Botswana's Debt Sustainability: Tracking the Path

1. Introduction

In terms of basic macroeconomic indicators, Botswana is, on the whole, in an enviable position relative to many African countries. The recent economic crisis notwithstanding, its growth rate has been more than average and its Balance of Payments position (as reflected in its foreign exchange reserves) has been impressive. Further, its exchange rate has been relatively stable compared to many middle and low income countries. Some of the weak points of the economy in recent years have been: (a) high inflation, even though it declined to a single digit in the last year (from 15% to about 7%); (b) relatively high unemployment for a fast growing economy (about 20%, according to the 2007 Informal Sector Survey); (c) stable financial sector, but with a wide spread between deposit and lending interest rates; and (d) lack of diversification, a heavy reliance on a few mineral products.

As was the case in many countries, the Botswana economy was hit hard by the global recession at the end of 2008 in which the demand for its minerals was drastically reduced (according to some estimates as much as 50%). And since mineral revenue significantly contributes (about 40% to 50%) to total government revenue, this has put a constraint on the revised government budget as reflected in the 2008/09 and 2009/10 Government Budgets). Consequently, in addition to relying on its substantial foreign exchange reserves, the government requested a loan from the African Development Bank to carry out its planned projects and to support the overall budget. The Bank recently granted a US $ 1.5 billion (or at current exchange rates, about P 10.5 billion) loan to Botswana, even though not the whole amount has been drawn down.

The fiscal policy question of interest is then, given that Botswana has a very small previously accumulated debt, one of the highest global credit ratings, and substantial foreign exchange reserves (usually around 20 months of imports) to rely on, should the recently acquired loan be of any serious fiscal concern? If so, how much? It received some attention in some quarters (in the popular media, for instance) and to some extent by the general public. The objective of this small note is, therefore, to examine the sustainability of the existing debt using two standard approaches in the literature and to track its likely immediate future path. The remainder of this note is organized as follows. Following this brief introduction, the Second sub-section will examine debt sustainability using a standard econometric technique of analysis; this will be followed by an elaborate framework to calculate the primary government budget balance (surplus or deficit) that is compatible with a sustainable debt in

[1]**Even though the budget was initially drafted around September 2008 just before the crisis started, a revised version of the budget tried to make some adjustments to reflect the impeding crisis.**

a dynamic setting in the Third sub-sections. And, finally, the Fourth sub-section presents a brief summary and conclusions.

2. Econometric Approach

The recent econometric literature for testing the sustainability of debt proceeded along two lines: one focusing on the flow and the other on the stock components of debt. The first approach (for instance used by Hamilton and Flavin (1986), Kreamers (1988), Wilcox (1989), Haug (1991) and Crosetti and Roubini (1991)), focused on testing whether the discounted value of the debt converges to zero in some future date or not. This has been examined using a unit root test to see whether the discounted debt stock is stationary or not whereby stationarity of the series is interpreted as indication of sustainability.

On the other hand, some authors focused on the proposition that for the stock of debt to converge to zero, the flow or the budget balance must on average be zero. This suggests that the necessary and sufficient condition for debt sustainability is for government revenue and expenditures to be co-integrated. Focusing on the latter approach, as Trehan and Walsh (1988, 1991), Hakkio and Rush (1991), and Arghyrou (2003) showed, the typical model specified in such analyses takes the following form.

$$\mathbf{Rt = \alpha + \gamma G\, t + ut} \qquad \mathbf{(1)}$$

Where R and G are real government revenue and expenditures, respectively; α, γ are coefficients and u is a white-noise error term.

In principle, equation (1) could be estimated in many ways. But Arghyrou (2003) favors using Dynamic OLS (DOLS). He argues that DOLS "is asymptotically equivalent to Johansen's (1988) maximum-likelihood estimator and is known to have a superior performance in small samples (p. 6)". The main advantage of the Stock and Watson (1993) or what is known as the DOLS model is that because of the lags and leads that are included, it captures any feedback the independent variables might have on the dependent variable and hence ensures consistency of estimates. Accordingly, the usual equation estimated including in this study takes the following form.

$$\mathbf{Rt = \alpha + \gamma G\, t + \sum_{i=k}^{K} \gamma i\, \Delta Gt\text{-}i + u\, t} \qquad \mathbf{(2)}$$

A test for the existence of co-integration (or lack thereof) between Rt and Gt indicates whether a given debt is sustainable or not. That is, if the two flow variables are co-integrated, a debt is said to be sustainable. Alternatively, once it is established that the variables are co-integrated, sustainability could be further tested using an Error-Correction formulation and checking the sign and significance of the error correcting term (Φ).

$$\Delta R_t = \delta + \sum_{t=1}^{m} \Psi_i \Delta R_{t-n} + \sum_{n=1}^{j} \gamma_i \Delta G_{t-n} + \eta \Phi_{t-1} + v_t \qquad (3)$$

Where Φ is the error-correcting term, δ, Ψ, γ, and η are respective coefficients, and Δ is first difference operator.

Hence, if η in (3) is significant it suggests that the debt in question is sustainable otherwise it indicates lack of equilibrium and, therefore, unsustainability of debt.

Accordingly, the following tests and estimations were carried out. First, Stationarity of government revenue, R, and expenditure, g, and their co-integration was tested using equation (1) above as reported in Appendix A. Second, the relationship between government revenue and expenditure was estimated using a Dynamic OLS (DOLS) using equation (2) which is reported in Appendix B. And finally, as an alternative, an Error correction model is estimated using equation (3) as reported in Appendix C. Botswana data from 1974/75 to 2008/2009, after adjusting for inflation and specifying in logs, was used to carry out the estimations.

As could be seen from the appendix, the co-integration tests and estimations results from the dynamic OLS and error correction models clearly suggest that the Botswana debt is sustainable. In particular, the relationship between G and R is robust and are co-integrated and the error-correction term is both significant and of the right sign indicating the sustainability of the Botswana debt

2. Debt Sustainability and the Fiscal Policy Path

While the above econometrics method has been widely used in the literature to assess the sustainability of debt, it does not track the dynamic path of the debt over time. It also fails to examine the impact of other crucial magnitudes (domestic debt, the monetary sector and inflation) in gauging the trajectories of debt sustainability. To remedy that, authors, such as Edwards (2002) and others, suggested the following relationship between public debt and the fiscal balance:

$$\Delta D_t = \{r^* \times DF_{t-1} + r \times DD_{t-1}\} + pb_t - \Delta B_t \qquad (4)$$

Where: ΔDt = changes in accumulated debt;
$DFt\text{-}1$ = accumulated foreign debt;
$DDt\text{-}1$ = accumulated domestic debt;
Pbt =primary government balance
ΔBt = Changes in monetary base used as a proxy for seignorage revenue;
And r^*, r are nominal interest rates on foreign and domestic debt, respectively.

The variable of interest in (4) is the government primary balance (Pbt) which is, the primary balance that is consistent with a sustainable debt burden. It is conventional to assume that international flow of credit (θ) will have an upper limit equal to or less than the growth of real GDP (g) and foreign inflation (π^*), and domestic credit (β) will increase by a similar magnitude. Both are, therefore, defined as follows:

$$\theta \leq (g + \pi^*) \text{ ; and } \beta \leq (g + \pi^*). \quad (5)$$

Given the above basic relationships, the dynamic path of the sustainable primary government balance could be written as:

$$\{Pbt/Yt) = [\{\theta - r^*\}(DF0/Y0)e^{(\theta-g-\pi^*)(t-1)} + \{\beta\text{-}rt\}(DD0/Y0)\, e^{(\beta-g-\pi^*)(t-1)}][1/(1+g+\pi^*)] - (g+\pi)(B0/Y0). \quad (6)$$

Similarly, the steady-state sustainable primary balance could be written as follows:

$$\{pb/Y) = \{g+\pi^* - r\}(DD0/Y0)[1/(1+g+\pi^*)] + (g+\pi)(Bt0/Y0) \quad (7)$$

Where: DF0/Y0 is the initial ratio of the face value of foreign debt to GDP
DD0/Y0 is the initial domestic debt to GDP ratio
π is the target rate of domestic inflation
B0/Y0 is the initial ratio of base money to GDP
t0 is time subscript.

Clearly, the sustainable primary balance that is consistent with a sustainable debt is determined by both initial ratios of domestic and foreign debts to GDP, nominal domestic and foreign interest rates, domestic and foreign inflation rates, the rate of growth of real GDP, and the sustainable increases in both foreign and domestic debt (θ and β).

Given the above basic relationship between government primary balance and debt outstanding, it is possible to develop various scenarios regarding the likely behavior of the determinants of debt sustainability. Among others, just to name a few, it is possible to consider different international credit flows, variations in GDP growth rates, changes in both foreign and domestic interest rates and inflation rates, and changes in the domestic exchange rate which may affect the domestic inflation rate if there is a substantial pass through to the domestic economy.

As a first step, this note is limited to considering the impact of different economic growth scenarios consistent with Botswana's economic position. It further assumes that international credit flows continue to be available at the rate of $\theta=\varrho g+ \pi^*$, where $0 \leq \varrho \leq 1$. It is unlikely that Botswana will need such a flow of credit, at least not in the immediate future once the recession is over, but it will strengthen the argument that the fiscal balance required to maintain a sustainable debt is not that constraining for Botswana, even if we assume the flow of credit will continue at such a rate.

Table 1: Summary of parameters and values used for simulation

Variable	Value	Explanations
Pb_t/Y_t	…	Primary balance to GDP ratio (to be computed).
θ	…	Values vary depending on assumptions.
r^*	0.03	The approximate interest rate for concessional loans
DF_0/Y_0	0.117	Ratio of foreign public debt to GDP (based on IMF Article IV 2009)
g		Different growth rates (ranging from -6 to 10%)
π^*	0.025	Since most debt is denominated in US$ and inflation in the US averaged around 2.5% in recent years.
β	$g+\pi^*$	Assumed a constant - domestic debt grows at this rate.
r_t	0.10	Recent BOB certificate implicit rate
DD_0/Y_0	0.15	The domestic debt is about 15% of GDP.
π	0.07	The most recent inflation rate (note that: some use the dollar denominated inflation target which will be less).
B_0 / Y_0	0.015	Recent ratio of base money to GDP.

Further, the evolution of Botswana's debt burden under different economic growth scenarios is examined to evaluate the speed with which it converges to a steady state.

The most recent Botswana data used to calculate the parameter values are summarized in table 1. Using these parameters and relevant assumptions , the computed sustainable path under different economic growth scenarios is presented in Table 2 (note that ϱ is given the value of 0.5 in this exercise). It has to be noted that even though the debt data used are based on IMF's 2009 Article IV for foreign debt and Bank of Botswana for domestic debt, they may slightly vary in different sources. Therefore, the result may marginally vary despite the economic fundamentals stated at the introduction (sizable reserves, excellent credit rating, recently decreased inflation rate, and generally prudent fiscal stance).

[3] **The variations introduced in this note are GDP growth rates while all the other parameters (inflation, exchange rates, interest rates etc) are left unchanged. Ideally, the model should be calibrated by using variations in these parameters for both sensitivity analysis purposes and to account for possible changes in the parameters. But due to time limitations, the current values of the parameters are assumed constant in the analysis except the growth rate.**

Using the above assumptions and the parameter values, the results show that even after the recent significant increase in foreign debt, fiscal sustainability does not seem to be of serious concern for Botswana even under extremely pessimistic economic growth scenarios compared to similar economies. For instance, under the initially forecast worst case economic growth performance of 2009 (-6%), the primary fiscal balance required to maintain a sustainable debt is a surplus of less than 2% at steady state. In other economic growth scenarios, the required primary balance to ensure sustainability is a very small percentage of GDP. For instance, even in the continuous growth scenario of only 2% per annum, the required budget balance to sustain the debt is a surplus of less than one percent of GDP.

Table 2: Debt Sustainability (under different Growth Scenarios)

Year	2%	3%	4%	5%	6%	7%	10%	-6%
2009	-0.91%	-0.73%	-0.52%	-0.30%	-0.09%	0.12%	0.77%	-2.85%
2010	-0.91%	-0.73%	-0.51%	-0.29%	-0.07%	0.14%	0.82%	-2.90%
2011	-0.91%	-0.73%	-0.50%	-0.28%	-0.05%	0.17%	0.87%	-2.95%
2012	-0.91%	-0.72%	-0.49%	-0.26%	-0.03%	0.20%	0.93%	-3.00%
2013	-0.90%	-0.72%	-0.49%	-0.25%	-0.01%	0.22%	0.99%	-3.05%
2014	-0.90%	-0.72%	-0.48%	-0.24%	0.01%	0.25%	1.05%	-3.11%
2015	-0.90%	-0.71%	-0.47%	-0.22%	0.03%	0.28%	1.12%	-3.17%
2016	-0.90%	-0.71%	-0.46%	-0.21%	0.05%	0.31%	1.18%	-3.23%
2017	-0.89%	-0.70%	-0.45%	-0.20%	0.07%	0.34%	1.25%	-3.29%
2018	-0.89%	-0.70%	-0.45%	-0.18%	0.09%	0.37%	1.32%	-3.35%
2019	-0.89%	-0.70%	-0.45%	-0.18%	0.09%	0.37%	1.32%	-3.35%
2020	-0.89%	-0.70%	-0.45%	-0.18%	0.09%	0.37%	1.32%	-3.35%
Steady-State	-0.76%	-0.63%	-0.49%	-0.36%	-0.24%	-0.11%	0.26%	-1.92%

[2] **Edwards (2002) defined debt sustainability as "a situation where increases in each type of debt are in line with the pace at which national and international creditors desire to accumulate government-issued securities".**

Another related issue of interest is the evolution of the debt over time under different economic growth rates. As is evident from Table 3, the yearly decline in the ratio of debt to GDP is very gradual, but still manageable under reasonable growth prospects. As indicated in Table 3, even if the debt accumulates at the rate of θ (= $g+\pi^*$) every year, the ratio of debt to GDP will decline to about 50% of the initial value as long as GDP growth rate exceeds 4% per annum. For instance, if we take the more realistic growth rate (at least in historical terms) of 5% to 6%, it takes about ten years to bring the ratio of debt to GDP to about 50% of its initial value. On the other hand, in the worst case growth rate of 2009 (-6%), the accumulated debt would only grow to about 17% of GDP in ten years (despite a continuous accumulation of debt at the above stated rate every year).

Table 3: Evolution of Debt under Different Growth Scenarios

Year	2%	3%	4%	5%	6%	7%	10%	-6%
2009	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
2110	11.19	11.07	10.96	10.85	10.75	10.64	10.33	12.12
2011	10.69	10.48	10.27	10.07	9.87	9.68	9.11	12.55
2012	10.22	9.92	9.63	9.34	9.07	8.80	8.04	13.00
2013	9.77	9.39	9.02	8.67	8.33	8.00	7.10	13.46
1014	9.34	8.89	8.45	8.04	7.65	7.28	6.26	13.94
2016	8.93	8.41	7.92	7.46	7.03	6.62	5.53	14.43
2017	8.54	7.96	7.42	6.92	6.45	6.02	4.88	14.95
2018	8.16	7.54	6.96	6.42	5.93	5.47	4.30	15.48
2019	7.80	7.13	6.52	5.96	5.44	4.98	3.80	16.03
2020	7.46	6.75	6.11	5.53	5.00	4.52	3.35	16.60

3. Conclusions

The motivation of this note was to shed light on the extent to which one should worry about the sustainability of the existing annual deficit and accumulated debt in Botswana. Accordingly, it attempted to examine the sustainability of the debt using two conventional approaches. The first approach used an econometrics technique to test for the co-integration of the government revenue and expenditures and thereby establish debt sustainability. This was further tested using recent econometric techniques to examine the convergence of the debt to a sustainable level. And the second approach attempted to trace the dynamic path of fiscal deficits and debt under various growth scenarios.

In sum, both approaches seem to suggest the same conclusion regarding the sustainability of the recently accumulated debt in Botswana despite the hype that it received in recent years. Therefore, according to the above examined econometrics test and computed figures, debt should not be among the issues that Botswana should be seriously concerned about in the short to medium term (i.e., as long as the economy recovers to its normal level). Even in the worst case scenario (as witnessed by the last recession), the fiscal effort required to bring the debt to a sustainable level is not that high (a cumulative fiscal surplus of about 3% of GDP over the next ten years), and the debt is unlikely to double itself in ten years provided all the parameter assumptions hold.

Before concluding, it is important to highlight some less emphasized issues in this paper. These include: First, the study did not carry out some sensitivity analysis by varying some of the parameters it used (exchange rate, interest rate, various debt flows etc). Instead it only focused on various GDP growth scenarios; second, different sources (publications) report various figures in relation to the used basic national data such as debt to GDP ratio, government deficits, monetary base, for instance. No attempt was made to examine the sensitivity of the results for any possible variation(s) in the figures of the basic data. And, finally, making a serious effort to net out the various components of government assets and liabilities in computing government's actual net indebtedness was considered beyond the scope of this brief note. Hence the macro aggregate of gross debt, as is usually the case, was taken as the true measure of public debt.

4. References

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Appendix A. Stationarity and Co-integration Tests

1. Government Expenditure: G

R ADF Test Statistic	-5.832909	1% Critical Value*	-3.6496
		5% Critical Value	-2.9558
		10% Critical Value	-2.6164

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(G,2)
Method: Least Squares
Date: 01/20/11 Time: 10:05
Sample(adjusted): 1979 2010
Included observations: 32 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(G(-1))	-1.106142	0.189638	-5.832909	0.0000
D(G(-1),2)	0.693682	0.164781	4.209719	0.0002
C	442.5690	205.2803	2.155925	0.0395

R-squared	0.547748	Mean dependent var	-94.05832
Adjusted R-squared	0.516559	S.D. dependent var	1492.509
S.E. of regression	1037.741	Akaike info criterion	16.81654
Sum squared resid	31230256	Schwarz criterion	16.95395
Log likelihood	-266.0646	F-statistic	17.56180
Durbin-Watson stat	2.217538	Prob(F-statistic)	0.000010

2. Government Revenue: R

ADF Test Statistic	-4.941632	1% Critical Value*	-3.6496

*MacKinnon critical values for rejection of hypothesis of a unit root.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(R,2)
Method: Least Squares
Date: 01/20/11 Time: 10:07
Sample(adjusted): 1979 2010
Included observations: 32 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(R(-1))	-1.392544	0.281798	-4.941632	0.0000
D(R(-1),2)	0.485529	0.208581	2.327769	0.0271
C	431.6231	223.9493	1.927325	0.0638

R-squared	0.509645	Mean dependent var	-53.22916
Adjusted R-squared	0.475828	S.D. dependent var	1546.357
S.E. of regression	1119.559	Akaike info criterion	16.96832
Sum squared resid	36348935	Schwarz criterion	17.10573
Log likelihood	-268.4931	F-statistic	15.07044
Durbin-Watson stat	2.117760	Prob(F-statistic)	0.000033

3. Co-integration Tests

Sample: 1976 2010
Included observations: 33
Test Assumptions assumption:
Lineardeterministic trend in the data
Series: G R
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.490265140967	22.2609825533	15.41	20.04	None **
0.000710403732591	0.0234516542335	3.76	6.65	At most 1

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 1 cointegrating equation(s) at 5% significance level
Unnormalized Cointegrating Coefficients:

G	R
-0.000234953745524	0.000252814475982
4.25790639649e-05	1.7399514571e-05

Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)

G	R	C
1	-1.07601807079	739.875068908
	0.0477573159742	

Log likelihood -529.690105761

Appendix B. Dynamic OLS Results

Dependent Variable: LOG(R)
Method: Least Squares
Sample(adjusted): 1978 2009
Included observations: 32 after adjusting endpoints
Convergence achieved after 10 iterations Backcast: 1977

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.877229	0.456448	1.921859	0.0656
LOG(G)	0.909125	0.054305	16.74105	0.0000
D(LOG(G))	-0.049983	0.196951	-0.253785	0.8017
D(LOG(G(-1)))	-0.284901	0.168963	-1.686176	0.1037
D(LOG(G(1)))	0.254197	0.166684	1.525028	0.1393
MA(1)	0.810160	0.099398	8.150695	0.0000

R-squared	0.974397	Mean dependent var	8.389228
Adjusted R-squared	0.969474	S.D. dependent var	0.727981
S.E. of regression	0.127191	Akaike info criterion	-1.118896
Sum squared resid	0.420615	Schwarz criterion	-0.844071
Log likelihood	23.90234	F-statistic	197.9051
Durbin-Watson stat	1.962953	Prob(F-statistic)	0.000000
Inverted MA Roots	-.81		

Appendix C. Error-Correction Estimation

Dependent Variable: D(LOG(R))
Method: Least Squares
Date: 01/20/11 Time: 10:36
Sample(adjusted): 1978 2007
Included observations: 30 after adjusting endpoints
Convergence achieved after 42 iterations
Backcast: 1977

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOG(G))	0.850676	0.154071	5.521323	0.0000
D(LOG(G(-1)))	-0.227893	0.169685	-1.343032	0.1913
D(LOG(G(1)))	0.199541	0.145665	1.369863	0.1829
ECM(-1)	-0.966499	0.241369	-4.004240	0.0005
MA(1)	0.724239	0.174497	4.150444	0.0003

R-squared	0.339250	Mean dependent var	0.090009
Adjusted R-squared	0.233530	S.D. dependent var	0.136579
S.E. of regression	0.119573	Akaike info criterion	-1.258770
Sum squared resid	0.357442	Schwarz criterion	-1.025237
Log likelihood	23.88155	F-statistic	3.208949
Durbin-Watson stat	1.921672	Prob(F-statistic)	0.029502
Inverted MA Roots	-.72		