Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.6, No.4, 2015

Budget Deficit and Macroeconomic Variables in Sierra Leone: An Econometric Approach

Sesay Brima* Emmanuel Alpha Mansaray-Pearce
School of Economics, Wuhan University of Technology, Wuhan 430070, P. R. China
*E-mail of corresponding author: brimasesay30@gmail.com

Abstract
Budget deficit has become an increasingly serious problem for Sierra Leone due to unsound public expenditures, system of government, tax evasion and weak policy coordination between the fiscal and monetary authorities. This study presents an investigation into the relationship between budget deficit and few macroeconomic variables in Sierra Leone using time series data for a period of 34 years (1980-2014). The study follow an econometric approach to derive the long run and short run relationships in which the Johansen's test of co-integration, vector error correction model (VECM) and the granger causality test techniques were employed. Results from the long run relationship show that exchange rate, gross domestic product and money supply have a negative and significant relationship with budget deficit whereas interest rate and inflation have a positive one, though interest rate is insignificant in the long run. The short run results are consistent with results from the long run except for exchange rate. Results from the granger causality test confirm causal link between exchange rate, gross domestic product, inflation, money supply and budget deficit. Policy recommendation call for solid policy coordination between the monetary authorities and fiscal authorities in Sierra Leone to instill closely controlled and efficient budgetary planning, taxation and public sector spending.
Keywords: Budget Deficit, Macroeconomic Variables, Econometric, Johansen's Co-integration, Vector Error Correction, Granger Causality.

1. Introduction

The continual increase in budget deficit in developing countries in recent years has brought the issue of fiscal deficit into the center stage. Budget deficit arises from fiscal operations of the government whenever expenditure exceeds revenue. The development of a budget deficit is often drawn from the Keynesian motivated expenditure-led growth theory of the 1930s. A good number of countries around the globe adopted this theory that government has to egg on the aggregate demand side of the economy in order to fuel economic growth. In Sierra Leone, government expenditure has persistently exceeded its revenue for decades (table 1). The main objective of the Sierra Leone budget deficit could be seen as realizing efficient allocation of income between the private sectors and the public sectors of the economy. The government does this with the use of fiscal policy which centers on the way the revenues and expenditures accumulating to the government are used for a particular period. In an effort to realize these objectives, the government may spend more money than the revenue collected and this leads to what we term budget deficit.

Budget deficit when exhausted are complemented with borrowing from the Central Bank of Sierra Leone (BSL), engage in short term securities like treasury certificates, treasury bills and the use of cash reserve deposits. If budget deficits are used for long term productivity investment like exporting and importing of capital goods and services, capital incentive goods, training and manufacturing new technology and technical expertise, the deficit will result to long term investment growth and will cultivate high economic growth, realize and speed up economic activities and stability. It was debated in world economics (2013) that budget deficit suggests an increase in the supply of government bonds. In order to improve the attractiveness of these bonds, the government offers them at a lower price which leads to higher interest rate and the increase in interest rate discourages the issue of private bonds, private investment and private spending. This will lead to financial crowding out of the private sector investment. Economists like Ahking and Miller (1983), Vuyyuri and Seshaiah (2004) and Friedman (1981) have hold up to the suggestion that central bank will be required to monetize the deficit resulting to an increase in the money supply and the rate of inflation. Exchange rate may depreciate or appreciate due to budget deficit.

Following the first oil shock since the 1970s, Sierra Leone's fiscal management has experience persistent budget deficit. Budget deficit (excluding grants) deteriorated from an average of -3.47% between the period 1970 and1975 to an average of -9.71% between the period 1976 and1979 and -10.40% an average between the period 1980 and1985. The increase in budget deficit during the late 1970s and early 1980s was partly attributed to the excessive expenditure incurred by the government for hosting the OAU summit, which as well saw the drop in revenue collection following the authorization of waivers for the importation of machinery, equipments and vehicles connecting to the preparation of the OAU summit. Nevertheless, during the period 1986-1990, government budget deficit declined from an average of -7.54% to -6.14% over the period 1991-1995, partly due to increase in revenue performance arising from solid fiscal regulation following the implementation

of the Structural Adjustment Program (SAP). By the end of the war in 2001, government expenditure increases in respect of resettlement, reconstruction and rehabilitation resulting to a higher budget deficit during the post war period. Budget deficit first recorded its highest average value of -12.45% over the period 2001-2005 which later declined by a slight margin to -12.13% over the periods 2006-2010 and finally skyrocketed to an all time high of -14.19% an average between 2011 and 2012 largely due to the huge government expenditure in infrastructural development and the recent outbreak of the Ebola virus disease (EVD).

Sierra Leone evidenced a positive real gross domestic product growth in the 1970s and 1980s, though the growth decreased from an average of 3.24% between the period 1970 and 1975 to an average of 0.86% between the period 1986 and 1990 but it improves tremendously in recent years and stood at 7.23% on average between 2011 and 2014 which is partly driven by the surge in iron ore production. Similarly, the rate of inflation which was 8.43% an average between the period 1970 and 1975 increases to 14.41% an average between the period 1976 and 1979 and to an average of 45.80% between the period 1980 and 1985 and skyrocketed to an all time high of 93.12% an average between 1986 and 1990 before taking a downward trend to an all time low of 6.53% an average between 2001 and 2005 and again increases to 12.33% an average between 2011 and 2014. Money supply growth was low in the early 1970s and follows an upward trend to an all time high of 73.12% an average between 1986 and 1990 before taking a downward trend. However, it stood at 24.83% an average between 2011 and 2014.

Table 1. Basic Macroeconomic Indicators for Sierra Leone, 1970 to 2014

Indicator	1970-1975	1976-1979	1980-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2014
Real GDP growth (%)	3.24	1.57	1.36	0.86	-6.1	-4.48	6.31	5.54	7.23
Money supply growth (%)	12.24	22.23	38.36	73.12	31.21	26.44	26.16	23.52	24.83
Real interest rate (%)	-11.84	-7.01	-36.19	-69.19	-12.64	5.24	-8.70	-9.21	-8.73
Inflation Rate (%)	8.43	14.41	45.80	93.12	48.12	21.37	6.53	12.61	12.33
Government Revenue (% of GDP)	16.57	16.75	11.34	6.17	10.81	8.93	13.40	15.91	17.98
Government Expenditure (% of GDP)	20.04	26.46	21.74	13.71	16.95	18.51	25.85	28.04	32.17
Budget Deficit excluding Grant (% of GDP)	-3.47	-9.71	-10.40	-7.54	-6.14	-9.58	-12.45	-12.13	-14.19

Source: computed by authors from International Financial Statistics and World Development Indicators

Sierra Leone is a member of the West African Monetary Zone (WAMZ) that is seeking to form a monetary union with a common central bank and a single currency. Certain convergence criterion has been set as a prerequisite for the formation of the monetary union for member countries. These incorporate; central bank financing of fiscal deficit of not more than 10.0 percent of previous year's tax revenue, single digit inflation, foreign external reserves sufficient to cover at least three months of nominal imports and fiscal deficit in percentage of GDP ratio of not more than 4.0 percent. Fulfilling these criteria has been a difficult problem for both the monetary and fiscal authorities in Sierra Leone. Consequently the persistent budget deficit has called for the examination of the causal relationship between budget deficit and macroeconomic variables in Sierra Leone.

The objective of the paper is to examine the long and short run relationships between budget deficit and macroeconomic variables-exchange rate, gross domestic product, inflation, interest rate and money supply in Sierra Leone using an econometric approach. This paper contributes to the empirical debate on the causal relationship between budget deficit and macroeconomic variables in the following ways: First, the paper uses an ordinary least square (OLS) method which is best appropriate for testing specific theories about the nature of economic relationship (Guajarati 2004). Second, the study is a step in the right direction, despite the growing literatures on the relationship between budget deficit and macroeconomic variables, the authors are not aware of any of this study in Sierra Leone. Hence in this study, the empirical evidence on the link between budget deficit and macroeconomic variables is drawn from the experience of Sierra Leone (a small open economy in Sub-Sahara Africa) that had experienced budget deficit since the 1970s.

The paper seeks to test the null hypothesis that macroeconomic variables- exchange rate, gross domestic product, inflation, interest rate and money supply have a significant relationship with budget deficit in Sierra Leone.

This study will enhance the potentiality of diverse users in the economy, such as researchers, policy

makers, and students etc who can use it as their reference materials in finding out the outcome of the above mentioned variables on budget deficit. It will give Policy makers an insight on the type of relationship that exists between budget deficit and macroeconomic variables and deficit financing. Similarly, financial analyst can use it to identify the extent of the behavioral pattern of the macroeconomic variables to deficit financing.

2. Literature Review

2.1. Theoretical literature

Several theories have tried to analyze the relationship between budget deficit and macroeconomic variables such as exchange rate, GDP growth, inflation, interest rate and so on which include; the Neoclassical school theory, the Keynesian school theory and the Ricardian school theory.

The neoclassical school proposes a negative relationship between budget deficit and macroeconomic variables. The base of their argument was that budget deficit leads to higher interest rate, does not encourage the issue of private bonds, private expenditure and private investment, increase inflation and leads to similar rise in current account shortfalls which may eventually cripple the economy's growth rate through resources crowding out. It was further argued by Yellen (1989) that in a typical neoclassical macroeconomic model, if resources are at full employment level in such a way that output is fixed, higher current consumption may mean equal and equalizing reduction in other forms of expediting. Consequently, net exports and investment must be fully crowding out. When the government sector expands, the private sector will contrast as a result of the rise in prices on these resources owing to excess demand by the government, thus this leads to a drop in consumption and investment by the private sector. As a result expansion in the government sector crowds out the private sector. According to this theory budget deficit have adverse effects on an economy and hence it advocates for a balanced budget at all time.

The Keynesian school on the contrary proposes a positive relationship between budget deficit and macroeconomic variables. They argue that normally changes in budget deficit leads to increase in aggregate demand, private investment and savings at a particular level of interest rate. Bernheim (1989) further argues that, an increase in government expenditure, leads to an increase in aggregate demand, which leads to the use of unnecessary resources which subsequently leads to an increase in output. This theory therefore asserts that budget deficit does not essentially have a harmful consequence on economic growth. Budget deficits can be used to fuel aggregate demand during periods of economic recessions in so doing shortening the period of recovery. They recommend that budget supervision should follow anti cyclical economic settings which imply during the periods of economic recession, the government should run a deficit to stimulate aggregate demand while in the period of economic boom; government should follow a surplus budgetary policy.

Finally, the Ricardian school approach was first proposed by David Ricardo in the 19th century which was later refined by Barro-Ricardo (1989). This theory put forward that budget deficit by the government do not affect the overall level of demand in the economy, because a rise in government budget deficit is in actual fact equivalent to a future rise in tax burden. Given that lower tax in the present is offset by higher tax in the future, it implies that budget deficits do not influence macroeconomic variables. The government may either finance its expenditure by taxing present tax payers or may borrow money. Nevertheless, they will ultimately repay their borrowing by increasing taxes above what they would have otherwise been in the future. Robert Barro has developed more refined distinctions on the same initiative, particularly using the theory of rational expectation. He argues that increase in budget deficit as a result of increase in government expenditure, must be paid for either at present or in the future, with total present value of receipt fixed by the total present value of expenditure.

2.2. Empirical Literature

Abel Ariyo Awe and Olalere Sunday Shina (2012) studied the nexus between budget deficit and inflation in Nigeria. Time series data covering 1980-2012 was used in their study. The study employed vector error correction mechanism (VECM) in determining the correlation between the variables, the result showed a causal relationship between budget deficit and inflation.

Musa Mayanja Lwanga and Joseph Mawejje (2014) studied the macroeconomic effects of budget deficit in Uganda. They have used time series data that covered1999-2011, vector error correction model and granger causality test were employed. Their results confirmed a co-integration (long run) relationship between the variables. Results from the vector error correction model suggested unidirectional causal relationship between budget deficit, current account balance, inflation and interest rate but no causal relationship between gross domestic product and budget deficit. Granger causality test results further confirmed unidirectional causation between budget deficit and current account, budget deficit and gross domestic products, inflation and budget deficit and a bi-directional relationship between gross domestic product and current account balance.

Genius Murwirapachena, Andrew Maredza and Ireen Choga (2013) studied the economic determinants of budget deficit in South Africa. They used time series data for a period of 30 years (1980-2010). The vector error correction model (VECM) was employed to determine the impact of the independent variables on the

dependent variable (budget deficit). Their result revealed that all the independent variables have positive impact on budget deficit except foreign debt.

Vincent N. Ezeabasili et al (2012) examined the relationship between economic growth and fiscal deficit in Nigeria. They used time series data for a period of 36 years (1970-2006). Co-integration and structural method were used and the result revealed a negative effect of fiscal deficit on economic growth. Similarly, Goher Fatima, Mehboob Ahmed and Wali Ur Rehman (2012) investigated the consequential effects of budget deficit on economic growth of Pakistan using time series data for a period of 31 years (1978-2009). Their result also showed a negative impact of budget deficit on economic growth. They suggested that the government should avoid certain level of deficit to achieve a desired level of growth. Also Ranjan Kumar Mohanty had done similar study in India and found a negative relationship between economic growth and fiscal deficit.

3. Data and Methodology

3.1. Data source

Data were sourced from International Financial Statistics and World Development Indicators (WDI) database on the World Bank. Annual time series data were collected on budget deficit, exchange rate, gross domestic product, inflation, interest rate and money supply for the period 1980-2014.

4. Methodology

The study presents an empirical investigation into the relationship between budget deficit and macroeconomic variables-exchange rate, gross domestic product, inflation, interest rate and money supply in Sierra Leone using an econometric technique. The methodology involves regressing budget deficit on its explanatory variables through the following procedures: Testing for stationary properties of the variables using the Augmented Dickey Fuller unit roots tests, followed by Johansen's co-integration test to check for the existence of co-integrating and long run relationships. Consequently the vector error correction model (VECM) and the granger causality test were employed to estimate the error correction term and causal relationship respectively. Finally, stability and diagnostic test were also conducted to determine the robustness of the model adopted. Following literatures reviewed, the model was adopted to take the following functional form:

$$\boldsymbol{BD = F(ER, GDP, IF, IR, MS)} \quad \textbf{(1)}$$

The econometric form of the model is given as

$$\boldsymbol{BD_t = \alpha_0 + \alpha_1 ER_t + \alpha_2 GDP_t + \alpha_3 IF_t + \alpha_4 IR_t + \alpha_5 MS_t + \varepsilon_t} \quad \textbf{(2)}$$

The log-log model has been employed to estimate the elasticity (degree of responsiveness) of budget deficit (BD) with respect to exchange rate (ER), gross domestic product (GDP), inflation (IF), interest rate (IR) and money supply (MS).

$$\boldsymbol{LogBD_t = \alpha_0 + \alpha_1 LogERt + \alpha_2 LogGDPt + \alpha_3 LogIFt + \alpha_4 LogIRt + \alpha_5 LogMSt + \varepsilon_t} \quad \textbf{(3)}$$

Where α_0 is a constant, α_1- α_5 are parameters to be estimated and $\boldsymbol{\varepsilon_t}$ is the error term. The apriori expectations of the model are that $\alpha_1, \alpha_2, \alpha_5 < 0$ and $\alpha_3, \alpha_4 > 0$. The model is estimated with the aid of E-views 7.2 software.

4.1. Econometric model Estimation

It is a standard practice for every effective research that requires the use of econometric technique to highlight the significance of investigating the data generating process that are fundamental to the variables before estimating the parameters and carrying out various hypothesis testing. This procedure is meant to avoid the problem of spurious regression results.

4.2.Unit Root Test

The first step in our analysis is to check for unit root. This test was done to determine the order of integration for each variable in the budget deficit function. A variable is said to have a unit root if it is non-stationary at level but became stationary after first differencing-integrated of order one. The Augmented Dickey Fuller (ADF) test was used which involve estimating the equation:

$$\Delta \boldsymbol{Y_t} = \boldsymbol{\alpha_0} + \boldsymbol{\alpha_1 Y_{t-1}} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \boldsymbol{\alpha}\, \Delta \boldsymbol{Y_i} + \boldsymbol{\varepsilon_t} \quad \textbf{(4)}$$

Where Δ is the difference operator, t is a time trend, Y_t is the variable under deliberation, n is the number of lags and ε_t is the stochastic error term. The null hypothesis is that the series is non-stationary against alternative hypothesis that the series is stationary. If the absolute value of the ADF test statistic is greater than the critical values, we reject the null hypothesis of non-stationary and conclude that the series is stationary. On the other hand, if the absolute value of the ADF is less than the critical values (in absolute terms), we fail to reject the null hypothesis and conclude that the series is non-stationary.

4.3. Co-Integration Test Analysis

Given that the variables are assumed to be stationary-integrated of the same order, the co-integration analysis will be appropriate to estimate the long-run budget deficit function since the theory assert that non-stationary time series are co-integrated if their linear combination is stationary. The co-integration tests involve testing for the presence of long-run equilibrium relationship between the variables of the same order of integration through the formulation of co-integration equation(s). The maximum likelihood test method recommended by Johansen and Juselius (1988, 1990) will be used. The co-integration requires the error term in the long-run relation to be stationary. Exclusively, given that Y_t is a vector of n number of stochastic variables, it follows that there exist a K-lag vector auto-regression with Gaussian errors of the following structure where Johansen and Juselius methodology adopt its initial point in the vector auto regression (VAR) of order k specified by:

$$\boldsymbol{Y_t = \delta + \beta_1 Y_{t-1} + \cdots + \alpha_k Y_{t-k} + w_t} \quad \textbf{(5)}$$

Where Y_t denotes an (nx1) column vector of k-variables that are integrated of order one, and w_t denotes a vector of white noise residuals. In representing the vector error correction model (VECM), equation (5) can be written as:

$$\Delta \boldsymbol{Y_t} = \boldsymbol{\delta} + \prod \boldsymbol{Y_{t-1}} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{k-1}} \boldsymbol{\Gamma_i}\ \Delta \boldsymbol{Y_{t-1}} + \boldsymbol{\varepsilon_t} \quad \textbf{(6)}$$

$$\prod = \sum_{i=1}^{k} \Gamma_i - I \text{ and } \Gamma_i = -\sum_{j=i+1}^{k} . \alpha_j$$

Where Δ is the difference operator, Y_t is an nx1 column vector of k-variables, δ is a constant, ε_t is an error term, $\boldsymbol{\Gamma}_1$ denotes the long-run coefficient matrix and $\prod$ denotes the short-run coefficient matrix. They both show the impact in the long-run and short-run respectively. Thus the significant issue is to determine the number of co-integrating vectors. Johansen and Juselius (1988, 1990) suggested the use of two statistical tests which are the trace test ($\boldsymbol{\lambda}_{trace}$) and the maximum eigen value test ($\boldsymbol{\lambda}_{max}$). These two tests are estimated with the aid of the following equations:

$$\boldsymbol{\lambda_{trace}(r) = -T \sum_{j=i+1}^{n} ln(1 - \hat{\lambda}_i)} \quad \textbf{(7)}$$

$$\boldsymbol{\lambda_{max}(r, r+1) = -T ln(1 - \hat{\lambda}_{r+1})} \quad \textbf{(8)}$$

Where

$\boldsymbol{\lambda}_{trace}$ test the null hypothesis r = 0 against the alternative of r > 0

T = number of usable observations

$\boldsymbol{\lambda}_i$ = Eigen values or estimated characteristics root

$\boldsymbol{\lambda}_{max}$ test the null hypothesis r = 0 against the alternative of r =1

If the null hypothesis of no co-integrating vector is rejected, it indicates that there is a long-run relationship among the variables in the model.

4.4. Vector Error Correction Model (VECM)

The vector error correction model (VECM) is a restrictive vector auto regressive (VAR) that can be use to estimate non-stationary time series that were identified to be co-integrated. It is designed in such a way that it restricts the long-run behavior of the independent variables to meet to their co-integrating relationship and at the same time allow for short-run correction. This can also be explained with the help of the equation:

$$\boldsymbol{\Delta X_t = \gamma_0 + \gamma_1 + \Delta Y_t + \lambda V_{t-1} + \varepsilon_t} \quad \textbf{(9)}$$

Substituting equation (3) into equation (9) to incorporate the error correction term to reflect the short-run dynamics yields:

$$\boldsymbol{\Delta LogBD_t = \alpha_0 + \sum_{i-1}^{q} \alpha_1 \Delta logBD_{t-j} + \sum_{i-1}^{q} \alpha_2 \Delta logER_{t-j} + \sum_{i-1}^{q} \alpha_3 \Delta logGDP_{t-j} + \sum_{i-1}^{q} \alpha_4 \Delta logIF_{t-j} + \sum_{i-1}^{q} \alpha_5 \Delta logIR_{t-j} + \sum_{i-1}^{q} \alpha_6 \Delta logMS_{t-j} + \lambda ECM_{t-1} + \varepsilon_t} \quad \textbf{(10)}$$

Where Δ is the first difference operator, q is the lag length, $\boldsymbol{\lambda}$ is the speed of adjustment and ECM_{t-1} is the lagged

error term and all other variables are described as earlier.

4.5. Granger Causality Test

The granger causality test was conducted in order to identify causal relationship between the variables under investigation and to ascertain whether the current lagged values of one variable affects another. Granger (1969) postulated that given two variables X and Y, X is caused by Y if X can be predicted well from previous values of X and Y than from previous values of X alone. This causal relationship can be explained with the aid of the following equations:

$$X_t = b_0 + \sum_{i=1}^{P} b_i Y_{t-i} + \sum_{j=1}^{q} d_i X_{t-j} + e_t \quad (11)$$

$$Y_t = c_0 + \sum_{i=1}^{P} c_i X_{t-i} + \sum_{j=1}^{q} r_i Y_{t-j} + w_t \quad (12)$$

These equations are based on the assumption that e_t and w_t are uncorrelated white noise error terms.

4.6. Diagnostic and Stability Test

To ascertain the robustness of the model used, standard practice calls for Stability and diagnostic test. The aim of this test is to investigate the stability of the coefficient estimate as the sample size increases. We want to find out whether the estimates will be different in enlarge samples and whether they will remain stable over. The stability of the estimated model is examined using the methodology of Cumulative Sum (CUSUM) and the Cumulative Sum of Squares (CUSUMQ) test proposed by Brown et al (1975). If the plot of CUSUM and CUSUMQ keep on within 5% significance level (depicted by two lines), then the coefficient estimates are said to be stable.

The diagnostic test is based on serial correlation, Autoregressive Conditional heteroskedasticity (ARCH), normality of the residual, functional form misspecification and heteroskedasticity test statistics.

5. Analysis of the Results

This section deals with an analysis of the empirical results. It starts with the test for stationary of the time series properties of the variables under investigation using the Augmented Dickey Fuller test by differencing each variable successively until stationary is achieved. This was followed by the maximum lag selection criteria for the Johansen's co-integration test and the Vector Error Correction model (VECM) estimation. The granger causality test and the stability and diagnostic test results are then analyzed to ascertain the robustness of the econometric model.

Table 2: Results of the Test for Stationary: Using Augmented Dickey Fuller Test

Variables	Level/ΔLevel	Calculated ADF	ADF critical value 5%	Probability Values	Included in test equation	Inference
LogBD	Level	-2.625694	-3.587527	0.2727	Intercept & trend	Non-stationary
	ΔLevel	-3.634328	-3.568379	0.0436		Stationary
LogER	Level	-3.407221	-3.568379	0.0693	Intercept & trend	Non-stationary
	ΔLevel	-4.876611	-3.557759	0.0023		Stationary
LogGDP	Level	-0.009658	-3.548490	0.9944	Intercept & trend	Non-stationary
	ΔLevel	-3.821661	-3.552973	0.0279		Stationary
LogIF	Level	-3.342087	-3.548490	0.0766	Intercept & trend	Non-stationary
	ΔLevel	-6.718638	-3.552973	0.0000		Stationary
LogIR	Level	-3.448934	-3.548490	0.0616	Intercept & trend	Non-stationary
	ΔLevel	-5.387609	-3.562882	0.0007		Stationary
LogMS	Level	-2.284209	-3.562882	0.4296	Intercept & trend	Non-stationary
	ΔLevel	-4.750207	-3.552973	0.0030		Stationary

Source: computed by authors using E-views software

The unit root test result revealed that all the variables in the budget deficit equation were non-stationary at their level but became stationary after first differencing. This suggests the use of co-integration analysis because the concept of co-integration requires variables must be integrated of same order.

5.1. Optimal Lag Selection

Before proceeding with the Johansen's test of co-integration and the Vector Error Correction Model (VECM) estimation, the optimal lag selection criteria was employed to determine the lag length to be used in carrying out the estimation. In table (3) the lag order selection criteria for sequential modified likelihood ratio (LR), final prediction error (FPE), akaike information criterion (AIC), schwarz information criterion (SC), and hannan-quinn information criterion (HQ) suggested the selection of an optimal lag of 1. The criteria by FPE, AIC, SC and HQ suggest that the lower the value, the better the model thus a maximum of lag one has been selected.

Table 3: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-196.3047	NA	0.008512	12.26089	12.53298	12.35244
1	19.51499	340.0795*	1.64e-07*	1.362728*	3.267374*	2.003583*
2	52.79476	40.33911	2.43e-07	1.527590	5.064790	2.717751
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5%level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Source: E-views output

5.2. Co-integration Test Results

Here the Johansen's co-integration test was used to check whether the variables are co-integrated or not. Both the trace statistics $\boldsymbol{\lambda}_{trace}$ and the maximum eigen statistics $\boldsymbol{\lambda}_{max}$ were used and the results are presented in table 4 and 5 below.

Series: LogBD LogER LogGDP LogIF LogIR LogMS

Lags interval: 1 to 1

Table 4: Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.746218	121.9752	95.75366	0.0003
At most 1 *	0.587101	76.72302	69.81889	0.0127
At most 2	0.535335	47.53283	47.85613	0.0536
At most 3	0.360227	22.24037	29.79707	0.2854
At most 4	0.203181	7.501173	15.49471	0.5202
At most 5	0.000181	0.005971	3.841466	0.9377
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Source: E-views output

Table 5: Unrestricted Co-integration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.746218	45.25217	40.07757	0.0120
At most 1	0.587101	29.19019	33.87687	0.1638
At most 2	0.535335	25.29246	27.58434	0.0955
At most 3	0.360227	14.73920	21.13162	0.3076
At most 4	0.203181	7.495202	14.26460	0.4323
At most 5	0.000181	0.005971	3.841466	0.9377
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Source: E-views output

The co-integration test result for the trace test indicates two co-integrating equations at the 5% significance level while the maximum Eigen test indicates one co-integrating equation. Since the power of the maximum Eigen test is higher than the trace test, we therefore employ the suggestion by the maximum Eigen test statistics in estimating the Vector Error Correction Model (VECM). However, the co-integration test result showed the existence of long-run relationship among budget deficit and macroeconomic variables-exchange rate, gross domestic product, inflation, interest rate and money supply. The result of the long-run budget deficit function is presented in table 6 below.

Table 6: Result of the long run budget deficit model

Dependent variable: LogBD				
Independent variables	coefficient	Standard error	t-statistics	conclusion
LogER	-3.106163	0.35186	-8.8278	Significant
LogGDP	-2.611608	0.47190	-5.5342	Significant
LogIF	0.353655	0.09922	3.5644	Significant
LogIR	0.049240	0.08859	0.5558	Insignificant
LogMS	-0.442950	0.16074	-2.7557	Significant
Constant	14.43325	……	……	……

Source: computed by authors from e-views output

Results from the long run budget deficit model reveal that exchange rate has an inverse relationship with budget deficit in the case of Sierra Leone. The coefficient was found to be negative and significant at the 1 percent level of significance suggesting that a 1 percent increase in exchange rate leads to approximately 3.106 percent fall in budget deficit on average in the long run. The degree of responsiveness of budget deficit with respect to exchange rate is -3.106. This finding is in line with the Neoclassical School proposition that interest rate is inversely related to budget deficit. Similar results were found in Nigeria by Vincent N. et al (2012) and in Pakistan by Goher Fatima et al.

Similarly, gross domestic product (GDP) has an inverse relationship with budget deficit. The coefficient was also found to be negative and significant from the value of the t-statistics greater than two. This

suggests a 1 percent increase in gross domestic product will reduce budget deficit by approximately 2.612 percent on average in the long run. The degree of responsiveness of budget deficit with respect to gross domestic product is -2.612. This finding is also in line with the Neoclassical School proposition that an increase in gross domestic product will reduce budget deficit. Similar results were also found in India by Ranjan Kumar Mohanty and in Nigeria and Pakistan by Vincent et al and Goher et al respectively.

As for inflation, it has a direct effect on budget deficit. The sign of the coefficient is positive and significant suggesting that a 1 percent increase in inflation will increase budget deficit by approximately 0.354 percent on average in the long run. The degree of responsiveness of budget deficit with respect to inflation is 0.354. This result is in contrary to the neoclassical theory, but in conformity with the Keynesians theory, which holds that inflation leads to an increase in budget deficit. Similar result was found in South Africa by Genius Murwirapachena, Andrew Maredza and Ireen Choga (2013).

With regards to interest rate, it has a direct relationship with budget deficit. The sign of the coefficient is positive even though insignificant as the value of the t-statistics is less than two, but the sign of the coefficient suggest that it has a positive relationship with budget deficit.

Finally, money supply has an inverse relationship with budget deficit. The sign of the coefficient is negative and significant implying that a 1 percent increase in money supply will reduce budget deficit by approximately 0.443 percent on average. The degree of responsiveness of budget deficit to money supply is -0.443. This result is also in conformity with the neoclassical school proposition and similar results were found in Nigeria, India and Pakistan by Vincent et al, Ranjan K Mohanta, and Goher et at respectively.

5.3. Short run dynamics (VECM)

The Vector Error Correction Model (VECM) has been used to determine the short run dynamics. The existence of long run relationship among the variables induces the estimation of the short run dynamic model. The vector error-correction model (VECM) is a restrictive vector autoregressive (VAR) model for the stationary forms of budget deficit, exchange rate, gross domestic product, inflation, interest rate and money supply. It was estimated using ordinary least square. The error correction mechanism is employed to examine the short-run and long-run behavior of the dependent variable (budget deficit) in relation to its independent variables. In the preceding section, it was manifested that there exists an exceptional co-integrating relationship between budget deficit, exchange rate, gross domestic product, inflation, interest rate and money supply. However, in the short run, there may be disequilibrium and the error correction model was consequently employed to eliminate divergence from the long-run equilibrium. The most important thing in the short run results is the speed of adjustment term. The result of the Vector Error Correction Model (VECM) is presented in table 7 below.

Table 7: Vector Error Correction Model

Dependent Variable: $\Delta LogBD_t$				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ECT_{t-1}	-1.014964	0.277015	-3.663933	0.0018
$\Delta LogBD_{t-1}$	0.118788	0.281239	0.422375	0.6778
$\Delta LogBD_{t-2}$	0.017422	0.008073	2.158002	0.0393
$\Delta LogER_{t-1}$	1.014575	0.424406	2.390577	0.0280
$\Delta LogER_{t-2}$	1.473174	0.450472	3.270289	0.0043
$\Delta LogGDP_{t-1}$	-0.891071	0.698806	-1.275134	0.2185
$\Delta LogGDP_{t-2}$	-1.220421	0.651212	-1.874077	0.0772
$\Delta LogIF_{t-1}$	0.418047	0.185240	2.256791	0.0343
$\Delta LogIF_{t-2}$	-0.003543	0.093457	-0.037911	0.9702
$\Delta LogIR_{t-1}$	0.225858	0.074875	3.016446	0.0053
$\Delta LogIR_{t-2}$	0.108485	0.073294	1.480128	0.1561
$\Delta LogMS_{t-1}$	-0.965095	0.444202	-2.172650	0.0381
$\Delta LogMS_{t-2}$	-0.548412	0.161974	-3.385813	0.0023
C	-0.307879	0.211921	-1.452801	0.1635
R-squared	0.820064	Mean dependent var	0.222762	
Adjusted R-squared	0.690109	S.D. dependent var	0.603164	
S.E. of regression	0.335768	Akaike info criterion	0.954845	
Sum squared resid	2.029327	Schwarz criterion	1.596105	
Log likelihood	-1.277526	Hannan-Quinn criter.	1.167405	
F-statistic	6.310407	Durbin-Watson stat	1.700441	
Prob(F-statistic)	0.000241			

Source: E-views output

The coefficient of the error correction term has the expected negative sign and also significant which confirms the existence of long run causal relationship running from money supply, interest rate, inflation, GDP, and exchange rate to budget deficit. The speed of adjustment of the error term is -1.01. The scale of the coefficient implies that 1.01percent of the disequilibrium in the preceding year's shock adjusts back to long run equilibrium in the current year.

The short run results of vector error correction model (VECM) reveal that budget deficit of two years back (2012) is positively related to budget deficit in the current year (2014).

Similarly, previous year's exchange rate in (2012) and (2013) are also positively related to budget deficit in the current year (2014). Conversely, gross domestic product in (2012) is negatively related to budget deficit in the present year (2014). Also previous years of inflation and interest rate (2013) are positively related to budget deficit in the current year. Money supply of both (2012) and (2013) are negatively related to budget deficit in the current year (2014). In summary, the short run results for gross domestic product, inflation, interest rate and money supply are consistent with findings from the long run results except for exchange rate.

The R- squared value is 0.820064, implying that approximately 82% of the variation in the budget deficit is explained by the independent variables, which is an indication of a very good fit. The overall equation is highly statistically significant as shown by the probability value of the F-statistic (0.000241).

5.4. Granger Causality Test Results

The granger causality test was conducted to examine whether causal relationship exist between the variables under investigation. The result based on the significant probability values less than or equal to 0.10 reveals that there exists bi-directional causal relationship between budget deficit and gross domestic product; inflation and exchange rate; gross domestic product and inflation; money supply and inflation.

The result further shows the existence of unidirectional causal relationship between budget deficit and exchange rate; budget deficit and inflation; budget deficit and money supply; gross domestic product and exchange rate; gross domestic product and interest rate; inflation and interest rate; money supply and interest rate. Similar results of these causal relationships were found in Nigeria by Abel and Olalere (2012) and in Uganda by Musa Mayanja Lwanga and Joseph Mawejje (2014). However, there was no causal relationship between interest rate and budget deficit; exchange rate and interest rate; money supply and exchange rate; gross domestic product and money supply. The overall results fail to reject the hypothesis of the study.

Table 8. Pair wise Granger Causality Test Result

Null Hypothesis:	Obs	F-Statistic	Prob.
LOGER does not Granger Cause LOGBD	34	46.7571	1.E-07
LOGBD does not Granger Cause LOGER		13.1637	0.0010
LOGGDP does not Granger Cause LOGBD	34	15.7128	0.0004
LOGBD does not Granger Cause LOGGDP		10.0740	0.0034
LOGIF does not Granger Cause LOGBD	34	0.20013	0.6577
LOGBD does not Granger Cause LOGIF		11.3203	0.0021
LOGIR does not Granger Cause LOGBD	34	0.12388	0.7272
LOGBD does not Granger Cause LOGIR		0.29882	0.5885
LOGMS does not Granger Cause LOGBD	34	4.10155	0.0515
LOGBD does not Granger Cause LOGMS		2.07250	0.1600
LOGGDP does not Granger Cause LOGER	34	1.63036	0.2111
LOGER does not Granger Cause LOGGDP		13.4965	0.0009
LOGIF does not Granger Cause LOGER	34	5.71705	0.0231
LOGER does not Granger Cause LOGIF		7.92390	0.0084
LOGIR does not Granger Cause LOGER	34	1.78655	0.1911
LOGER does not Granger Cause LOGIR		0.07502	0.7860
LOGMS does not Granger Cause LOGER	34	0.32934	0.5702
LOGER does not Granger Cause LOGMS		0.02605	0.8728
LOGIF does not Granger Cause LOGGDP	34	6.71126	0.0145
LOGGDP does not Granger Cause LOGIF		7.30338	0.0111
LOGIR does not Granger Cause LOGGDP	34	5.72078	0.0230
LOGGDP does not Granger Cause LOGIR		0.14098	0.7099
LOGMS does not Granger Cause LOGGDP	34	0.04823	0.8276
LOGGDP does not Granger Cause LOGMS		0.07793	0.7820
LOGIR does not Granger Cause LOGIF	34	3.43876	0.0732
LOGIF does not Granger Cause LOGIR		1.04336	0.3149
LOGMS does not Granger Cause LOGIF	34	6.22401	0.0181
LOGIF does not Granger Cause LOGMS		4.05520	0.0528
LOGMS does not Granger Cause LOGIR	34	0.04179	0.8394
LOGIR does not Granger Cause LOGMS		3.27795	0.0799

Source: E-views output

5.5. Diagnostics and stability test results

Diagnostics and stability tests were also conducted to ascertain the robustness of the model used. The test results are reported in table 9.

Table 9. Diagnostics Test Result

Test Type	Null Hypothesis	Statistic	Probability	Inference
Normality Test (Jarque-Bera Statistics)	Errors are normally distributed	Jarque-Bera Statistics= 0.6628	Probability = 0.7179	Fail to reject Ho
Serial Correlation (Breush-Godfrey Serial Correlation LM Test)	No serially correlated errors	F-statistics = 1.131096	Prob. Chi-Square = 0.1577	Fail to reject Ho
ARCH Test (Autoregressive Heteroskedasticity Test)	ARCH effect does not characterize model's errors	F-statistics = 0.514978	Prob. Chi-Square = 0.4621	Fail to reject Ho
Heteroskedasticity Test (Breush-Pagan-Godfrey)	Homoskedasticity	F-statistics = 1.550060	Prob. Chi-Square = 0.2397	Fail to reject Ho
Model Specification Test (Ramsey RESET Test)	Model is correctly specified	F-statistics = 2.211028	Probability = 0.3769	Fail to reject Ho

Source: E-views output

The diagnostic test suggests good fit of the model. The model does not suffer from the problems of non-normality of the errors, serially correlated errors, ARCH effect, heteroskedasticity and functional form misspecification from the probability values greater than 5%.

With regards stability test, the results of both the CUSUM and CUSUMQ plots lie within the 5% critical band width which confirm the stability of the coefficients and the correct specification of the model.

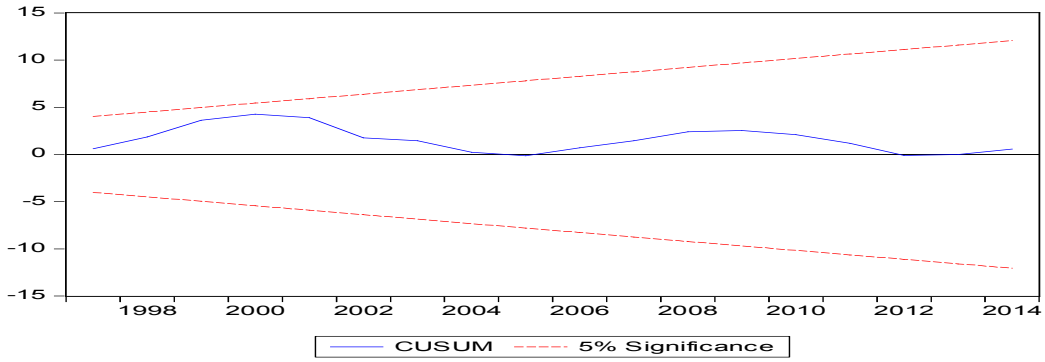

Figure 1: Plot of Cumulative Sum (CUSUM)

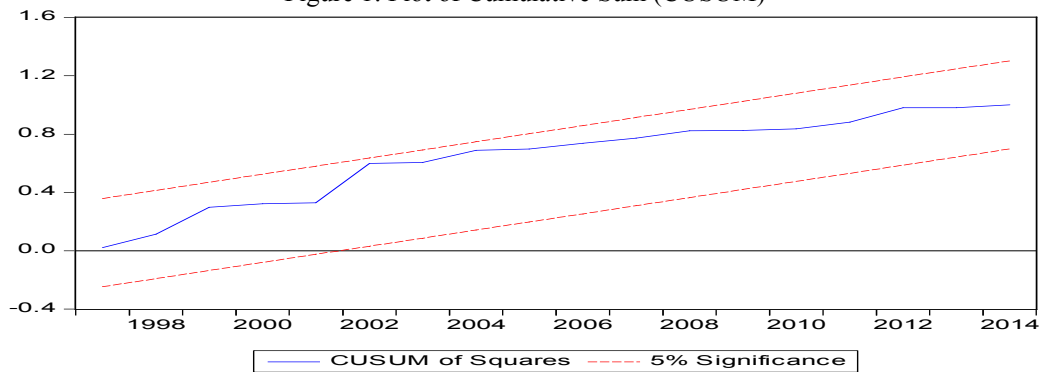

Figure 2: Plot of Cumulative Sum of Squares (CUSUMQ)

6. Conclusion and Policy Recommendation

6.1. Conclusion

Budget deficit has become an increasingly serious problem for Sierra Leone due to unobserved public expenditures, system of government, tax evasion, corruption and probably mismatch in policies between fiscal and monetary authorities. The study presents an investigation into the relationship between budget deficit and selected macroeconomic variables in Sierra Leone for a period of 34 years (1980-2014). The study followed an econometric approach in which various tests were conducted in order to avoid spurious regression results. Budget deficit was taken as dependent variable while exchange rate, gross domestic product, inflation, interest rate and money supply as independent variables. All the variables were found to be stationary after first differencing. Results from the long run relationship show that exchange rate, gross domestic product and money supply has a negative and significant relation with budget deficit in Sierra Leone. These findings are in line with

the neoclassical school proposition that there exist an inverse relationship between budget deficit and macroeconomic variables, which holds that increase in these variables reduces budget deficit. For instance a 1 percent increase in exchange rate, gross domestic product and money supply will cause budget deficit to decrease by 3.106, 2.612 and 0.443 percent respectively. Interest rate and Inflation were found to have positive relation with budget deficit, though interest rate is insignificant. A 1 percent increase in inflation will cause the deficit to increase by 0.354 percent. Result for the relationship between budget deficit and inflation is in contrary to the neoclassical theory, but in conformity with the Keynesians theory, which holds that inflation leads to an increase in budget deficit.

Results from the vector error correction model (VECM) further confirm both long run and short run relationship between the variables. It show that there is a long run causal relationship running from money supply, interest rate, inflation, GDP, and exchange rate to budget deficit. The short run results for gross domestic product, inflation, interest rate and money supply are consistent with findings from the long run results with an exception of exchange rate. The granger causality test result show bi-directional causal relationship between budget deficit and gross domestic product; inflation and exchange rate; gross domestic product and inflation; money supply and inflation, and unidirectional causal relationship between budget deficit and exchange rate; budget deficit and inflation; budget deficit and money supply; gross domestic product and exchange rate; gross domestic product and interest rate; inflation and interest rate; money supply and interest rate. However, there was no causal relation between interest rate and budget deficit; exchange rate and interest rate; money supply and exchange rate; gross domestic product and money supply.

6.2. Policy Implication and Recommendation

The above findings have important policy implications since there is a presence of causal link between exchange rate, gross domestic product, inflation, money supply and budget deficit. If exchange rate cause budget deficit, it will be essential for the country to improve on its exchange rate even more. The result provides evidence to support the exchange rate-led budget deficit hypothesis. Therefore exchange rates are essential in contributing to economic growth through budget deficit. Sierra Leone government should exhibit a high sense of transparency in the fiscal operations to bring about reasonable budget deficits. Budget deficits, where evidenced should be directed to industrious investment, like infrastructural development (electricity provision, road construction etc), that would serve as incentives to productivity via the attraction of foreign direct investment in order to reduce the prevalence of budget deficit in Sierra Leone.

Furthermore, the implication of these findings was, inflation and budget deficit could be caused by money supply implying that they were both monetary phenomenon. Budget deficit was also found to be caused by inflation. The increase in money supply can as well help to reduce the size of budget deficit in an economy; but, the same increase in money supply may still leads to an increase in inflation. Thus solid monetary policy should be focused on balancing the role money supply performs to inflation and budget deficit. From the causal relationship that exist between inflation and budget deficit, relevant measures should be put in place in enhancing policy coordination between the monetary authorities and the fiscal authorities of Sierra Leone so as to instill closely controlled and efficient budgetary planning, taxation and public sector spending.

References

Abel Ariyo Awe and Olalere Sunday Shina (2012) “The Nexus between Budget Deficit and Inflation in the Nigerian Economy” Research Journal of Finance and Accounting Vol 3, No10. 78-92 www.iiste.org

Ahking, F.W, and Miller S. M (1985) “The Relationship between Government Deficits, Money Growth and Inflation” Journal of Economics, Vol.7.

Ahmed. H. and Miller S. M. (2000) “Crowding-out and Crowding-in Effects of the Components of Government Expenditures”. Contemporary Economic Policy, Vol. 18, No 1.

Barror R. (1987) “Government Spending, Interest Rates, Prices, and Budget Deficits in the United Kingdom, 1701-1918. Journal of Monetary Economics, 20, No. 2, September, pp.221-47.

Dickey D., W. A. Fuller (1981), “Likelihood ratio statistics for autoregressive time series with unit root”, Econometrica, vol.49, No.4, Evanston, Illinois.

Engle, Robert F. and Granger, C.W.J (1987), "Cointegration and Error Correction: Representation, Estimation, and Testing," *Econometrics,*55, 251-76.

Evans, P. (1987) “Do Budget Deficits Rise Nominal Interest Rates”? Journal of Monetary Economics 20, No. 2 September, pp.281-300.

Genius Murwirapachena, Andrew Maredza and Ireen Choga (2013) “The Economic Determinants of Budget Deficits in South Africa” Mediterranean Journal of Social Sciences. Vol 4 No 13. Doi:10.5901/mjss.2013.v4n13p561.

Friedman, M. (1968) “The Role if Monetary Policy” American Economic Review, Vol. 58.

Goher Fatima, Mehboob Ahmed and Wali ur Rehman (2012) “Consequential Effects of Budget Deficit on

Economic Growth of Pakistan. International Journal of Business and Social Science. Vol. 3 No. 7.
Granger, C.W.J (1986). Developments in the Study of Cointegrated Economic Variables. *Oxford Bulletin of Economics and Statistics*, 48(3), 213-228. http://dx.doi.org/10.1111/j.1468 0084.1986.mp48003002.x
Granger, C.W.G, and J.L Lin, (1995), "Causality in the Long run, Econometric Theory" 11(1): 530-536.
Musa Mayanja Lwanga and Joseph Mawejje (2014) "Macroeconomic Effects of Budget Deficits in Uganda: A Var-VECM Approach" Economic Policy Research Center. Research Series No. 117.
Onuorah Anastasia Chi- Chi and Odita Anthony Ogomegbunam (2013) "Relationship between Macro-Economic Variables and Budget Deficit" International Journal of Management Sciences. Vol. 1, No. 10, 416-426. http://www.rassweb.com
Ranjan Kumar Mohanty "Fiscal Deficit-Economic Growth Nexus in India: A Cointegration analysis
Robert Dauda Korsu and Lansana Daboh "A Macroeconomic Model of the Sierra Leone Economy: The Role of Fiscal and Monetary Policies in Stabilization
Vincent N. Ezeabasili, Ioraver N. Tsegba and Wilson Ezi-Herbert (2012) "Economic Growth and Fiscal Deficit" Economics and Finance Review Vol. 2(6) pp.85-96. http://www.businessjournalz.org/efr.
Vuyyuri, Srivya and Seshaiah, S. Venkata (2004) "Budget Deficits and other Macroeconomic Variables in India" *Applied Econometrics and International Development.* AEEADE. Vol. 4-1 (2004)

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar