EFFECT OF EXTERNAL PUBLIC DEBT ON THE EXCHANGE RATE IN KENYA

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ABSTRACT

Kenya being a developing country has a budget whose revenue is widely composed of primary exports. However, primary exports are insufficient sources of revenue for they are of low value. In an attempt to supplement the inadequate revenue successive governments have obtained huge sums of external public debt to finance national development programmes. In 1980, the level of external debt was US$ 3386.81M. The debt had grown over the years to a record of US$ 16,179.13M in 2014. The accumulated high external debt levels have serious implications to the official exchange rate. The study adopted a causal research design. The research targeted a population of data for 53 years covering the period 1963 - 2014. Ordinary Least Squares approach was used to analyze data retrieved from the World Bank and Kenya National Bureau of Statistics from 1980 to 2014. An Error Correction Model that flexibly combines the short run and long run dynamic models in a single system was adopted by the study. Inferential statistics were obtained by applying the PcGive Ox-metrics, Stata and E-views while prior tests on unit root, co integration, and granger causality were done before estimation. Findings of this study indicate that external public debt stock, debt service payment and foreign reserves have a positive and significant effect on exchange rate. The study recommends that the government adopts the debt relief strategies that will help reduce the external public debt level.

INTRODUCTION

Background of the Study

Public debt can be defined as the entire stock of direct government fixed term contractual obligations (Mukui, 2013). It is composed of both the external and domestic debt. External public debt is that debt that is owed to external creditors who include bilateral creditors, multilateral creditors and private institutions. Domestic public debt on the other hand is the debt owed to holders of government securities such as treasury bonds, bills and non- interest bearing stock (Kamundia, 2015). Debt financing occurs when a country is running on a deficit budget. A deficit budget arises when the public expenditure exceeds public revenue in a given financial year. According to Sobel, Stroup, Macpherson and Gwartney (2006), when an economy is operating below its potential capacity, the government should come up with expansionary fiscal and the budget deficit financed either by borrowing from the domestic market or foreign borrowing. Much of Kenya's borrowing is made externally. By the end of 2014, external public debt was 51.3% of the total debt. Kenya prefers external borrowing for it is able to acquire it on friendlier terms than domestic borrowing. The friendlier terms are lower repayment interest rates and longer repayment period. In addition to the friendlier terms the country is able to cushion its economy from the risk of crowding out private investments arising from high interest rates resulting from domestic borrowing (Panizza, 2008). Kenya's external debt structure is composed of multilateral creditors, bilateral creditors, supplier creditors and foreign commercial banks.

Benefits accruing from external public debt depends on whether prudent borrowing is done and whether the funds are properly managed. According to Mukui (2013), prudent external borrowing that is utilized in productive investment creates macroeconomic stability and also provides capital inflow which promotes domestic savings and thus creating investment demand. However high debt levels that are not well managed are a burden to an economy (Were, 2001). This is because the high cost of servicing the debt is not supported by the economy and thus large portion of the collected revenue is

used in repayment of the debt. The size of Kenya's external public debt has created a debate regarding its effect on the exchange rate. High external public borrowing causes a depreciation of the country's exchange rate. According to Reinhart and Rogoff (2009) heavy borrowing from the foreign markets dries up the capital and foreign exchange since the country's reserves are used to repay foreign debts principle and interest. A deficiency of the foreign reserves in a country destabilizes the economy because the heavily indebted country does not have funds to participate in foreign trade and thus leading to a decline in the reserves the country holds back for supporting its currency. The country consequently loses in terms of foreign exchange to other stable countries. External public debt has been changing over the years. In 1980, the debt level stood at US$ 3386.81M representing 48.1% of GDP. The debt level rose to US$ 7055.56M which was 85.8% of GDP by the end of 1990. The increase in debt was due to high oil prices. In addition, the country faced drought conditions which led to food imports (valued at US$ 1461M) that were facilitated by external funding (Onyango, 2014). By 2000, the external public debt declined to US$ 6189.02M representing 49.3% of GDP. The decline in external public debt followed the introduction of the SAP. With the intervention of the Bretton woods institutions large publicly owned entities were privatized and a number of new monetary policies were introduced. During the same period, there were many major changes including the removal of price controls, import licensing and foreign exchange controls. However, many of the suggested reforms did not succeed and thus leading to the suspension of monetary assistance by the World Bank and IMF between 1991 and 1992. As a result of this suspension, the country experienced the highest ever external public debt to GDP of 131.9% in 1993.Towards the end of 2010, the external public debt level had raised to US$ 8811.57M which was 27.5%. By 2014, the external public debt level stood at US$ 16,179.13M which was 49% of GDP. According to Irungu (2015), the increase in external public debt over the last decade was due to the high appetite for external public funds in order to finance mega infrastructural projects such as the standard gauge railway (SGR), the LAPSSET project and the Kulalu-Galana irrigation project. The exchange rate also recorded changes in the same period. The exchange rate depreciated by 14% in the year 1981/82. Depreciation continued over the years and between 1995 -1999, it had depreciated by 21%. However, this was followed by periods of appreciation and in 2007, the rate appreciated by 30% after which depreciation took centre stage (Kiptui & Kipyegon, 2008).

Hypotheses of the Study

$H0_1$: External Public Debt stock has no significant effect on the exchange rate in Kenya
$H0_2$: Debt service payment has no significant effect on the exchange rate in Kenya
$H0_3$: Foreign reserves have no significant effect on the exchange rate in Kenya

CHAPTER TWO: LITERATURE REVIEW

Theoretical Review

This section covers David Ricardo's theory of public debt and Purchasing Power Parity theory.

David Ricardo's Theory of Public debt

This theory is built on the reasoning that the primary burden to the community was derived from the wasteful habit of public expenditure itself and not from the different methods used to finance such expenditure. He observed that financing of public expenditure is made by funds drawn from the liquid resources of the community and it would not make any great difference whether such funds were raised by loans or taxes. Where the funds are raised through loans, this is referred as public debt. A country that holds external public debt has to service the debt which in most cases done by the use of foreign currency. The continuous increase or decrease in the demand for foreign currency tends to have an effect on the exchange rate.

Purchasing Power Parity (PPP) Theory

In ideally efficient markets, identical goods should fetch one price based on the theory developed by Cassel (1918). According to the theory, when exchange rates are fluctuating over time, the rate of exchange between two currencies in the long run will be fixed by their respective purchasing powers in their own economies. The theory asserts that after exchange rates are taken into account, a bundle of goods in one country should cost the same in another country. The foreign exchange market is considered to be in equilibrium when the deposits of all currencies equal rate of return that was expected. According to Lessard (2007), the PPP theorem states that under a floating exchange regime, a relative change in purchasing power parity for any pair of currency calculated as a price ratio of traded goods would tend to be approximated by a change in the equilibrium rate of exchange between the two currencies. Nominal interest rate differentials between two countries tend to reflect exchange rate fluctuations. This according to Giddy and Dufey (2007) is referred as the International Fisher effect a phenomenon observed by Irvying Fisher.

When the International Fisher effect holds, interest rates in appreciating currencies tend to be low enough, and in depreciating currencies high enough, to offset expected currency gains and losses. If the foreign exchange rates are efficient, then the two theorems must hold and therefore foreign exchange rates take into account all expected interest rate and purchasing power differentials (Mbogo, 2015).

The link between external public debt and the exchange rate can be explained by the use of foreign reserves. A country uses the foreign reserves to stabilize its currency in case it loses value with respect to other currencies. According to Reinhart and Rogoff (2009) heavy borrowing from the foreign markets dries up the capital and foreign exchange since the country's reserves are used to repay foreign debts principle and interest. A deficiency of the foreign reserves in a country destabilizes the economy because the heavily indebted country does not have funds to participate in foreign trade and thus leading to a decline in the reserves the country holds back for supporting its currency. The country consequently loses in terms of foreign exchange to other stable countries.

Empirical review

Fida, Khan and Sohali(2012) did an analysis of exchange rate fluctuations and external debt: empirical evidence from Pakistan for the period 1983-2008. Johanson cointegration test was applied to examine the long run cointegration relationships among exchange rates and the relevant exogenous variables in the Natrex model. The Autoregressive Distributive lag model was applied to examine the role of external debt in the fluctuation of exchange rate. The results suggested that there was a long run cointegration relationship between the exchange rate and external debt variables. The study informed that in order to achieve commercial policy objectives, policy makers have to work towards the stability of exchange rate. The study focused on the relationship between external debt and exchange rate but failed to determine the effect of external debt on exchange rate.Zakaree, Sanji and Idakwoji (2015) examined Effect of Public External Debt on Exchange Rate in Nigeria using the Ordinary Least Square method on secondary data. The findings revealed that all the independent variables, that is, external debt, debt service payment and foreign reserve proved to be statistically significant in explaining exchange rate fluctuation in Nigeria. Also all the independent variables had positive effect on exchange rate fluctuation. Based on the findings, the study recommended that the government should ensure that all public borrowing, where and when necessary be directed towards productive economic activities which can generate returns to service and pay up the debt at maturity. The study however only focused on the effect of Public external Debt on exchange rate in Nigeria. This research intends to fill the gap by finding the effect of external debt on exchange rate in Kenya.

Alam and Taib (2013) did an Investigation of The Relationship of External Public Debt with Budget Deficit, Current Account Deficit and Exchange Rate depreciation in Trap and Non-Debt Trap Countries by running panel ordinary least square regressions with fixed and random effects modeling. Findings were that external debt is positively related to budget deficit, current account deficit and exchange rate

depreciation in the panels of six debt trapped and eight non-debt trapped countries. The study informed that budget deficit, current account deficit and exchange rate depreciation played a significant role towards external public debt of a country and therefore policy makers should consider these factors while making decision on external borrowing. The study however only focused on the relationship between external debt variables and the exchange rate rather than the effect of external debt on the exchange rate.Blessing (2013) studied an Empirical Analysis of the Effect of Debt on the Nigerian Economy for the period 1980-2010 using linear regression. In order to achieve the aim of the study, the researcher used external debt stock, external debt service payment and exchange rate as variables to determine their effect on Gross Domestic Product and Gross capital Formation. The study found out that: Nigeria's external debt stock had a significant effect on her economic growth and Nigeria's Debt service payment had a significant relationship with her Gross capital Formation. The researcher recommended that the government should avoid borrowing as much as possible and that since developing countries need to borrow at one time or the other to supplement their internal savings, borrowing should become an option only when highly priority projects are considered. In addition to this, the researcher also pointed that borrowed funds should be strictly monitored and evaluated to ensure they are used for the purpose for which they are borrowed. However the results only give the effect of exchange rate on external debt but fail to give the effect of external debt on exchange rate.

CHAPTER THREE: METHODOLOGY

Research Design

The study employed causal research design. According to Kasomo (2006), a causal research design identifies a cause - effect relationship among variables that cannot be manipulated. This research design helped in identifying the effect of external public debt on the exchange rate.

Location of the Study

The study was conducted in Kenya with data being collected from the World Bank and Kenya National Bureau of Statistics. Kenya was of key interest due to its strategic position as East Africa's economic hub (Mukolla, 2013).

Population

The target population of the study was data for exchange rate for a period of 53 years running from 1963 to 2015. This is the period since independence till the financial year 2014/2015.

Sampling Procedure and Sample Size

Purposive sampling was applied in this study. According to Kombo and Trump (2006), purposive sampling is a non-probabilistic technique in which the researcher is allowed to use objects from the population in such a manner that the chosen objects contain specific characteristics with respect to the objectives of the study. The study used data for the period 1980-2014. The choice of the period was informed by the fact that Kenya started adopting the Structural Adjusted Programmes in 1980 in order to revive the growth of the economy through the efficient utilization of internal and external resources (Mukui, 2013). The period was also long enough to capture the effect of external public debt on the exchange rate.

Data Collection

The study employed secondary data collected from the World Bank data bank and the Kenya National Bureau of Statistics for 35 years spanning from 1980 to 2014.The extracted data was filled in the data collection checklist.

Data Analysis

Inferential analysis was adopted in this study. The technique was best suited for the study for it draws conclusions concerning relationships as well as differences found in the findings (Otieno, Korir & Mudaski, 2011). Once data was collected, it was edited, organized and cleaned and then entered in Microsoft excel where it was log transformed to linearize it and then imported to Eviews, Pcgive

OxMetrics and Stata for analysis. Unit root test for stationarity was then conducted followed by cointegration test to distinguish between long-run and short–run relationship after which granger causality tests were performed to examine causal relationship among the variables. VAR diagnostics and tests were then performed to determine the lag length, test for the normality of the residuals and test for the serial correlation of the residuals. Ordinary Least Squares estimation method was then performed on the data to obtain the models with t-statistic being used as the test statistic. After estimation, diagnostic checks that include test for multicollinearity, autocorrelation and heteroscedasticity were performed to find out whether that the assumptions of the Classical linear Regression Model (CLRM) were held. When the assumptions are held the Ordinary Least Square estimators are said to be Based Linear Unbiased Estimators (BLUE). Structural breaks in the economy the economy will be the economy were taken care of by inclusion of dummy variables in the model.

Model Specification

In order to identify the effect of external public debt on the exchange rate in Kenya, the exchange rate model was developed from past empirical studies. A dummy variable were incorporated in the models in order to take care of the structural break in 1992.

Exchange Rate Model

The effect of external public debt on exchange rate model follows specification by Zakaree, Sanji and Idakwoji (2015). Exchange rate is modelled as a function of external public debt, debt service payment and foreign reserve. A dummy variable for the first tribal clashes in 1992 was incorporated in the model. The model can be stated in stochastic form as follows:

$$\Delta \mathrm{LogER}_t = \alpha_0 + \alpha_1 \Delta \mathrm{Log(EXD)}_{t-i} + \alpha_2 \Delta \mathrm{Log(DSP)}_{t-i} + \alpha_3 \Delta \mathrm{Log(FR)}_{t-i} + \alpha_4 \mathrm{D92} + \varepsilon_t$$

Definition of Variables

Log ER: Logarithm of Exchange Rate
Log EXD: Logarithm of External Public Debt measured as a percentage of GDP
Log DSP: Logarithm of Debt Service Payment measured as a percentage of GDP
Log FR: Logarithm of Foreign Reserve measured as a percentage of GDP
D92: Dummy variable for the tribal clashes in 1992
α_0: Constant term
ε_t: Error term
α_1 ,α_2 , α_3 ,α_4 are coefficients of the independent variables

Estimation Techniques

This section contains the error correction model, unit root test, cointegration test, granger causality test and vector autoregressive test.

Error Correction Model (ECM)

The Error Correction Model is the best appropriate model for estimating economic variables that are individually cointegrated which means that there is meaningful long-run relationship between them and are non-stationary as shown by empirical studies (Otieno, Korir & Mudaski, 2011). Error-correction methodology is suitable for it is able to induce flexibility by combining both the long-run and short-run dynamic equilibrium models in a uniform system. The methodology also ensures data coherence, consistency and theoretical rigour. The Error - Correction methodology was carried out in the following steps:

Test for Stationarity/ Unit Root Test

The Ordinary Least Square (OLS) assumes that the variables under consideration be stationary. This means that the mean, variance and covariance of the variables are time invariant. However, almost all macroeconomic variables are found to be non-stationary. According to Gujarati (2003), carrying out regression using the non-stationary variables yields spurious results and is referred to as spurious or non-sense regression. Similarly, a series is said to be stationary if its mean and variance are constant over time no matter the point at which they are measured, otherwise it is a non-stationary series. A

stationary time series is important for it is possible to generalize its behavior to other time periods unlike a non-stationary time series whose behavior can only be studied for the time period under consideration and therefore each set of time series data will be for a particular episode. Non-stationary time series will thus be of little practical value during forecasting (Gujarat, 2003). A non - stationary series is said to be containing a unit root and in this case, the series may require do be differenced to make it stationary. If a series has no unit root, then it is said to be integrated of order zero, I (0). The Augmented Dickey Fuller (ADF) test was employed to test for stationarity. Mackinnon critical values for rejection of null hypothesis of unit root at 5% level of significance were compared with the test results. The variables were stationary if the test results were found to be less than the MacKinnon critical values at 5% level of significance.

Cointegration Test

Cointegration analysis provides a platform for explicitly distinguishing between short-run and long-run estimations through the error correction formulation. The tests are done in case the time series is non-stationary in order to ensure long-run relationships. Engel granger two steps approach was used to test for cointegration. According to Johansen and Juselius (1990), if the variables are cointegrated of the same order, then an error correction model forms a linear combination of the variables in the model.

Granger Causality Test

After the long-run relationship between external public debt stock, debt service payment and foreign reserves and exchange rate had been established, the next step was to examine the Granger causal relationship among the variables. According to Granger (1969), a variable say Z is said to granger cause M if and only if the forecast of M is improved by using past observations of Z together with those of M. Granger causality can take three forms: unidirectional, bidirectional or neutral causality. Unidirectional causality exists from Z to M if Z causes M but M does not cause Z. Bidirectional causality is said to exist if Z causes M and M causes Z. If neither Z nor M causes the other, then the variables are said to neutral cause each other. Null hypothesis will be rejected at 5% level of significance. A P-Value of less than 0.05 indicated causality in the results at 5% level of significance.

Vector Auto Regression (VAR)

Vector Autoregression (VAR) is a way to summarize the dynamics of macroeconomic data. The VAR models provide empirical evidence on the response of macroeconomic variables to exogenous impulses.

Vector Diagnostics and Tests

This study employed Lag selection test, LM Multiplier test and Normality test as the vector diagnostics and tests.

Lag Order Selection

The Akaike Information Criteria (AIC), Hannan-Quinn Information Criterion (HQIC) and the Schwarz Bayesian Criteria (SBC) were used to select the number of lags for each of the models. According to Gujarat (2003), the model with the least value of the AIC, HQIC and SBC is preferred. Models with different lags were run and the model with least values of the AIC, HQIC and SBC was selected.

LM Multiplier Test

LM Multiplier tests were carried to ascertain the existence autocorrelation in the residuals. Null hypothesis for absence of autocorrelation in the residuals is accepted if the obtained critical value is more than 0.05.

Normality Test

Ordinary Least Squares (OLS) assumes that the error term is normally distributed. Jarque Bera test, Skewness test Kurtosis test statistics were employed to test for normality. Residuals are said to be normally distributed if the null hypothesis for the test statistics being statistically different from zero is accepted.

Diagnostic Tests

The diagnostic checks carried out were multicollinearity test, autocorrelation test and heteroscedasticity test

Multicollinearity Test

Multicollinearity is said to occur when there is inter-correlation among the explanatory variables. Though multicollinearity is not a problem, the degree of collinearity is of primary concern since explanatory variables that are highly correlated present difficulties for it makes it difficult to isolate the effect of each explanatory variable on the explained variable. In this study, the researcher detected multicollinearity using the coefficient of determination (R^2).Multicollinearity is present when there is a high coefficient of determination but few significant t-ratios.

Autocorrelation

The problem of autocorrelation exists when variances of the error terms are serially interdependent. The values of the stochastic term should be serially independent according to the Classical Linear Regression Model assumption of non- autocorrelation. This means that the disturbance occurring at one point of a set of observation should not be related with another disturbance occurring at another point of the set of observation. Autocorrelation can be caused by a faulty functional form of the model, omission of explanatory variables from the model, effects of shocks over time on time series data and sluggishness of economic time series. The result of autocorrelation will be inefficient and inconsistent parameter estimates and biasness of estimator variances. The researcher used the Durbin Watson (d-test) to detect autocorrelation. Autocorrelation is present if the d-test assumes values close to or exact values of 0 and 4. A value of 0 shows evidence of perfect positive autocorrelation while 4 shows evidence of perfect negative autocorrelation. Values ranging from 2 to 2.5 show evidence of no autocorrelation.

Heteroscedasticity

Heteroscedasticity occurs when the assumption of homoscedasticity is violated. The assumption requires that the variances of the residuals should be constant. Presence of heteroscedasticity means that the results will have statistically insignificant coefficients as well as misleading statistical inferences. Heteroscedasticity occurs as a result of presence of outlier observations, omission of some important variables in the model, incorrect transformation of the model or incorrect functional form of the model. The researcher used Breusch-Pagan test for Heteroscedasticity where the null hypothesis is that for a constant variance. Heteroscedasticity will be absent if the null hypothesis for constant variance is accepted while a rejection of the null hypothesis will imply the presence of heteroscedasticity.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results and discussions of the research findings on the effect of external public debt on exchange rate in Kenya. The chapter consists of unit root test, cointegration test, granger causality test, VAR diagnostics and tests, model estimation and post estimation diagnostic tests.

4.3 Unit Root Test

Data was transformed into natural logarithms in order to achieve stationarity in variance and to take care of the non-linearities in the relationships. Data is said to be stationary if the ADF statistics are less than the Mackinnon critical values. In case the ADF statistics are higher than the Mackinnon critical values, the data is not stationary. The non-stationary data is differenced and the new ADF statistic is compared with the Mackinnon critical values to test for stationarity.

4.3.1 Unit Root Test for the Exchange Rate Model

This section contains the test of stationarity of the variables in the exchange rate model.

Table 1: Unit Root Test for Exchange Rate Model Variables

Variable	Lag	ADF	Integration Order
ΔLog ER	1	-2.901035	I(1)
$\Delta\text{Log ER}_{t-1}$	1	-3.101035	I(1)
$\Delta\Delta\text{Log ER}_{t-1}$	1	-6.306500	I(0)
Log EXD	1	-2.085666	I(1)
$\Delta\text{Log EXD}_{t-1}$	1	-2.428809	I(1)
$\Delta\Delta\text{Log EXD}_{t-1}$	1	-5.082428	I(0)
Log DSP	1	-0.908628	I(1)
$\Delta\text{Log DSP}_{t-1}$	1	-2.455392	I(1)
$\Delta\Delta\text{Log DSP}_{t-1}$	1	-6.288117	I(0)
Log FR	1	-2.173793	I(1)
$\Delta\text{Log FR}_{t-1}$	1	-5.546131	I(0)
Significance Level	Level form Mackinnon critical values	First Difference Mackinnon critical values	Second Difference Mackinnon critical values
5%	-3.5514	-3.5562	-3.5614

Table 1 shows results of unit root test for exchange rate model variables. Presence of unit root in the variables was determined by carrying out the ADF test. All the variables were found to be non-stationary when in level at Mackinnon critical value of -3.5514 at 5% level of significance for rejection of null hypothesis. After the first differencing, foreign reserves were found to be stationary at Mackinnon critical value of -3.5562 at 5% level of significance. Exchange rate, external public debt and debt service payment were found to contain a unit root at 5% level of significance. After the second difference, the exchange rate, external debt and debt service payment were all found to be stationary at Mackinnon critical value of -3.5614 at 5% level of significance.

4.4 Cointegration Test

This test was performed to explicitly distinguishing between short-run and long-run estimations through the error correction formulation. The tests are done in case the time series is non-stationary in order to ensure long-run relationships. The test is performed by carrying out a stationarity test for the residuals obtained after running the long-run regression model. The ADF statistics obtained are compared with the Mackinnon critical values. There is presence of cointegration if the ADF statistics are less than the Mackinnon critical values. Cointegration is absent if the ADF statistics are higher than the Mackinnon critical values. Results of cointegration are presented in Table 7.

Table 2: Cointegration Test Results

Model	ADF test on residuals	Mackinnon critical values at 5% level of significance
Exchange Rate Model	- 4.544632	-3.5514
Economic Growth Model	- 4.197113	-3.5514
Inflation Model	- 3.862728	-3.5514
Private Investments Model	- 3.732051	-3.5514

Table 2 gives the cointegration results of the residuals in the long run exchange rate model. The ADF statistics for the residuals of the exchange rate model, economic growth model, inflation model and private investments model show the existence of cointegration since they are less than the Mackinnon critical values of -3.5514 at 5% level of significance.

4.5 Granger Causality Test

This test was performed to ascertain the direction of causality between the external public debt and the macroeconomic variables. Null hypothesis for no granger causality is rejected at 5% level of significance. Granger causality takes three forms: unidirectional, bidirectional on neutral causality. Unidirectional causality is present when the causality moves in one direction while bidirectional causality is present when causality moves in both directions. There is neutral causality when there is no causality between two variables.

4.5.1 Granger Causality Test for Exchange Rate Model

Granger causality test was performed on the variables in the exchange rate model to establish whether causality was present and the direction of the causality.

Table 3: Pairwise Granger Causality Test for Exchange Rate Model

Null Hypothesis	Lags	F- Statistics	P-Value
DSP does not Granger Cause ER	2	0.06313	0.00745
ER does not Granger Cause DSP		5.86674	0.93895
EXD does not Granger Cause ER	2	0.33503	0.02547
ER does not Granger Cause EXD		4.19612	0.71814
FR does not Granger Cause ER	2	9.03157	0.00094
ER does not Granger Cause FR		2.56345	0.09499

Table 3 shows the outcome of the Granger causality test between exchange rate and debt service payment, external public debt and foreign reserves. The choice of the optimal lag was based on AIC, HQIC and SBC tests. Null hypothesis for no causality is rejected at 5% level of significance. Unidirectional causality was found between external public debt and exchange rate, debt service payment and exchange rate and between foreign reserves and exchange rate at 5% a level of significance.

4.6 VAR Diagnostics and Tests

This section covers lag selection, LM test for the serial correlation of the residuals and normality of the residuals.

4.6.1 Lag Selection

Lag selection was carried out by using AIC, HQIC and SBC tests. The model that displayed the least values of the Akaike Information Criteria (AIC), Hannan - Quinn Information Criteria (HQIC) and Schwarz Bayesian Criteria (SBC) was selected.

Table 4: Lag Selection Results

Model	Test	Lag 1	Lag 2	Lag3
Exchange Rate	AIC	-1.60602	-1.49428	-1.55051
	HQIC	-1.51554	-1.41889	-1.49019
	SBC	1.32847	-1.26299	-1.36548

Table 4 provides the

results of lag selection. Lag selection was done using AIC, HQIC and SBC tests under Vector Autoregression. The model lags were selected based on the coefficients of AIC, HQIC and SBC. The models selected had the least coefficients of AIC, HQIC and SBC. Lag 1 was selected for the exchange rate model.

4.6.2 LM Multiplier Test

This section contains the LM Multiplier test of the serial correlation between the error terms. There is absence of serial autocorrelation of the error terms if the P-value is more than 0.05.

Table 5: LM Multiplier Test Results

Model	Chi-square	Probability chi-square
Exchange Rate	1.2060	0.28979

Table 5 shows the LM Test results for the exchange rate model. At 5% level of significance, null hypothesis for no serial correlation was accepted and thus there was no serial correlation between the error terms.

4.6.3 Normality Test

Skewness, Kurtosis and Jarque Bera tests were used to test for the normality of the residuals at 5% level of significance. Normality of the residuals is present if the P-value of the residuals is more than 0.05.

Table 6: Normality Tests

Model	Skewness	Kurtosis	Jarque Bera	Probability
Exchange Rate	0.518327	2.930419	1.574262	0.455149

Results in Table 6 show that null hypothesis for no normality of the residuals was accepted at 5% for the Skewness, Kurtosis and Jarque Bera tests since the P-value was more than 0.05. Residuals for the exchange rate model are normally distributed.

4.7 Diagnostic Tests

This section contains the diagnostic checks. The diagnostic checks are test for multicollinearity, autocorrelation test and heteroscedasticity test.

4.7.1 Multicollinearity Test

Multicollinearity test was carried out to establish whether the explanatory variables were correlated. A high value for R-squared but few significant t - ratios is an indication of presence of multicollinearity. The exchange rate model in Table 6 was found to have an R-squared of 0.999909 with many significant t-ratios. This indicates the absence of multicollinearity. The absence of multicollinearity implies that the data is reliable and can be used in making inferences.

4.7.2 Autocorrelation

Autocorrelation test was performed to establish whether the error terms were serially interdependent using Durbin Watson statistics. Autocorrelation is present if the Durbin Watson statistics are close to 0 and 4. A value of 0 shows evidence of perfect positive autocorrelation while 4 shows evidence of perfect negative autocorrelation. A Durbin Watson value that is close to 2 indicates absence of autocorrelation. Results of the autocorrelation test are presented in Table 7. Absence of autocorrelation implies that the data is reliable for use in estimation.

Table 7: Autocorrelation Results

Model	Durbin Watson Statistics
Exchange Rate	2.19

Table 7 results show that exchange rate model has a Durbin Watson statistics of 2.19. This statistic is close to 2 and thus indicating the absence of autocorrelation in the error term.

4.7.3 Heteroscedasticity

Heteroscedasticity in the exchange rate model was detected by performing Breusch- Pagan test to establish whether the residuals had a constant variance. Heteroscedasticity is present if the P- value is less than 0.05.

Table 8: Test for Heteroscedasticity Results

Model	Obs*R-squared	Probability chi-square
Exchange Rate	10.77969	0.29113

Results in Table 8 show that null hypothesis for constant variance of the error terms was accepted at 5% level of significance. This implies that the error terms of the exchange rate model have a constant variance since the p-values are greater than 0.05 and hence indicating the absence of heteroscedasticity. Absence of heteroscedasticity implies that the data is reliable for making inferences.

4.8 Estimation of the Empirical Models

This section contains the estimation results of the exchange rate model. The level of significance for the independent variables was tested using t - ratios at 5% level of significance. The overall significance of the model was tested by using the F-statistic at 5% level of significance. R-squared was used to give the portion of the dependent variable that was explained by the independent variables at 5% level of significance.

Estimation of the Empirical Model

A model was run to assess the effect of external public debt on the exchange rate in Kenya. External public debt, debt service payment and foreign reserves were included as the explanatory variables with exchange rate being the explained variable. The level of significance was tested using t-ratios at 5% level of significance. A variable is statistically significant if the p-value of the t-ratios is less than 0.05. Estimation results of the model are presented in Table 9.

Table 9: Exchange Rate Estimation results

	Coefficient	Std.Error	t-value	t-prob
Constant	0.00576073	0.003522	1.64	0.1406
D2LNEXD	0.157544	0.01253	12.6	0.0000
D2LNEXD_1	0.0740404	0.01221	6.06	0.0003
D2lnDSP	-0.194045	0.005463	-35.5	0.0000
D2lnDSP_1	0.0180087	0.005983	3.01	0.0008
DLNFR	0.129841	0.006006	21.6	0.0000
DLNFR_1	0.0789492	0.005023	15.7	0.0000
ECT_1	-1.02252	0.01841	-55.5	0.0000
D92	0.0142274	0.01595	-0.892	0.3985
R-squared	0.999909	F-Statistic 3828(0.00)		
Durbin Watson statistic	2.19			

Note: 'D' before the variable symbol implies first difference of the variable. 'D2' implies second difference.

The results in Table 17 can be presented in the following equation

LNER= 0.0058 + 0.7040LNEXD + 0.0180LNDSP + 0.0789LNFR + 0.0142D92- 1.0225ECT

Table 9 presents the OLS regression results for the exchange rate model. The F statistic is 3828 with a P - value of 0.00 which is less than 0.05 implying that the independent variables external public debt, debt service payment and foreign reserves determine exchange rate. The measure of goodness of fit given by

R squared is 0.99909 implying that 99.909% of the variations in the exchange rate model are explained by external public debt, debt service payment and foreign reserves.

The coefficients of the first lag were used in interpreting the findings. The regression results indicate that external public debt, debt service payment and foreign reserves are statistically significant at 5% level of significant. The results show that ceteris paribus, a unit increase in external public debt as a percentage of GDP leads to a depreciation of the exchange rate by 0.07404 units. A unit increase in debt service payment brings about a 0.01800 depreciation of the exchange rate. The exchange rate depreciates by 0.07894 following a unit increase by foreign reserves. A dummy variable to capture shocks in 1992 was found to have had a positive effect on the exchange rate in Kenya. This is due to the first tribal crashes that occurred during the year. The lagged error correction term (ECT) was included in the model to capture the long-run dynamics between the cointegrating series. The error correction term is correctly signed (negative) and statistically significant. The coefficient indicates a speed adjustment of 102.25 % from actual exchange rate in the previous year to equilibrium exchange rate.

External public debt, debt service payment and foreign reserves are positively related to the exchange rate. The positive effect implies that a change in any of the explanatory variables causes a depreciation of the exchange rate. According to Reinhart and Rogoff (2009) an increase in external public debt causes a depreciation of the exchange rate by drying up the capital and foreign exchange as the foreign reserves are used in the repayment of the foreign debt principle and interest. A deficiency of the foreign reserves in a country destabilizes the economy because the heavily indebted country does not have funds to participate in foreign trade and thus leading to a decline in the reserves the country holds back for supporting its currency. The country consequently loses in terms of foreign exchange to other stable countries. The findings are consistent to those of Zakaree, Sanji and Idakwoji (2015) who studied the Effect of Public External Debt on Exchange Rate in Nigeria.

Conclusions

The study found out that external public debt, debt service payment and foreign reserves have a significant effect on the exchange rate. This led to the conclusion that higher levels of external public debt, debt service payment and foreign reserves would bring about a depreciation of the exchange rate

Recommendations

There is need for the Kenyan government to seek for debt relief strategies such as the heavily indebted poor countries in the Sub- Saharan countries. These strategies include debt restructuring, debt rescheduling and reduction in debt servicing. This measure will help reduce external public debt and hence a reduction of the foreign reserves used to repay external public debt. This will control the depreciation of the exchange rate.

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