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An Empirical Assessment of Fiscal Sustainability in South Africa

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Abstract
The aim of this study was to empirically analyse whether the government maintained its public debt position on a sustainable path during the period 1990-2013. Following diagnostic evaluation of unit root and cointegration properties of the time series data, a fiscal reaction function was estimated to examine whether the government's fiscal policies were consistent with the intertemporal government budget constraint. A typical three-variable framework of the Vector Error Correction Model (VECM) was used in E-views. The computed results confirm that the government maintained a sustainable fiscal policy during the period under review by adjusting the primary deficit or surplus in response to variations in its debt positions.
Keywords: Fiscal sustainability, public debt, primary balance, intertemporal budget constraint

1.Introduction

Fiscal policy remains an integral instrument achieving broad economic objectives across the globe. The modus in which a government responds to its debt positions affects the stability of the economy; which further translates into public debt trends. With protracted surges in government expenditure positions in most emerging economies, fiscal sustainability analysis remains very important to ensure macroeconomic stability (Budina & van Wijnbergen, 2007). Following Giammarioli et al., (2007), several methods can be used to assess fiscal sustainability. According Stoica & Leonte (2011), the broadly applied method involves examining if the government behaves in line with the present value borrowing constraint (PVBC). Therefore, a government is deemed fiscally sustainable if the present value of future revenues flows exceeds the value of outstanding (Schick, 2005).

In attempts to influence the direction of the economy through manipulation of taxes and spending, fiscal authorities face three possible fiscal policy stances; neutrality, expansionary and contractionary positions (Abdulla, Mustafa & Dahalan, 2012). A fiscal stance improves sustainability only if it fulfills the government's intertemporal budget constraint. The choice of fiscal policy stance reflects the modus in which the government adjusts its debt levels. According to De Mello (2005), the intertemporal budget constraint (IBC) requires that a government should respond to increases in public debt by making appropriate adjustments of primary balance. Bohn (2007) stresses that such an adjustment process characterizes an error correction mechanism whereby the increase in debt-to-GDP ratio should be responded to by improving the primary balance to capture or reverse the increase in debt-to-GDP ratio.

The objective of this paper was to analyse how the South African government reacted to its debt position during the period 1990-2013. The paper is organised as follows: Section 2 reviews literature and provides a theoretical framework on fiscal sustainability. Section 3 specifies the econometric methodology and estimation method. Section 4 presents, analyses and interprets the empirical findings; while Section 5 provides conclusion and recommendations.

2. Literature Review and Theoretical Framework

Although numerous studies on fiscal sustainability primarily focused on industrial economies (Buiter, 1985 and Blanchard, 1990); recently studies have shifted the focus towards emerging market economies. Some studies that have concentrated on emerging economies include Chalk & Hemming (2000), Mendoza (2003) and Izquierdo & Panizza (2003). Theoretically, fiscal sustainability is defined from either static or inter-temporal budget constraints dimensions (Abdulla, Mustafa & Dahalan, 2012). The static budget constraint is satisfied only if the public sector is able to finance its current expenditure with its revenue and new borrowing, and meet its maturing liabilities. Similarly, the inter-temporal budget constraint is formulated based on the solvency criteria; which require that the present discounted value of future primary budget balances should at least be equal to the value of the outstanding stock of debt (Akyiiz, 2007). On contrary, Akyiiz (2007) criticizes the analysis of sustainability based on solvency concept; indicating that the concept does not impose specific constraints on debt at particular points in time. Schick (2005) further elaborates that applying the solvency condition is difficult due to lack of comprehensive balance sheets that capture all assets and liabilities.

In light of the nexus between solvency and stability (Schick, 2005); numerous methods have been applied by previous studies to assess fiscal sustainability. For example, Abdulla, Mustafa & Dahalan (2012) used the VAR approach; while Goyal, Khundrakpam & Ray (2004) used the cointegration methodology. Furthermore, Lusinyan & Thornton (2009) used unit root and cointegration test techniques to real revenue and spending data;

and Tshiswaka-Kashalala (2006) used the econometric approach to analyse fiscal policy sustainability. Telatar, Bolatoglu & Telatar (2004) applied Bohn's (1998) within the framework of Bayesian Gibbs sampling simulation to observe periodic changes in Turkish government fiscal behaviour. Oyekele & Ajilore (2014) employed an error correction approach; and Deyshappriya (2012) used the multiple OLS regression technique to analyze whether or not governments had violated the intertemporal budget constraints. According to Cunddington (1996), fiscal sustainability analysis; whether based on either the basic accounting framework or present value constraint (PVC) approach, begins with analyzing the intertemporal budget constraint (IBC) of the government specified in baseline nominal terms as:

$$B_t = (1+i)B_{t-1} + M_{t-1} - M_t + G_t - Z_t \qquad \text{-----------------------} (1)$$

where B_{t-1} denotes the stock of public debt at end of period t-1; M_{t-1} symbolizes the monetary base at the end of period t-1; G_t represents government spending during period t; Z_t denotes total revenues during period t; and i represents the (constant) interest rate between period t-1 and t. To derive a true indicator of fiscal sustainability, the government IBC is computed for period t+1; solve for b_t and substitute the resulting expression into $\tilde{b}_t$ to obtain $\tilde{b}_{t-1}$ as a function of t+1; period t variables and the initial debt stock b_{t-1}. Repeating the procedure yields:

$$\left(\frac{1+\theta}{1+r}\right)^n \tilde{b}_{t+n} = \left(\frac{1+r}{1+\theta}\right)\tilde{b}_{t-1} + \sum_{s=0}^{n}\left(\frac{1+\theta}{1+r}\right)^s \left(\tilde{d}_{t+s} - z\tilde{m}_{t+1}\right) \qquad \text{-------------------------} (2)$$

For large samples, the intertemporal solvency requires that:

$$\lim_{n\to\infty}\left(\frac{1+\theta}{1+r}\right)^n \tilde{b}_{t+n} = 0 \qquad \text{------------------------} (3)$$

To further derive an indicator that makes the definition of a sustainable fiscal path operational; the permanent primary deficit $(\tilde{d}_t^*)$ is defined as the fixed level of primary deficit whose present discounted value at period t equals the present discounted value of actual primary deficits:

$$\sum_{s=0}^{\infty}\left(\frac{1+\theta}{1+r}\right)^s \tilde{d}_t^* = \sum_{s=0}^{\infty}\left(\frac{1+\theta}{1+r}\right)^s \tilde{d}_{t+s} \qquad \text{---------------------} (4)$$

Hence; $$\tilde{d}_t^* = \frac{r-\theta}{1+r}\sum_{s=0}^{\infty}\left(\frac{1+\theta}{1+r}\right)^{s+1}\tilde{d}_{t+s} \qquad \text{----------------------} (5)$$

Combining equations (4) and (5) yields:

$$-\tilde{d}_t^* = \left(\frac{r-\theta}{1+\theta}\right) = \left(\frac{r-\theta}{1+\theta}\right)\tilde{b}_{t-1} \qquad \text{----------------------} (6)$$

Equation (6) indicates that if fiscal policy is sustainable, the permanent primary surplus ($-\tilde{d}_t^*$) must equal the effective real interest payments on initial stock of government debt. Resultantly, the true indicator of fiscal sustainability (φ_t^*) can be formulated as:

$$\varphi_t^* \equiv \left(\frac{r-\theta}{1+\theta}\right)\tilde{b}_{t-1} + \tilde{d}_t^* \qquad \text{----------------------} (7)$$

Fiscal policy in current time period t is deemed sustainable only if $\varphi_t^* = 0$. When $\varphi_t^* > 0$, the planned path of ($\tilde{g}_t$, $\tilde{z}_t$) violates the government intertemporal budget constraint. Conversely, if $\varphi_t^* < 0$, the planned path of ($\tilde{g}_t$, $\tilde{z}_t$) does not violate the government intertemporal budget constraint; hence the fiscal policy is deemed sustainable.

3. Methodology and Estimation Procedure

3.1 Data

Time series quarterly data on primary balance-to-GDP ratio and debt-to-GDP ratio for the period 1990-2013 was used. The output gap variable was computed as the percentage difference between actual GDP and potential GDP; upon which data on potential GDP was generated using the Hodrick-Prescott filter using E-views prior to econometric estimation of results.

3.2 Stationarity Tests

The ADF approach was used to perform unit root tests of variables in levels and first difference, with both intercept and trend. The tests were undertaken to examine whether the difference between non-stationary series becomes stationary when the same variables move together in the long run, even though they may drift apart in the short run. The ADF tests were applied on the rationale that they perform satisfactorily even for small samples. The tests were performed following the equation:

$$\Delta y_i = \beta_1 + \delta y_{i-1} + \sum_{j=1}^{p-1} a_j \, \Delta y_{i-j} + u_i \qquad \text{------------------------------- (8)}$$

where: u_i represents a pure white noise error term, $\Delta y_{i-j} = y_{i-1} - y_{i-2}$ and p denotes the class of autoregression; the null hypothesis being $\delta = 0$. The ADF tests with trend variable were performed based on the regression below:

$$\Delta y_i = \beta_1 + \beta_2 t + \delta y_{i-1} + \sum_{j=1}^{p-1} a_j \, \Delta y_{i-j} + u_i \qquad \text{------------------------ (9)}$$

where: t represents the time or trend variable; with the null hypothesis being $\delta = 0$.

3.3 Cointegration Tests

Following analysis of the order of integration, the study proceeded further to test for the presence of cointegration among variables using the Johansen (1988) maximum likelihood cointegration approach. The maximum eigenvalue (λ_{max}) method was applied to detect existence of cointegrating vectors based on the premise that the technique is more reliable in small samples (Hamilton, 1994).

$$\lambda_{max} = -T \log\left(1 - \lambda_{r+1}\right) \qquad \text{------------------------- (10);}$$

Where: the null hypothesis r ≤ g cointegrating vectors, with (g = 0, 1, 2, 3, ---) is tested against the alternative hypothesis r = g + 1.

3.4 Estimation Procedure

The Vector Error Correction Model (VECM) was used to test for sustainability of fiscal policy in South Africa during the period 1990:1-2013:4. Denoting primary balance-to-GDP ratio, debt-to-GDP ratio and output gap by (B/Y), (D/Y) and Y_gap; respectively, the behaviour of government was analysed using a fiscal reaction function estimated following integration of a system of some equations:

$$B/Y = \alpha + D/Y_{t-1} + \varepsilon_t \qquad \text{--------------------------- (11)}$$

In consideration of the existence of government inertia in fiscal policy reaction, a lag of the B/Y ratio was added to equation (11) above. In taking consideration of the government's effort to pursue short-run demand stabilisation (De Mello, 2005), output gap was added to the equation as an exogenous variable; yielding the fiscal reaction function as:

$$B/Y_t = \beta_1 + \beta_2 B/Y_{t-1} + \beta_3 D/Y_{t-1} + \beta_4 Y\_Gap_t + \varepsilon_t \qquad \text{-------------------------- (12)}$$

Given the nature of the Vector Error Correction (VEC) model, estimation was undertaken as a model containing two equations; (11) and (12).

$$\Delta(B/Y)_t = \alpha_{11} + \pi_{12}\left[(B/Y)_{t-1} - \theta_{12}(Y/D)_{t-1} - \theta_{13}\right] + \varphi_{11}\Delta(B/Y)_{t-1} + \varphi_{12}\Delta(D/Y)_{t-1} + \phi_4(Y\_Gap)_t + \varepsilon_{11t} \text{ --(13)}$$

$$\Delta(D/Y)_t = \alpha_{21} + \pi_{13}\left[(B/Y)_{t-1} - \theta_{12}(D/Y)_{t-1} - \theta_{13}\right] + \varphi_{21}\Delta(B/Y)_{t-1} + \varphi_{22}\Delta(D/Y)_{t-1} + \phi_4(Y\_Gap)_t + \varepsilon_{21t} \text{ -(14)}$$

where: $(B/Y)_{t-1} - \theta_{12}(D/Y)_{t-1} - \theta_{13}$ in (13) and (14) denotes the deviation from long run relationship given by the formulation:

$$(B/Y)_{t-1} = \theta_{12}(D/Y)_{t-1} + \theta_{13} \quad \text{--------------------- (15)}$$

The output gap was included in the short-run dynamics of equations (14) and (15) to capture the probability of fiscal policy reaction to business cycles. The parameter π_{12} represents the error correction term, which captures the fiscal reaction to the D/Y. Thus, the error correction term captures the response of primary balance-to-GDP ratio to deviations from the long-run equilibrium path captured in equation (15). The VECM approach estimated the fiscal reaction function as a model containing equations (13) and (14); yielding:

$$\Delta V_t = \varpi V_{t-1} + \sum_{t=i}^{k} \xi_i \, \Delta V_{t-i} + \sum_{t=j}^{n} \Phi_j \, Z_{t-j} + c_t + \varepsilon_{kt} \quad \text{------------------------ (16)}$$

where: V_t represents a 3x1 vector containing I(1) endogenous variables (primary balance-to-GDP ratio, D/Y ratio and a constant); Z_t represents a 1x1 vector containing an I(0) exogenous variable (output gap); ξ_i denotes 2x2 coefficient matrices; Φ_j represents a 2x1 vector containing coefficients of the exogenous variable; c_t is a vector containing constants and ε_{kt} denotes IDD error terms. The parameter ϖ was decomposed into τ and $\vartheta^{/}$ matrices:

$$\varpi V_{t-1} = \tau \vartheta^{/} V_{t-1} = \begin{bmatrix} \tau_{11} \\ \tau_{12} \end{bmatrix} \begin{bmatrix} 1 & -\vartheta_{12} & -\vartheta_{13} \end{bmatrix} \begin{bmatrix} B/Y_{t-1} \\ D/Y_{t-1} \\ 1 \end{bmatrix} \quad \text{-------------------------- (17)}$$

where: τ denotes a 2x1 matrix of 2 variables and 1 cointegrating relationship that contains the long-run equilibrium adjustment parameter; and $\vartheta^{/}$ represents a 1x3 matrix containing long run parameters, including a constant.

4. Results and Discussion

This section provides results which provide evidence on how the government historically reacted to its debt position, and determine whether or not the government's reaction enhanced fiscal policy sustainability. Unit root and cointegration tests were performed prior to estimation of the fiscal reaction function.

Table 1: Unit Root Test Results for B/Y ratio and D/Y ratio

Data Series	With Intercept and Trend	
	Level	First Difference
B/Y ratio	-6.89***	-17.26***
D/Y ratio	-1.74	-6.41**

***;**; * denote significance at 1 percent, 5 percent and 10 percent levels; respectively.

The ADF unit root tests were performed at both level and first difference; upon which the optimal lag selection was based on the Akaike Information Criterion. The integration properties of the variables were investigated in order to avoid the problem of spurious regression. The results indicate that B/Y ratio is an I(0) variable at 1 percent level, while the D/Y ratio is an I(1) variable at 5 percent level. The stationarity test results for the debt-to-GDP ratio suggest that the behaviour of the respective variable may be close to a random walk. The cointegrating relationship between variables was tested using Johansen eigenvalues and L.R. statistics.

Table 2: Johansen Cointegration Test for Linear Deterministic Trend – Lag Interval: 1 to 1

Eigenvalue and L.R. Test Statistics		
H_0 H_1	r = 0 r = 1	r ≤ 1 r = 2
Eigenvalue L.R. statistic	0.206212 24.73745**	0.025059 2.562173
*(**) denotes rejection of the null hypothesis at 5% (1%) significance level		
Critical Values		
1% Sig. level 5% Sig. level	21.04 16.41	6.75 3.79

The eigenvalue and the likelihood ratio (LR) test statistics confirm existence of one cointegrating relationship at 1 percent level of significance. Given the presence of cointegrating equations, the estimates of the fiscal reaction function were computed based on the VEC model.

Table 3: Vector Error Correction Model Results

Cointegrating Equation:		
log(B/Y ratio (-1))	1	
log(D/Y ratio (-1))	-0.237916	
	(-2.31988)	
Constant	7.676438	
Error Correction Equation:	dlog(B/Y ratio)	dlog(D/Y ratio)
Cointegrating Equation	-0.585644	0.021028
	(-4.73821)	(0.80036)
dlog(B/Y ratio (-1))	-0.283413	-0.023708
	(-2.86525)	(-1.16606)
dlog(D/Y ratio (-1))	-0.745779	0.353195
	(-1.45050)	(3.34201)
Constant	-0.036159	0.082772
	(-0.06460)	(0.71937)
Y_Gap	0.362281	-0.164161
	(0.95940)	(-2.11499)
Adj. R-squared	0.437722	0.170036
Sum sq. resids	2534.446	107.0804
S.E. equation	5.366612	1.103097
F-statistic	18.90504	5.712041

The results on the long run component of the cointegrating equation indicate that for every 1 percent increase in the D/Y ratio, the B/Y ratio increases by nearly 0.24 percent. The minus sign in front of the parameter of long run component of the cointegrating equation depicts a positive relationship between the variable to which the parameter relates and the variable on which the vector is normalized. Furthermore, the results for the B/Y ratio equation reveal that marginally above half of the deviation from the long run equilibrium is corrected in the first quarter after the deviation occurred. This is confirmed by the estimated fiscal response to deviations from the long-run equilibrium path equal to -0.59.

Though statistically insignificant, the positive coefficient of the Y_Gap in the short run dynamics of the B/Y ratio designates countercyclical behaviour by the government. Conversely, the output gap coefficient in the short run dynamics of the D/Y ratio suggests presence of differentiated countercyclical fiscal policy. This implies that a negative Y_Gap increases the adjustment in D/Y ratio; while a positive output gap lowers the adjustment. Consistent with findings from previous similar studies by Tshiswaka-Kashalala (2006), Lusinyan & Thornton (2009), Burger, Stuart, Jooste & Cuevas (2011) and Calitz, Du Plessis & Siebrits (2013), results from this study indicate that the government's fiscal policy was sustainable during 1990-2013.

5. Conclusion and Recommendations

5.1 Conclusion

The objective of this study was to examine how the South African government reacted to its debt position within the context of the government intertemporal budget constraint. Using quarterly time series data on B/Y ratio and D/Y ratio, the sample period for the study spanned from 1990 to 2013. Prior to empirical investigation of the sustainability position of the country's fiscal path, stationarity and cointegration properties of time series data were investigated based on the ADF and Johansen cointegration procedures; respectively. Given the evidence of both stationarity and cointegration between variables, the government's reaction to its historical debt positions was analysed using the Vector Error Correction model. The computed results indicated that fiscal policies remained sustainable during the sample period, hence the government behaved in a fiscally sustainable manner.

5.2 Recommendations

Fiscal policy remains an effective tool for achieving growth and employment; and reducing poverty and income distribution inequalities. This enhances macroeconomic performance in the economy. Given the continuous rising unemployment, poverty and income distribution inequalities in the economy, the country's fiscal policy needs to be formulated and implemented in such a way that it eloquently promotes inclusive growth and equitable income distribution. From the domestic economy viewpoint, the government total debt in relation to the domestic bond market remains high. Rising public D/Y ratios entail the risk of increasing pressure on sovereign financing capacity, creditworthiness and country ratings. In that respect, fiscal consolidation is required in the future coming years to put public debt on a declining path and keep the path stable in both the medium term and long run periods.

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