

## **Botswana: Selected Issues**

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BOTSWANA

**Selected Issues**

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Approved by the African Department

November 20, 2007

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## I. CALCULATING FISCAL SUSTAINABILITY BENCHMARKS FOR BOTSWANA<sup>1</sup>

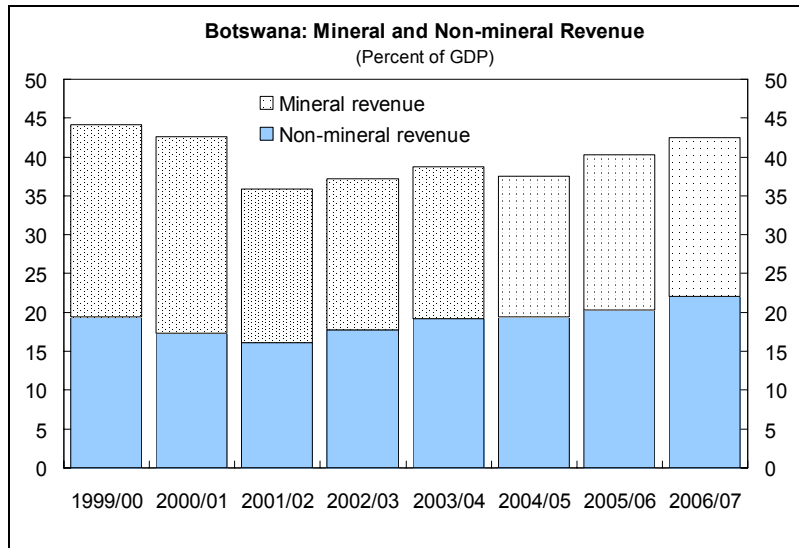
### A. Introduction

1. **Botswana is a diamond-rich middle-income country that faces a likely sharp decline in the production of its most valuable resource within a generation.** Currently, diamond exports make up about 75 percent of total exports. Revenues from minerals constitute around half of government revenues (Text Figure). However, a steep decline in diamond production is expected around 2021—absent significant new discoveries or improvements in existing technologies.

2. **There is a strong case for smoothing fiscal expenditure in resource-rich countries and thereby saving part of the revenues from these resources for the future.**<sup>2</sup> First, adjusting spending rapidly and abruptly

is costly and inefficient. Thus, it is advisable to insulate the budget, as much as possible, from the impact of fluctuating resource revenues and allowing a smoother and more rational path for public spending. Second, when a nation's public wealth is primarily derived from exhaustible resources, the optimal use of revenues from these resources raises questions of sustainability and intergenerational equity. How much should a government save for future generations? What level of public consumption can be maintained after natural resources have been exhausted?

3. **The degree of smoothing of expenditures is difficult to determine and should ultimately reflect government spending priorities.** In the context of a middle-income country like Botswana, the government seeks to maintain a relatively constant or even increasing level of public services over time. In order to have the income in the future to sustain these services, it is important that the government balances the trade-off between spending and saving from the revenues that result from exploiting non-renewable resources.



<sup>1</sup> Prepared by Jens Clausen (AFR).

<sup>2</sup> We do not examine in this paper the impact of resource spending on other macroeconomic variables, such as the exchange rate. See Iimi (2006) for a discussion of whether Botswana avoided the resource curse and Chapter II for an analysis assessing the external stability and the level of the exchange rate in Botswana.

4. **Nonetheless, in a developing country with many still unmet needs, there could also be a case for spending mineral revenues upfront.** Depending on the composition of spending and the rate of return on public investment, one could also argue that it makes sense not to save at all or to save little from today's revenues (Takizawa et al., 2004). Ultimately, the level of spending should not depend only on current revenues from non-renewable resources but should be determined in light of the likely quality of this spending, the government's capacity to manage it effectively, and its time preference.

5. **This chapter proposes a methodology that Botswana could use to augment its existing fiscal policy framework.** Assuming a simplified social welfare function that smoothes expenditure—a reasonable assumption for a middle-income country—this chapter calculates a sustainability benchmark for the non-mineral balance based on a notion of a “permanent income” from non-renewable resources.<sup>3</sup> Such a benchmarked balance can guide spending decisions and revenue goals.

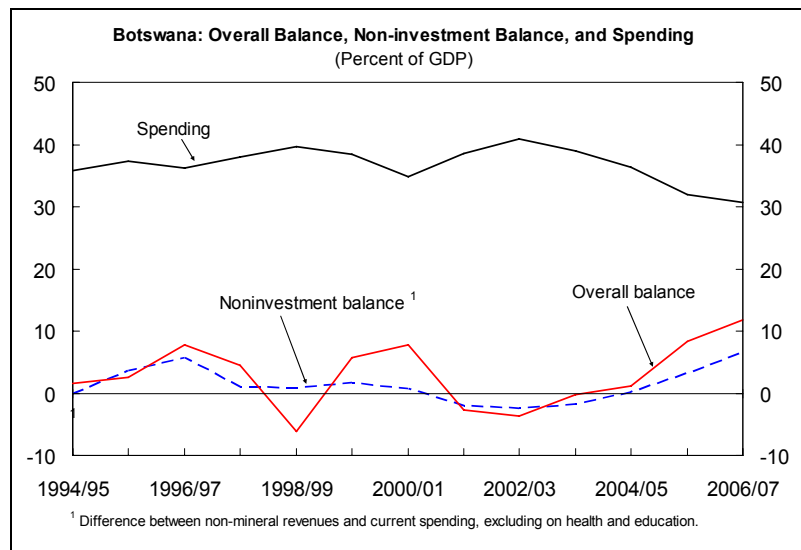
6. In the following, Botswana's fiscal framework is discussed (section B), followed by the calculation of sustainability benchmarks for Botswana (section C). A sensitivity analysis (section D) looks at the impact of varying assumptions and the robustness of the results before concluding.

### B. Botswana: Three Fiscal Objectives Have Been Met

7. **The authorities in Botswana have met three of their fiscal objectives laid out in their policy documents**

(among them the mid-term review of the National Development Plan 9, which is to end in 2009). The government has (i) achieved a budget surplus in most years (Text Figure); (ii) kept spending below the ceiling of 40 percent of GDP, and (iii) has also mostly achieved a surplus in the “non-investment” balance—

defined by the authorities to be the difference between non-mineral revenues and current spending (excluding expenditure on health and education, which the authorities regard as investment in human capital).



<sup>3</sup> Basdevant (2006) provides an earlier application of the permanent income hypothesis to fiscal spending in Botswana. Other studies that analyze fiscal sustainability in resource-rich countries include Carcillo et al. (2007) for the Republic of Congo, Jafarov and Leigh (2007) for Norway and Olters (2007) for a range of oil-producing countries in Sub-Saharan Africa.

8. **Overall balances often do not, however, tell the whole story.** Overall balances could improve due to higher mineral revenues and then be misinterpreted as “fiscal consolidation” or “fiscal adjustment.” When mineral revenues rise, a fiscal expansion could be temporarily masked by an improving overall balance. To get a better sense of the fiscal stance, it is important to use a multiple-indicator approach.

9. **The “non-investment balance” is a useful indicator.** A positive non-investment balance—keeping current spending (excluding expenditure on health and education) below non-mineral revenues—means that mineral revenues will be the main source of funds for expenditure on physical and human capital. However, there are certain drawbacks. Among them the problem that the non-investment balance does not take into account that with declining mineral revenues it then becomes necessary to find alternative funds to replace and expand capital infrastructure in the future.

10. **The non-mineral primary balance is an additional fiscal indicator for a multiple indicator approach.** By excluding mineral-related revenues and expenditures and net interest from the overall fiscal balance, it provides a picture of the fiscal situation abstracting from the mineral sector. The non-mineral primary balance can provide an analytically important tool in that it provides a useful measure of the fiscal effort and underlying fiscal policy stance (Barnett and Ossowski, 2003). It can constitute a key input into a fiscal sustainability and intertemporal analysis.

### C. Calculating Fiscal Sustainability Benchmarks for Botswana

11. **The “Permanent” Income Hypothesis (PIH) suggests that a government spend only the “permanent” part of revenue and save the remainder.** The return on fiscal savings would help sustain spending in the post-diamond period. To compute a “permanent” income, the projected stream of mineral revenues is transformed into a hypothetical annuity with the same net present value. The annuity is hypothetical in the sense that it is purely used to compute the “permanent” part of mineral revenues, but the minerals in the ground are not actually sold against a financial instrument.

12. **The calculation of the annuity is based on several assumptions,** which will be varied to test for robustness: (i) diamond production will sharply decline around 2021;<sup>4</sup> (ii) the real return on *future* savings is 4½ percent;<sup>5</sup> (iii) the income from annuitized mineral revenue is spread until 2050 to keep the time horizon realistic from a political economy point of view and also to take note of the uncertainty about resource discoveries and the growth of

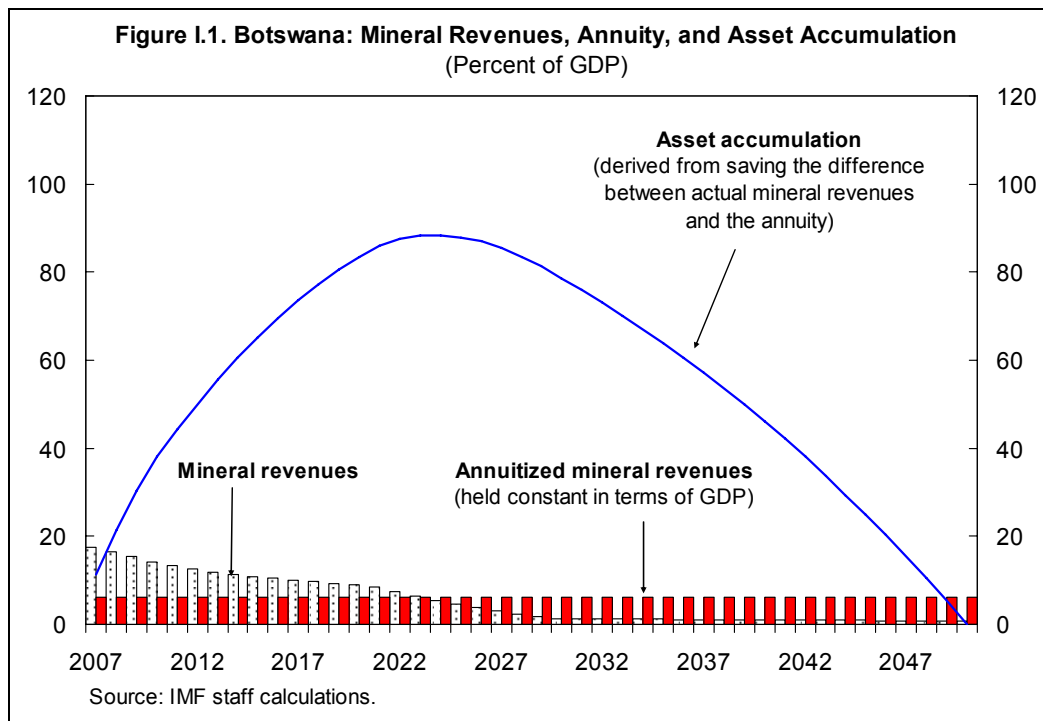
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<sup>4</sup> The analysis does not explicitly incorporate projections about minerals beside diamonds.

<sup>5</sup> The assumption on the return of savings is based on the experience of the Norwegian Pension Fund (Norges Bank, 2007). The past rates of returns of the Pula Fund are unknown. The stock of savings in the Pula Fund are not included in this analysis to focus on the effect of *future* savings and to abstract from monetary policy issues (see also the accompanying staff report on this).

non-mineral revenues; and (iv) the hypothetical annuity is programmed to stay constant in terms of GDP.<sup>6</sup>

13. **The amount saved each year equals the difference between actual mineral revenues and the value of the annuity** (Figure I.1, see also below). The annuity is thus a conceptual device that helps in determining the appropriate level of annual savings for accumulation in a wealth fund from which expenditures can be funded once mineral revenues decline. An annuity programmed to be constant in terms of GDP (at 6⅓ percent of GDP) requires high initial savings. With declining mineral revenues, the amount saved each year decreases. In 2023, when mineral revenues are projected to be lower than the value of the annuity, the stock of assets starts declining from a peak of close to 90 percent of GDP until all savings are consumed in 2050.



14. **Calculating sustainability benchmarks assumes that “permanent” income equals the annuity plus non-mineral revenues.** Expenditure is set equal to this “permanent” income, which implies smoothing expenditure over time. The *benchmarked overall balance (BOB)* implies saving the difference between actual mineral revenues (*MR*) and the annuitized mineral revenues (*A*). This follows from the following:

$$\text{“Permanent” income (PI)} = \text{Annuity (A)} + \text{Non-mineral revenues (NMR)} \quad (1)$$

<sup>6</sup> While we also present a scenario in which the annuity is programmed to stay constant in real terms (see below), the assumption here is that the contribution to spending from mineral revenues, i.e. the annuity, should be flat over time in terms of GDP. Programming it in terms of GDP ensures that initial savings are significant while mineral revenues are still high. Also, with regard to communicating the analysis, phrasing it in terms of GDP seems most intuitive.

$$\text{Expenditure } (Ex) = \text{“Permanent” income } (PI) \quad (2)$$

$$\text{Revenue projection } (R) = \text{Mineral revenues } (MR) + \text{Non-mineral revenues } (NMR) \quad (3)$$

$$\text{Benchmarked overall balance } (BOB) = \text{Revenue projection } (R) - \text{Expenditure } (Ex) \quad (4)$$

Inserting (1), (2), and (3) into (4) yields:

$$\begin{aligned} BOB &= R - PI = MR + NMR - (A + NMR) \\ &= MR - A + NMR - NMR \\ &= MR - A \end{aligned}$$

with  $MR$  standing for mineral revenues,  $NMR$  non-mineral revenues,  $A$  the annuitized mineral revenues.

15. **The benchmarked non-mineral balance is equal to the difference between non-mineral revenues and “permanent” income** (non-mineral revenues and the annuity). The *benchmarkd non-mineral balance* ( $BNMB$ ) implies that it is sustainable to run a non-mineral deficit the size of the annuity ( $A$ ), which follows from the following:

$$\text{Benchmarked non-mineral balance } (BNMB) = \text{Non-mineral revenues } (NMR) - \text{Expenditure } (Ex) \quad (5)$$

Inserting (1) and (2) into (5) yields:

$$\begin{aligned} BNMB &= NMR - PI = NMR - (A + NMR) \\ &= NMR - NMR - A \\ &= -A \end{aligned}$$

with  $NMR$  being non-mineral revenues and  $A$  the annuitized mineral revenues.

16. **Applying this methodology to Botswana, the benchmarked balances suggest that continued fiscal restraint is needed to achieve longer-term fiscal sustainability** (Table I.1). The benchmarked non-mineral balances derived from a permanent income suggest a lower deficit in 2007 and 2015 (corresponding to a higher surplus in the overall balance) compared to the projected balance—with the exception of scenario (c), in which part of the restraint needs to take place later. The calculations suggest a range of sustainable non-mineral deficits of between -9 and -19 percent of non-mineral GDP in 2007, while the non-mineral deficit is projected at -17½ percent of non-mineral GDP—below the midpoint of the range. For the overall balance, the estimated benchmarked balances suggest a sustainable range of surpluses between 6 and 12 percent of GDP for 2007, while the overall balance is projected at 8 percent of GDP.



**Table I.1. Botswana: Fiscal Sustainability Benchmarks**

	Non-mineral Primary Balance		Overall Balance	
	2007 (Percent of non-mineral GDP)	2015	2007 (Percent of GDP)	2015
<b>Staff projections</b> <sup>1</sup>	-16.0	-15.7	8.0	-0.2
<b>Sustainability benchmarks:</b>				
Revenue projections minus expenditure that follows "permanent" income				
(a) <i>Conservative assumptions</i> Baseline revenues <sup>1</sup> and conservative interest rate assumption	-8.2	-7.2	12.1	5.2
(b) <i>Less conservative assumptions</i> Baseline revenues and optimistic interest rate assumption	-9.3	-8.3	11.3	4.4
(c) <i>Less conservative assumptions—back-loaded adjustment</i> Baseline revenues and optimistic interest rate assumption; annuity constant in real terms	-17.2	-10.6	6.0	2.7
(d) <i>Optimistic assumptions</i> Optimistic mineral revenues and optimistic interest rate assumption	-12.9	-11.4	8.9	5.9

Source: IMF staff calculations.

<sup>1</sup> Revenue projections assume a slow increase in non-mineral revenues and a decrease in mineral revenues in terms of GDP. Expenditure projections assume that capital expenditure and expenditure on health and other critical areas increase in terms of GDP.

(a) The conservative interest rate assumption refers to a nominal interest rate of around 7¾ percent that corresponds to a real interest rate of 3 percent. The past rates of return on the Pula Fund are unknown. In comparison, the Norwegian Government Pension Fund has earned an annualized net real return of 4.6 percent since 1997.

(b) The optimistic interest rate assumption refers to a nominal interest rate of around 9¼ percent that corresponds to a real interest rate of about 4½ percent. Being more optimistic concerning the return on assets allows for somewhat larger non-mineral deficits and lower overall balances relative to (a).

(c) Programming the annuity to stay constant in real terms (rather than in terms of GDP) yields lower initial savings as suggested by the benchmarks. Thus, this scenario assumes a more back-loaded adjustment.

(d) Assuming a slower decline in the path of mineral revenues changes the value of the annuity and thereby allows for higher non-mineral deficits relative to (b).

**17. The permanent income calculations indicate that the spending ceiling should be reduced.** A high non-mineral primary deficit is not sustainable over time when mineral resources are exhaustible. This has implications for a sustainable spending level. While the current National Development Plan provides a ceiling of 40 percent of GDP, these calculations here suggest to consider limiting spending to around 30 percent of GDP. This assumes spending is limited to non-mineral revenues (assumed to increase from the current 22 percent of GDP to around 23½ percent in 2010/11) and annuitized mineral revenue of

about 6½ percent of GDP. The suggested 30 percent of GDP ceiling is very close to the estimated 2006/07 outcome of 31 percent of GDP. In that sense, there would be no need to cut spending, but also no room to increase spending to the 40 percent of GDP ceiling.

18. **As indicated earlier there are limitations to this analysis.** These calculations do not address whether the level of capital spending is optimal. The higher the return on public spending, the higher recurrent revenues, the higher a sustainable non-mineral deficit.

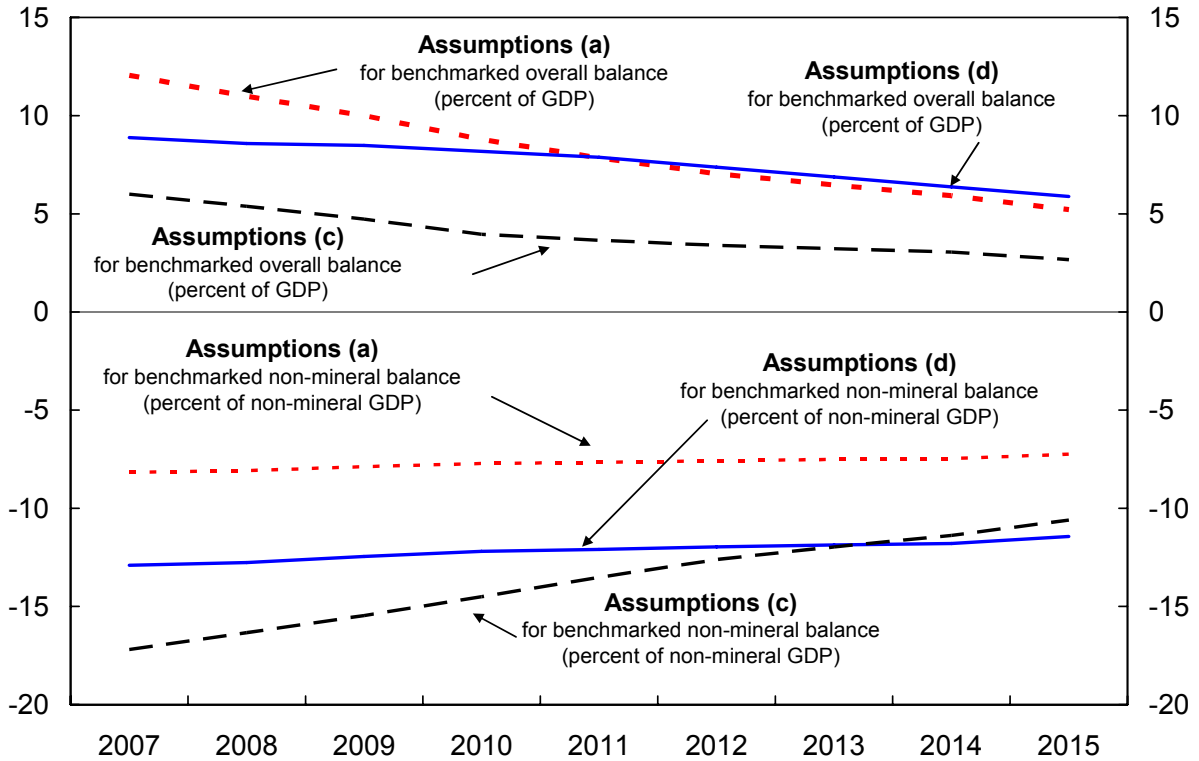
#### **D. Sensitivity Analysis**

19. **The level and path of the benchmarked balances depend on key assumptions** about the path of mineral revenues, the expected rate of return on savings, the time horizon, the path of the annuity, and when adjustment occurs (Table I.1, and Figures I.2 and I.3).

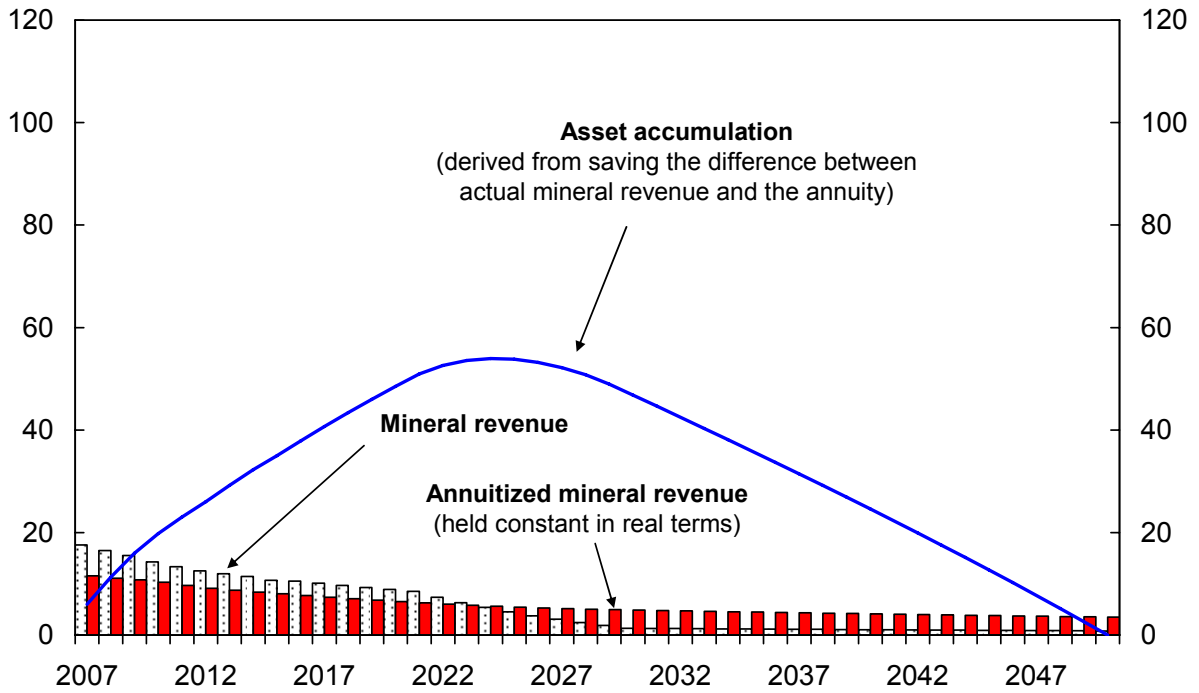
- The greater the remaining mineral deposits the lower the benchmarked fiscal adjustment needed for sustainability.
- A more conservative interest rate assumption to calculate the return on savings requires a larger adjustment.
- If the horizon is lengthened to 2100 and mineral wealth spread until then, the value of the annuity is reduced by 2 percentage points of GDP and adjustment needs to be larger.
- If the annuity declines over time in terms of GDP, adjustment needs to take place later (see also Figure I.3).
- The estimated needed adjustment increases the longer it is postponed. For example, if an adjustment only started in 2010, the value of the annuitized mineral revenue would decline by 2 percentage points of non-mineral GDP, and the benchmarked non-mineral deficit would become more ambitious at -8 percent of non-mineral GDP instead of -10 percent (with set of assumptions b).

20. **An annuity programmed to be constant in *real terms* yields low initial savings** (Figure I.3). Since nominal GDP is growing faster than inflation, the annuity is declining in terms of GDP (its value starts with close to 12 percent of GDP and declines to 3½ percent of GDP). The stock of assets reaches only a peak of around 55 percent of GDP. This scenario allows for a back-loaded adjustment.

**Figure I.2. Botswana: Sensitivity Analysis for Benchmarked Balances**



**Figure I.3. Botswana: Mineral Revenues, Annuity, and Asset Accumulation (Percent of GDP)**



Source: IMF staff calculations.

## E. Conclusions

21. **This chapter suggests that it is essential to save a substantial portion of mineral revenues now to ensure fiscal sustainability for a post-diamond period.** The permanent income calculations indicate that the spending ceiling should be reduced. A high non-mineral primary deficit is not sustainable over time when mineral resources are exhaustible. The estimated outcome for the last fiscal year is very close to the ceiling recommended here, suggesting that there is no need to cut spending but to refrain from increasing spending.

22. **There are limitations to this analysis.** First, the calculations presented here assume that it is socially optimal to smooth expenditure over time. However, the degree of smoothing expenditure and therefore the optimal level of spending is uncertain. Spending a larger portion of the mineral revenues upfront and spending less later could increase social welfare (depending on the social welfare function, the composition of spending, and the rate of return of public investment). Second, Botswana's potential to develop other natural resources and to strengthen non-mineral revenues are uncertain and might be larger than assumed in the sensitivity analysis. It is thus essential to guide fiscal policy by comparing the marginal benefit from spending to the return on a financial asset that could be acquired instead, for the use of resource revenues. A broader issue, not discussed in this paper, is the optimal rate of exploitation of public natural resources.

23. **Taking the non-mineral primary balance into account can help clarify desirable fiscal policies.** Calculating benchmarked balances based on permanent income can contribute to making medium- to long-term fiscal policy choices. This analysis suggests that the authorities could consider supplementing their current fiscal goals with that of reducing the non-mineral primary deficit in their National Development Plan 10.

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## II. ASSESSING EXTERNAL STABILITY IN A RESOURCE-DEPENDENT, DEVELOPING ECONOMY: THE CASE OF BOTSWANA<sup>7</sup>

### A. Introduction

24. **For developing countries that depend mainly on the export of non-renewable resources, external stability and exchange rate assessments are particularly challenging.** First, existing methodologies are ill-suited to assess the implications for external stability and the exchange rate of the exhaustion of a natural resource within a predictable time-frame. Second, current account volatility is particularly high in natural resource exporters because of commodity price fluctuations, which makes it difficult to separate underlying trends from temporary fluctuations. Third, in countries that experience both rapid growth and change as well as high volatility, past values of fundamentals are poor guides of appropriate future values consistent with external stability and exchange rate equilibrium.<sup>8</sup>

25. **To overcome these limitations, the chapter uses a combination of approaches to assessing external stability and the level of the exchange rate in Botswana, including<sup>9</sup>**

- A description of balance of payments trends, vulnerabilities, and the evolution of a number of REER indices (CPI-based, productivity-based, and the internal terms of trade);
- An econometric estimation of the equilibrium real effective exchange rate (EREER), involving direct estimation of a reduced-form relationship between the real exchange rate and its fundamental determinants (this updates the analysis presented in Iimi (2006) by using a more direct measure of productivity differentials and by extending the sample period by a few years);
- An assessment of the sustainability of the projected current account and net foreign assets (NFA) position that explicitly takes into account the exhaustibility of diamond receipts: it compares the projected current account path to a trajectory consistent with medium-term fiscal sustainability (i.e. one that incorporates saving part of the natural resource receipts to maintain a “permanent” level of income and consumption beyond the natural resource production horizon); and
- An assessment of competitiveness based on non-price indicators, such as external sector outcomes, production costs and the quality of the business environment.

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<sup>7</sup> Prepared by Corinne Deléchat and Matthew Gaertner.

<sup>8</sup> Data limitations compound these problems.

<sup>9</sup> A number of recent studies use a similar eclectic approach, see for example Gutierrez (2007), Murgasova (2004) and Ramirez and Tsangarides (2007).

26. **Results indicate that, overall, there is no immediate threat to external stability and that Botswana's REER is close to its medium-term equilibrium value**, based on past trends in fundamental determinants. However, a forward-looking assessment taking into account the need to accumulate savings to sustain imports and consumption beyond the horizon of diamond production suggests that larger current account surpluses may be needed. Alternative REER indices and structural competitiveness indicators also point to several areas that government should continue to target: (i) declining labor productivity in tradables (except mining), particularly in manufacturing industries; (ii) high utility prices and inadequate information technology and communication infrastructure; (iii) a skills mismatch, compounded by difficult ties in hiring expatriate skilled labor, and other labor market rigidities; and (iv) other competitiveness obstacles such as difficult access to land and the high cost of financing for small enterprises.

## **B. External Sector Developments and Key Vulnerabilities**

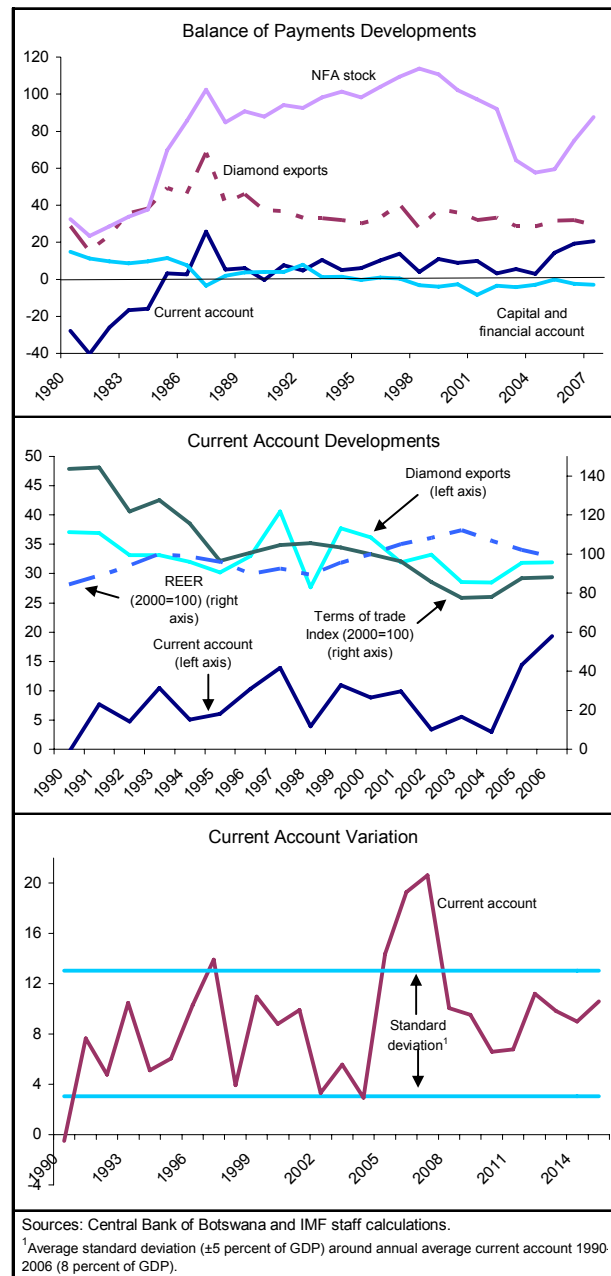
### **Balance of payments**

27. **Current account developments and main vulnerabilities are closely linked to diamond exports** (Figure II.1). For 2006, diamond exports represented 74 percent of total goods exports and 32 percent of GDP. Historically, the 1980s were characterized by average current account deficits of about 8 percent of GDP, driven by large (though declining) imports and in the early 1980s a dip in diamond export receipts. The 1990s saw more stable diamond exports and a comfortable current account surplus, averaging about 8 percent of GDP between 1990 and 2006. Diamond and current account developments seem to have been driven by terms of trade movements (reflecting mainly changes in diamond prices).

28. **Current account volatility is high.** The average annual standard deviation for the current account in the period 1990-2006 is 5 percent of GDP, and for terms of trade it is about 20 percentage points. Such volatility makes it difficult to retrieve some notion of "underlying current account." Nevertheless, aside from an above-average peak in 2005-2007 linked to the 2004-05 devaluations and the switch to a crawling peg (as well as to higher diamond production and minerals prices), the current account trajectory is expected to remain within historical standard deviations.

29. **There seem to be no significant balance sheet vulnerabilities stemming from the capital and financial account.** The capital and financial account surplus averaged about 7½ percent of GDP during the 1980s, with annual net foreign direct investment (FDI) flows accounting for about 4 percent of GDP and other capital inflows accounting for the rest. During the 1990s the capital and financial account surplus declined to about 1 percent of GDP on average: FDI and other flows were almost nonexistent. This account turned slightly negative starting in 1999, reflecting offshore investments by the rapidly growing pension funds, particularly after the Public Officers Pension Fund was set up in 2001. External debt at less than 3 percent of GDP is extremely low, and direct foreign exchange exposures of the financial sector are limited, so that exchange rate and liquidity risks are well contained. The recent financial sector assessment indicates that the banking sector could be mostly vulnerable to credit risk stemming from a global downturn that led to a fall in diamond revenues (See Botswana—Financial Sector Stability Assessment). The capital and financial account is projected to shift to net inflows of about 2 percent through 2015, thanks to temporarily higher FDI flows associated with mining and energy projects.

Figure II.1. Botswana: Balance of Payments Trends (Percent of GDP)



30. **Reserve coverage is adequate.** The current account surpluses have allowed for the accumulation of a significant stock of reserves, amounting to 75 percent of GDP at the end of 2006, of which 20 percent of GDP (about 6 months of imports) are liquid reserves and



55 percent (about 19 months of imports) represent the Pula Fund.<sup>10</sup> The rate of growth of NFAs fell below that of nominal GDP in 1998, at which point NFAs as a percent of GDP started declining.<sup>11</sup> However, the central bank explicitly targets 6 months of import cover for liquid reserves, and there are specific triggers for when Pula Fund assets could be accessed (e.g., in case of simultaneous adverse shocks, though the first line of defense would be corrective macroeconomic policies, or seeking external funding of development projects.) The current liquid reserve coverage is sufficient to withstand a two-standard-deviation adverse current account shock for two years.

### **Evolution of REER indices**

31. **All REER measures indicate that the real appreciation between 2000-2004 was more than offset by devaluations in 2004 and 2005 and the subsequent switch to a crawling peg exchange rate regime** (Figure II.2). Movements in the CPI- and productivity-based REER begin with a decade of relative stability starting in 1990, followed by a trend appreciation starting in about 2000, that was reversed by the devaluations and the switch to a crawling peg.<sup>12</sup> Although both the CPI and the relative productivity-based REERs moved together between 1995 and 2000, the real appreciation and subsequent depreciation were more pronounced in the relative productivity-based REER. By the end of 2006, the annual CPI-based REER was 5 percent below its average annual value for 1995-2000, and the productivity-based REER was 10 percent below. Although the gap between the two has recently been narrowing, the bilateral real exchange rates of the main import (South Africa) and export (United States) trading partners have tended to move in opposite directions.

32. **The availability of sectoral productivity data sheds some light on the likely sources of the real appreciation.** The evolution of the components of the CPI-based REER shows that the appreciation was mainly caused by an increase in relative prices rather than by nominal exchange rate movements. From the productivity-based REER and the internal

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<sup>10</sup> The Pula Fund is composed of the government's investment account, which reflects savings from accumulated fiscal surpluses held with the central bank, and the central bank's reserve accumulation above the target for liquid reserves. Pula Fund assets are invested in longer-term instruments, with the objective to ensure that national savings are deployed to contribute to sustainable economic development.

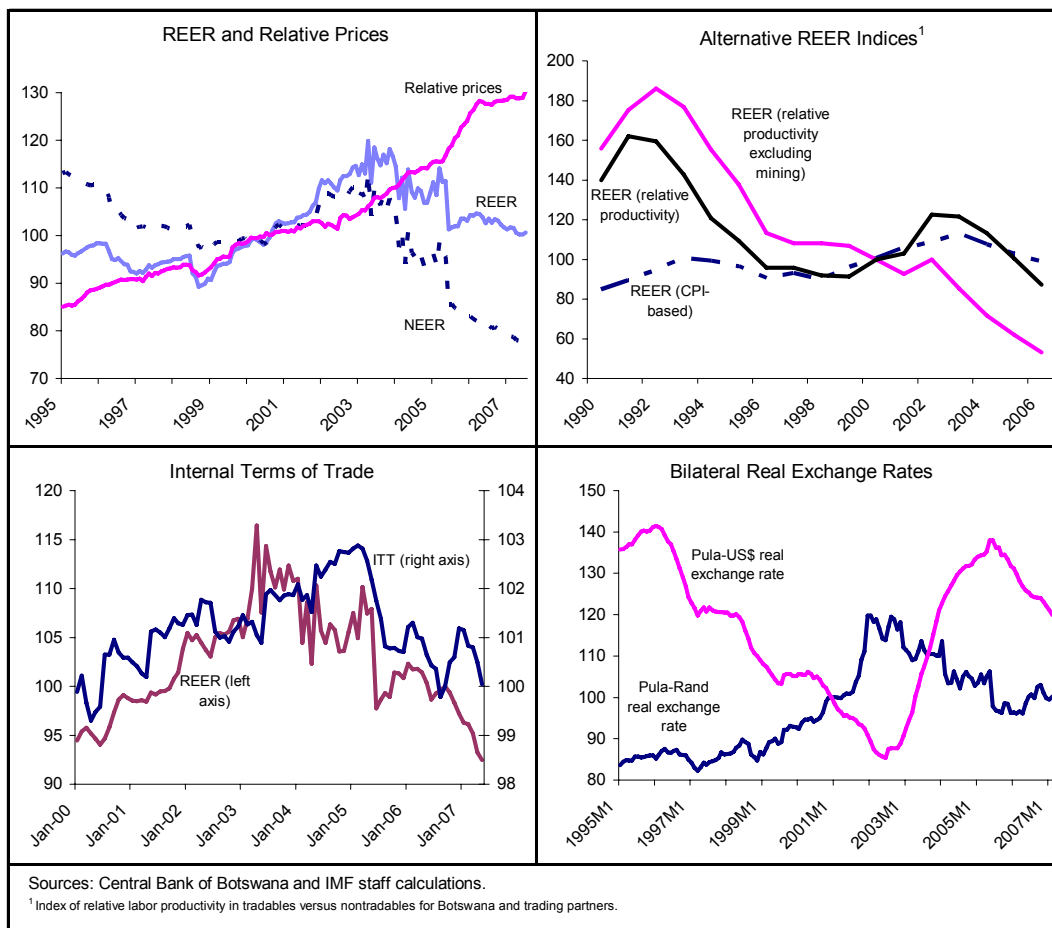
<sup>11</sup> The government funded the privatization of pension funds through capital transfers, which lowered official reserve assets by about P13.5 billion between 2001 and 2005.

<sup>12</sup> The productivity-based REER was calculated by computing a relative productivity index of Botswana's labor productivity in tradables versus non-tradables relative to trading partners. Data on Botswana's sectoral labor productivity were obtained from the Botswana National Productivity Centre. Data on trading partners' labor productivity (weighted using the same INS weights entering the REER calculations) were obtained from the IMF Research Department (CGER database).

terms of trade measure (ITT<sup>13</sup>), it appears that the real appreciation was linked to rapid productivity improvements in the diamond sector (which largely dominates tradables). Excluding mining, labor productivity in tradables versus nontradables in Botswana has been declining compared to trading partners. Mining wage increases may have led to wage and price increases in the nontradables sectors (a classic symptom of Dutch disease), as reflected in some increase in the relative price of nontradables versus tradables.

33. **The shift from a fixed to a crawling peg in 2005 appears to have resulted in greater stability of the REER.** The CPI-based REER depreciated by 2 percent in the twelve months through August 2007, compared with average annual appreciation of 5 percent from 1999-2004. This leaves the REER roughly unchanged from mid-2005, with the depreciation of the NEER offsetting the relative price differential in Botswana against its main trading partners.

Figure II.2. Botswana: Real Effective Exchange Rate Indices (2000=100)



<sup>13</sup> The internal terms of trade measure is constructed here as the relative price of nontradables to tradables, based on price indices provided by the authorities. This measure follows closely the theoretical definition of the real exchange rate.

### C. Equilibrium Exchange Rate Estimation

34. **In this section, we estimate an equilibrium real exchange rate for Botswana to inform our assessment of exchange rate valuation.** We use the behavioral equilibrium exchange rate model (BEER) to assess whether and the extent to which REER movements reflect either an equilibrium adjustment to changing fundamentals or a deviation from its equilibrium level. Our assessment extends the exchange rate analysis in Iimi (2006).

#### Behavioral equilibrium exchange rate approach

35. **This approach estimates the EREER by identifying structural determinants using an exchange rate model.**<sup>14</sup> The framework adopted in this paper is based on that proposed by Clark and MacDonald (1999). The starting point is the real interest rate parity condition, where the change in the real exchange rate ( $q$ ) is equal to the real interest rate ( $r$ ) differential plus a risk premium ( $\rho$ ). This parity condition can be expressed as:

$$q_t = q_{t+k}^e + (r_t - r_t^*) + \rho_t$$

where  $q_{t+k}^e$  is the expectation of the real exchange rate at period  $t+k$ . The future expected real exchange rate is then interpreted as the long-run component of the real exchange rate, which is assumed to be a function of macroeconomic fundamentals.

36. Iimi (2006) estimates a long-run equilibrium equation for Botswana that incorporates real interest rate differentials, terms of trade, NFA, the relative price of domestic nontradables to tradables, and a risk premium factor, defined as the difference between Botswana's fiscal deficit and the weighted average of the deficits of its trading partners. Because Botswana has a large fiscal surplus, almost no external debt, and very limited domestic capital markets, specifying a risk premium may not be relevant. Therefore, in line with the literature, we instead use the ratio of government spending to GDP as one of the fundamental determinants of the equilibrium exchange rate (IMF, 2006). Our initial specification also includes a measure of trade openness.<sup>15</sup>

- **Terms of trade:** A positive terms of trade movement would either appreciate the nominal exchange rate or increase domestic demand through the wealth effect, leading to upward pressure on the relative price of nontradable goods and an REER appreciation.
- **Capital flows** (proxied by the NFA of the banking system relative to GDP): An increase in capital inflows would either appreciate the nominal exchange rate or increase domestic demand through the wealth effect, causing the REER to appreciate.

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<sup>14</sup> For a more extensive discussion of the theoretical approach underlying the BEER methodology and its application to Botswana see Iimi (2006).

<sup>15</sup> The weights attached to both the net foreign assets and the fiscal deficit differential are not statistically significant in Iimi's estimation.

- **Relative productivity:** Less developed economies tend to experience productivity improvements in the tradable goods sector as they converge toward more advanced economies. As productivity increases, wages and prices of nontradable goods will tend to increase relative to those of trading partners, causing the domestic currency to appreciate in real terms. This captures the Balassa-Samuelson effect. Our estimation uses a relative productivity index<sup>16</sup> to capture this effect, rather than the relative price of nontradables to tradables used in Iimi (2006).
- **Government spending:** The impact of government consumption on the REER would depend on the share of tradables in government spending. If the government spends relatively more on nontradables, an increase in consumption should lead to REER appreciation.
- **Trade openness** (proxied by the ratio of exports and imports of goods and services to GDP): A more open trade regime with fewer restrictions will tend to lower the domestic price of tradable goods, resulting in a depreciation of the REER.

### Estimation results

37. Analysis of the order of integration of the REER and the variables in our empirical model indicates that they are integrated of order one, based on the augmented Dickey-Fuller tests (Appendix Table 1). We then estimate a vector error correction model (VECM), employing the Johansen methodology (1995) to identify a long-run (cointegration) relationship between the exchange rate and macroeconomic fundamentals.

38. We first determine the appropriate lag-length of the VAR. As the sample size is small, we start with a VAR with two lags, then estimate a VAR with one lag, and test whether the simplification from two to one lag is statistically valid using an F-test of the residuals. Here the F-statistic is strongly significant, indicating that the specification with two lags is the appropriate one (Appendix Table 2).

39. The Johansen procedure is then applied to test for the existence and the number of cointegrating equations; two are found in the initial set of dependent and explanatory variables. Because the sample size is small (1980-2006) and the presence of more than one cointegrating equation complicates identification of the equilibrium relationship between the REER and its fundamental determinants, we look for a combination of explanatory variables, to include the key REER determinants, but with just one cointegrating vector.

40. Our preferred specification includes the real interest rate differential ( $r-r^*$ ); the terms of trade ( $ltot$ ); government consumption ( $lgc\_gdp$ ); and relative productivity ( $lrelprod$ ). We

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<sup>16</sup> This index is constructed as labor productivity in tradable/non-tradable goods in Botswana relative to the weighted average of labor productivity in tradable/non-tradable goods in its main trading partners. The tradable goods sector in Botswana excludes mining so as to reflect competitiveness in the nonmining economy, which is more sensitive to the level of the real exchange rate. This relative productivity measure appears to be a longer and more robust series than the relative price measure used by Iimi (2006).

found that the NFA and the indicator of trade openness were not significant determinants of the REER.<sup>17</sup> Results from the Johansen trace and the maximum eigenvalue cointegration tests indicate that there is one cointegrating vector in the estimated system at the 95 percent level of confidence (Appendix Table 3); the coefficients of the cointegrating vector are plausible in magnitude and with the expected signs. All of the coefficients in this specification were determined to be statistically significant with the exception of the terms of trade. Although residuals plots indicate some outliers (Appendix Figure 1), formal tests do not reject normality and no autocorrelation (Appendix Table 5).

41. The resulting long-run equilibrium equation is written as follows (t-statistics between brackets; also see Appendix Table 4):

$$\ln REER = 0.034(r-r^*) + 0.042ltot + 0.338lgc\_gdp + 0.052lrelprod + 2.946$$

$$\begin{array}{cccc} [13.02] & [1.42] & [3.53] & [4.11] \end{array}$$

42. Using Hodrick-Prescott filters of these fundamental determinants of the REER as proxies for their equilibrium values, we then estimated the equilibrium long-run real exchange rate for Botswana, along with a 95 percent confidence interval around the equilibrium (Figure II.4).

43. The results indicate that the real exchange rate was sharply overvalued prior to nominal devaluations in 2004 and 2005, and that the resulting real depreciation restored the REER roughly toward its equilibrium value during 2006. While the actual REER remained relatively close to the EREER for most of the 1990s, it started to diverge in about 2000-2001 as it appreciated faster than the EREER; by 2003 the estimated overvaluation was 10.8 percent. This broadly corresponds with the assessment in Iimi (2006), which concluded that the real exchange rate overvaluation during 2000-2003 appeared to have been corrected by the subsequent devaluations. Figure II.4 does suggest that part of the real appreciation between 2000 and 2004 reflected an appreciation of the EREER, which appears to have stabilized around its 2006 value. In turn, this equilibrium appreciation possibly captured an improvement in the terms of trade and tight monetary policy, reflected in higher relative real interest rates compared to trading partners.

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<sup>17</sup> Net foreign assets were not found to have an important role in determining the exchange rate. This likely reflects the privatization of the public pension system, which resulted in a large decline in the ratio of net foreign assets to GDP from 2001 to 2005 as the government drew down its investment account with the central bank to transfer assets to domestic pension funds, only part of which were reinvested in foreign assets. At the same time there was an appreciation of the real exchange rate due to the depreciation of the rand. Although he included this in his final estimation, Iimi (2006) also determined that changes in net foreign assets did not have a significant role in determining the equilibrium exchange rate in Botswana.

44. Results of EREER estimation must, however, be interpreted with caution. As with all econometric methods, issues of data quality, limited time series (a particular problem in cointegration analysis), sensitivity of the results to sample period, choice of variables, and the smoothing method used to retrieve the fundamentals will influence the results derived from estimating a reduced-form equation for a single country. Equilibrium exchange rate estimation may not be robust to the choice of estimation method—single country versus panel—either (Chudik and Mongardini, 2006, Roudet, Saxegaard and Tsangarides, 2007). However, our results remain consistent with Iimi’s findings: the coefficients on the common variables are of similar magnitude and the coefficient on our productivity variable is more plausible, this for a longer sample and a different set of explanatory variables.

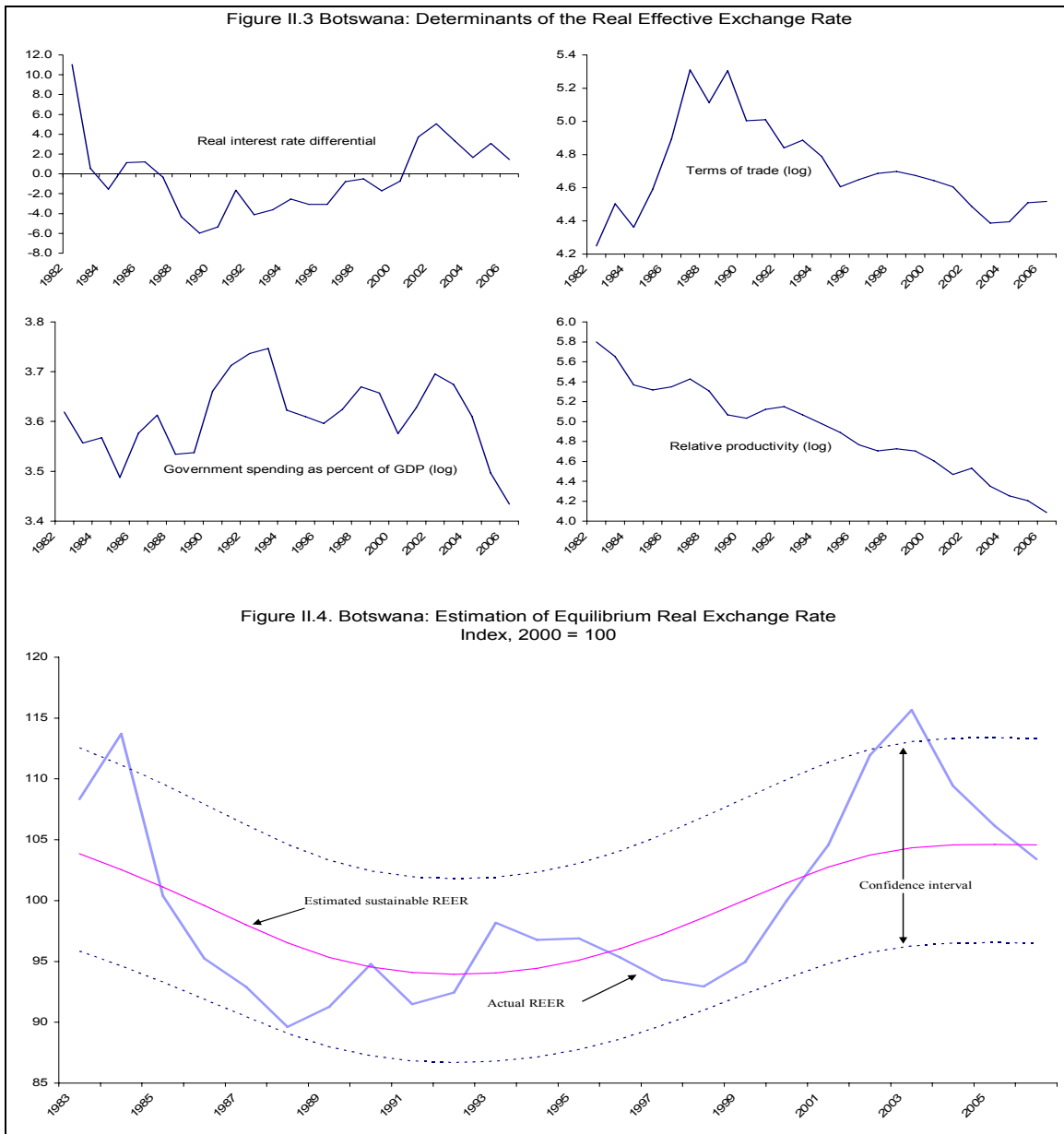
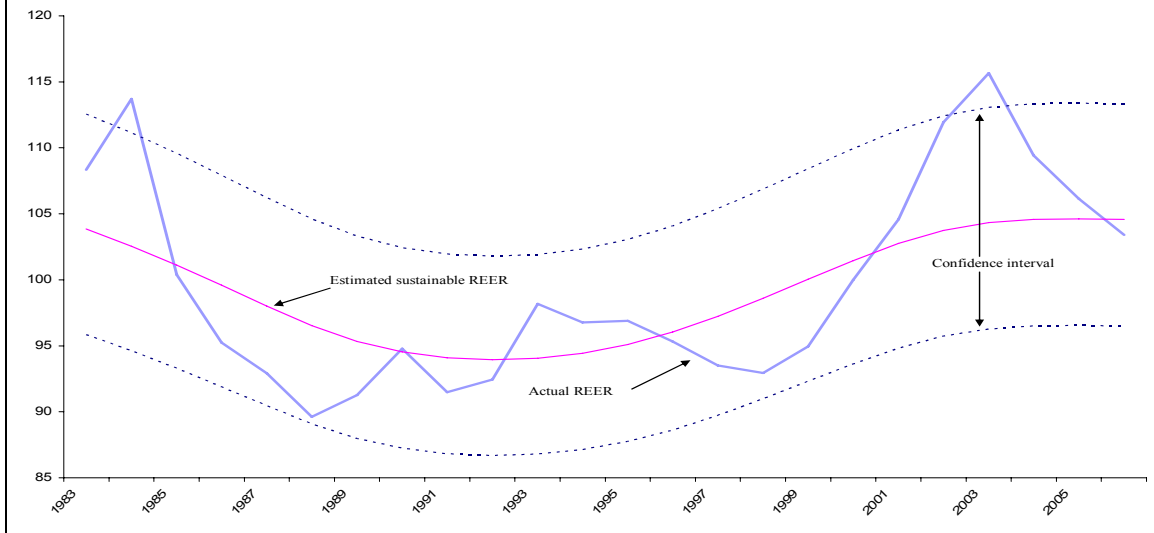


Figure II.4. Botswana: Estimation of Equilibrium Real Exchange Rate Index, 2000 = 100



### D. External Sustainability Approach

45. **One of the three methodologies put forward by the Consultative Group on Exchange Rate Issues (CGER), the external sustainability approach relies on the intertemporal budget constraint for the whole economy.** It involves calculating the current account balance-to-GDP ratio that would stabilize the NFA position at some benchmark value. Unlike the EREER approach, this is not an econometric approach, and it is based on fairly straightforward assumptions about GDP growth and inflation. The main difficulty comes in selecting a sensible benchmark value for the NFA position. The CGER methodology uses a backward-looking benchmark (latest actual value), to allow for cross-country comparisons.

46. **For exporters of exhaustible natural resources, however, the NFA benchmark consistent with external sustainability becomes a policy target and can be given a more forward-looking, normative content.** Specifically, the sustainable current account or NFA position can be defined analogously and consistently with the requisites for medium-term fiscal sustainability. In the fiscal sustainability analysis, the sustainable overall fiscal balance is defined as the difference between total revenue (mineral and non-mineral) and permanent income (non-mineral revenue + annuity from projected stream of mineral revenue) or, more simply, the difference between mineral revenue and the annuity. In terms of external sustainability, this analysis implies that the sustainable current account position can be calculated as the difference between mineral exports and the annualized discounted value of the projected stream of mineral exports.<sup>18</sup> The annuity is calculated so as to remain a constant share of GDP through the period. While there are other ways to model the annuity (e.g. keeping it constant in real terms or as a share of per capita GDP), the method chosen here has the merit of being consistent with the presentation in Chapter I and to easily translate into the definition of a sustainable current account-to-GDP ratio.<sup>19</sup>

47. **The sustainable current account path for Botswana may be somewhat above the projected path based on current policies** (Figure II.5). The assumptions used to calculate the baseline and alternative sustainable

Table II.1. Botswana: Assumptions (Percent)		
	Baseline	Alternative
Interest rate to discount revenue flows	9.3	7.8
Long-term inflation	4.7	4.7
Long-term real growth	4.4	4.4
Real rate of return	4.4	3.0

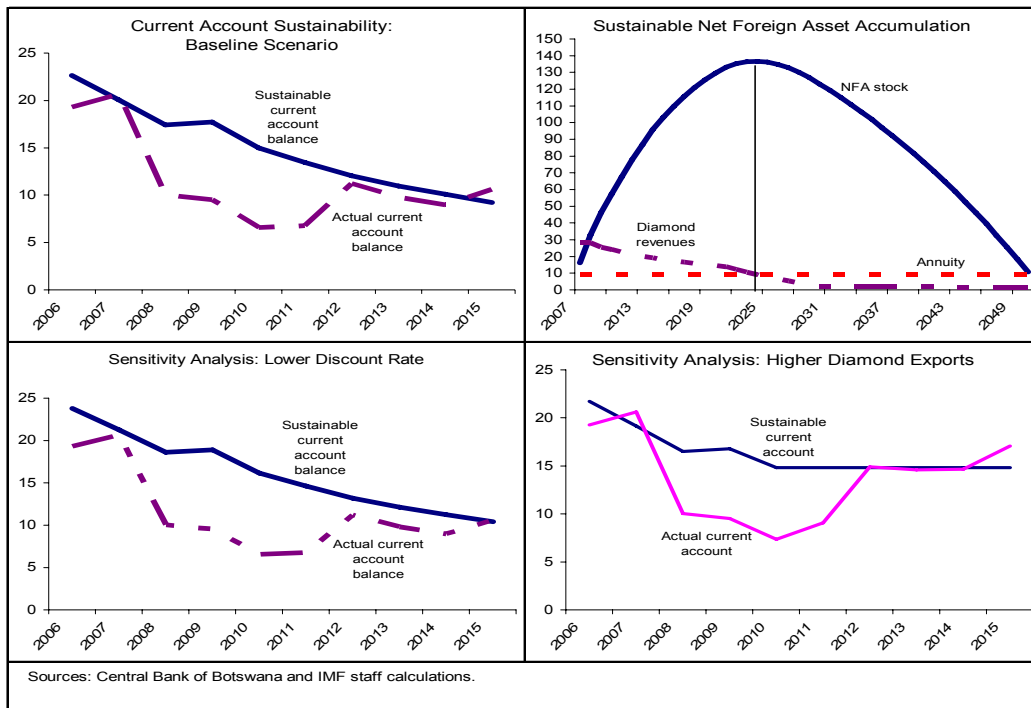
<sup>18</sup> Sustainable current account calculations are based on the same assumptions as the benchmark fiscal balance calculations in Chapter I: diamond resources would begin to decline abruptly in 2021, and the annuity is calculated between 2007 and 2050 to keep the analysis within a reasonable time frame.

<sup>19</sup> Olters (2007) calculates permanently sustainable non-oil primary deficits as a percent of non-oil GDP for sub-Saharan oil-producing countries, calibrating a formal model of permanent income and habit formation.

balance are summarized in Table II.1. Based on these, the annuity value of diamond receipts is calculated to be about 9.2 percent of GDP. Over the projection period the actual current account path stays below the sustainable current account benchmark by an average of about 3½ percent of GDP. In contrast with the results of the equilibrium exchange rate analysis above, this would imply a slightly overvalued exchange rate. However, the projected lower surpluses for 2007-2013 are transitory: they reflect imports of capital goods linked to large mining and energy projects. As these projects are mostly financed by FDI inflows, and as long as their returns are higher than would be derived from the accumulated financial savings from diamond exports, such investment would be consistent with long-run current account sustainability. The sustainable current account path is consistent with the sustainable non-mineral fiscal balance derived in Chapter I, that would imply limiting fiscal expenditures to about 30 percent of GDP.

48. **Sensitivity analysis can be conducted around this simple baseline scenario.** For example, a lower discount rate (see alternative scenario in Table 1), which would imply that greater value is attached to future imports and consumption, would lower the annuity value. This would lead to a continuing need for higher savings, and would further increase the gap between the actual and sustainable current account. Higher diamond revenue (assuming diamond exports stabilize at 25 percent of GDP between 2010 and 2015 instead of declining) would both allow for higher annual savings and improve the projected current account, thus narrowing of the gap between the sustainable and projected current account surplus.

Figure II.5. Botswana: External Sustainability Assessment  
(Percent of GDP)





49. **Saving the difference between diamond export revenues and the annuity under the sustainable current account path also provides a sustainable benchmark path for NFAs.** New NFA accumulation is driven each year by saving (and investing) the difference between diamond exports and the annuity. The stock of NFAs starts declining as diamond export receipts fall below the size of the annuity, in about 2023, when diamond production drops. However, this analysis abstracts from important additional considerations, namely (i) the starting stock of NFAs; (ii) the need for NFAs to include not only resource savings but also sufficient liquid reserves to help cushion external shocks; and (iii) significant movements in the capital and financial accounts. Here we assume that the initial NFA stock is zero, and look at the NFA accumulation needed to smooth imports at a permanent income level, equal to the sum of non-mineral exports and the annuity, in line with the sustainable current account path. If one also tried to maintain liquid reserves at about 6 months of imports, significantly higher annual savings would be necessary. Finally, the evolution of FDI and portfolio flows might be different depending on how the large energy and mining projects are financed.

50. **Taking into account the current stock of NFAs would allow for more flexibility in determining the sustainable current account path through 2050.**<sup>20</sup> At year-end 2006, NFAs amounted to 75 percent of GDP, and included both liquid reserves of about 6 months of imports (about 20 percent of GDP) and longer-term savings in the Pula Fund (another 55 percent of GDP). If one takes the Pula Fund (or some portion of it) as the starting amount of savings, then either annual savings out of diamond export receipts can be smaller to sustain imports at the permanent level until 2050, or that level can be sustained for a longer period. However, if the objective was both to maintain liquid reserves at their current level and to ensure sufficient saving of diamond revenue to sustain a permanent level of imports through 2050, then the NFA stock—even starting from the end-2006 NFA position—would be rapidly drawn down.

## E. Export Performance and Nonprice Competitiveness Indicators

### External sector outcomes

51. **Export performance has been disappointing** (Figure II.6). The share of total exports in GDP has been roughly constant since 1997, and the share of non-mining exports in non-mining GDP actually declined by 10 percentage points between 1997 and 2006, from 18 to 8 percent. Growth in the volume of both diamond and other exports has declined in recent years. In terms of market shares, Botswana's exports do perform better than other SACU members (excluding South Africa) thanks to diamonds, but remain far behind South Africa. Botswana's share of world trade has also been stagnant in recent years. The recent

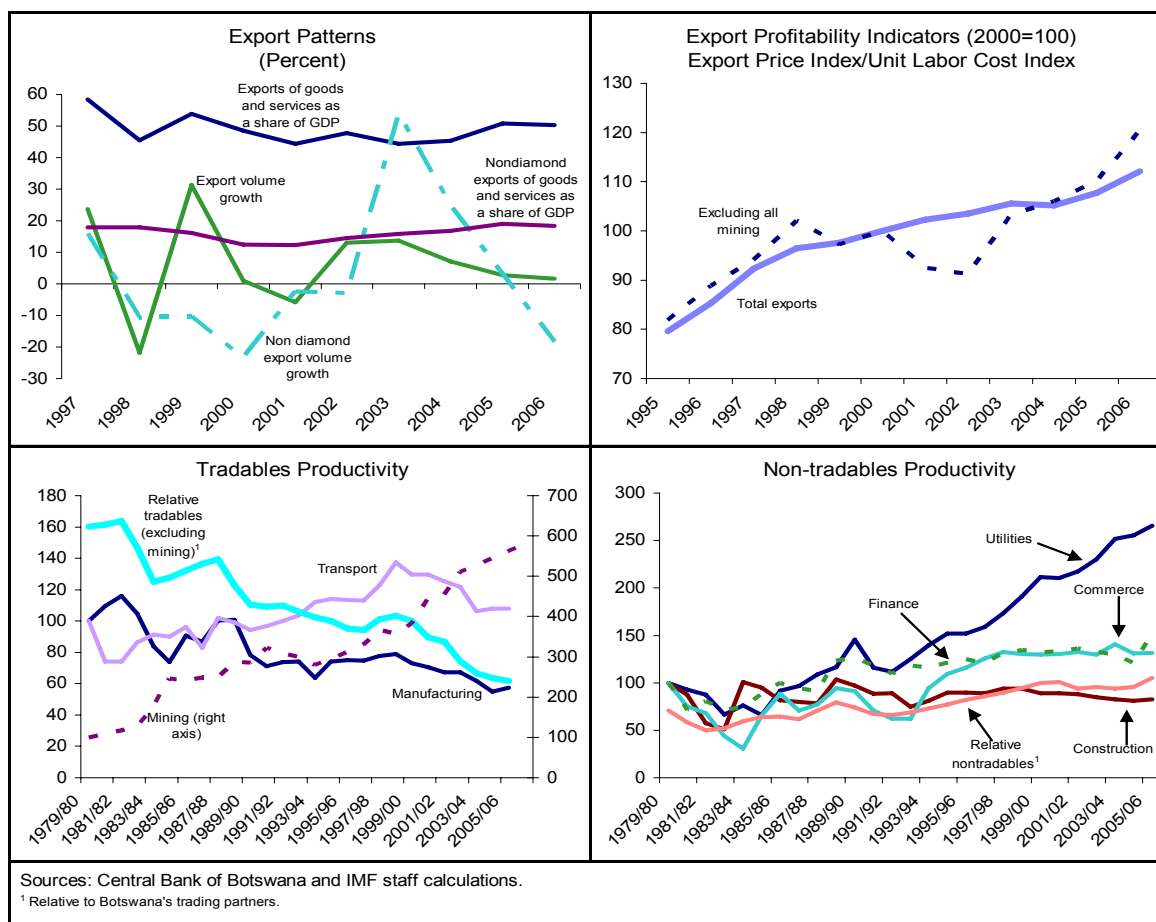
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<sup>20</sup> Alternatively it would allow to smooth imports over a longer period of time.

improvement in export profitability is due to a combination of higher export prices following the devaluation and to modest improvements in productivity, mostly in mining activities.

52. **Sectoral productivity trends show a worrying decline in labor productivity in tradables sectors other than mining.** Productivity in transport and manufacturing has been declining since the late 1990s, though there appears to have been an uptick in the past two years. In nontradables, only utilities show a strong improvement in labor productivity.

Figure II.6. Botswana: Export Performance Indicators



## Nonprice indicators of competitiveness

### *Infrastructure costs*

53. **Infrastructure costs in Botswana are higher than in other countries in the region** (Table II.2). Although airfreight costs appear competitive, except with respect to South Africa, sea freight costs to Europe are higher. Utility costs (water, electricity and telecommunications) are higher than in the region. Another issue is the high cost and deficiencies in information technology (IT) infrastructure, and the government monopoly on voice-over-internet-protocol (VOIP) services (BIDPA, World-Bank, 2005).

### *Survey-based measures of competitiveness*

54. The results of recent competitiveness surveys are mixed, but indicate a somewhat worse performance for Botswana than for direct competitors in the region, notably South Africa. Competitiveness rankings across countries and over time must be interpreted with caution: underlying surveys may not be strictly comparable across countries, and the evolution of a country's ranking is influenced by the (varying) total number of countries included. Overall, Botswana tends to perform better than Lesotho and Swaziland in each year, but worse than the other upper middle-income countries in the group, in particular South Africa (Table II.3).

Table II.2. Botswana: Comparative Costs of Infrastructure Services (U.S. dollars)

	Botswana	Kenya	Mauritius	Mozambique	Namibia	South Africa	Zimbabwe
Airfreight (per kg)	1.84	1.70	2.57	2.18	2.33	1.17	2.22
Sea freight to Europe (per 20-foot container)	2.00	1.40	1.80	1.50	1.08	1.00	2.00
Electricity (per kwh)	0.10	0.02	0.08	0.04	0.04	0.06	0.05
Water (per m3)	1.02	0.35	0.52	0.35	0.67	0.30	0.34
Telecom to EU (per minute)	4.04	4.00	1.65	3.60	1.23	2.21	2.58

Source: Namibian Investors, reproduced in UNCTAD (2002), quoted in BIDPA-World Bank (2005).

Table II.3. Botswana: Competitiveness Rankings\*

	2001	2002	2003	2004	2005	2006	
<b>Business Competitive Index (BCI) Ranking</b>							
Argentina	...	52	65	68	72	61	78
<b>Botswana</b>	...	...	53	55	57	55	69
Chile	...	29	29	30	29	29	29
Colombia	...	59	56	58	62	60	59
Lesotho	...	...	...	...	...	...	115
Malaysia	...	37	25	24	23	23	20
Mauritius	...	46	49	45	51	50	48
Namibia	...	...	50	53	49	80	75
South Africa	...	28	30	28	28	30	33
Swaziland	...	...	...	...	...	...	...
<i>No. of Countries</i>	...	74	79	97	100	113	121
<b>Global Competitiveness Index Ranking</b>							
Argentina	...	...	...	...	54	69	
<b>Botswana</b>	...	...	...	...	72	81	
Chile	...	...	...	...	27	27	
Colombia	...	...	...	...	58	65	
Lesotho	...	...	...	...	...	112	
Malaysia	...	...	...	...	25	26	
Mauritius	...	...	...	...	55	55	
Namibia	...	...	...	...	79	84	
South Africa	...	...	...	...	40	45	
Swaziland	...	...	...	...	...	...	
<i>No. of Countries</i>	...	...	...	...	117	125	
<b>Ease of Doing Business Ranking</b>							
Argentina	...	...	...	...	93	101	
<b>Botswana</b>	...	...	...	...	44	48	
Chile	...	...	...	...	24	28	
Colombia	...	...	...	...	76	79	
Lesotho	...	...	...	...	116	114	
Malaysia	...	...	...	...	25	25	
Mauritius	...	...	...	...	32	32	
Namibia	...	...	...	...	39	42	
South Africa	...	...	...	...	28	29	
Swaziland	...	...	...	...	67	76	
<i>No. of Countries</i>	...	...	...	...	175	175	

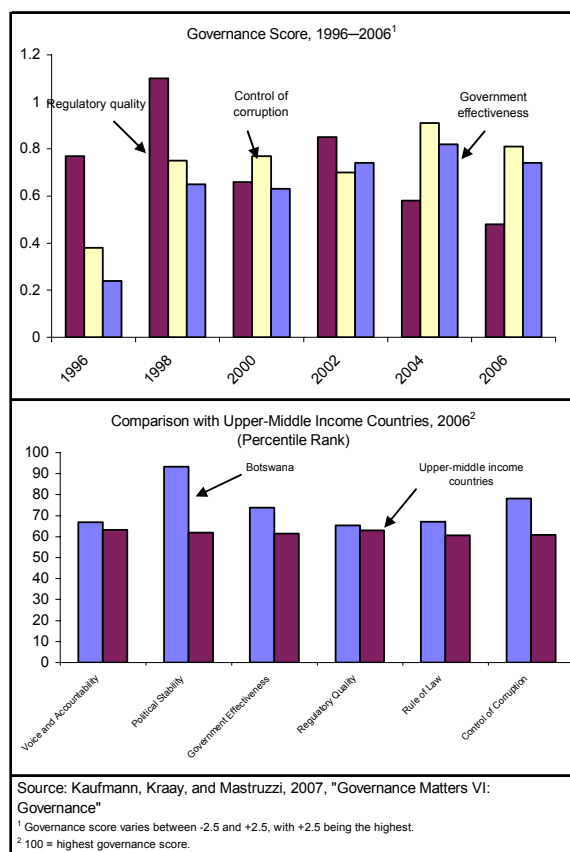
Sources: World Economic Forum; World Bank, Doing Business.

\* 1 = most competitive

55. **Perceived impediments to doing business in Botswana are related to the labor force and the functioning of the labor market, an inefficient government bureaucracy, inadequate and high-cost infrastructure, as well as issues of access to and cost of finance, in particular for smaller firms.**<sup>21</sup> Labor market issues include a skills mismatch that leads to both high unemployment and shortages of skilled labor, compounded by difficulties in obtaining work/residence permits for expatriate skilled workers. The HIV/AIDS epidemic is also taking its toll on productivity of the workforce. Although access to financial services is available to a larger share of the population in Botswana than in other countries in the region, small and medium-sized businesses find it difficult or too costly to obtain loans (see Botswana—Financial System Stability Assessment).<sup>22</sup> A 2004 FIAS report on obstacles highlighted these issues and also focused on the need for Botswana to improve the regulatory environment and remove administrative barriers to investment. In particular, it encouraged the authorities to continue their efforts to improve operational efficiency of public service and administration.

56. **Governance indicators, an area where Botswana's worldwide reputation is excellent, do show some deterioration in the regulatory quality dimension,** which measures the ability of the government to formulate and implement sound policies and regulations that promote private sector development. There also appears to be a recent decline in government effectiveness (the quality of public services, of the civil service, and of government policies and implementation capacity) and in control of corruption, though both indicators remain above historical trends. However, Botswana's performance continues to compare favorably to other upper-middle income countries (Figure II.7).

Figure II.7. Botswana: Governance Indicators



<sup>21</sup> According to annual competitiveness surveys conducted in Botswana by the World Economic Forum. See World Economic Forum, Global Competitiveness Reports, 2003–2007, and also the FIAS Report, 2004.

<sup>22</sup> A number of government initiatives and institutions attempt to provide subsidized financial services to small businesses, but their effectiveness in reaching the intended beneficiaries has been found to be limited.

## F. Summary and Conclusions

57. **Using a combination of approaches, the paper finds that Botswana's REER is broadly in line with economic fundamentals and consistent with external sustainability, indicating no threat to external stability.** A *description of balance of payments and real effective exchange rate developments* indicates no immediate threat to external stability: current account volatility is high due to the dependence on diamond exports, but reserve coverage is adequate and there are no significant balance sheet vulnerabilities stemming from the capital and financial account. *REER measures* indicate that the 2004-2005 devaluations and the switch to a crawling peg regime have undone the previous overvaluation, which was linked to poor productivity in nontradables versus tradables relative to Botswana's trading partners, and restored REER stability. *Equilibrium exchange rate estimation* confirms that, after a period of overvaluation, Botswana's REER is now broadly consistent with economic fundamentals (though the small sample size limits the reliability of the results). Based on current policies, the projected current account path through 2015 is consistent with *external sustainability*, provided that the future return of investments in mining and energy is higher than that on accumulating financial assets.

58. **Export performance and other indicators suggest a number of structural competitiveness obstacles that could explain the low labor productivity and poor export and export diversification outcomes.** Being a small, landlocked, and partly arid country, Botswana faces a number of "natural" competitiveness obstacles that weigh on the ability to diversify the non-mineral part of the economy. The small size of the domestic market makes it unattractive to large foreign investors outside mining, and utilities costs are higher than in neighboring countries, raising production costs. The recent fall in nondiamond export volume growth and declining labor productivity in non-mining tradables are worrisome trends, and the authorities have rightly made productivity enhancements and export diversification national priorities. Competitiveness surveys suggest a number of priority areas:

- *Labor market and education reforms* aiming at easier access to work and residence permit for expatriate skilled workers, and adapting education and vocational training to the skill requirements of the economy;
- *Continuing efforts to improve the efficiency of the government and the regulatory environment.* Following the 2004 FIAS report, the government is following up on the recommendations to improve procedures such as company licensing, reducing the time it takes for new businesses to get connected to utilities; it is also revising the foreign investment code and setting up a new competition policy. Further and perhaps faster progress in these areas would go a long way to increase the attractiveness of Botswana as an investment destination.
- *Implementing an appropriate mix of fiscal and monetary/exchange rate policy that allows for lower real interest rates; streamlining/privatizing publicly-subsidized financial services.*

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## APPENDIX

**Data Sources**

The REER is the multilateral CPI-based exchange rate of the pula, as calculated by the *IMF Effective Exchange Rate Facility*.

**real interest rate differential ( $r-r^*$ ):** The Botswana real interest rate refers to the CPI-deflated prime lending rate; data on both CPI and the prime lending rate are taken from the IMF, *International Financial Statistics* (IFS). The foreign real interest rate is defined as the weighted average of long-term government bond yields, deflated by the CPI, for trading partner countries; data are taken from the IFS.

**terms of trade ( $ltot$ ):** The terms of trade, defined as the relative price of exports to imports, are constructed based on trade data from the Central Statistics Office and the Bank of Botswana, and commodities prices from the IMF *World Economic Outlook* database.

**government consumption ( $lgc\_gdp$ ):** Defined as the ratio of government expenditure to GDP; based on data from the Ministry of Finance and Development Planning, the Central Statistics Office and the IFS.

**relative productivity ( $lrelprod$ ):** Defined as relative labor productivity in tradable/non-tradable goods (excluding mining) in Botswana against the weighted average of labor productivity in tradable/non-tradable goods for trading partner countries. Data for Botswana are taken from the Botswana National Productivity Centre, *Botswana Productivity Statistics Update 2006*. Data for trading partner countries are taken from the IMF Research Department (CGER Database).



Appendix Table 1. Unit Root Tests (Augmented Dickey-Fuller)

Variable	ADF	P-Value	Conclusion
<i>ln(REER)</i>	-3.16	0.037	I(1)
<i>(r-r*)</i>	-3.43	0.019	I(1)
<i>ln(tot)</i>	-5.50	0.000	I(1)
<i>ln(gc_gdp)</i>	-3.91	0.007	I(1)
<i>ln(relprod)</i>	-7.75	0.000	I(1)

Appendix Table 2. Test for Model Reduction

	Statistic	Value	p-value
VAR(2) to VAR(1)	F(25,38)	2.53	0.005

Note: The F statistic test the null hypothesis that it is appropriate to reduce the model by one lag.

Appendix Table 3. Cointegration Tests :  
Trace Test and Maximum Eigenvalue

Number of Hypothesized Cointegrating Equations	Trace		Max-Eigen	
	Statistic	P-value	Statistic	P-value
None *	92.30	0.00	56.52	0.00
At most 1	35.78	0.41	17.42	0.54
At most 2	18.36	0.54	11.28	0.62
At most 3	7.08	0.57	6.63	0.53
At most 4	0.45	0.50	0.45	0.50

Appendix Table 4. Results of Cointegration Estimation<sup>1</sup>

<u>Estimates of the cointegrating relationship</u>	
Real interest rate differential	-0.034 -0.003 [-13.024]
ln(terms of trade)	-0.042 -0.029 [-1.427]
ln(government consumption)	-0.338 -0.096 [-3.532]
ln(productivity)	-0.052 -0.013 [-4.110]
Constant	-2.946
<u>Estimates of the short term coefficients</u>	
Dln(REER)	-0.376 -0.139 [-2.699]
D(Real interest rate differential)	44.841 -6.469 [ 6.932]
Dln(terms of trade)	-0.065 -0.526 [-0.124]
Dln(government consumption)	0.172 -0.234 [ 0.733]
Dln(productivity)	1.107 -0.206 [ 5.364]
R-squared	0.367
Adj. R-squared	0.156

<sup>1</sup>Variables in first differences. Standard errors below coefficient estimates, and t-statistics between brackets.

Appendix Table 5. Residuals Tests

Test	Value	P-value
Vector AR 1-1 test:	F(25,20) = 1.230	[0.321]
Vector Normality test:	Chi <sup>2</sup> (10)= 6.0206	[0.814]

Appendix Figure 1. Equilibrium REER Estimation: Cointegration Residuals

