Fiscal Policy and Debt Dynamic: Evidence from Tanzania

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Abstract
This paper investigates fiscal policy and debt dynamics in Tanzania by using time series data for the period 1970 to 2011. The methodologies adopted include unit root tests, cointegration tests and fiscal reaction function. The three approach employed validate similar results that fiscal policy for Tanzania has not been sustainable for the annual sample period 1970-2011. The unit root tests report that the data generating process of debt follow non-stationary process. Alternatively, in testing the null hypothesis of no-cointegration, our results show that there is weak cointegration between government expenditure and revenue which make fiscal policy to be unsustainable. In supporting the ensuing findings, the fiscal reaction function provides evidence that there is negative linear relationship between primary balance and debt relative to GDP. This is additional evidence that fiscal policy has not been sustainable, and the government is advised to take corrective measures to counteract the accumulation of debt.

Keywords: -Ponzi game, Inter-temporal budget constraint, Transversality condition, Fiscal reaction function.

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1.0   Introduction

Government deficit has been one of the areas of much concern in Tanzania's current macro-economic problems. In particular, the increase in government expenditure is regarded to have significant impact to country's debt accumulation, as well as country's inflation and external imbalance. Budget deficit in Tanzania is funded through domestic and foreign borrowing. From economic point of view, these two sources have different impact on budget deficit. For instance, foreign financing is less inflationary than domestic financing in most of developing countries due to the fact that the economies of these countries are characterized by low access to capital markets and high dependency on advanced countries for foreign reserves.

Fiscal sustainability is based on the need for a fiscal deficit to be financed, in other words it is based on the concept of inter-temporal budget constraint which requires that the current value of debt be equal to the present value of expected future primary surpluses. In this regard fiscal policy is sustainable if the present value of debt reaches zero at the limit. The issue of whether the current fiscal policy is sustainable is important because it helps the government to undertake corrective action for future policy. However, there has been a debate among scholars and policy makers on how to assess fiscal sustainability. While scholars are trying to assess the sustainability basing on how the government can finance the deficit without running a Ponzi game, policy makers are interested on which instruments can ensure about the future path of fiscal policy.

In general, two possible strategies have been widely used to test fiscal sustainability basing on the inter-temporal budget constraint as a benchmark. One of these methods is to construct indicators of fiscal policy sustainability along the lines proposed by Blanchard (1990). Another method assumes that fiscal sustainability is the stationary process of debt series (Hamilton and Flavin, 1986; Wilcox, 1989; Makrydakis et al, 1997). Later works developed alternative tests for fiscal sustainability basing on the assumption that if government revenue and expenditure are cointegrated then fiscal policy is sustainable (Hakkio and Rush, 1991; Tanner and Liu, 1994; Ahmed and Rogers, 1995; Haug 1995). Recently, fiscal reaction function has been used to assess fiscal sustainability (Bohn, 1998; de Mello, 2005, Song 2009). Unlike unit root and cointegration approaches, fiscal reaction function approach helps to examine if government is taking corrective action when fiscal deficit start to rise.

In Tanzania domestic borrowing has been mostly done by issuing debt from domestic banks in order to finance government deficit. In 1990s as economic stabilization recovery and liberalization policies and other related structural adjustment reform program began implemented, the access of foreign financing increased. This has served the government from relying on relatively expensive domestic borrowing. At the same time, it has helped the government to allow sufficient credit fund for the private sector and a necessary accumulation of foreign reserves.In general, the trend of fiscal performance in Tanzania during the sample period of 1970 to 2011 can be divided into three periods.

The trend shows that the government deficit to GDP ratio has been high during the period between 1970s and 1980s, where the highest deficit reached 11.4%, at the same time government debt stood

at 40.31% in 1981 as indicated in figure 1 and 2. This situation was associated with the oil shock, and the war between Tanzania and Uganda. Apart from the ensued budgetary imbalance, Tanzania was implementing economic policy which appeared to have minimal contribution to economic growth. The government then decided to embark on economic recovery policy in 1986 which appeared to have a significant contribution by turning budget deficit to surplus at the end of 1988 and earlier of 1990s. However, during 1999 to 2011 period, the trend shows that the government deficit and debt have been rising. This may be contributed by the need for the government to achieve rapid economic growth, which is done by expanding expenditure on projects and infrastructure development.
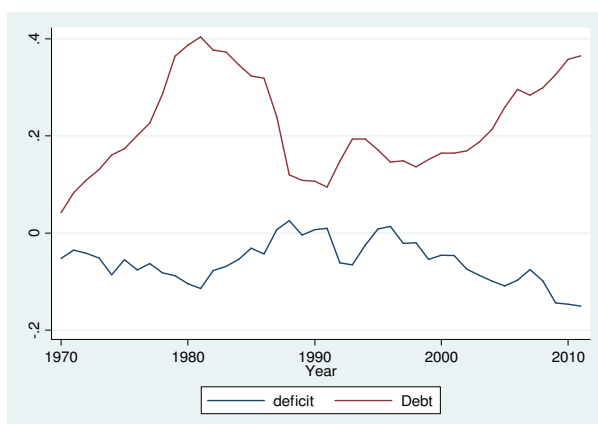
Figure 2:- Trend of central government debt and budget deficit between 1970 -2011.
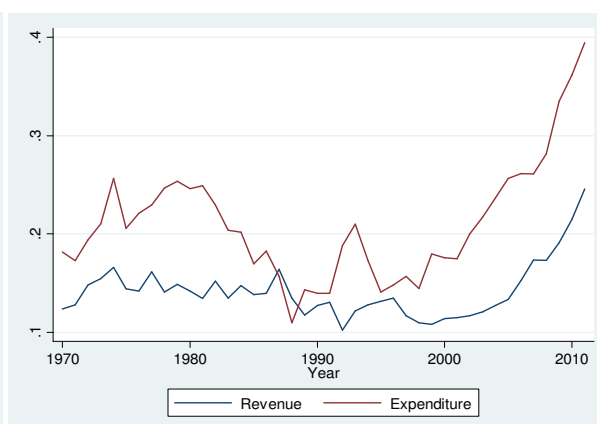
Figure 2:- Trend of government revenue and expenditure between 1970 -2011

In the context of this trend we need to examine if it is feasible for the government to run a deficit forever. Therefore, the analysis of fiscal sustainability in this paper is carried by unit root, cointegration and fiscal reaction function approaches. The Augmented Dickey- Fuller and Phillip-Perronare adopted for unit root test statistic analysis, while Engle and Granger and Johansen method are used for cointegration analysis.

The unit root tests report that the data generating process of debt follow non-stationary process. Alternatively, in testing the null hypothesis of no-cointegration, our results show that there is weak cointegration between government expenditure and revenue which make fiscal policy to be unsustainable. In supporting the ensuing findings, the fiscal reaction function provides evidence that there is negative linear relationship between primary balance and debt relative to GDP.

The remainder of this study is organized as follows. Section two reviews the literature on fiscal policy and debt dynamics. Section three provides the methodology to be used in this study. Section four reports and discusses the estimated results. Section four offers conclusion and policy implications.

2.0 Literature Review

Evaluation of fiscal sustainability is based on two conditions; inter-temporal government budget constraint and debt to GDP dynamics. These two conditions set a background for testing fiscal policy sustainability. With regard to the theoretical side, the test of fiscal sustainability can be divided into three approaches; the unit root test, cointergration test and fiscal reaction function. While in practice, the construction of fiscal indicators is the approach commonly used to assess fiscal sustainability.The Unit root test is one of the methods commonly applied in assessing fiscal sustainability. Time series data which contains one or more characteristics roots equal to unit is called non-stationary process, for the case of time series data that contains characteristics of roots less than unit is called stationary process. In this regard the test of unit root on historical time series data of fiscal variables aim to detect the stationary process which is a fundamental condition for inter-temporal government budget constraint to be satisfied. Therefore, when the fiscal or debt time series are stationary, it is regarded that the fiscal policy is on a sustainable path. It implies that the current government debt would be offset by the future primary surplus in present value term.

Cointegration is also another approach used in assessing fiscal policy sustainability. It assumes that if a group of variables are individually integrated of the same order, and there is at least one linear combination of these variables which is stationary, then the variable are said to be cointegrated, in other words these variable have a long run equilibrium relationship. To be more specific, government expenditure and revenue time series are regarded to be cointegrated, which means they are attracted to their long run equilibrium relationship. It is assumed that, when such kind of relationship among these variable exist, then the fiscal policy is considered to be sustainable. Empirical evidence on the unit root testing fiscal sustainability has been shown in the work of Makrydakis et al. (1997). The study was assessing the hypothesis of long run fiscal policy sustainability by means of conventional unit root tests that do not allow for possible regime shifts and testing procedure which allows for endogenous determination of possible regime changes in Greece. The results showed strongly the failure of the Greek government to satisfy inter-temporal budget constraint in the long run. It was identified that the cause of this failure was due to a regime shift which took place in 1979.

Besides the empirical evidence of sustainability presented basing on the unit root approach, there is ample evidence on alternative test of sustainability; that is sustainability requires government revenue and expenditure to be cointegrated. Hakkio and Rush (1991) used cointegration test approach to test the United States post war fiscal sustainability. The underlying assumption to this approach is that when the government revenue and expenditure are cointegrated, then the transversality condition in the present value of government budget constraint holds. They observed the U.S quarterly values of government revenues and expenditure from the second quarter of 1950 and the fourth quarter of 1988. The finding showed that government expenditure was growing more rapidly than government revenue. Which means the increase in government debt is not consistent with the current fiscal policy in such a way that the present value of debt deviates from zero as limit.

Tanner and Liu (1994) in their study presented evidence that U.S deficit is sustainable and they also admitted that structural shift of fiscal policy has occurred due to some events during the first

Reagan administration; these changes included expenditure policy, economic recovery and legal framework. Since they used similar data set of Hakkio and Rush (1991), they imposed a dummy variable for a level shift in the cointegration vector at pre-defined in the first quarter of 1981 and fourth quarter of 1981.They reported evidence of cointegration and rejected the null hypothesis of no cointegration. This evidence was contrary to the conclusion made by Hakkio and Rush (1991) indicating the failure of rejecting the null hypothesis of no cointegration from 1950 to 1989 and 1964 to 1989.

Ahmed and Rogers (1995) unlike the previous studies, this study applied large sample of annual observations from 1792 to1992 for US fiscal data and 1692 to1992 for UK fiscal data. They tested whether the UK and U.S are consistent with the present value budget constraint. Using the cointegrationregression they employed Perron unit root test statistics to get the results. The empirical test suggested that the UK and U.S government are consistent with the inter-temporal budget constraint. In the same study, Afonso (2005) adopted cointergration test to validate fiscal sustainability condition of each EU-15 countries. Using Engle and Granger method, it was found that most of the EU-countries are characterized by unsustainable fiscal policy.Bohn (1998) tried to establish how the US government reacted to the accumulation of public debt. Using annual fiscal data observation from 1916 to 1995, the results showed that the US government had responded to increases in the debt to GDP ratio by raising the primary surplus through either cutting non-interest expenditure or raising revenue. Therefore, this was strong empirical evidence to believe that U.S fiscal policy is consistent with an increase in government debt.

Blanchard *et al*. (1990) proposed a forward looking approach anchored by tax-gap indicators. This approach recognizes the conditions which ensure that the inter-temporal budget constraint is satisfied at any given fiscal policy. These include a series of tax and expenditure policies, the current debt to GDP ratio and macroeconomic indicators defined by the series of interest rate and national income growth. However, the main limitation of the tax gap approach is in the arbitrary choice of time horizon required and the target of debt to GDP ratio at the end of the period. It does not provide immediately change into policy indications. For instance, a positive gap indicates some budgetary pressures in the future, but it is silent about their timing.

Fiscal policy sustainability can be assessed basing on fiscal reaction function. This is relatively a new approach developed by (Bohn, 1998), and recently being widely used in assessing fiscal policy sustainability (de Mello 2005; Song 2009). This technique allows determining if a government is taking corrective actions to be consistent with its inter-temporal budget constraint by analyzing the relationship between primary balance and debt to GDP ratios. The method suggests that if primary balance reacts positively to debt-GDP ratios, then this is considered as a signal that the government is undertaking corrective actions to achieve fiscal policy sustainability. Bohn (1998) suggested to test whether primary balance is a positive linear function of debt-GDP ratio. If this hold, then a given inter-temporal budget constraint holds, hence fiscal policy is sustainable. The test framework can be conducted by using a simple cointegration regression model if debt and primary balance are both non-stationary while residual series are stationary.

There are many studies supporting fiscal reaction function as measure of fiscal sustainability. deMello (2008) investigates the trend of fiscal performance in Brazil. Using monthly data for the period 1995 to 2004 the empirical analysis shows that all levels of government responded strongly to changes in debt by adjusting their primary budget surplus targets. The simple cointegration regression model using ADF and PP test statistic was used to justify sustainability condition. This approach was also adopted by Song (2009) to test fiscal policy sustainability in Korea using sample observation from1970 to 2007 fiscal data. Empirical results suggested that Korea's fiscal policy has been maintained in a sustainable path basing on the inter-temporal budget condition.

3.0 Methodology and Data Sources
This paper uses competing methodologies to test whether fiscal policy of Tanzania has been sustainable. We follow the unit root test approach proposed by Hamilton and Flavin (1986), cointegration test approach developed by Hakkio and Rush (1991) and fiscal reaction function suggested by Bohn 1998 as they have been presented in the literature, but we involve deeper analysis of time series by employing different tests statistic.

3.1 Unit root test
Consider the first order autoregressive model which may contain a unit root.

$$d_t = \lambda d_{t-1} + \varepsilon_t \tag{1}$$

Where d_t denotes the current debt stock and d_{t-1} is the debt stock lagged one period, ε_t is the white noise error term with zero-mean and constant variance. When $\lambda = 1$ the regression equation (1) become a non-stationary process, if this happen the fiscal policy is unsustainable. When $\lambda < 1$, the series in the model is stationary, at this point the fiscal policy is regarded to be sustainable because interest rate is growing faster than the debt stock, and the creditors will be willing to lend the government since it is making promise to pay back the debt. Therefore stationarity is desirable because it ensure that the fiscal policy engaged by the government is on the sustainable path.

3.1.1 Augmented Dickey-Fuller (ADF) Test statistic
As shown in equation (1) that when $\lambda = 1$ then the time series follow a non-stationary process. The idea of ADF unit root test for non-stationarity is to regress d_t on its lagged one period value of d_{t-1} and find out whether the estimated λ is statistically equal to unit or not. The regression model(1) can be manipulated by subtracting d_{t-1} in both sides to get

$$d_t - d_{t-1} = (\lambda - 1)d_{t-1} + \varepsilon_t \tag{2}$$

This can also be presented as

$$\Delta d_t = \rho d_{t-1} + \varepsilon_t \tag{3}$$

Where $\rho = (\lambda - 1)$, and Δ denotes the first difference operator. Following this modification, we would estimate the regression equation under equation [3] and test for the null hypothesis of $\rho = 0$ against the alternative hypothesis of $\rho < 0$. Therefore if $\rho = 0$, then $\lambda = 1$, meaning that the series under consideration is non-stationary. The point of interest in making decision on rejection or non-rejection of the null hypothesis of $\rho = 0$ is to follow Dickey and Fuller (DF) test statistic, and DF

test statistic is based on the assumption that the error term (ε_t) of the regression is a white noise. However, in most cases the DF test have been found to have low power to detect the serial correlation in the error term of the regression time series. Due to this problem the Augmented Dickey-Fuller test statistic have been developed to restitute the problem. In ADF test statistic the lag of the first difference are incorporated in the regression equation in order to make the regression error term to follow a white noise process, then the regression model can be represented in the following form

$$\Delta d_t = \rho d_{t-1} + \beta_i d_{t-1} + \varepsilon_t \tag{4}$$

The model (4) can include deterministic component such as drift and trend, in this case the model can be presented as

$$\Delta d_t = \alpha + \beta_t + \rho d_{t-1} + \delta_i d_{t-1} + \varepsilon_t \tag{5}$$

Where α denotes a constant(drift), β is the coefficient on time trend series, ρ is the coefficient of d_{t-1}, $\Delta d_t = d_t - d_{t-1}$ is the first difference of d_t , d_{t-1} is a lagged once order of d_t, Δd_{t-i} represents changed lagged values, ε_t is error term of the autoregressive of order p. Now, the regression equation can be decomposed into three possible regression models:-

    (i)   Pure random walk without a drift, this is defined by imposing α =0 β = 0 ρ =0 to equation (5) which lead to obtain the following model

$$\Delta d_t = \rho d_{t-1} + \varepsilon_t \tag{6}$$

    (ii)   A random walk with drift, it is obtained by setting β = 0 ρ = 0 to equation (5) then the model become

$$\Delta d_t = \alpha + \rho d_{t-1} + \Delta d_{t-1} + \varepsilon_t \tag{7}$$

    (iii)   Deterministic trend with drift, is derived by setting β ≠ 0 to equation (5) then the model become

$$\Delta d_t = \alpha + \beta_t + \rho d_{t-1} + \delta \Delta d_{t-1} + \varepsilon_t \tag{8}$$

The parameter of interest in the Augmented Dickey-Fuller test is ρ. For ρ = 0 the d_t series contain a unit root.

3.1.2 Phillips-Perron (PP) Test statistic
Phillips-Perron unit root test is an alternative strategy for allowing errors that are not independent identically distributed. It deals with potential serial correlation in errors by applying a correction factors that estimates the long run variance of the error process. Similar to ADF test, PP test requires specification of a lag order which indicates the number of lags to be included in the long run variance estimate. More important PP tests might be more powerful than the ADF test. So far they use the same critical values.

3.1.3 KPSS Test statistic
ADF and PP unit root tests are specific for the null hypothesis that a time series are stationary in their first difference integration order. On other hand, stationarity tests are for the null hypothesis that the series are stationary at zero integration order. In line with this, KPSS test is commonly used

to test the stationarity. KPSS test is derived from the Autoregressive Moving average (ARMA). Let us consider the ARMA model with deterministic component of drift and trend below:-

$$\Delta d_t = \alpha + \beta_t + \rho d_{t-1} + \mu_t \tag{9a}$$

$$\mu_t = \mu_{t-1} + \varepsilon_t \tag{9b}$$

Where ε_t is error term, μ_t is a residual zero order integration series. μ_t is a pure random walk with innovation error variance ζ_2.

3.2 Cointegration Test
Our concern is to test the regression model

$$R_t = \alpha + \beta G_t + \varepsilon_t \tag{10}$$

Where α is a constant or intercept, β is the slope and ε_t is the regression error term. If the null hypothesis of unit root is rejected, then the long run equilibrium relationship in the form of OLS regression is estimated. Although we understand that there are several test statistic, we will rely only Engle and Granger cointegration test which is widely used. According to Engle and Granger (1987), in order to determine whether the two variables are cointegrated, it is necessary to follow the following steps:-

     (i)   Pre-test each variable to examine their order of integration
     (ii)   Estimate the Error Correction Model (ECM)

When these variables are integrated of the same order, then it should be tested if these variables are cointegrated. The purpose of pre-test is to determine the order of integration of each variable. This will enable to meet the necessary requirement of cointegration that two variables are integrated of the same order. This is facilitated by unit root test to show if there is a non-stationary process in each variable of observation. We apply the following autoregressive models

$$\Delta R_t = \alpha + \delta_t + \lambda R_{t-1} + \beta_i R_{t-1} + \varepsilon_t \tag{11}$$

Where R stand for government revenue, α denotes a constant(drift), δ is the coefficient on time trend series, λ is the coefficient of lagged once revenue, ΔR_t is the first difference of R_t , R_{t-1} is a lagged once order of R_t, ΔR_{t-i} represents differenced lagged values, ε_t is error term of the autoregressive of order P. The government expenditure series can also represented with the same form of the above autoregressive model.

If the variables R and G are cointegrated, then the OLS gives the indication that there is a long-run equilibrium relationship among these variable. If estimate of β range from 0.5 to 1 this is regarded as strong relationship. After estimating the OLS regression, the next step is to determine if the variables are cointegrated or not. This involve unit root test on the residual series by using the test statistics. The residual series which is denoted by μ_t is a series of estimated values of the deviation from the long-run relationship and they are estimated from:-

$$\mu_t = R_t - \hat{R} \tag{12}$$

3.2.1 Estimate the Error Correction Model (ECM)
Error correction model (ECM) is used to investigate in what way fiscal variable change and converge toward new equilibrium in the event of external shock on fiscal variables. Since non-

stationary series shocks have permanent effects and their effect never dies over time, hence they will not go back to the previous equilibrium; instead they will converge to a new equilibrium where cointegration between the variables holds. As the variable such as R and G are cointegrated we can run the error correction model as below

$$\Delta R_t = \beta_1 + \beta_2 \Delta G_t + \beta_3 \mu_{t-1} + \varepsilon_t \qquad (13)$$

Here R and G are I(1) variables β_1 is the intercept, β_2 is the short run error correction coefficient, β_3 is the long run error correction coefficient estimated in model, ε_t is the white noise, μ_{t-1} is the one period lag residual of the model and is also known as equilibrium error term of one lag. This μ_{t-1} is the error term that guides the variables R and G of the system to restore back to equilibrium.

3.2.2 Johansen cointegration test

Johansen test is one of the methods which can be used to test the number of cointegrating relationship using VECM. Similar to any other hypothesis test, the inference is made by comparing the critical values and test statistics. If test statistics is greater than critical value, then the null hypothesis is rejected. Johansen proposed two likelihood ratio statistics namely the trace statistics and eigenvalue. These will be provided by stata software. The null hypothesis to be tested is that there is no number of cointegration relationships (rank = r = 0).

3.3 Data

The time series data applied for fiscal sustainability test model were obtained from various sources including the Bank of Tanzania, Tanzania Revenue Authority, Ministry of Finance and National Bureau of Statistics. The data used to estimate parameters are observations of annual data over the period 1970-2011. The sample size was determined by the availability of the data.

The time series data variable includes nominal undiscounted central government debt, government expenditure, government revenue, and budget deficit, primary deficit and GDP. All variable are converted into real values by dividing each nominal value to GDP deflator and then express them relative to GDP (dividing each variable to real GDP). The purpose of this transformation is to take into consideration of economic interpretation; such transformation really takes into account the dimension of the economy. Then the variables are defined as follow:-

    (i)   R is real government revenues which includes taxes and non-taxes
    (ii)   G is real government expenditure (inclusive of interest payment
    (iii)   d is real undiscounted central government debt
    (iv)   b is the real budget deficit
    (v)   GDP is the real gross domestic product.
    (vi)   pS is a real primary balance

4.0 Estimation
4.1 Unit Root Test

The results of ADF and PP in Table 1 and 2 reports that the null hypothesis of unit root tests of real central government debt is not rejected at 5 per cent level of significance for the period 1970-2011. At the same time the result in Table 3 for the case of KPSS test indicates the rejection of null

hypothesis of trend stationary for central government debt series at 5 per cent level of significance. Hence we make a conclusion that there is a unit root in the data generating process of the debt data.

Table 1: ADF Unit root test results for debt

	No constant	Constant	Constant and Trend
Test statistics	-0.485	-2.285	-2.262
Critical Values 1%	-2.641	-3.668	-4.27
Critical Values 5%	-1.95	-2.966	-3.552
Critical Values 10%	-1.605	-2.616	-3.211

Table 2: PP Unit root test results for debt series at lag1

	No constant	Constant	Constant and Trend
Z(rho)	-0.22	-6.906	-6.826
Z(tau)	-0.156	-2.054	-2.262
Critical values 5%			
Z(rho)	-7.508	-12.916	-18.888
Z(tau)	-1.95	-2.964	-3.548

Table 3: KPSS test results for trend stationary debt series

Lag order	Test statistic
0	0.402
1	0.214

Since the three unit root test statistics above yield consistent results that the central government debt series follow non-stationary process. Therefore, linking our results to the condition of inter-temporal budget constraint outlined in the literature, it is possible to conclude that the fiscal policy of Tanzania from 1970-2011 has been unsustainable. The central government debt to GDP is growing faster that the level of primary surpluses that is required to offset the current debt. If we assume that the fiscal policy would continue in the same path for the distant future, there is a great possibility to threaten fiscal solvency.

4.2 Co-integration tests
We also used alternative approach for assessing fiscal sustainability in Tanzania. We tested the null hypothesis for no cointegration between government spending and revenues expressed to GDP ratio. Engle and Granger and Johansen methods were adopted to facilitate the test. We started with Engle and Granger method, and the regression model subjected to this test is

$$R_t = \alpha + \beta G_t + \varepsilon_t \tag{14}$$

The null against alternative hypothesis
$$H_0: \beta = 1$$
$$H_1: \beta \neq 1$$

The first step was to conduct a pre-test in order to examine the presence of unit root for government expenditure and revenue as a ratio to GDP, and evaluate if they are best characterised by I(0) and I(1) integration. This is the necessary requirement of cointegration that two variables should integrated of the same order. The class of ADF, PP and KPSS unit root tests are employed to show whether there is a unit root in each variable of observation.

4.2.1 Pre-test step

The autoregressive model through equation 15 to 18 below were tested for I(0) and I(1) integration of government revenue and expenditure respectively

$$R_t = \alpha + \lambda R_{t-1} + \eta_t \tag{15}$$

$$\Delta R_t = \alpha + \rho R_{t-1} + \eta_t \tag{16}$$

$$G_t = \alpha + \lambda G_{t-1} + \eta_t \tag{17}$$

$$\Delta G_t = \alpha + \rho G_{t-1} + \eta_t \tag{18}$$

For the regression equations [15] and [17] we set the null hypothesis of non-stationarity $\lambda = 1$ and for the case of equations [16] and [18] the null hypothesis against alternative is $\rho = 0$. We also reject the null hypothesis when the test statistic is greater than critical value in absolute value. According to the results summarized in Table 4 for the case of both ADF and PP unit root test, there is no evidence to reject the null hypothesis that the government expenditure and revenue are all non-stationary in levels. However, it is possible to conclude that all the series of the government expenditure and revenue are stationary of the first differences.

Table 4: ADF and PP unit root test results for R_t, G_t and Pbt

Variable	ADF	PP	Critical(zt)	Remarks
R_tI(0)	-2.154	-2.238	-2.964	Unit root
G_tI(0)	-1.201	-1.323	-2.964	Unit root
Pb_tI(0)	-1.735	-1.818	-2.964	Unit root
R_t(1)	-7.301	-7.371	-2.966	Stationary
G_tI(1)	-6.18	-6.18	-2.966	Stationary
Pb_tI(1)	-5.805	-5.797	-2.966	Stationary

Critical value z(t) 5%

4.2.2 The second step for cointegration test

The second step was to estimate the Ordinary Least Square (OLS) regression model and test the statistical significance of the coefficient of the dependent variable of Gt. The results are reported in Table 5.

Table 5: Cointegration regression equilibrium results ($R_t = \alpha + \beta G_t + \varepsilon_t$)

Revenue	Coefficient	Std error	t-statistics	P-Value
Expenditure	0.2237	0.0576	3.88	0.000
Constant	0.9133	0.117	7.8	0.000

$R^2 = 0.2894$ Durbin-Watson 0.8896

$$R_t = 0.0911 + \lambda 0.2236GG_t \tag{19}$$

In order to be confident that our model is not spurious we have also conducted diagnostic test and compare Durbin-Watson (d) statistic and R-square (R^2) ,we find d-statistic = 0.8896397 while R^2 = 0 .2894. Since d-statistic is greater than R^2 then our model is not spurious, then we proceed. The coefficient of G_t is positive and statistically significant at 5% level. This imply that when the government expenditure increase by 100%, then revenue increase by 22%. It can also be shown that the model does not fit the data well, since R^2 is 0.289 which suggest that only 28.9% of the variation in the government revenue is explained by the changes in government expenditure. However, our interest was to test the null hypothesis of no cointegration between government revenues and expenditure. This was made possible by estimating the residual of our regression model and then tests the stationarity of the series of the residual.

$$Estimate \mu_t = R_t - (0.0911 + 0.2236G_t) \tag{20}$$

The formal ADF unit root test was adopted to test the stationarity of the residual of the following form:

$$\Delta \mu_t = -\rho \mu_{t-1} + \varepsilon_t \tag{21}$$

Table 6: The ADF unit root test results for residual I(1) with no constant

	Test Statistics	Critical value 1%	Critical value 5%	Critical value 10%
Z(t)	-3.132	-3.662	-2.964	-2.614

P-value for z(t) = 0.0245

The null hypothesis of coefficient of first lag of residual is zero, H_0: $\rho = 0$, if the null hypothesis is rejected then the series is stationary and the conclusion is that the government revenue and expenditure are cointegrated.

4.2.3 Error Correction Model (ECM)
Although government expenditure and revenue for Tanzania are not cointegrated, we are also interested to estimate the error correction model in order to examine the speed at which these variables takes to adjust toward equilibrium when there is an event of external shock. The appropriate estimation model for Error Correction Model (ECM) is conducted by running the regression below:-

$$\Delta R_t = \beta_1 + \beta_2 \Delta G_t + \beta_3 \mu_{t-1} + \varepsilon_t \tag{22}$$

Table 7: Results of Error Correction Model (ECM)

Revenue	Coefficient	Std error	t-statistics	P-Value
D.Expenditure	0.2517	0.0848	0.3	0.768
L.residual	-0.4865	0.1352	-3.6	0.001
Constatnt	0.0009	0.0019	0.5	0.621

R^2=0.2788

The ECM estimation is $\Delta R_t = 0.0009 + 0.2517\Delta G_t - 0.4865\mu_{t-1}$ (23)

From the above equation the coefficient of lagged once residual enter with a correct sign of negative 0.4865 and is statistically significant different from zero, which means that the speed of adjustment back to new equilibrium is only 48.65% annually.

4.3 Fiscal reaction function

Bohn (1998) developed the assumption that fiscal policy is sustainable as long as primary balance and debt to GDP ratio are cointegrated. In connection to this assumption we adopt cointegration test in order to analyses the Tanzania fiscal sustainability. The main purpose is to make a robust check of the results obtained earlier, as well as to find direct evidence if the government is undertaking corrective measure against debt accumulation. The two step approach of Engle and Granger method was used to validate the sustainability condition.Following that, primary balance and government debt to GDP ratios are non-stationary, then we tested the cointegration between primary balance and debt to GDP ratio by estimating the following regression equation with OLS.

$$pS_t = \alpha + \beta d_t + \varepsilon_t \tag{24}$$

The regression results of equation [24] in Table 8 show a negative and statistically significant coefficient of β = -0.2578. This has implication that, 1 per cent increases of debt relative to GDP the primary surplus on average decreases by 0.2578.

Table 8: Regression results: Primary balance on debt to GDP

Primary balance	Coefficients	Std error	Test-statistics	P-value
Debt	-0.257770	0.054370	-4.74	0.000
Constant	1.28430	1.26674	1.01	0.317

R^2 = 0.3779; Durbin Watson= 1.8479829

We further employed the ECM to check for the speed at which the primary balance and debt GDP adjust to new equilibrium when there are some changes of fiscal policies. We estimated the following equation.

$$\Delta pS_t = \beta_1 + \beta_2\Delta d_t + \beta_3\mu_{t-1} + \varepsilon_t$$

Table 9: Error correction model: Primary balance on debt to GDP

D.PrimayBalance	Coefficients	Std.Error	Test-statistics	P-value
D.debt	-0.5443653	0.9984	-5.45	0.768
L.residual	-0.4198283	0.1119	-3.75	0.001
Constant	0.2844308	0.3106	0.92	0.366

R^2=0.4682

The ECM estimation:-

$$\Delta pS_t = 0.2844308 - 0.5443653\Delta d_t - 0.4198283\mu_{t-1}$$

The results in Table 9 shows that the coefficient of residuals lagged once has entered with a correct sign of negative and it is statistically significant, which means that it takes 41.98 speed annually for primary balance to adjust towards a new equilibrium with the increase debt to GDP. On the other hand, the model shows that the short run equilibrium between primary surplus and debt to GDP is -0.544.

4.4 Johansen cointegration test
Due to the limitations of Engle and Grange methods we adopt Johansen cointegration test in order to ensure that our results are precise. We set the null against alternative hypothesis as followH0: r = 0 H1: r > 0, where r is the number of variables which have long run equilibrium relationships. The results in Table10, shows that the null hypothesis of no cointegration is rejected at 5% level of significance.

Table10: Johansen cointegration test results

Rank	Trace statistics	Critical value 5%
0	29.4204	15.41
1	3.6694*	3.76

Following both methods of Engle and Granger and Johansen cointegration test producing the same results, it can be possible to interpret that the government revenues and expenditures are cointegrated, and the results can be used to assess the fiscal policy sustainability for Tanzania between 1970 and 2011. Since we follow Hakkio and Rush (1991), then fiscal policy is sustainable when β = 1. In this context the test statistics in our result shows that government revenue and expenditures are cointegrated but the coefficient β < 1. That is to say, 1% increases of government expenditure relative to GDP, revenue on average increases by 0.22 per cent relative to GDP. Therefore, it is possible to conclude that fiscal policy in Tanzania may not have been sustainable for the period 1970 -2011 because government expenditure exhibited high growth than revenue.

5.0   Conclusion and Policy Implications

The inter-temporal budget constraint has been used as a benchmark for analysis of sustainability of fiscal policy. We have addressed the issue of fiscal sustainability in Tanzania using competing methodologies for the tests. Our findings are that according to the unit root tests, we found that the data generating process of debt to GDP ratio follows non-stationary process, hence violating the inter-temporal budget constraint. Further evidence shows that the presence of unit root in the data generating process of debt to GDP ratio is without deterministic component of drift and trend; we can interpret this process to be consistent with either unsustainable or strong sustainable condition of fiscal policy. If there would be positive drift and trend in the series of the debt, there would be additional evidence to conclude that the fiscal policy is unsustainable. Alternatively, we have applied Engle and Granger and Johansen method to test the cointegration between government revenue and expenditure.

Both methods yield similar results that there is cointegration between government revenue and expenditure but the estimated cointegrated coefficient β is statistically significant less than one. As a result, government expenditure is growing faster than revenue. For example estimate coefficient for real government expenditure and revenue expressed in GDP ratio shows that 100% increase in government expenditure, revenues increase by only 22%. Therefore, we can regard this as unsustainable level. In addition to the results obtained through unit root and cointegration tests, the fiscal reaction function analysis shows that the primary surplus and debt to GDP ratio have a negative linear relationship. Therefore we find further evidence that the inter-temporal budget constraint for Tanzania has been violated for the period and the government is not undertaking corrective measure to counteract the accumulation of debt, especially by adjusting policies of taxes and revenues which could have significant impact on interest rate growth.

Consequently, our results show that fiscal performance in Tanzania is plausible unsustainable according to the three alternative approaches used in this paper. These results appear to be not consistent with the evolution of policy changes that have been taking place since 1986. We further argue that the remarkable decrease in deficit between the ends of 1980s and earlier of 1990s was not caused by the policies changes, but was due to stochastic changes. Although the approaches implemented in this paper to tests fiscal sustainability have been widely supported in the literature, they have limited practicability. The main reason is that the tests are based on the past characteristics of data generating process of fiscal aggregates, while the sustainability of fiscal policy is related to their future characteristics. Even if the fiscal policy is unsustainable, government could still claim that a policy change designed for the future would make it sustainable. Therefore, the tests may provide an irrelevant guide on fiscal policy in the future.

We further argue that any conclusion to be derived from our results should bear in mind the limitations of the analysis, due to the fact that this analysis is based on the past data generating process and, consequently the future evolution of policy changes and their impact on current fiscal performance are not taken into account. Therefore, the fiscal sustainability in Tanzania should be interpreted in the sense that there are problems in marketing debt which are expected to arise under the assumption that the variables involved follow the behavior of the past in the future, which forms the condition of a sustainability analysis. We suggest a future work to follow either tax gap

indicators proposed by Blanchard (1990) or fiscal stance index proposed by Polito (2007), these two distinct indices are more forward looking approach which focuses on the short-term implications of the current fiscal policy. Since fiscal policy changes over time, then forward looking approach would be appropriate measure for fiscal sustainability that reflects these changes.

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