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Structural breaks and fiscal deficit sustainability in EAC countries: Empirical evidence

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Abstract: The study examines fiscal sustainability of the East African Community (EAC) Countries by testing for cointegration between government spending and revenue. The study tests for breaks in the long-run relationship between spending and revenue using Bai and Perron's (2003) method. The presence of regime shifts is then accounted for when testing for cointegration by using testing procedures suggested by Gregory & Hansen (1996) and Hatemi-J (2008) to respectively account for one and two endogenous breaks. The findings show that the presence of regime shifts in the relationship between government spending and government revenue could not be rejected for all the EAC countries. Moreover, both cointegration tests used accounting for regime shifts suggest that government spending and revenue are cointegrated for all the EAC countries thus indicating that fiscal deficits in the EAC countries are sustainable. However, the cointegrating coefficient shows that budget deficits are only weakly sustainable in the long-run for Burundi, Kenya, Tanzania and Uganda and strongly sustainable for Rwanda. The finding implies that for Burundi, Kenya, Tanzania and Uganda, fiscal sustainability needs to be reinforced otherwise the countries are at high risk of default since they spend more than they earn.

Keywords: Fiscal Deficits, Government Spending, Government Revenue, Structural Breaks, Cointegration, EAC Countries

1. Introduction

East Africa Community (EAC) is a regional economic grouping comprising of Burundi, Kenya, Rwanda, Tanzania and Uganda in which the macroeconomic convergence criteria concerning the fiscal balance is such that the ratio of budget deficit to GDP (including grants) be not more than 2% and not more than 5% (excluding grants). EAC falls short on both criteria and has instead been running severe budget deficits. For the period 2004-2012 for instance, EAC's ratio of budget deficit[1] (percentage of GDP) was on average 3.4% inclusive of grants and 7.3% when grants are excluded. This raises the question of the sustainability of the fiscal deficits of the EAC countries.

Based on the government's inter-temporal budget constraint, Hakkio and Rush (1991) and Quintos (1995) proposed to test for cointegration between government revenue and government spending in order to examine fiscal sustainability. Fiscal deficits are said to be sustainable if there exists a cointegration relationship between government revenue and spending. Two forms of sustainability are highlighted; a strong sustainability if the cointegrating coefficient is equal to 1 and weak if it is between 0 and 1.

Following Hakkio and Rush (1991) and Quintos (1995), a number of studies from both developing and developed countries have examined cointegration between government revenue and spending in order to test for fiscal sustainability.

For the developing world, among others are Oshikoya and Tarawalie (2010) for WAMZ countries, Nseera (2013) for Lesotho, Tshiswaka-Kashalala (2006) and Lusinyan and Thornton (2009) for South Africa, Cerro et al. (2009) for Argentina, Ghatak and Sánchez-Fung (2007) for Peru, the Philippines, South Africa, Thailand, and Venezuela, Deyshappriya (2012) for Sri Lanka, Abdullah et al. (2012) for Malaysia and Robledo and Velandia (2011) for eight Latin American countries, namely, Argentina, Chile, Colombia, Ecuador, Panama, Peru, Paraguay and Uruguay, just to mention but a few.

From the findings, Oshikoya and Tarawalie (2010)

[1] Data from Regional Economic Outlook, Sub-Saharan Africa, May 2013

reached the conclusion that fiscal deficits are weakly sustainable for all the WAMZ countries except for Sierra Leone where they were found to be unsustainable, Lusinyan and Thornton (2009) support the weak form of fiscal sustainability for South Africa, Deyshappriya (2012) suggests that fiscal policy is unsustainable for Sri Lanka, Abdullah et al. (2012) concludes that fiscal deficits are sustainable in the long-run for Malaysia while Ghatak and Sánchez-Fung (2007) fails to validate fiscal sustainability for Peru, the Philippines, South Africa, Thailand, and Venezuela.

And for the developed countries, studies on fiscal sustainability abound such as Marinheiro (2006) for Portugal, Afonso and Rault (2007) for the euro area, Landolfo (2008) for the euro area and USA, Kuştepeli and Önel (2005) for Turkey, Bajo-Rubio et al. (2006) for Spain, Claeys (2007) for European Union countries and Bajo-Rubio et al. (2008) for US. Claeys (2007) and Afonso and Rault (2007) support fiscal sustainability for the euro area and Landolfo (2008) concludes that fiscal deficits are sustainable for the euro area and USA, while Kuştepeli and Önel (2005) found that fiscal deficits are weakly sustainable for Turkey.

Although the empirical literature is not exhaustively explored in this paper, the general trend seems to indicate that only few studies (Kuştepeli and Önel, 2005; Marinheiro, 2005 and Afonso and Rault, 2007) allow for structural breaks when analyzing cointegration between government revenue and spending. Failure to account for these breaks when examining cointegration between government revenue and spending, in light of the fact that these breaks can be present in the series or in the long-run relationship, can lead to faulty conclusions regarding fiscal sustainability, hence inappropriate policy recommendations.

This paper overcomes this key weakness by applying two cointegration tests which account for structural breaks; Gregory and Hansen (1996) test accounting for one endogenous break and Hatemi-J (2008) test which accounts for two endogenous breaks. Further still, despite the abundant empirical literature on fiscal sustainability for other regions, to the best of my knowledge, studies on the concept are lacking for the EAC countries.

For the rest of the paper, section 2 presents the conceptual framework, section 3 presents data and methodology, section 4 presents and discusses the results and section 5 concludes the study.

2. Conceptual Framework

Following Hakkio and Rush (1991), Quintos (1995) provided a framework for testing fiscal sustainability. Their analysis starts with the following one-period government's budget constraint:

$$\Delta B_t = G_t^r - R_t \tag{1}$$

where B_t is government debt, R_t, government revenue and $G_t^r = G_t + r_t B_{t-1}$ is government spending inclusive of interest payments, with G_t being primary government expenditure and r_t is the real interest rate assumed to follow a stationary process with mean r.

With the above assumption, equation (1) can be re-written as:

$$B_t - (1+r)B_{t-1} = E_t - R_t \tag{2}$$

where $E_t = G_t + (r_t - r)B_{t-1}$ is G_t^r when interest rates are around a zero mean.

Using forward substitution, the present value of the government's borrowing constraint is written as:

$$B_t = \sum_{j=0}^{\infty} \frac{1}{(1+r_t)^{j+1}}(R_{t+j} - E_{t+j}) + \lim_{j\to\infty} \frac{B_{t+j}}{(1+r_t)^{j+1}} \tag{3}$$

Equation (3) can be written in terms of difference as follows:

$$\Delta B_t = \sum_{j=0}^{\infty} \frac{1}{(1+r_t)^{j+1}}(\Delta R_{t+j} - \Delta E_{t+j}) + \lim_{j\to\infty} \frac{\Delta B_{t+j}}{(1+r_t)^{j+1}} \tag{4}$$

Since $\Delta B_t = G_t^r - R_t$, equation (4) is also equivalent to:

$$G_t^r - R_t = \sum_{j=0}^{\infty} \frac{1}{(1+r_t)^{j+1}}(\Delta R_{t+j} - \Delta E_{t+j}) + \lim_{j\to\infty} \frac{\Delta B_{t+j}}{(1+r_t)^{j+1}} \tag{5}$$

According to Hakkio and Rush (1991) and Quintos (1995), fiscal deficits are sustainable if the present value of the stock of public debt goes to zero in infinity, that is, $\lim_{j\to\infty} \frac{\Delta B_{t+j}}{(1+r_t)^{j+1}} = 0$, in this case, the public debt $\Delta B_t = G_t^r - R_t$, does not grow without limit.

According to Quintos (1995), if $\lim_{j\to\infty} \frac{\Delta B_{t+j}}{(1+r_t)^{j+1}} = 0$, testing for fiscal sustainability from equation (5), implies testing for the stationarity of fiscal deficits ΔB_t or alternatively testing for the stationarity of $G_t^r - R_t$. This comes down to testing for cointegration between government spending (including interest payments) G_t^r and government revenue R_t (assuming that G_t^r and R_t are both non stationary variables but I(1) processes) with the cointegration vector being [1, -1].

Hence, according to Quintos (1995), testing whether budget deficits are sustainable implies testing for cointegration relationship between government expenditure and government revenue using the following long-run relationship:

$$R_t = \alpha + \beta G_t^r + \varepsilon_t \tag{6}$$

However, Quintos (1995) differentiates between strong sustainability and weak sustainability. If G_t^r and R_t are cointegrated with $\beta = 1$, fiscal deficits are strongly sustainable in Quintos' (1995) sense, but if $0 < \beta < 1$, fiscal deficits are only weakly sustainable and they are unsustainable if $\beta \leq 0$.

3. Data and Methodology

The study uses annual data on government expenditure (in percentage of GDP) and government revenue (in percentage of GDP) for the EAC countries, namely, Burundi, Kenya, Rwanda, Tanzania and Uganda covering the period 1985-2012. Data were collected from "Selected Statistics on African Countries" published by African Development Bank (2006, 2007, 2008), and "Regional Economic Outlook, Sub-Saharan Africa" published by International Monetary Fund (May, 2013).

To test whether fiscal deficits are sustainable, we test for cointegration between government expenditure and government revenue using two cointegration tests with structural breaks; Gregory and Hansen (1996) and Hatemi-J (2008).

The conventional cointegration tests mostly used in empirical literature, Engle & Granger test, Johansen (1990) and Enders and Siklos (2001) do not take into account the possibility of structural breaks in the long-run relationship, hence they assume that the cointegrating vectors do not vary overtime. Building on Engle & Granger test, Gregory and Hansen (1996a, 1996b) and Hatemi-J (2008) developed cointegration tests accounting for structural breaks in the cointegrating equation, with Gregory and Hansen (1996) accounting for one endogenous break and Hatemi-J (2008) capable of accounting for two endogenous breaks.

Let y_t and x_t be two non-stationary variables integrated of order 1, to test for cointegration, Engle and Granger (1987) propose to test for unit root on the residuals from the following regression:

$$y_t = \alpha + \beta x_t + \varepsilon_t \tag{7}$$

If the residuals series ε_t is stationary, then there is a cointegration relationship between the variables. To test for unit root on the residuals, Augmented Dickey-Fuller (ADF) test and the z_α and z_t tests proposed by Phillips (1987) to account for first order serial correlation are commonly used. Gregory and Hansen (1996) showed however that those tests are misspecified if there are structural breaks which have occurred in the period of study (Hatemi-J, 2008).

Gregory and Hansen (1996a, 1996b) and Hatemi-J (2008) propose the use of same test statistics (ADF, z_α and z_t) but based on models accounting for breaks and they generate new critical values.

To account for one endogenous break, Gregory and Hansen (1996a, 1996b) propose the following four models:

Model 1: Level Shift (C)

$$y_t = \alpha_0 + \alpha_1 \phi_{t\tau} + \beta_1 x_t + \varepsilon_t, \; t = 1, \ldots, n \tag{8}$$

where $\phi_{t\tau}$ is a dummy variable such that $\phi_{t\tau} = \begin{cases} 1 \; if \; t > n\tau \\ 0 \; if \; t \leq n\tau \end{cases}$ and $\tau \in (0,1)$ denotes the relative timing of the break point.

In model 1, the structural break affects the intercept only; α_0 is the intercept before the break and α_1 is the change in intercept at the time of the break.

Model 2: Level Shift with Trend (C/T)

$$y_t = \alpha_0 + \alpha_1 \phi_{t\tau} + \varphi_1 t + \beta_1 x_t + \varepsilon_t, \; t = 1, \ldots, n \tag{9}$$

Like in model 1, in model 2, the break affects also only the intercept but unlike model 1, model 2 contains a trend.

Model 3: Regime Shift Where Intercept and Slope coefficients Change (C/S)

$$y_t = \alpha_0 + \alpha_1 \phi_{t\tau} + \beta_1 x_t + \beta_2 x_t \phi_{t\tau} + \varepsilon_t, \; t = 1, \ldots, n \tag{10}$$

Model 3 is a model with regime shift in which the structural break affects both the intercept and the slope coefficient. β_1 is the cointegrating slope coefficient before the shift and β_2 is the change in the cointegrating slope coefficient at the time of the break.

Model 4: Regime Shift Where Intercept, Slope Coefficients and Trend Change (C/S/T)

$$y_t = \alpha_0 + \alpha_1 \phi_{t\tau} + \varphi_1 t + \varphi_2 t \phi_{t\tau} + \beta_1 x_t + \beta_2 x_t \phi_{t\tau} + \varepsilon_t \tag{11}$$

Model 4 is a model in which the structural change affects the intercept, the slope coefficient and the trend function.

For each of the above models, unit root tests are performed on the residuals series, ε_t using ADF, z_α and z_t tests. Gregory and Hansen (1996) propose the following tests:

$$ADF^* = \inf_{\tau \in T} ADF(\tau)$$
$$Z_\alpha^* = \inf_{\tau \in T} Z_\alpha(\tau)$$
$$Z_t^* = \inf_{\tau \in T} Z_t(\tau)$$

Since there can be more than one structural break in a cointegrating relationship, we also adopted a cointegration test advanced by Hatemi-J (2008), which accounts for two structural breaks. Hatemi-J (2008) considers only a model with regime shift in which two endogenous breaks affect both the intercept and the slopes coefficients.

$$y_t = \alpha_0 + \alpha_1 D_{1t} + \alpha_2 D_{2t} + \beta_0 x_t + \beta_1 D_{1t} x_t + \beta_2 D_{2t} x_t + \varepsilon_t \tag{12}$$

where D_{1t} and D_{2t} are dummy variables defined as:

$D_{1t} = \begin{cases} 0 \ if \ t \le [n\tau_1] \\ 1 \ if \ t > [n\tau_1] \end{cases}$ and $D_{2t} = \begin{cases} 0 \ if \ t \le [n\tau_2] \\ 1 \ if \ t > [n\tau_2] \end{cases}$ with $\tau_1, \tau_2 \in (0,1)$

Hatemi-J (2008) suggests the following tests:

$ADF^* = \inf_{(\tau_1,\tau_2)\in T} ADF(\tau_1,\tau_2)$

$Z_\alpha^* = \inf_{(\tau_1,\tau_2)\in T} Z_\alpha(\tau_1,\tau_2)$ where $T = (0.15n, 0.85n)$

$Z_t^* = \inf_{(\tau_1,\tau_2)\in T} Z_t(\tau_1,\tau_2)$

4. Empirical Results and Discussion

4.1. Unit Root Tests Results

Before testing for unit root, we test for the presence of structural breaks in the series, breaks which can occur due to political or economic events. We employ Bai and Perron (2003) method which suggests three tests, namely, *SupF* test, *AveF* test and *ExpF* test. Bai and Perron (2003) test of structural breaks was performed using "strucchange", an R package for testing structural change developed by Achim Zeileis et al. (2001). The test results are reported in table 1; they indicate that the null hypothesis of no structural break in the series, government spending (% GDP) and government revenue (% GDP), is strongly rejected by the *SupF* test, *AveF* test and *ExpF* test at 1% level for all the countries of EAC. This implies that structural breaks have occurred in these countries due to political, economical factors, etc. during the period of study and affected the evolution of those two variables.

To test for unit root in the series government spending and government revenue, we therefore use a test which accounts for breaks in the series. As Baum (2001) points out, when testing for unit root, if breaks are not accounted for when they are present in the series, there might be a confusion of structural breaks in the series as evidence of non-stationarity. This study uses a test accounting for one endogenous break in the series, proposed by Lanne et al. (2003). Unit root test results are reported in table 2; the optimal lag used is selected by Akaike Information criterion (AIC) out of a maximum lags of 5 and the break date is selected endogenously by the software. Considering both an impulse dummy and a shift dummy, unit root tests results indicate that the null hypothesis of unit root in the series, government spending and government revenue, cannot be rejected by Lanne et al. (2003) test for all the EAC countries at 5% level of significance. However, for the first differences of the same variables, Lanne et al. (2003) test strongly rejects the null hypothesis of a unit root at 1% level. Unit root test results therefore suggest that the series we use in this study, that is government spending (% GDP) and government revenue (% GDP) are non-stationary processes, integrated of order one, I (1), for all the countries under consideration.

4.2. Cointegration Tests Results

Since government spending (% GDP) and government revenue (% GDP) were found to be non stationary integrated of order one, I (1) for all the countries, we proceeded to test for cointegration between them. Prior to testing for cointegration, we test for the presence of structural breaks in the long-run relationship between government spending, G_t and government revenue, T_t using Bai and Perron (2003) test. In other words, we test whether the null hypothesis of no structural change against the alternative that the slope coefficient is time-variant.

$$R_t = \alpha + \beta_i G_t + u_t, i = 1,2,...,t \quad (13)$$

The null hypothesis of no structural change (slope coefficient is time-invariant) in the long-run relationship is written as:

$$H0: \beta_i = \beta, \ i = 1,...,t$$

SupF, *AveF* and *ExpF* test statistics proposed by Bai & Perron (2003) are used with a trimming parameter h = 0.15 as suggested by the author, that is, the test is done for the central 70% observations. Results tests for structural breaks in the long-run relationship are reported in table 3.

Table 1. *Test Results for the presence of structural breaks in the series*

	Government Revenue (% GDP)			**Government Spending (% GDP)**		
	Sup-F	***Ave-F***	***Exp-F***	***Sup-F***	***Ave-F***	***Exp-F***
Burundi	104.65*** [0.000]	30.17*** [0.000]	49.30*** [0.000]	193.14*** [0.000]	34.71*** [0.000]	93.53*** [0.000]
Kenya	79.02*** [0.000]	22.04*** [0.000]	36.50*** [0.000]	57.50*** [0.000]	19.57*** [0.000]	25.76*** [0.000]
Rwanda	91.22*** [0.000]	30.14*** [0.000]	42.56*** [0.000]	49.29*** [0.000]	14.23*** [0.000]	21.60*** [0.000]
Tanzania	128.49*** [0.000]	32.31*** [0.000]	61.20*** [0.000]	81.62*** [0.000]	20.59*** [0.000]	37.77*** [0.000]
Uganda	92.00*** [0.000]	23.64*** [0.000]	42.95*** [0.000]	68.25*** [0.000]	18.68*** [0.000]	31.08*** [0.000]

Notes: Between the brackets [.] are the p-values and *** denotes rejection of the null hypothesis at 1% level of significance

Table 2. *Results of Unit Root tests with a structural break: Lanne et al. (2003) test*

	Impulse Dummy			Shift Dummy		
	S.L Value	**Break Date**	**Lag**	**S.L Value**	**Break Date**	**Lag**
Burundi						
G	-1.509	2003	3	-1.971	2003	2
Δ G	-3.630***	2003	2	-1.557	2003	1
T	-1.244	2004	1	-2.188	2004	4
Δ T	-3.888***	2004	5	-3.878***	2004	5
Kenya						
G	0.128	2000	1	-2.262	1997	5
Δ G	-6.828***	2000	0	-7.743***	1997	0
T	-1.382	2000	0	-2.483	1994	0
Δ T	-4.086***	2000	0	-5.050***	1994	0
Rwanda						
G	-1.916	1994	0	-1.352	1994	0
Δ G	-5.579***	1994	0	-4.992***	1994	1
T	-1.049	1994	1	-1.404	1994	0
Δ T	-4.965***	1994	1	-4.806***	1994	0
Tanzania						
G	-0.905	1993	0	-2.372	2004	0
Δ G	-6.404***	1993	0	-9.099***	2004	0
T	-0.002	2005	2	-1.767	2004	0
Δ T	-7.128***	2005	0	-7.053***	2004	0
Uganda						
G	-2.062	1991	0	-2.806	1991	0
Δ G	-7.147***	1991	0	-3.831***	1991	1
T	-2.681	1991	1	-1.668	1991	1
Δ T	-6.929***	1991	0	-3.487***	1991	0

Notes: JMulTi software, version 4.23, was used to perform the tests. S.L. stands for Lanne, Saikkonen and Lutkepohl (2003) test. Δ is the difference operator. The lag length is selected using Final Prediction Error (FPE). Break dates are selected automatically by the software. *** denotes rejection of the null hypothesis at 1% level. Critical values are from Lanne et al. 2002): C.V (1%) = -3.48, C.V (5%) = -2.88 and C.V (10%) = -2.58

Table 3. *Test Results for structural breaks in the long-run relationship*

	Test Statistics		
	Sup-F	*Ave-F*	*Exp-F*
Burundi	19.22*** [0.001]	2.79 [0.206]	6.57*** [0.002]
Kenya	99.43*** [0.000]	14.60*** [0.000]	46.67 [1.000]
Rwanda	37.51*** [0.000]	16.74*** [0.000]	16.32*** [0.000]
Tanzania	24.58*** [0.000]	15.80*** [0.000]	10.36*** [0.000]
Uganda	13.72** [0.020]	5.01** [0.036]	4.75** [0.010]

Notes: Between the brackets [.] are the p-values; ** & *** denote rejection of the null hypothesis at 5% and 1% level respectively

Table 4. *Gregory-Hansen (1996) Cointegration tests Results*

Panel a: Gregory-Hansen (1996) Cointegration tests

Model	ADF*	Break	z_t^*	z_a^*	Break	Lag
Burundi						
C	-4.99**	2008	-5.02**	-27.52	1989	3
C/T	-3.27	2005	-5.17**	-28.11	1994	5
C/S	-5.03**	1995	-4.70*	-25.63	1989	3
C/S/T	-6.41***	1993	-6.53***	-33.41	1993	0
Kenya						
C	-4.66**	1995	-3.70	-18.51	1994	1
C/T	-4.34	1995	-3.75	-19.00	1994	1
C/S	-4.95*	1995	-4.59	-24.62	1993	1
C/S/T	-4.95	1995	-4.34	-22.86	1994	1
Rwanda						
C	-4.37*	1997	-4.57*	-23.68	1995	0
C/T	-4.59	1990	-4.68	-25.51	1990	0
C/S	-6.65***	1995	-6.78***	-35.19	1995	0
C/S/T	-7.20***	1995	-7.34***	-37.89	1995	0
Tanzania						
C	-5.65***	1989	-5.72***	-30.33	1989	0
C/T	-6.39***	2008	-5.66***	-29.67	1989	3
C/S	-5.92***	1993	-5.72***	-30.38	1989	3
C/S/T	-7.42***	2007	-6.11***	-32.50	1989	3
Uganda						
C	-5.65***	1993	-5.76***	-31.09	1993	0
C/T	-6.43***	2007	-6.56***	-34.39	2007	0
C/S	-5.06**	1993	-5.15**	-28.09	1993	0
C/S/T	-6.78***	2006	-6.91***	-35.62	2006	0

Panel b: Asymptotic Critical Values

	Model C			Model C/T			Model C/S			Model C/S/T		
	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
ADF*	-5.13	-4.61	-4.34	-5.45	-4.99	-4.72	-5.47	-4.95	-4.68	-6.02	-5.50	-5.24
z_t^*	-5.13	-4.61	-4.34	-5.45	-4.99	-4.72	-5.47	-4.95	-4.68	-6.02	-5.50	-5.24
z_a^*	-50.07	-40.48	-36.19	-57.28	-47.96	-43.22	-57.17	-47.04	-41.85	-69.37	-58.58	-53.31

Notes: Gregory-Hansen (1996) test was performed using "ghansen", a STATA module available in the statistical software components archive. The lag length was selected using Akaike Information Criterion out of a maximum lag of 5. Break dates are selected automatically by the software. *, ** and *** denote rejection of the null hypothesis at 10%, 5% and 1% level respectively.

As shown in table 3, *SupF*, *AveF* and *ExpF* tests for structural breaks in the long-run relationship between government spending and revenue, reject the null hypothesis of time-invariant slope coefficient for all the countries at least for 5% level, although *AveF and ExpF* fail to reject the null hypothesis of no structural breaks, for Burundi and Kenya respectively. Nonetheless, the results imply that there are structural breaks which have occurred in the period of study to affect the relationship between government spending and government revenue for the EAC

countries. This finding supports our justification for the use of cointegration tests accounting for breaks in the relationship between government spending and government revenue.

As mentioned earlier, to test for cointegration between government spending and revenue, Gregory-Hansen (1996) test accounting for one endogenous break and Hatemi-J (2008) test accounting for two regime shifts are used. Gregory-Hansen (1996) cointegration tests results are reported in table 4 and Hatemi-J (2008) Cointegration tests results are in table 5.

Table 5. *Hatemi-J (2008) Cointegration test Results with two regime shifts (Model C/S)*

Panel a: Hatemi-J (2008) Cointegration test with two regime shifts				
Test statistic	**Test Value**	**Break Date 1**	**Break Date 2**	**Lag**
Burundi				
ADF*	-5.993*	1997	1999	0
z_t^*	-7.407**	1997	2004	
z_a^*	-36.415	1997	2004	
Kenya				
ADF*	-5.759*	1991	1991	1
z_t^*	-5.865*	1989	1989	
z_a^*	-31.478	1989	1989	
Rwanda				
ADF*	-8.600***	1993	1993	0
z_t^*	-8.972***	1993	1993	
z_a^*	-40.739	1993	1993	
Tanzania				
ADF*	-7.139***	1993	2004	3
z_t^*	-5.947*	1989	2004	
z_a^*	-31.126	1989	2004	
Uganda				
ADF*	-6.125**	1993	2004	0
z_t^*	-6.242**	1993	2004	
z_a^*	-33.085	1993	2004	
Panel b: Asymptotic Critical Values				
	1% CV	5% CV	10% CV	
ADF*	-6.503	-6.015	-5.653	
z_t^*	-6.503	-6.015	-5.653	
z_a^*	-90.794	-76.003	-52.232	

Notes: Hatemi-J (2008) test was performed using "CItest2b", a GAUSS module written by Hatemi-J (2009) available in the statistical software components archive. The lag length was selected using Akaike Information Criterion out of a maximum lag of 5. Break dates are selected automatically by the software. *, ** and *** denote rejection of the null hypothesis at 10%, 5% and 1% level respectively. Asymptotic critical vales are from Hatemi-J (2008).

Gregory-Hansen (1996) tests results indicate that ADF* and z_t^* tests reject the null hypothesis of no cointegration at 5% level for all the models (model with level shift, C, model with level shift and with trend, C/T, model with regime shift, C/S, and model with regime and trend shift, C/S/T) for Tanzania and Uganda, and at least at 10% level and for some models for Burundi, Kenya and Rwanda. However, z_a^* fails to reject the null hypothesis of no cointegration for all the countries and for all the models. Break dates for ADF* and for z_t^* and z_a^* were selected automatically by the software.

The results of Hatemi-J (2008) test for cointegration accounting for two regime shifts reported in table 5 suggest that ADF* and z_t^* tests reject the null hypothesis of no cointegration at least at 10% level for all the countries under study. As it was for Gregory-Hansen (1996) test, for Hatemi-J (2008), z_a^* test also fails to reject the null hypothesis of no cointegration for all the countries.

Nevertheless, both Gregory-Hansen (1996) and Hatemi-J (2008) cointegration tests accounting for regime shifts, give evidence that there is cointegration relationship between government spending and revenue for all the EAC countries of Burundi, Kenya, Rwanda, Tanzania and Uganda. The findings therefore confirm that fiscal deficits in the EAC Countries are sustainable. What remains to be found however, is whether the fiscal deficits are strongly or weakly sustainable.

Table 6. *The estimated long-run equilibrium relationship between government spending and revenue*

Country	α	β	$F[H0:\beta=1]$
Burundi	-2.91 (-1.23)	0.92*** (12.33)	151.9*** [0.000]
Kenya	5.33 (1.20)	0.62*** (3.40)	11.53*** [0.002]
Rwanda	-6.73 (-1.47)	1.16*** (5.48)	30.01*** [0.000]
Tanzania	3.66** (2.78)	0.64*** (9.80)	96.07*** [0.000]
Uganda	-2.07*** (-1.64)	0.94*** (13.78)	189.8*** [0.000]

Notes: The estimated long-run equilibrium equation is $R_t = \alpha + \beta G_t + u_t$, where R_t and G_t are the government revenue and spending respectively. $F[H0:\beta=1]$ is the Wald coefficient restriction test statistic. Between the parentheses (.) are the t-statistics and between the brackets [.] are the p-values. ** and *** indicate rejection of the null hypothesis respectively at 5% and 1% level of significance.

To check for the degree of fiscal sustainability, strong or weak, we estimate equation (6) by OLS and use the Wald coefficient restriction test to check whether the cointegrating coefficient β is statistically equal to 1, $(H0:\beta=1)$. The test results are shown in table 6. They indicate that Wald coefficient restriction test rejects the hypothesis that $\beta=1$ for all the EAC countries. The estimated cointegrating coefficient β is less than 1, that is,

$0 < \beta < 1$, for Burundi, Kenya, Tanzania and Uganda, implying that fiscal deficits in these countries are only weakly sustainable. Quintos (2005) has warned however that countries that are weakly sustainable, that is, for which $0 < \beta < 1$, are at high risk of default since they spend more than they earn.

However, for Rwanda, the estimated cointegrating coefficient was found to be greater than 1, which would mean that one dollar spent by the government of Rwanda yields more than one dollar of revenue. This suggests therefore that the intertemporal budget constraint is not violated for the case of Rwanda.

5. Conclusion

The objective of this paper was to test for fiscal sustainability in the EAC countries, namely, Burundi, Kenya, Rwanda, Tanzania and Uganda, by testing for cointegration between government spending and government revenue. Bai and Perron (2003) test indicated that the presence of regime shifts cannot be rejected whether in the series government spending and government revenue or in their long-run relationship in the countries under study. The presence of structural breaks in the series motivated us to use a unit root test accounting for breaks, Lanne et al. (2003) test. Unit root test results indicated that the series, government spending and government revenue, are non-stationary processes, integrated of order one for all the EAC countries. We then proceeded to test for cointegration between government spending and government revenue since they are both integrated of order one, that is, I (1). Moreover, since the presence of regime shifts could not be rejected in the relationship between government spending and government revenue, we decided to use cointegration tests accounting for breaks. Two cointegration tests accounting for regime shifts were used; Gregory-Hansen (1996) test accounting for one regime shift and Hatemi-J (2008) test accounting for two regime shifts. The results from both tests suggest that government spending and revenue are cointegrated for all the EAC countries. However, the cointegrating coefficient for Burundi, Kenya, Tanzania and Uganda was found to be less than 1, implying that fiscal deficits in those EAC countries are weakly sustainable in the long-run. For Rwanda, the findings suggested that the intertemporal budget constraint is not violated. The findings imply that for Burundi, Kenya, Tanzania and Uganda, fiscal sustainability needs to be reinforced otherwise they are at high risk of default since they spend more than they earn.

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