Econometric Modelling of Short Run Parsimonious and Long Run Co-integrated Real Exchange Rate Determinants in Kenya

Bunde Aggrey Otieno
Faculty of Business Studies
Department of Business Administration
Chuka University, P.O. Box 109 – 60400, Chuka, Kenya.
aggreyotieno@yahoo.com.

ABSTRACT

A country's exchange rate is an important determinant of the growth of its cross border trading and it serves as a measure of international competitiveness. Appreciation of the shilling real exchange rate in Kenya attracted public attention in the last decades, especially from exporters and importers who have argued that the weakening shilling is eroding their competitiveness. The objective of this study was to investigate parameters influencing real exchange rate in Kenya. The data comprised of annual time series data for Kenya over the sample period 1960 to 2010.The study was guided by Montiel's theory.In this theoretical model, economy's endogenous variables are determined by predetermined and exogenous policy variables.Predetermined variables are endogenous variables that change slowly over time and exogenous policy variables include fiscal and monetary policy variables, trade policies and variables under the control of domestic authorities. The study adopted Error Correction Model, because of its ability to induce flexibility by combining the short run dynamic and long run equilibrium model in a unified system. Inferential statistics were applied using PC Give, unit root, co integration and granger causality tests were done prior to estimation. The use of cointegration technique allowed the study to capture the equilibrium relationship between non-stationary series within a stationary model. The results of long run co-integrated equilibrium and short-run parsimonious real exchange rate models revealed that real exchange rate is influenced by internal factors such as aid, government expenditure, technological progress, nominal exchange rate and commercial policy stance. External factors proxied by terms of trade also tend to play a critical role as they lead to real exchange rate depreciation. The study concluded that policy management need to focus on ensuring the prevalence of sound macroeconomic fundamentals and effectively target and manage all variables influencing long run behavior of real exchange rate in Kenya.

Key Words: Econometric, Modeling, Exchange Rate, Kenya.

INTRODUCTION

The relationship between a country's exchange rate and economic growth is a crucial issue from both the descriptive and policy prescription perspectives. As Edwards (1999) puts it "it is not an overstatement to say that real exchange rate behaviour now occupies a central role in policy evaluation and design". A country's exchange rate is an important determinant of the growth of its cross-border trading and it serves as a measure of its international competitiveness (Bah and Amusa, 2003). The real exchange rate, in particular, defined as the relative price of foreign goods in terms of domestic goods, is of greater significance, as it is an important relative price signaling inter-sectoral growth in the long run and acts as a measure of international competitiveness. In other words, the real exchange rate plays a crucial role in guiding the broad allocation of production and spending in the domestic economy between foreign and domestic goods. The real exchange rate's level, relative to an equilibrium real exchange rate level, and its stability have been shown to importantly influence export growth, consumption, resource allocation, employment and private investments. Because of this important role the real exchange rate plays in the economy, emerging economies, in particular, are encouraged to conduct their policies so as to get this macroeconomic relative price right. The 'right' real exchange rate is one that does not stray too far from its equilibrium value. The deviation of the actual or observed real exchange rate from the equilibrium real exchange rate is referred to as misalignment (Montiel, 2003) when the real exchange rate is misaligned, it can lead to a distortion in price signals that affect the allocation of resources in the economy.

In developing countries, misalignment in the real exchange rate has often taken the form of overvaluation, which adversely affects the tradable goods sector or export sector. Overvaluation results in a real decline in the price of foreign goods relative to domestic goods. A decline in the price of foreign goods in terms of domestic goods has two primary effects on the export sector. First, on the production side, fewer resources will be allocated towards

producing goods that can be exported, since these goods will be expensive for foreigners; at the same time, production of substitutes for foreign goods will also decline these both destroy the current account. Second, on the consumption side, a fall in the price of foreign goods relative to domestic goods will stimulate domestic spending on foreign goods. The net effect is making exports less competitive in foreign markets, while stimulating imports, hence a current account deficit. Consequently, domestic manufacturer's incentives and profits will be lowered leading to declining investment and export volumes.

Problem Statement

Real exchange rate is an active source of discussions in Kenya, where exports performance has improved since 2002, but continues to fall short of the ambitions of the vision 2030. The level of the Kenya shilling exchange rate continues to be determined by the forces of demand and supply in the foreign exchange market. Questions have arisen in the policy arena and in the public domain in most cases revolving around the possible reasons for persistent appreciation of the shilling real exchange rate against key currencies. Empirical studies on the Kenyan economy explaining the impact of shocks to real exchange rate movements are scanty (Kiptui and Kipyegon, 2008). Pollin and Heintz (2007) have recently called for a reassessment of monetary policy with a view to achieving a more depreciated shilling.

Kenya adopted a unified and flexible exchange rate in the early 1990s, as part of a market-based reform program designed to improve the investment environment and spur economic growth according to Ndung'u, (2008). The real exchange rate has been a policy target, and in most exchange rate regime changes the aim is to maintain a stable and competitive real exchange rate. A number of researchers have argued that real exchange rates are crucial not only for attaining sustained general economic performance and international competitiveness, but have a strong impact on resource allocation amongst different sectors of the economy, foreign trade flows and balance of payments, employment, structure of production, consumption and external debt crisis (Edwards, 1989, and Edwards and Savastano, 1999).

MATERIALS AND METHODS

Model Specification

$$\Delta LogRER^{*}{}_{t} = \beta_0 + \beta_1 \Delta LogTOT_{t-1} + \beta_2 \Delta LogAID_{t-1} + \beta_3 \Delta LogGCN_{t-1} + \beta_4 \Delta LogCPS_{t-1} + \beta_5 \Delta LogTEP_{t-1} + \beta_6 \Delta LogNER + \mu_t$$

Where:

Log RER* - Logarithm of equilibrium Real Exchange Rate
Log TOT - Logarithm of external terms of trade
Log AID - Logarithm of external aid inflows (real net ODA to Kenya)
Log GCN - Logarithm of government consumption of non-tradable
Log CPS - Logarithm of commercial policy stance
Log TEP - Logarithm of technological progress
Log NER - Logarithm of Nominal Exchange Rate

Estimation Techniques

Error Correction Model (ECM)

Empirical studies have shown that the Error Correction Model is best suited model estimation when economic variables are individually non-stationary and cointegrated, i.e. when there is a meaningful long-run relationship between them. The error-correction methodology is appealing because of its ability to induce flexibility by combining the short-run dynamic and long-run equilibrium models in a unified system. At the same time, it ensures theoretical rigour and data coherence and consistency. This modeling strategy adopted in this study involved the following steps:

Stationarity/Unit Root Test

The classical regression technique, the Ordinary Least Square assumes that the variables under consideration are stationary which means, in simple words, their mean, variance and covariance are time invariant. It is found that almost all macroeconomic variables are non-stationary. Unfortunately, a regression carried out with such non-stationary series gives spurious results and is referred to as spurious or non-sense regression (Gujarati, 2003). A series is referred to as stationary if its mean and variance are constant over time and "the value of the covariance between the two time periods depends only on the distance or lag between the two time periods, not on the time at which the covariance is calculated" (Gujarati, 2003). In a stationary time series data, the shocks will be temporary and over time their effects will be as the series revert to its long run mean value. A time series data that is stationary has the following properties. First **E** $(\boldsymbol{Y_t})$= Constant for all **t**, second property is that **Variance**$(\boldsymbol{Y_t})$= Constant for all **t**, the third property is that **Covariance**$(\boldsymbol{Y_t, Y_{t+k}})$= Constant for all **t** and $\mathbf{k \neq 0}$. Given that the data have constant mean, variance as well as the covariance, then such data is stationery. One of the reasons that we need to ensure the use of stationary data is to avoid spurious regression results. In the case of non-stationary data, the mean and variance of this data is not constant and hence varies with time. When such a data is used, it might result in unreliable signs of the coefficients as well as very high t- ratios (Kennedy, 2003). One of the methods of detecting non-stationary data is through Durbin Watson statistics and $\boldsymbol{R^2}$. If $\boldsymbol{R^2}$**>DW** statistic, the implication is that the regression result is unreliable or spurious. Different tests for checking unit root were used in this study. Such tests included Augmented Dickey Fuller test (ADF) as well as Philip Peron test (PP). The researcher first took a case of an autoregressive model of order one (AR (1)) such that:

$$\boldsymbol{X_t=\beta X_{t-1}+e_t} \quad \text{3.1}$$

In this case $\boldsymbol{e_t}$ is the white noise process while $\boldsymbol{|\beta|<1}$ will indicate that the data is stationery. When $\boldsymbol{|\beta|>1}$ then it implies that the series is unstable. When $\boldsymbol{|\beta|=1}$ then it implies that the time series data comprises the unit root and the series is trendy as well as non-stationary. When $\boldsymbol{|\beta|=1}$ we deduct $\boldsymbol{X_{t-1}}$from both sides of the equation 1 as follows:

$$\boldsymbol{X_t-X_{t-1}=\beta X_{t-1}-X_{t-1}+e_t} \quad \text{3.2}$$

$$\boldsymbol{\Delta X_t= e_t}$$

In this case $\boldsymbol{e_t}$ is the white noise while $\boldsymbol{\Delta X_t}$ is the stationery series. If a series $\boldsymbol{X_t}$already has property of stationary variable or it is stationary at the level then it is written as I (0). Given that the series is stationary after taking the first difference then it is written as I (1). This study will use Augmented Dickey Fuller and Philip Peron tests for verifying the order of integration.

Test of Stationarity using Augmented Dickey Fuller Test [ADF]

This test is used to check the stationarity of each variable. The ADF is also used in the checking the order of the integration of the variables under consideration. The ADF test is based on the following equation:

$$\boldsymbol{\Delta X_t= \gamma X_{t-1}+ \sum_{i=1}^{p} \beta_i X_{t-1}+e_t} \quad \text{3.3}$$

Where:

$\boldsymbol{\Delta}$ = first difference operator
$\mathbf{t}$ = time subscript
$\boldsymbol{e_t}$ = is the error term
$\boldsymbol{P}$= is the lag operator. The finding of the ADF test will be based on the following form, in an analysis without the intercept and trend, the equation will be of the following form:

$$\boldsymbol{\Delta X_t= \gamma X_{t-1}+ \sum_{i=1}^{p} \beta_i X_{t-1}+e_t} \quad \text{1}$$

In an analysis with the intercept and no trend, the equation will be of the following form:

$$\Delta X_t = \alpha_0 + \gamma X_{t-1} + \sum_{i=1}^{p} \beta_i X_{t-1} + e_t \quad \text{.....3.5}$$

In a case where the analysis includes an intercept and a trend, the equation will be in this form:

$$\Delta X_t = \alpha_0 + \gamma X + \beta t + \sum_{i=1}^{p} \beta_i \Delta X_{t-1} + e_t \quad \text{..... ..3.6}$$

The decision rule in this case is that, if the t-statistics is greater than the critical value, then the null hypothesis should be rejected. Otherwise the null hypothesis should be accepted.

Test of Stationarity Using Phillip-Perron Test [PP]

This test was developed by Phillips and Perron in 1988 (Maddala, & Kim, 1998). It is a generalized test of the Augmented Dickey-Fuller (ADF) test. The test equation of Phillip-Perron is given as:

$$\Delta X_t = \alpha_0 + \gamma X_{t-1} + \mu_t \quad \text{.....3.7}$$

PP test makes amendment to the t-statistics of coefficient γ in order to remove serial correlation in μ_t (error term). PP test is a modification of ADF test that takes into account less restrictive nature of the error process

Cointegration Test

This concept was introduced by Granger in the year 1981. Later in 1987, other individuals like Engle Granger, Engle and Yoo gave more explanation on the same concept (Banerjee, 2003). The primary goal of the concept of co integration is to find out the long run relationship between the variables being studied. Cointegration analysis was used to avoid spurious regressions while at the same time providing a means of explicitly distinguishing between long-run and short-run estimations through the error correction formulation. Cointegration tests are conducted in case of non-stationarity of the series to ensure long run relationships. Such techniques include Engle Granger, Autoregressive Distributed lag, and the Johansen Juselius techniques. Given that all variables have the same order of integration on level I (1), then the OLS is used in the analysis. Given that all variables are integrated of order I (0) and that there is one explanatory variable then in such a case Engel Granger cointegration is applied in the analysis. However, given that the integration is the same for all variables under consideration, and that there are more than one explanatory variable, then Johansen Juselius approach is applied in the analysis of that data. Given that the order of the integration of the variables under consideration is not the same, then in such a case ARDL is used to analyze the data. If the variables are integrated of the same order, then Johansen – Juselius Maximum Likelihood method of cointegration is applied to obtain the number of cointegrating vectors. If the variables are cointegrated of the same order, an error correction model forms a linear combination of the variables included in the model (Johansen and Juselius 1990).

Granger Causality Test

Once the long run relationship between Real Exchange Rate and its fundamentals was established the next logical step for purposes of this study was to examine the Granger causal relationship among the variables. X is said to granger cause Y if and only if the forecast of Y is improved by using the past values of X together with the past values of Y (Granger, 1969). Granger causality distinguishes between unidirectional and bidirectional causality. Unidirectional causality is said to exist from X to Y if X causes Y but Y does not cause X. If neither of them causes the other, then the two time series are statistically independent. If each of the variables causes the other, then a bidirectional or mutual feedback is said to exist between the variables.

RESULTS AND DISCUSSIONS

Unit Roots and Cointegration Test

The time series properties of all variables were ascertained prior to estimation. In this connection, tests to detect non-stationarity and determine the order of integration of the variables in the model as well as tests to determine the causality between the variables were rigorously conducted. Elbadawi and Soto, (1995) pointed out that such tests for non-stationarity also verify whether the series could be represented more appropriately as a difference or trend stationary process. The Augmented Dickey–Fuller (ADF) test for the existence of unit roots was used and the Granger causality test was pursued for determining causality. The causal relationships between the real exchange rate and its determinants were thus examined. Generally, the real exchange rate variable is said to be Granger caused by a specific fundamental, say aid variable, if the current values of the real exchange rate can be predicted with more accuracy through the use of the aid variable's past values. The real exchange rate was regressed

on its own lags and that of the fundamental. Feedback effects for mutual causality were checked by running the test in a reverse manner. The results of the unit root test are presented in Table 1 below. As is evident from the results, the Augmented Dickey–Fuller tests point to the existence of non-stationarity for the levels of the various variables but these variables became stationary when the first difference was taken.

Table1. Unit Root Test for Real Exchange Rate Model Variables

Variable	Lags	Augmented Dickey – Fuller	Order of integration
DLog RER $_{t-1}$	1	-3.658320	I(1)
DLog TOT $_{t-1}$	1	-5.605113	I(1)
DLog AID $_{t-1}$	1	-3.615532	I(1)
DLog GCN $_{t-1}$	1	-5.054172	I(1)
DLog CPS $_{t-1}$	1	-4.829783	I(1)
DLog TEP $_{t-1}$	1	-5.302551	I(1)
DLog NER $_{t-1}$	1	-3.402865	I(1)

Source: Authors estimation results, 2015.

Tests of Co Integration between RER and Explanatory Variables

Many time series are nonstationary individually, but move together over time, that is, there are some influences in the series (for example, market forces), which imply that the two series are bound by some relationship in the long-run. Brooks shows that a co integrating relationship may also be seen as a long term or equilibrium phenomenon, since it is possible that co integrating variables may deviate from the relationship in the short run, but their association would return in the long-run. This concept is particularly important in this study where we seek to identify and distinguish those variables that have a long term relationship with the real exchange rate.

Table2. Long run Test of Cointegration between RER and its determinants

Dickey–Fuller (DF) test on residuals	-4.264324
Augmented Dickey–Fuller (ADF) test on residuals	-4.472053
Phillips–Perron (PP) test on residuals	-3.325144

Source: Authors estimation results, 2015.

Table 2 show results of DF, ADF and PP tests. A comparison of the computed Dickey Fuller and Augmented Dickey–Fuller test results with the Mackinnon critical values of about -2.947 and -2.612 at the 5percent and 10 percent significant levels, respectively, tends to support co integration between the real exchange rate and its fundamentals. The existence of co integration is also upheld by the Phillips–Perron test, whose critical values at the 5percent and 10percent significant levels are -2.945 and -2.611, respectively.

Table3. Short run Test of Cointegration between RER and determinants

Dickey–Fuller (DF) test on residuals	-4.783656
Augmented Dickey–Fuller (ADF) test on residuals	-4.386352
Phillips–Perron (PP) test on residuals	-3.238547

Source: Authors estimation results, 2013.

The results from tests for co integration on the residuals in the short run equation real exchange rate model (as shown in Table 3 attest to the existence of co integration. All three tests (i.e., DF, ADF and PP) show values that compare favorably with their respective Mackinnon critical values to support co integration. Critical values for rejection of the null hypothesis of a unit root are -2.9472 at 5 percent level and -2.6118 at 10 percent level of significance.

Granger Causality Tests for RER Model

Table4. Pairwise Granger Causality Test for RER Model

Null Hypothesis	Lags	F-Statistics	P- Value
AID does not granger cause RER*	1	4.28134	0.01205
RER does not granger cause AID		0.31123	0.34122
TOT does not granger cause RER*	1	3.50025	0.12504
RER* does not granger cause TOT		0.41602	0.24123
CPS does not Granger cause RER*	1	3.12140	0.04915
RER does not Granger cause CPS		0.10632	0.42100
TEP does not Granger cause RER*	1	5.56061	0.01330
RER does not Granger cause TEP		0.12634	0.56917
GCN does not Granger cause RER	1	2.18052	0.23651
RER does not Granger cause GCN		0.21500	0.54424

Source: Authors estimation results, 2013.

The outcome of the Granger causality test to ascertain the direction of causality between the real exchange rate and its fundamentals is as shown in Table 4 above. A bivariate analysis was employed to test for causality. Null hypothesis is rejected at 5 percent level of significance (P>0.05). The choice of the optimal lag length was based on the Schwartz Bayesian criterion. A P-Value of less than 0.05 (P<0.05) indicated causality in the empirical results. Unidirectional causality was observed between aid (AID) and real exchange rate (RER) with a P-Value of 0.01205, commercial policy stance (CPS) and RER with P-Value of 0.04915, technological progress (TEP) and real exchange rate (RER) with P-Value of 0.0133. No granger causality was observed between government expenditure (GCN) and real exchange rate (RER) with a P-Value of 0.23651 and terms of trade (TOT) with a P-value of 0.12504. Because of the importance of the two parameters they were included in the model to capture the fiscal action of the government and its influence on RER and TOT included to capture economy's openness but the statistical significance of the two parameters were carefully observed during the estimation process. The results of the Granger causality test and the unit root test allowed for the direct estimation of the co integration regression using Ordinary Least Squares (OLS).

Estimation of the Econometrics Model

Table5. Long-run Cointegrated Equilibrium Model Results

Dependent variable: Log RER
Method: Ordinary Least squares
Sample: 1960–2010
Included observations: 50

Variable	Co-efficient	Standard error	t-statistics	P-Value
C	3.626702	0.523100	6.933095	0.0001*
DLog TOT_{t-1}	0.404622	0.299082	1.352879	0.0060*
DLog AID_{t-1}	-0.231233	-0.176242	1.312019	0.0004*
DLog GCN_{t-1}	-0.556046	-0.201527	2.759163	0.0038*
DLog CPS_{t-1}	-0.320067	-0.024575	13.024089	0.0000*
DLog TEP_{t-1}	-1.245013	-0.104858	11.873323	0.0000*

R-squared	0.911032	Adjusted R-squared	0.937182	AIC	-1.046457
SIC -1.242048	F-statistic	71.31134	Durbin–Watson stat		1.435031

*** 1% ** 5% and *** 10% Level of Significance**
Source: Authors estimation results, 2015.

Table 6. Short-run Parsimonious RER Model results

Dependent variable: Log RER
Method: Least squares
Sample: 1960–2010
Included observations: 50

Variable	Co-efficient	Standard error	t-statistics	P-Value
C	1.343122	0.462401	2.904669	0.0068
D Log AID $_{t-1}$	-0.487251	-0.156231	3.118785	0.0004*
DLog RER	-0.234625	-0.732534	0.320292	0.0006
DLog GCN $_{t-1}$	-1.410147	-0.694015	2.031868	0.0081*
DLog CPS $_{t-1}$	-0.527102	-0.135709	3.884060	0.0786***
D Log TEP $_{t-1}$	-2.965452	-0.803212	3.691991	0.0230***
DLog NER $_{t-1}$	0.318720	0.238649	1.335178	0.0023*

R-squared	0.747644	Adj. R-sq	0.706250	Akaike info criterion	-2.150641
SIC -1.23366	F-statistic	15.10568	Durbin–Watson stat	2.34264	

* 1% ** 5% and *** 10% Level of Significance
Source: Authors estimation results, 2015.

DISCUSSIONS

Econometric Diagnostic Tests

Multicollinearity Diagnostics

Multicollinearity test was done to establish whether the explanatory variables were stochastic or non-stochastic. High R^2 but few signification t-ratios are classic symptoms of multicollinearity. The existence of multicollinearity does not affect the BLUE (Best Linear Unbiased Estimates) property of the estimates. A multivariate analysis was carried out to establish the relationship between RER and its explanatory variables. Empirics of the model analyzed indicated that the fitted model had a high explanatory power with R^2 of 0.911 in the Long run cointegrated model indicating that independent variables explained dependent variable 91 percent. In the short run parsimonious model R^2 of 0.7063 indicated an explanatory power of 70.6 percent. High explanatory power in the two models coupled with very many significant t-ratios indicated the absence of collinearity between independent variables.

Autocorrelation Diagnostics

Economic time series often display the characteristic feature of inertia or sluggishness, this tendency generates a momentum which propels it in its upward movement until such a movement is slowed down by a change in one or more of the estimators in the economy. This means that in time series regression successive observations are likely to be interdependent giving rise to autocorrelation. A test to determine the existence of autocorrelation was done to show whether the successive values of the error term were sequentially independent as stipulated in the assumptions of the Classical Linear Regression Model. A first order autocorrelation test was done by looking at the Durbin Watson statistics in the estimation results. The most celebrated test to determine the existence of serial correlation the Durbin Watson test was employed. The DW result of 1.4350, 2.34264 in the Long run cointegrated and short run parsimonious respectively indicated the absence of autocorrelation between independent variable and stochastic term in the three models.

Testing Statistical Significance of Parameters Estimates

Statistical significant was confirmed by positive values of t-statistics estimated at 1 percent ($P<0.01$) level of significance in the Long run cointegrated Real exchange rate Model. In the short run parsimonious model, fundamentals were estimated at 1 percent and 5 percent level of significance. Foreign Aid, Government expenditure, Technological progress and Nominal exchange rates were statistically significant at 1 percent level of significance ($P<0.01$) and Commercial Policy Stance measured at 5 percent level of significance.

Interpretations of Co-efficient of Parameter Estimates

Government Expenditure

The study results show a negative relationship between government expenditure and real exchange rates. The impact of government expenditure on the real exchange rate depends on whether such spending is predominantly on tradable goods or non-tradable goods. An increase in government spending on tradable goods creates a trade deficit, which requires a real depreciation in the exchange rate in order to maintain external balance. The real depreciation in the exchange rate induces an increase in the production of tradable goods, allowing an increase in total spending on tradable goods. In contrast, an increase in government spending on nontradable goods leads to an increase in their relative price in order to maintain equilibrium in the nontradable goods market. An increase in the relative price of nontradable goods, in turn appreciates the real exchange rate. The extent to which government expenditure affects the real exchange rate depends on the marginal propensity to spend on non-tradable; the higher it is the more likely an increase in government expenditure which causes the real exchange rate to appreciate. Theoretically government spending is expected to increase aggregate demand and exert an upward pressure on the prices of non-traded goods. This would then lead to an appreciation of the currency in the short-run. In the long-run, however, Government spending leads to an accumulation of domestic and foreign debts. Debt-service requirements in the long run could call for higher taxes and therefore a reduction in aggregate demand thus causing the real exchange rate to depreciate in the long-run. Thus, the real exchange rate is a function of the sectoral composition of the government spending, with an increase in government spending on tradable goods leading to a depreciation of the real exchange rate, and when its increase falls heavily on nontradables as the results suggests, the real exchange rate appreciates.

Foreign Aid

Likewise to government expenditure, real exchange rate appreciates with an increase in foreign aid inflow. Foreign aid inflow was treated as an exogenous variable in the study it proxied monetary policy stance in the economy. A negative sign attached to the co-efficient of Foreign Aid which is significant at 1 percent level of significance indicates appreciation of Real exchange rates. The study findings show that Exchange Rate appreciates with increase in foreign aid inflows which increases aggregate demand and exert upward pressure on prices of non-tradables, thus causing an appreciation of the real exchange rate. Increases in foreign aid inflows leads to accumulation of international reserves at the central bank and a monetary expansion (M_3).

Excess money supply in an economy puts an upward pressure on the prices of non-tradable goods thereby inducing inflation, which in turn causes the real exchange rate to appreciate. An increase in this variable results in an addition to household incomes equal to the amount of foreign aid transfer. Additional transfer income permits an expansion of consumption which in turn will raise the price of nontradable goods and eventually an appreciation of the real exchange rate. Most countries resort to sterilized intervention in the foreign exchange market to curtail this problem. When a central bank pursues a non-sterilized intervention in the foreign exchange market upon excessive inflow of foreign aid, the outcome is an increase in domestic money supplies which give rise to inflationary tendencies and put pressure on the real exchange rate to appreciate. Sterilized intervention may work to shield the real exchange rate from appreciating in the short-run but could well trigger further foreign aid inflows as it causes short-run interest rates to increase, and hence induce an appreciation in the real exchange rate.

Technological Progress

Technological progress was proxied by index of agricultural production; it is an indicator of real economic growth. In the empirical results its co-efficient is negative and statistically significant at 1 percent level of significance. Its effect on the real exchange rate depends on how technological progress affects the prices of non-tradables. On one hand, productivity shocks increase incomes and raise demand in the economy. Empirical results show that it exert pressure on prices of non-tradable to rise thus causing an appreciation of the currency. This was depicted by a negative sign attached to its co-efficient. However, there is also a possibility that the productivity shock could raise supply of non-tradable goods and therefore lower prices thus ultimately causing a depreciation of the currency.

Terms of trade

Consistent with theoretical expectations terms of trade leads to real exchange rate depreciation. This was exhibited by positive co-efficient of at 1 percent level of significance. The positive sign on terms of trade variable implies that the substitution effect associated with such improvements dominate the income effect. An improvement in the terms of trade implies more favorable export prices. The increase in export earnings leads to a rise in

aggregate demand thus resulting in price increases. Since the prices of tradables are determined in the international markets, the increase in prices will mainly affect non-tradable leading to a depreciation of the domestic currency.

Commercial Policy Stance

According to empirical results commercial policy stance or trade policy is another variable that leads to real exchange rate appreciation. A negative co-efficient of Commercial Policy Stance indicates an appreciation of real exchange rates. An increase, for example, in an import tariff can increase the domestic price of imports, which are part of tradable goods. This, in turn, shifts domestic demand towards nontradables, which will lead to an increase in their price beyond those of tradable, resulting in a real appreciation of the exchange rate. The increased demand for foreign currency, following an increase in the domestic price of imports, also appreciates the real exchange rate. An increase in export subsidies also creates a balance of payments surplus which requires an appreciation of the real exchange rate to correct. Thus, commercial liberalization or more open economy is likely to be associated with a more depreciated real exchange rate.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The study sought to develop an empirical model of the real exchange rate in Kenya. The empirical estimation concluded that terms of trade, aid inflows, government consumption, commercial policy stance and technological progress are salient variables in the long-run equilibrium real exchange rate model for Kenya. In the short run, however, pertinent variables as far as the parsimonious model is concerned are nominal exchange rate, together with all the real fundamentals with the exception of terms of trade. Foreign aid inflows have an appreciating effect on the real exchange rate this is shown by the negative co-efficient of Aid in the long run Real exchange rate model. In summary, while Kenya has judiciously avoided acute overvaluation over the years, the empirical literature has become increasingly favorable to the view that undervalued exchange rates are good for growth. However, the real exchange rate is only one of many determinants of export performance and in Kenya, the issue of appropriate policy assignment is important. Fiscal policies are far more prominent than monetary policies in determining the real exchange rates in the medium to long run, and within the domain of monetary policy, regulatory policies should not be overlooked in the midst of debate over policies that operate directly on the exchange rate. While maintaining a stable exchange rate is important, strategies that lead to a relatively overvalued exchange rate could be a disincentive to export, implying that flexibility in the exchange rate movements, in line with the fundamentals of the economy might be beneficial.

Recommendations

The results of this study have a number of policy implications: First, the presence of long run co-integrated movements between the real exchange rate and its determinants found in this study implies the effectiveness of targeting all variables influencing the long run behavior of real exchange rate. Second, the real exchange rate is shocked by factors that are outside the direct control of policy makers, such as the terms of trade. The policy implication is that the authorities' ability to influence the movements in the real exchange rate is limited. The authorities may however reduce the impact of this shock, in the long run, by utilizing policies to promote the diversification of traded goods and acting on other fundamentals. Third, liberalizing trade to ensure more openness is one of the tools in the policy maker's arsenal to avoid overvaluation both in the short and long run. With the rising level of globalization, openness through an export-led growth strategy is inevitable. However, to compete globally, costs including transaction costs should be minimal. That notwithstanding, trade liberalization or openness might also be associated with increased volatility, especially for commodity exports, therefore justifying the need for strategic supportive domestic policies to help those sectors that might not be able to cope with the wave of globalization. With advances in economic integration, particularly the East African Community and Common Market for East and Southern Africa, together with African Growth Opportunity Act, there is a potential export opportunities that can be explored to Kenya's advantage, including promotion of the non-traditional exports and tourism industry.

REFERENCES

Bah, I. and Amusa, H.A. (2003). Real exchange rate volatility and foreign trade: evidence from South Africa's exports to the United States. *The African Finance Journal*, 5, 2: 1-20.

Banerjee, A. (2003). *Co-integration, error correction, and the econometric analysis of non-stationary data*. Oxford [u.a.: Oxford Univ. Press.

Edwards, S. (1989). *Real exchange rates, devaluation and adjustment: exchange rate policy in developing countries*. Cambridge: The MIT Press.

Edwards, S. and Savastano, M.A.(1999). *Exchange rates in emerging economies: what do we know? What do we need to know?* Available: http:// ideas.repec.org/s/nbr/nberwo.html. 25/1/2013.
Elbadawi A and R. Soto. (1995). Theory and Empirics of Real exchange rates in Sub-Saharan Africa and other Developing countries, Preliminary report part of World Bank project.
Engle, R.F. and C.W.J.Granger.(1987). Co-integration and error correction. Representation, estimation, and testing. *Econometrica, vol. 55, no. 2: 251–76.*
Granger, C.W.J. (1969). Investigating Causal Relation by Econometric and Cross-sectional Method. *Econometrica*, *37*: 424 – 438.
Gujarati, D.N. (2003). *Basic Econometrics.* 4Th Ed. New York: McGraw – Hill Inc.
Johansen, S. and K. Juselius. (1990). Maximum Likelihood Estimation and Inferences on Cointegration: with application to the demand for money. *Oxford Bulletin of Economics and Statistics,* Vol. 52: 169 – 210.
Kennedy, P. (2003). *A guide to econometrics*. Cambridge, Mass: MIT Press.
Kiptui, M. and Kipyegon, L. (2008). External Shocks and Real Exchange Rate Movements In Kenya. *Annual Conference on Econometric Modeling in Africa*. South Africa: University of Pretoria.
Maddala, G. S., & Kim, I.-M. (1998). *Unit roots, cointegration and structural change*. Cambridge: Cambridge Univ. Press.
Montiel, P. J. (2003). *Macroeconomics in emerging markets*. Cambridge: Cambridge University Press.
Ndung'u, N.S. (2008). The exchange rate and interest rate differential in Kenya: a monetary and fiscal dilemma. *KIPPRA Discussion Paper No. 2*. Nairobi: Kenya Institute for Public Policy Research and Analysis.
Pollin, R. and Heintz, J. (2007). Expanding Descent Employment in Kenya: The Role of Monetary Policy, Inflation Control and the Exchange Rate. *International Poverty Center Country study* No. 6.

Bio – Data

Bunde Aggrey Otieno received B.Sc. Degree and M.A. Degree in Economics from Moi University in the year 2007 and 2013, respectively. He has served as a Research associate with Kenya Institute for Public Policy Research and Analysis (KIPPRA), Kenya National Bureau of Statistics (KNBS), Centers for Disease Control and Prevention (CDC KEMRI/CDC Atlanta Georgia) and as an Economist with State Department of Agriculture, he has taught as a part time lecturer in the department of Economics of Moi University, Kenya, Department of Management science, University of Eldoret, Kenya and Faculty of Commerce, Kisii University, Kenya. In July 2014 he was appo inted as a Young Professional by the Kenya Institute for Public Policy Research and Analysis (KIPPRA). Currently he is pursuing PhD in Economics and serving as a lecturer in Economics in the Department of Business Administrati on of Chuka University, Kenya. I have published articles in a number of International Journals that includes the African Journal of Education Science and Technology (AJEST), the International Journal of Sciences Basic and Applied Research (IJBAR), International Journal of Sciences and Research (IJSR). My research interests are mainly on Public sector economics, Monetary Economics, Energy Economics, Financial Economics, Environmental and Natural Resource Economics, International Trade, Agricultural Economics and Infrastructural Economics.

Appendix 1: Regression Variable Plots