal distribution.

Autocorrelation or serial correlation is usually inherent in time-series data mostly due to omission of relevant variables or correlation across periods of those variables that are included. Although the estimates maybe unbiased and linear, the minimum variance property is lost, the *t* and *F* statistics are unreliable and therefore there is a likelihood of wrong conclusions from hypothesis tests. To test for the presence of serial correlation in the ARDL estimates the Breusch-Godfrey serial correlation LM test was used. The test results use an *F* statistic and an Obs*R-squared which is a Breusch-Godfrey LM test statistic. The probability value of the computed test statistic (P values) was above 0.05 and hence the null hypothesis of the residuals no serial correlation could not be rejected at 5 percent significance level. In a situation where the error terms do not have constant variance, they are said to be heteroskedastic. Consequently, the Ordinary Least Squares does not provide the estimate with the smallest variance despite the unbiased estimates of the parameter. In this study, the Auto Regressive Conditional Heteroskedasticity (ARCH) test was utilized to check for the absence of ARCH effects residuals in the ARDL models. The probability value of the computed test statistic (P values) was above 0.05 and hence the null hypothesis of homoscedasticty could not be rejected at 5 percent significance level.

4.2.2 Model Specification and Parameter Stability Tests

To ensure that the functional form of the model used was linear model specification test was carried out. The test is intended to avoid specification errors which include: omission of relevant variable, inclusion of unnecessary variable, adoption of the wrong functional form, errors of measurement and incorrect specification of the error term. The Regression Specification Error Test (RESET) proposed by Ramsey, (1969) was used in this study because it is a general test for the specification errors highlighted. The results of the Ramsey RESET show that obtained probability values are above 0.05 and therefore the null hypothesis could not be rejected.

A Cumulative Sum (CUSUM) test was used to test for structural stability. The CUSUM test detects any systematic eventual movements where the coefficients values reflect a possible structural instability. The CUSUM test is based on a plot of the sum of the recursive residuals. If this sum goes beyond a critical bound, a conclusion is made that there was a structural break at the point at which the sum began its movement toward the bound. The CUSUM test is based on the cumulated sum of the residuals:

$$W_t = \sum_{j=K+1}^{T} \frac{W_t}{\hat{\sigma}}$$

where k is the minimum sample size, Wt is the cumulative sum. The CUSUM test is performed by plotting Wt against t. The null hypothesis of the test imply that Wt has a mean of zero, E(Wt) = 0 with any departure from zero assessed by two 5 percent significance assessment lines whose distance in between increases with t. If Wt crosses the critical lines it signifies structural instability (Farhani, 2012). The results presented in Figure 2. show the divergence of the plots is not significantly far from the zero line and the residuals are within the standard error band.

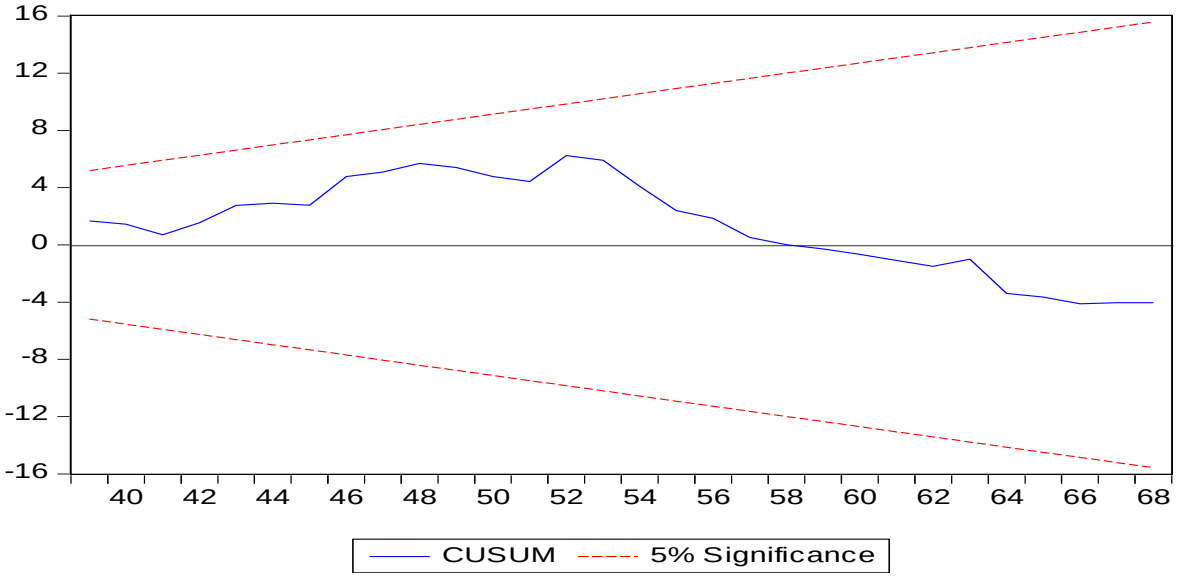

Figure 2. CUSUM Test from the Long Run Real Exchange Rate Equation

4.3.1 Determining the Extent of Kenya's Real Exchange Rate Misalignment

The estimation of the misalignment started with establishment of the determinants of the real exchange rate. This was achieved through the use the autoregressive distributed lag (ARDL) modeling techniques given its usefulness when variables are integrated of order zero and order one. Model 3.18 was estimated and the long run coefficients of the determinants of exchange rate are presented in Table 2.

Table 2: Long-Run effects of Economic Fundamentals on Real Effective Exchange Rate

Dependent Variable – log of Real Effective Exchange Rate				
Variable	**Coefficient**	**SE**	**t-Statistic**	**P-Value**
Government expenditure	0.071	0.050	1.42	0.20
Log of Net Foreign Assets	0.415**	0.170	2.44	0.02
Log of Productivity	0.354***	0.128	2.76	0.01
Tax Revenue	-0.119	0.097	-1.23	0.23
Oil Prices	-0.001***	0.000	-1.73	0.00
Openness	0.015**	0.007	2.11	0.04
Terms of Trade	0.004**	0.002	2.44	0.02

Source: Author's computations

The coefficient on government expenditure was found to be positive but statistically insignificant. The apriori expected sign for government expenditure was ambiguous. Most open-economy macroeconomic models such as the traditional Mundell-Fleming-Dornbusch framework and in standard dynamic general-equilibrium models hold that any unanticipated increase in government spending for a given country appreciates it currency in real terms. This assertion holds only with the assumption of complete financial markets. However, these models contrast empirical predictions which find that there is persistent depreciation of the real exchange rate due to any unexpected exogenous increase in government expenditures. Government expenditure raises the demand for both imported and locally produced goods, and the resultant increase in public spending raises inflation domestically hence deteriorating the current account. Given that prices are sticky and monetary policy does not respond too aggressively to (expected) inflation, the subsequent surge in the long-term real interest rate is smaller than the increase in the risk premium, causing the real exchange rate to depreciate. Similar findings were reported by other studies such as Edwards, (1989) which conclude that in most countries government expenditure as a share of GDP had a positive sign and insignificant in most developing countries. A similar study by Eyquem and Bouakez, (2012) concluded that in a small-open-economy with sticky prices, incomplete and imperfect financial markets is likely to be in line with the empirical position albeit the magnitude of the real depreciation will be small.

On the log of net foreign assets the coefficient is positive and significant at the convectional five percent level. A one percent rise in the NFA position leads to an exchange rate depreciation of 0.41 percent. According economic theory the exchange rate reacts positively to any shocks on the net foreign asset position (*i.e.* an increase in the NFA position leads to an exchange-rate appreciation). As expected, the net foreign assets coefficient is therefore correctly signed. Indeed, according to similar results by Kubota, (2009) this is caused by the transfer effect where in the long run, transfer of external wealth into the domestic economy appreciates the exchange rate.

The coefficient of the log of productivity was positive and significant at one percent level. On average, a one percent increase in productivity depreciates the real exchange rate by 0.35 percent. Theoretically, higher productivity tends to appreciate the real exchange rate however according to Balassa, (1964) and Samuelson, (1964) the effect depends on whether the productivity is in the traded or non-traded sector. Although Kenya has a traded sector, the trade configuration is such that her manufactures are concentrated in east Africa while she exports unprocessed agricultural goods to the rest of the world. This may explain the resultant depreciation of the currency despite any increase in productivity in the traded sector. The results are in line with Jordan and Eita, (2015) who argues that when

productivity improvement is concentrated in the tradable sector relative to the trading partner it results in exchange rate appreciation. According to Wu, (1999) if the productivity between the traded and the non-traded sectors increases in the home country the real exchange rate appreciates.

The tax revenue coefficient had the expected negative sign and but was not a significant determinants of real exchange rate. An increase in taxes as a proportion of GDP reduces private sector spending on locally-produced goods hence reducing the relative price of domestic goods, this leads to a real depreciation of the currency. Lugaiyamu, (2015) found no long run equilibrium relationship between real exchange rate and tax revenue in Tanzania.

The coefficient of real world oil prices is negative and significant at one percent level. A one percent increase in oil prices appreciates the real effective exchange rate by 0.1 percent. Although other empirical studies show ambiguous results, there is a general consensus that oil prices significantly affect the exchange rate with the magnitude increasing with the dependency on oil. Ngoma, *et al*., (2016) shows that increases in real oil prices produces exchange rate appreciations in Nigeria, South Africa and Tunisia and real depreciations in Egypt and Ghana. Similar results were found by Nyamunga, (2017) who found that a 1 percent increase in oil prices appreciated the Kenyan shilling appreciated with 0.05 percent.

The coefficient for trade openness is statistically significant at the 5 percent level. A one percent increase in trade openness depreciates the KES-USD exchange rate by 1.5 percent. This finding is in line with the theory that trade openness weakens the real value of the local currency in developing countries. Increase openness favours the stronger economy in this case EU and hence more imports than exports. The increased imports lowers the price of tradeable goods in the domestic economy. According to Purchasing power parity theory tradeable goods become cheaper hence the local currency depreciates. The results show that openness is a constraint on policymakers' incentives to stabilize the domestic currency in real terms. Nkalu, (2016) found that trade openness was a significant variable and had a positive impact of 59 percent on Nigeria's exchange rate. Other studies that found similar results include Zakaria, (2011). This can be explained by the increased volume of KES being traded foreign exchange market due to increased openness. This implies that trade liberalization has positive impact on role of exchange rate in the economy.

Regarding the terms of trade (TOT) the coefficient is positive and significant at 5 percent level. On average therefore, a one percent increase in terms of trade depreciates the real effective exchange rate leads by 0.4 percent. Improvement in terms of trade represents a

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greater demand for the country's exports abroad therefore higher export revenues. The higher exports result to an increased demand for the country's currency hence appreciation. Depreciation of the currency occurs if the price of imports rises at a higher rate than that of its exports.

The long run fitted values obtained from the determinants of real effective exchange rate were then used to compute the exchange rate misalignment following Mwega, (2014) as

$Mis = \left(\frac{ERER - REER}{REER}\right) * 100.$ ERER is the estimated equilibrium exchange rate proxied by the fitted values, REER is the observed exchange rate, and *Mis* is a misalignment index. Figure 3. plots the misalignment values in percentages.

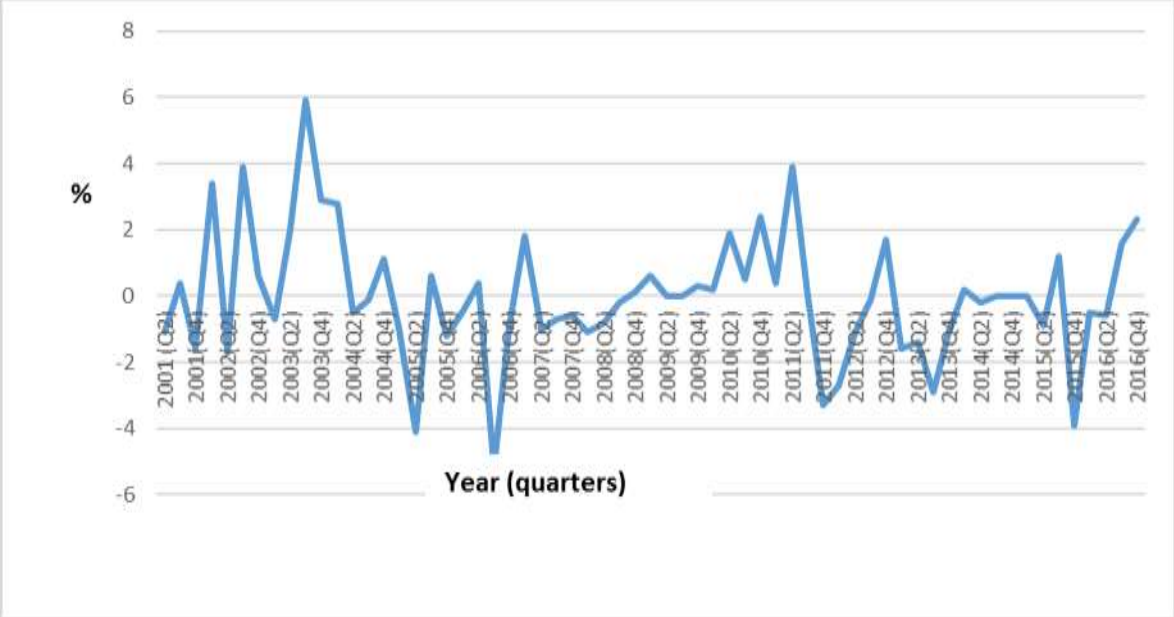

Figure 3. Real Exchange Rate Misalignment

Source: Author's computations

Figure 3. shows that the real effective exchange rate appreciated and depreciated in different periods. Notable is the overvaluation between 2001 and 2004 and 2009 to 2011. The low misalignment between 2004 and 2008 could be attributed to a change in government in 2003, and the prolonged appreciation of the exchange rate during this period. The misalignment in the period considered was 5.9 percent overvaluation and the maximum undervaluation was 5.2 percent. Generally, from Figure 4.1 the real exchange rate is misaligned but within 6 percent range which is in line with a study by Kiptui and Ndirangu (2015), that found that between 2000 a d 2014, the exchange rate misalignment was within 10 percent of its equilibrium level, exhibited both periods of overvaluation

and undervaluation, and was driven by the economic fundamentals. The results show spikes and dips that can be traced to volatility in this period which moved with periods of appreciation and depreciation.

In comparison with the entire period, the period between 2000 and mid 2003 exhibit high spikes which correspond to mild appreciation of the KES. The crossing over into a new millennium in 2000 saw the depreciation of many currencies worldwide. For the Kenya Shilling however, the cross over to the new millennium saw a steady though relatively low appreciation of the currency. The significant spike between 2003Q2 and Q4 can be attributed to the political risky event of the 2003 elections. According to Ochieng, (2013), an increase in political risk depreciates the currency of the country that is experiencing the political risk. Exchange rates reacts just before the politically risky event or in the middle of the risky event because the foreign exchange market reacts to expected changes in the business environment. Typical of floating exchange rate regimes, agents react to a political risk by selling currency of the risky country and buying currency of countries that are considered stable. This can explain the noticeable spikes in 2003, 2005 (constitutional referendum) 2007 and 2010 (inauguration of the Constitution).

Results show that between 2005 and 2007/8 there was noticeable exchange rate appreciation and there are erratic spikes clustered in 2007 particularly associated with political risk. A noticeable incident in that period in Kenya was the 2007 elections, and the subsequent post-election violence. The appreciation from 2004 died down considerably with the onset of election year in 2007. According to (CBK, 2008), the Central Bank attributed the onset of the exchange rate depreciation to the increased demand for the dollar triggered by announcement of plans to import maize.

The period 2009-2014 signified the historical exchange rate depreciation. Contrary to previous spikes where they occurred in a period of appreciation, the notable spikes in this period occurred during a depreciation. According to Omolo (2014), in a span of 148 days covering June to October, 2011, the exchange rate moved from 86 to 105 and back to 100 KES/USD, hence explaining the high fluctuation. There is also a large spike at the end of 2011 associated with a temporary currency appreciation from an all-time high of 105 when the shilling crashed. The Central Bank attributed the exchange rate appreciation to the contractionary Monetary Policy implemented from November to June 2012 to reduce inflationary expectations and exchange rate volatility. (CBK, 2012).

5.0 SUMMARY, CONCLUSION AND POLICY IMPLICATIONS

5.1 Summary

This study sought investigate the determinants of Kenya's real exchange rate; and to establish the extent of Kenya's exchange rate misalignment. In order to achieve the objective, the monetary theory with sticky prices was adopted using the rational expectations hypothesis with no bubble solution using an ARDL model. The determinants that had a positive influence on the real exchange rate were: net foreign investments, productivity, trade openness and terms of trade. On the other hand, international Brent crude oil prices negatively influenced the exchange rate. The real exchange rate was overvalued up to 5.9 percent, and undervalued up to 5.2 percent, at different periods indicating misalignment. However, it was more often undervalued than overvalued with a mean misalignment of -0.003 percent.

5.2 Conclusions

One of the objectives of this study was to determine the extent of *RER* misalignment between the observed and equilibrium *RER*. Generally, the estimated long run parameters of the real exchange rate were found to be in line with the theoretical predictions. The considered macroeconomic fundamentals except government expenditure and tax revenue were significant determinants of the real effective exchange rate. The results show that during the period of study 2000Q1 to 2016Q4, the actual *RER* rate had more episodes of undervaluation than overvaluation. Misalignment was detected and was within 6 percent deviation from the long run equilibrium level. Further, the study found that the exchange rate exhibited a volatile trend. The study therefore concludes that Kenya's exchange rate is closely aligned to its long run macroeconomic fundamentals and that the adoption of the floating exchange rate regime has achieved one of the intended purpose namely reduction of exchange rate misalignment associated with overvaluation under the fixed exchange rate. Misalignment shown by spikes and dips follows exchange rate volatility and moved with periods of appreciation and depreciation.

5.3 Policy Implications

The determinants of exchange rate that ensure that it does not deviate from its equilibrium point play a significant role in managing particularly exchange rate misalignment. Most open-economy macroeconomic models hold that any unanticipated increase in government expenditure for a given country appreciates it currency in real terms but only if financial markets are complete. However, these models contrast empirical predictions which find that there is persistent depreciation of the real exchange rate due to any unexpected exogenous increase in government expenditures. Despite the minimal magnitude of the real depreciation in this study, the findings offer a way forward

in which treasury can influence the exchange rate through the government expenditure.

The results show that an increase in productivity measured as gross investment as a percentage of GDP depreciates the Kenyan currency meaning it is concentrated in the non-traded sector. Any productivity increase in the traded sector may not influence the exchange rate due to low volume and as EAC Trade and Investment 2017 Report points out, manufactured goods constitute the bulk of EAC trade. This is in contrast to the primary goods exported to EU and rest of the world. In order to influence the exchange rate through the productivity channel, the results show that the country can enhance her products sold beyond EAC and also include value addition through processing of the agricultural exports. Structural reforms that enhance agricultural productivity and competitiveness of exports should be pursued. In addition, strategies such as tax concessions and subsidies that promotes tea and other agricultural exports to EU should be pursued as the key drivers of trade policy

The results show that rising world Brent oil prices have an appreciating effect on the Kenya's exchange rate. As the price of Brent crude oil prices increases, the Kenya shilling loses value and this has a great impact for Kenya since it is a net importer of oil. Consequently, rising oil prices imply that it is relatively more expensive for the country imports. The results show that the exchange rate can be influenced by tempering the high dependency on oil imports by expanding the refining capacity of oil discovered in the country as well as accelerating and expanding alternative sources of energy such as wind, geothermal and solar.

Appendices

Appendix 1: Results of the Stationarity Test

	KPSS LM statistic		
Variable	**Level**	**First difference**	**Order of Integration**
Foreign reserves		0.397***	I(1)
Gross Domestic Product		0.619**	I(1)
Foreign Gross Domestic product		0.078***	I(1)
Government Expenditure	0.605***		I(0)
Inflation	0.065***		I(0)
Money supply (M3)		0.715***	I(1)
Real Effective Exchange Rate		0.217***	I(1)
Trade Balance	0.073***		I(0)
Terms of Trade		0.396***	I(1)
Net Foreign Assets		0.364***	I(1)
Productivity		0.722***	I(1)
Volatility	0.615***		I(0)
Relative Prices of Imports		0.263***	I(1)
Relative Prices of Exports	0.411***		I(0)
Tax Revenue		0.152***	I(1)
World Oil Prices		0.184***	I(1)
Trade Openness		0.739***	I(1)
Misalignment	0.180***		I(0)
Exports	0.213***		I(0)
Imports		0.098***	I(1)

[***], and [**] denote significant levels at 1%, and 5%

Source: Author's Computations

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