Environment and Development Economics 9: 485–505 © 2004 Cambridge University Press
DOI: 10.1017/S1355770X04001469 Printed in the United Kingdom

Sustainable development in mineral economies: the example of Botswana

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ABSTRACT. The Hartwick–Solow rule for sustainability requires that depletion of natural capital be offset by a compensating increase in other forms of capital capable of generating as much income as the natural capital they replace. Many countries have not been successful in transforming natural capital into other forms of wealth. This paper investigates the process of wealth transformation for Botswana, one of the most successful resource-rich countries. Using an expanded measure of wealth that includes manufactured capital, natural capital and net foreign financial assets, Botswana's per capita wealth has increased over the past 20 years. Government has recovered and reinvested rent. However, examination of the public sector capital budget reveals considerable unproductive investment. While correction for unproductive investments still indicates sustainable development, results suggest that aggregate indicators such as national wealth or genuine savings may be misleading without further attention to the process by which natural capital is transformed into other forms of wealth.

1. Introduction

National income and economic well-being depend on a country's wealth – produced assets, natural capital, and human capital. In addressing the management of exhaustible resources, Solow (1974, 1986) and Hartwick (1977) showed that an economy would be economically sustainable if total wealth is non-declining. Although natural capital is a large component of wealth, it has not yet been systematically included in the national economic accounts of most countries. This omission is being gradually corrected by the construction of environmental accounts, which will provide better indicators of sustainability and well-being (United Nations, 1993a, 2001).[1]

The Hartwick–Solow rule for sustainability requires that depletion of natural capital, such as minerals, be offset by a compensating increase

The views expressed here are those of the authors and do not necessarily reflect the views of the Bank of Botswana. The authors would like to thank Richard Auty, Jay Salkin, and several anonymous reviewers for their helpful comments.

[1] Human capital has also been omitted, but there is no agreement yet about how to measure human capital.

in other forms of capital. Many countries have not been successful in transforming natural capital into other forms of wealth. Governments, frequently the owners of natural resources, are under considerable pressure to spend mineral revenues on current consumption rather than to reinvest them, especially in developing countries where many basic needs remain unmet, and rent-seeking behaviour may be especially difficult to resist. Auty and Mikesell (1998) and Sachs and Warner (1995) found that, as a group, resource-rich developing countries have performed worse, economically, than resource-poor developing countries over the past 30 years, a phenomenon known as the 'resource curse'.[2]

The ability to transform non-renewable natural capital into other forms of productive wealth is the key to successful economic development of resource-rich economies. This process requires several steps: policies that promote economic efficiency in resource extraction so that maximum rent is generated, the recovery of resource rent by a responsible agency that will reinvest the revenues, and investment in alternative assets that produce as much income as the natural capital they replace. Although there is an extensive literature on public sector capital in public finance economics, the third point has received relatively little attention in the literature on sustainable development.

Even in countries with strong government commitment to promoting efficient resource exploitation and reinvestment of rents, much of the rents support public sector capital, and it is not clear that the new investment is very productive. A fundamental problem concerns the definition and measurement of public sector capital. As currently measured in the national accounts, public sector capital is valued at the cost of capital, an assumption that is very difficult to sustain (Pritchett, 1997, 2000). While there may be positive externalities to infrastructure and human capital investments these can easily be exaggerated and will also decline as the range of public investments is extended outside the provision of core public goods (Isham and Kaufmann, 1999).

In a major report on development and public infrastructure, the World Bank (1994) points out that the economic benefits of infrastructure investments are often reduced by insufficient attention to costs and benefits in project choice, low operating efficiency, inadequate maintenance, and lack of attention to the needs of users.

These problems suggest that, due to incorrect pricing, empirical measures of sustainability must go beyond aggregate indicators, such as total wealth (for example Dasgupta and Mäler, 2000) or genuine savings (Kunte *et al.*, 1998), and examine the *process* by which mineral revenues are transformed into other forms of capital. Given the enormous revenues that accrue to governments and their role in reinvestment, it is particularly important to assess public sector capital. Botswana has been chosen as a case study for this paper, and is a particularly relevant example for two reasons. First, natural capital is especially important in Botswana: minerals, mainly

[2] For further discussion of this issue, its causes, and why a few countries, like Botswana, have escaped the resource curse, see Auty, 2001; Auty and Mikesell, 1998.

diamonds, form the largest single component of its national wealth, and account for one-third of GDP, half of government revenue, and most of its exports. Second, the government of Botswana has been a notable exception to the dismal economic performance of resource-rich developing countries. In the past 25 years real per capita income growth has averaged 5.4 per cent per annum. Poverty, while still high, is falling (Jefferis, 1997).

Botswana has consistently reinvested most of its mineral revenues in accordance with criteria explicitly aimed at economic sustainability and the enhancement of the stock of physical and human capital. As such, Botswana is widely considered to be an excellent example of resource management with future generations in mind. At the same time, however, the central role that government has played in developing the economy brings to the fore the issues of investment productivity, and whether this is adequately addressed by the existing policy framework (Wright, 1995, 1997a).

This paper investigates the process of wealth transformation for Botswana, one of the most successful resource-rich countries. The organisation of the paper is as follows. Section 2 discusses the methodology and data used for this study, in particular the environmental accounts and policy guidelines for the share of resource rent that should be reinvested. Section 3 reviews Botswana's economic sustainability over the past 20 years, using an expanded definition of wealth that includes mineral assets and net foreign financial assets. This is followed in section 4 by an analysis of the process by which mineral revenues have been transformed by government into other forms of wealth. The productivity of different categories of public investment is evaluated. Concluding remarks about management of mineral revenues are provided in the final section.

2. Methodology and data sources

2.1. Wealth and sustainability

In an exhaustive review of definitions of sustainability, Pezzey (1992) has identified the definition of sustainability that is most often used by economists: an economic development path is sustainable if well-being per capita does not decline at any point. Solow (1974, 1986) and Hartwick (1977) derived the conditions necessary for economic sustainability in an economy dependent on a non-renewable resource, like minerals, the Solow–Hartwick rule: non-declining total wealth to be achieved by reinvesting all the rents from the non-renewable resource in other forms of capital (assuming that resources are priced efficiently). The relationship between sustainable well-being and constant wealth was further elaborated by Pearce and Atkinson (1993), and formalized by, among others, Hamilton and Clemmens (1999) and Dasgupta and Mäler (2000).

Drawing on Hamilton and Clemmens, a simplified version of this formalization states that, for a closed economy producing a composite good that can be consumed, or invested in either produced capital or human capital, $F(S_P, Q, S_H) = C + \Delta S_P + m$, where S_i are stocks of produced, natural and human capital; Q is use of a non-renewable resource; C is consumption; m is investment in human capital; the change in the stock of human capital is a function of investment, $\Delta S_H = q(m)$; and the depletion

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of natural capital is equal to extraction, $\Delta S_N = -Q$; and where well-being, V, is defined as the discounted sum of all future utility, $V = \sum_{\tau=t}^{\infty} \frac{U(C)}{(1+\delta)^{\tau-t}}$, then, a change in well-being is proportional to the change, in the value of assets

$$\Delta V = U_c \cdot \sum p_i \Delta S_i \tag{1}$$

where U_c is the marginal utility of consumption, p_i are the shadow prices of produced, natural and human capital, respectively. It is relatively straightforward to expand this model for renewable resources, pollution and environmental degradation, and population growth, as well as for other specifications of the utility functions, including for example utility derived from environmental quality (Dasgupta and Mäler, 2000) From equation (1), the rule for sustainability can be expressed, adjusted for population growth, as

$$\frac{K_{t+1}}{P_{t+1}} \geq \frac{K_t}{P_t} \tag{2}$$

where P is population and K is the value of total wealth the sum of the products of the stocks of assets and their shadow process $K = \sum K_i = \sum p_i S_i$. For an open economy, such as Botswana, the concept of wealth is expanded to take into account the importance of holdings of net foreign financial assets, so K is defined to include K_F, net foreign financial assets as well as produced, natural, and human capital

$$K = \sum (K_P + K_N + K_H + K_F) \tag{3}$$

Using equations (2) and (3) to monitor sustainability over time raises two major challenges: (1) assets must be valued at their correct prices and (2) all assets must be included. Regarding the first issue, this paper reviews evidence that the prices used to measure public sector capital are incorrect and explores the implications for sustainability. Regarding the second issue, human capital is not readily measurable at this time; however, there are measures for the other three components of wealth in Botswana: manufactured capital is recorded in the national accounts, net foreign financial assets are measured and reported by the central bank,[3] and, with the recent implementation of environmental accounts in Botswana, a measure of natural capital has now become available.

2.2. Measuring the value of natural capital

Environmental accounting, described in the System of Environmental and Economic Accounts (SEEA) provides a method to measure the value of natural capital (UN, 1993a, 2003). This method had been used to compile monetary accounts for sub-soil assets, arguably the most important natural

[3] For this analysis, net foreign financial assets are defined as government's net foreign financial assets. Little information is available about private holdings, but these are estimated to be quite small, relative to government's holdings, and, for the purpose of estimating trends in national wealth, can be ignored.

asset, for Botswana. (For a more detailed description of methodology and sources, see Lange, 2001; Lange *et al.*, 2003).

The environmental accounts do not, at this time, include a measure of the value of three other important assets – land, water, and wildlife – because of a lack of data. While this omission may affect the level of natural capital, it is not expected to bias time trends of national wealth. Land, the most important natural resource in the balance sheets of other countries, does not change in quantity, and has not been seriously degraded in Botswana. If anything, the value of land around urban areas has increased somewhat. Fragmentary evidence suggests some depletion of water and wildlife, but the effects are expected to be small relative to changes in the other components of national wealth.

The value of minerals is the present discounted value of the stream of net income (rent) they are expected to generate in the future.[4] For each year, t, and each mineral, j, resource rent (R) is calculated as the value of production or total revenue is calculated as the value of total revenue (TR), minus the marginal exploitation costs, which include intermediate consumption (IC), compensation of employees (CE), consumption of fixed capital (CFC), and the opportunity cost of capital invested in mining, of 'normal profit' (NP), where normal profit is the product of produced capital (K) and its rate of return (i):

$$R_t^j = TR_t^j - IC_t^j - CE_t^j - CFC_t^j - NP_t^j \tag{4}$$

$$NP_t^j = iK_{P,t}^j \tag{5}$$

For constructing indicators of sustainability, it is essential that assets are correctly priced. There are a number of reasons why the prices of natural capital might be distorted, although this is probably less likely with minerals than with more complex assets such as forest ecosystems. However, some observations can be made. In actual implementation, data about marginal costs are not generally available, so countries have used average cost, an approach recommended by the SEEA (UN, 2003). The use of average cost is likely to overestimate resource rent and the value of the mineral asset, although there has been no systematic investigation of the potential distortion.

Except for the rate of return on produced capital, data obtained from Botswana's national accounts, which are considered quite reliable, were used to calculate rent each year for each mineral. In line with recommendations of Botswana's Ministry of Finance and Development Planning (MFDP), a rate of 10 per cent was used. In the full report on the mineral accounts a sensitivity analysis was performed using a 20 per cent return to capital (Lange, 2001).

[4] An alternative is the net price method, which does not discount future earnings, assuming that real rent rises at the same rate as the discount rate according to Hoteling's Rule. Since there has been little empirical evidence for this, the net price method is rarely used now. Further discussion of this issue can be found in (UN, 2003).

Having calculated the value of rent in a given year, the formula for calculating the asset value for each mineral is (superscript, j, for each mineral has been omitted below for easier reading)

$$K_{N,0} = \sum_{t=0}^{T} \frac{p_{N,t} Q_t}{(1+r)^t} \tag{6}$$

$$p_{N,t} = \frac{R_t}{Q_t} \tag{7}$$

$$T_t = \frac{S_{N,t}}{Q_t} \tag{8}$$

where T is the remaining lifespan of the resource, and other variables are defined as above.

Valuation should be based on expected future extraction paths, production costs, and market prices. However, in most instances this information is lacking so it is assumed (a procedure recommended in the SEEA) that both the future volume of extraction and the per unit rent remain constant over time, although, as will be seen, both have fluctuated over time. A social discount rate of 10 per cent is used, based on MFDP guidelines. Because mineral prices can fluctuate a great deal from one year to the next, a five-year moving average price (rent per unit) was used in the valuation in order to reduce volatility and better represent the longer-term value.

As with many economic variables, in order to assess trends over time, asset values must be converted to constant price (volume) measures. The SEEA, unfortunately, does not address the appropriate way to measure constant-price natural capital. Only one country, Australia, has published constant-price natural capital for which they used unit rent in the base year. An alternative would be to use the GDP deflator. While the GDP deflator approach seems conceptually the better method, since there has been no experience yet with this method, the constant unit rent method is used for the accounts presented here, with the base year as 1993 (see Lange, 2002 for a discussion of this issue and its implications for asset valuation).

Mineral accounts have been constructed for Botswana's three major minerals: diamonds, (accounting for 94+ percentage of mining value added in recent years), copper/nickel (mined jointly), and coal. Other minerals have not been included at this time because they were not economically important, but may be included in future work. Most data about physical accounts were obtained from the Annual Reports of the Department of Mines (Department of Mines, various years). Diamond reserves data were obtained from the 1999 Annual Report of DeBeers, the government's joint partner in Debswana, which operates the diamond mines (DeBeers, 2001). Coal reserves (data obtained from CSO, 2000), have been measured for only two of Botswana's 11 coalfields and will last thousands of years at current rates of extraction. The quality of the coal is low, so it has not been economically feasible to export coal and it is only used domestically, mainly for power production.

2.3. Rules for reinvestment of rent from non-renewable resources

The Hartwick Rule for sustainability requires that the rent generated by a non-renewable resource must be reinvested in other forms of capital. In Botswana, fiscal policy is firmly based in a tradition of prudence and medium-term planning, developed at a time when subsistence under harsh and drought-prone conditions taught the value of effective use of limited resources and saving at times when surpluses occurred. Recognizing that the revenues from diamonds represented mostly asset sales rather than value-added in production, the government of Botswana saw the need for reinvestment of these revenues in order to sustain development (see, for example, Ministry of Finance and Development Planning, 1991: 27).

Without a formal investment rule, the emphasis has been to reserve *all* mineral revenues for investment expenditure (Government of Botswana, 1994), which is the intent of Hartwick's Rule. From the mid-1990s, a formal rule to this effect was introduced which is now routinely included in the various assessments of economic performance produced by the government (Ministry of Finance and Development Planning, 1994). This measure, which, following Salkin (1994), has been labelled by commentators the Sustainable Budget Index (SBI), is simply the ratio of non-investment spending to recurrent revenues

$$SBI = \frac{Spending_{non\text{-}investment}}{Revenue_{recurrent}} \tag{9}$$

An SBI value of 1.0 or less has been interpreted to mean that public consumption is sustainable because it is financed entirely out of revenues other than from minerals, and that all the revenue from minerals is used for public investment. An SBI value greater than 1.0 means that consumption relies in part on the mineral revenues, which is unsustainable in the long term.

To calculate the SBI, the government expands the definition of public sector investment so that it includes not only the capital budget (referred to in the public finance data as 'development expenditure'), but also that portion of the recurrent budget used for education and health, interpreted as investment in human capital. Government has assumed that 30 per cent of the recurrent budget is investment in human capital. While this is a rule of thumb rather than derived from a detailed identification of specific expenditures, the 30 per cent approximates the combined share of health and education in the recurrent budget over the past 20 years. Thus non-investment spending in the SBI is equal to 70 per cent of the recurrent budget.

While the SBI has been subject to extensive examination from both a practical and theoretical perspective, the precise theoretical derivation from principles of sustainability remains an issue. The SBI rule has the obvious advantage that it is clear and easy to understand. However, it has an inherent problem as a policy rule because it dictates an action to be taken – reinvesting all mineral revenue in public sector and human capital – but without any objective against which to optimize allocation of rents, both inter-temporally and among alternative assets, and to assess the usefulness of the allocation.

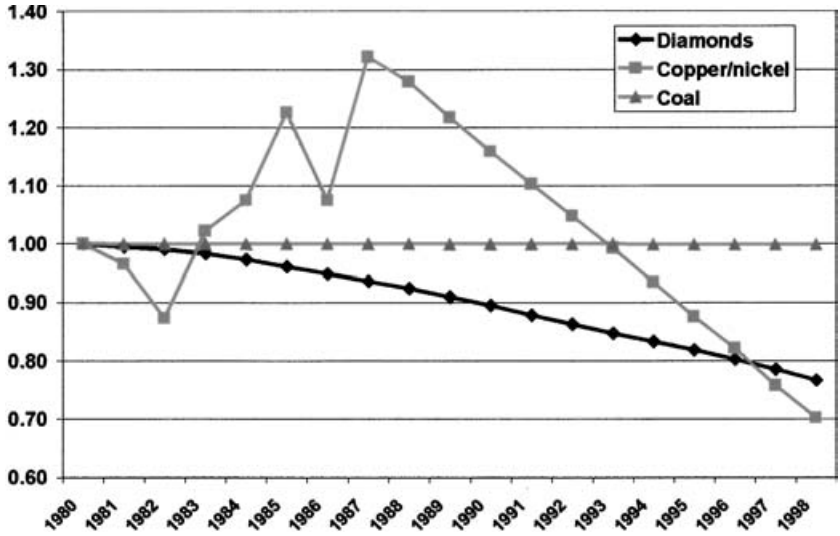

Figure 1. *Index of mineral reserves, 1980 to 1998 (1980 = 1.00)*
Source: Based on Lange, 2001.
Note: Figure shows reserves at the close of each year relative to reserves in 1980.

Another problem with the SBI is the assumption that all development spending is productive investment. Also, there is no inter-temporal dimension to the SBI and, as such, there are ways in which mineral revenues not invested immediately can subsequently be used to fund recurrent spending. Wright (1997b) argues that the SBI is the optimal rule where a maximin approach to risk assessment is adopted, and that this is an appropriate strategy for a government concerned with safeguarding the interests of future generations.

3. Natural capital and total wealth in Botswana

The first part of this section reviews the level and composition of Botswana's wealth over the past 20 years to determine whether Botswana is using its mineral wealth in a manner that promotes sustainability, that is whether per capita wealth is non-decreasing, and whether depletion of mineral wealth is compensated for by an increase in other forms of wealth.

3.1. Physical and monetary accounts for minerals

Physical indices of mineral reserves, which show the reserves at the close of each year relative to reserves in 1980, are shown in figure 1. Generally, physical reserves have declined because extraction has been greater than new discoveries or other changes. Over the past 20 years, less than 25 per cent of known diamond reserves have been extracted. The extraction of copper/nickel was partly offset by new discoveries and reclassification of reserves from 1983 to 1988, but by 1998, about 30 per cent of copper/nickel

https://doi.org/10.1017/S1355770X04001469 Published online by Cambridge University Press

Table 1. *Mineral wealth and total wealth of Botswana, 1980 to 1997 (millions of pula in constant 1993/1994 prices)*

	Diamonds	*Copper-nickel*	*Coal*	*Total mineral wealth*	*Total wealth*	*Per capita wealth (pula per person)*
1980/81	7,896	386	42	8,323	14,686	16,184
1981/82	7,677	358	43	8,078	15,223	16,177
1982/83	12,024	378	46	12,448	20,039	20,536
1983/84	16,608	424	44	17,076	25,420	25,124
1984/85	19,928	458	44	20,431	29,764	28,368
1985/86	19,545	452	49	20,046	31,732	29,168
1986/87	20,261	482	56	20,799	34,125	30,255
1987/88	20,452	480	65	20,996	36,518	31,233
1988/89	23,513	471	68	24,053	41,899	34,576
1989/90	23,542	450	74	24,067	44,864	35,728
1990/91	26,690	428	89	27,207	50,828	39,068
1991/92	25,414	420	88	25,921	52,455	39,529
1992/93	24,563	409	101	25,073	53,183	39,134
1993/94	22,722	414	99	23,236	53,166	38,221
1994/95	23,947	403	101	24,451	56,197	39,436
1995/96	25,792	375	100	26,267	59,443	40,742
1996/97	27,089	391	85	27,566	64,524	43,131
1997/98	30,451	354	87	30,892	70,368	45,890

Source: Based on figures from Lange, 2001.
Notes: Constant price values calculated using the unit rent for 1993/94. Value of Closing Stock reported.

reserves had been extracted. Less than 1 per cent of the known coal reserves have been extracted.

The monetary accounts (table 1) indicate that diamonds clearly constitute Botswana's main form of mineral wealth – in constant 1993 prices, diamonds accounted for at least 95 per cent of the total. Although physical reserves of Botswana's most important mineral, diamonds, have declined, value in constant prices has been increasing over time. This is due entirely to the increasing level of extraction of diamonds over time, and, hence, less discounting of future rents. Since the formula for calculating asset value assumes the same level of extraction in all years of a mine's lifetime, a year with low extraction (as in the early 1980s when world demand for diamonds was low and Botswana was still developing its mining capacity) would yield a low asset value because much of its diamonds would only be extracted far in the future, subject to heavy discounting. The power of discounting future income reduces the value of the assets considerably – at a 10 per cent discount rate rent accruing 50 years in the future is worth less than 1 per cent of its nominal value. By increasing extraction, the delay in receiving rent was substantially reduced, increasing the value of its diamonds.

3.2. Total national wealth

Figure 2 reports total national wealth (in constant 1993 prices): produced assets (public and private), mineral assets, and government's net foreign

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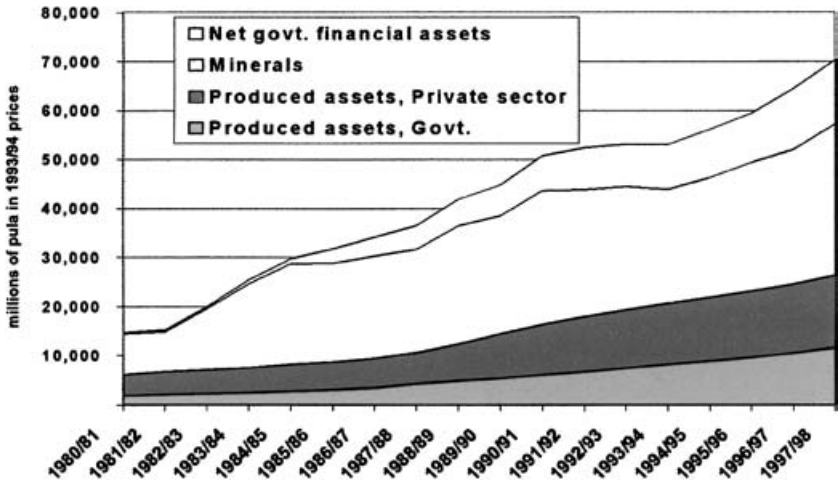

Figure 2. *Value of assets by type of asset, 1980 to 1997 (constant 1993/94 prices)*
Source: Based on Lange, 2001.
Note: Net government financial assets converted to constant prices using the GDP deflator.

financial assets. Foreign financial assets are especially important in the wealth of a country like Botswana because limited domestic investment opportunities require that at least some of the revenue from minerals be invested overseas. Over time, all forms of capital have been increasing from almost 15 billion pula in 1980 to over 70 billion in 1997. During this time, the composition of national wealth has changed, especially since the mid-1980s.

As the share of mineral wealth declined from 57 per cent to 44 per cent between 1980 and 1997, net foreign financial assets increased from 2 per cent to 19 per cent. The share of public produced capital also grew, 13 per cent to 16 per cent, while the share of private sector capital declined significantly, 29 per cent to 22 per cent. The depletion of mineral assets is being offset by investment in other assets. Both public and private capital have grown faster than population. However, wealth creation has been dominated by the public sector: public sector capital (produced assets plus net foreign financial assets) has grown at an average annual rate of 15 per cent, while private sector capital has grown only 7.7 per cent annually. Furthermore, the economy is still dominated by mining and the declining share of private capital reflects slow progress in achieving government's objective of economic diversification.

More important than the total value of capital stock is the *per capita* value of capital stock. Capital stock must grow at least as fast as population in order to maintain living standards, but to improve living standards, capital stock must grow more quickly. Per capita assets almost tripled between 1980 and 1997, increasing from about 16,000 pula to 46,000 pula in 1993 constant prices (table 1).

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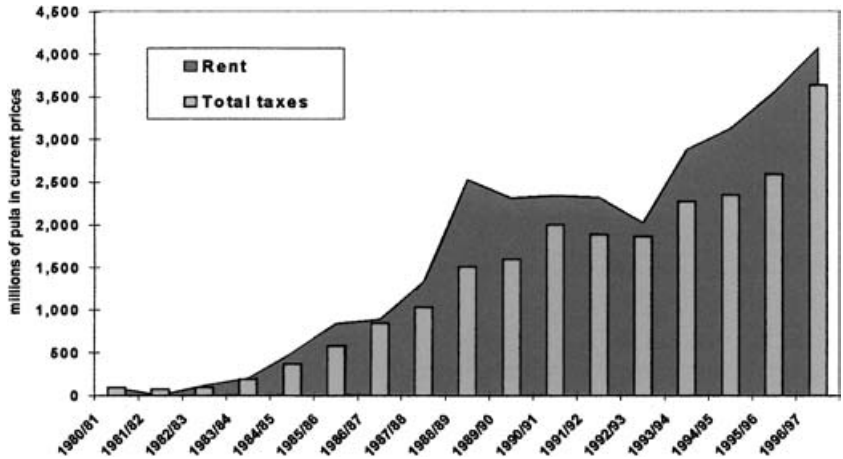

Figure 3. *Resource rent and taxes from mining in Botswana, 1980 to 1997*
Source: Based on Lange, 2001.
Note: Rent calculations assumed a 10 per cent return to fixed capital.

4. Transforming mineral wealth into other forms of capital

This section addresses the process of transforming mineral revenues into other forms of capital. First, the amount of rent generated by mining and the share recovered by the government is reported. Then, reinvestment of rent by the government is assessed in terms of the SBI. The investments made by the government from mineral revenues are examined in detail and some adjustments are made to the measure of public sector investment so that it more accurately reflects the productivity of public sector investment. The SBI is then adjusted to reflect this more accurate assessment of productive investment.

4.1. Resource rent: recovery and reinvestment by government

The previous section indicates that replacement of mineral wealth by other forms of wealth has, indeed, been occurring. Examination of the collection of resource rent by the government and the use for investment provides a clearer picture of the process by which this has happened. Most countries, including Botswana, levy special taxes and royalties on minerals to capture resource rent. The government has, in fact, been successful in recovering the resource rent generated by mining in all years (figure 3), with recovery averaging 75 per cent of rent. Because of the large role of diamond mining in the economy, the government is very dependent on revenues from mining, particularly diamonds. In many years, mineral revenues accounted for more than half of total government revenue.

Over most of the period, all mineral revenues have been reinvested in public capital. The capital and development budget, what is narrowly defined as public sector investment, constitutes a large share of both government budget and GDP, averaging 38 per cent of the total government budget and 13 per cent of GDP over the past 25 years (figure 4). The SBI,

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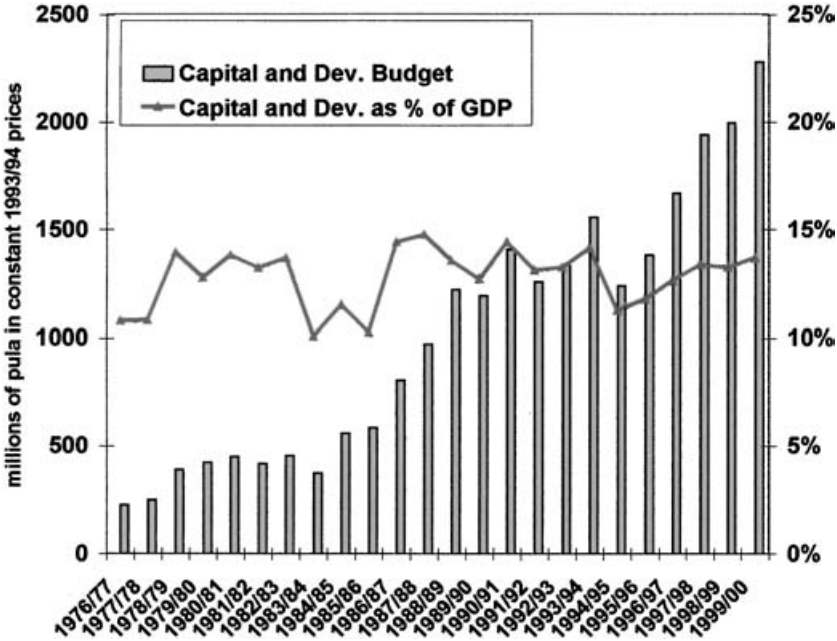

Figure 4. *Public sector investment as share of GDP (in constant 1993/1994 prices) Source:* Authors' calculations based on CSO (*Statistical Bulletin*, various years) and Government of Botswana (*Annual Financial Statement*, various years).

which includes the capital and development budget as well as investment in human capital from the recurrent budget, has remained well under 1.00 until the 1990s (figure 5). It first passed 1.00 in 1994/95, and has now been over 1.00 for 2000/01 and 2001/02.

Human capital is an especially important component of public investment and the SBI. Figure 6 also shows the effect of adding recurrent expenditures for education and health to conventionally defined public sector investment. If they had not been included as part of investment but instead had been included as part of recurrent spending, the SBI would have averaged 1.07 from 1976 to 2001, which is unsustainable.

4.2. Productivity of government investment

Since the mid-1970s public sector investment has never been less than 30 per cent of total gross fixed capital formation and has at times approached 50 per cent (Wright, 1999). There are two very different components of public sector assets: manufactured capital and foreign financial assets.

In the early 1980s, foreign financial assets were relatively small (figure 2), and these assets were held primarily to provide a foreign exchange reserve for imports. As diamond revenues grew, these assets increased rapidly. The objective of a risk-weighted financial return is the sole determinant of this portfolio. In recent years, foreign financial assets became the second or third largest source of government revenue after mineral revenues.

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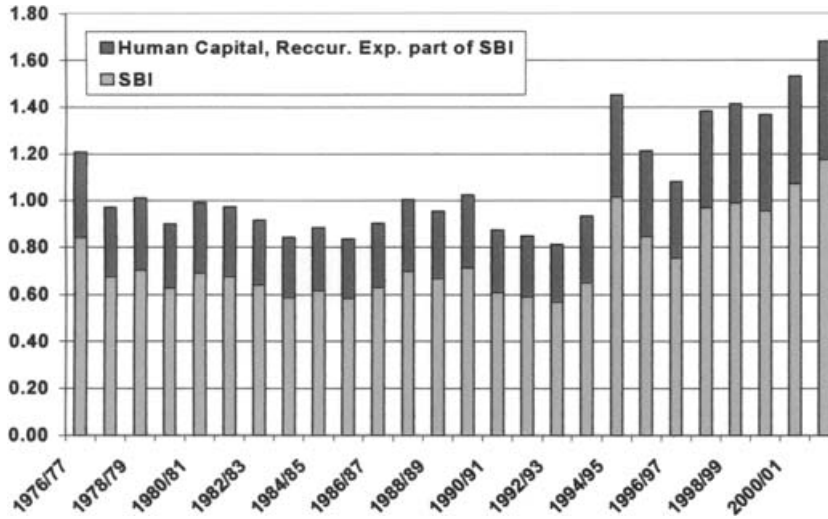

Figure 5. *Sustainable Budget Index, 1976 to 2001*
Notes: The human capital component shown in the graph is measured as 30 per cent of the recurrent budget, which approximates recurrent expenditures for health and education. Figures for 2001/2002 are based on the budget published at the start of the year.
Source: Authors' calculations based on Government of Botswana, various years.

The value of foreign financial assets is continuously revised by the Bank of Botswana to reflect changing market conditions, so that the reported value reflects the best current assessment of their true underlying value, that is, their capacity to generate income. The same certainty cannot be assumed for valuation of the other component of government investment, manufactured capital and human capital, because these forms of capital do not generate incomes that can be directly and solely attributed to them.

In the national accounts, the value of investment and capital stock is measured by the cost of an investment. This is reasonable for private sector investment because, in theory, competitive markets assure that the cost of private sector investments is equal to the income they generate. In addition, the profitability of an industry provides a means for measuring the value of its investments, and for assessing whether the cost of an investment is, in fact, equal to its income-generating capacity. However, this is not the case for public sector investments, which are insulated from competitive pressures and where investment decisions, for a variety of reasons, have not always been based on the expected economic returns (at least narrowly defined or where the returns are easily quantified financially). These reasons range from the use of wider, non-economic criteria to assess the desirability of spending, a lack of rigor in undertaking cost–benefit analyses, and a lack of control in project implementation leading to changes in scope and/or costs that may undermine such analyses. Despite a well-deserved reputation for careful planning at both the macro and micro levels, all these problems exist to some extent in Botswana, possibly exacerbated by the large inflows

of public revenues, which have weakened the overall budget constraint. Thus, use of the national accounts' valuation of the stock of public capital as an indicator of its underlying investment value must be treated very cautiously.

Even if considered to be of good enough quality, consistent national accounts data exist only for the period since 1974. This inevitably constrains productivity analysis, especially for government investments, which are likely to be long term in nature. However, a start can be made in assessing the productivity of the government's investment programme by examining the structure of investment.

Such an examination must be seen in the context of the literature on the sources of economic growth (for example, Temple, 1998 and the 'Economic Growth Resources Website'[5]). In the case of Botswana, some attempt has been made to examine growth within a total factor productivity framework, and reached the tentative conclusion that a slowdown in productivity growth could be attributed to a declining quality of government investment (Bank of Botswana, 1994; Leith, 1997). However, this did not focus on the composition of public sector investment, and the robustness of the conclusion can be questioned in the light of problems with the data (Wright, 1999).

The review of government's investment programme will identify which components of government's capital budget, if any, are clearly not productive, that is not generating income at least equal to the cost of investment. While this is not sufficient to allow revisions of the time series of public sector capital stock, it does allow revision of the SBI, the indicator of sustainability. These revisions will provide a more accurate assessment of economic performance and changes in national wealth. Furthermore, this assessment may indicate how to improve the allocation of public sector investment, both between foreign financial assets and fixed capital investments, as well as among different categories within the capital budget.

Taken as a whole, public investment does not seem to have exceeded levels at which additional such investment is detrimental to growth. Isham and Kaufmann (1999) estimate this level at around 10 per cent of GDP. The initial observation by most experts about Botswana's public spending is that the profile over time is broadly in line with what might be seen as good for growth (Leith, 2001). Public spending has emphasized public infrastructure: shares of the capital budget going for roads, expansion of water and electricity connections, and communications have averaged 12 per cent, 11 per cent, and 8 per cent, respectively, between 1976 and 2000 (table 2). More recently, there has been an increasing emphasis on investment in education and health in the capital budget, averaging 19 per cent of the capital budget over the entire period, and 24 per cent over the last five years, in addition to the 30 per cent of the recurrent budget spent on human capital. However, the shares within the capital and development budget only tell part of the story; there are two major qualifications to this favourable picture.

[5] www.bris.ac.uk/Depts/Economics/Growth

Table 2. *Development budget of Botswana, 1976–2000*

	1976–1980	*1981–1985*	*1986–1990*	*1991–1995*	*1996–2000*	*All years*
Defence	9%	7%	15%	15%	8%	11%
Education and health	19%	16%	19%	18%	24%	19%
Economic services, of which:	55%	55%	46%	41%	41%	47%
Agriculture	8%	9%	11%	4%	5%	7%
Mining	7%	5%	4%	7%	3%	5%
Water and electricity	8%	11%	9%	9%	15%	11%
Roads	22%	14%	7%	10%	11%	12%
Other transportation and communications	6%	12%	11%	7%	4%	8%
Other economic services	4%	4%	5%	3%	4%	4%
Other development spending, of which:	17%	23%	19%	26%	28%	23%
General administration,	15%	16%	15%	20%	22%	18%
Housing, urban and regional development						
Food, social welfare and other community services	2%	6%	4%	6%	6%	5%
Total	100%	100%	100%	100%	100%	100%
Government Development Budget as Share of:						
Total government budget	41%	38%	44%	35%	33%	38%
GDP	12%	13%	13%	13%	12%	13%

Source: Authors' calculations based on Government of Botswana, 2001.

First, examination at the sectoral level reveals clear cases where budget items are not productive. Three examples of these deficiencies are identified here in the sectors of defence, community and social services, and agriculture. Together these averaged nearly one-quarter of public investment over the past 25 years.

Defence has accounted for an average of 11 per cent of the capital budget from 1976 to 2000. According to IMF guidelines no spending on defence should be regarded as an investment. This said, the Botswana government's justification of the rapid build up in defence spending as being necessary to establish the Botswana Defence Force (BDF) from scratch is not without merit. At independence, Botswana had no armed forces and, as a front-line state during the apartheid era of South Africa (and in a region where significant social and political instability still exists), it had a real need to build up a defence capacity. However, there is widespread concern that the force's budget is not subject to serious scrutiny or control.

Food, Social Welfare, and Other Community and Social Services have accounted for an average of 5 per cent of government's capital budget, rising from 2 per cent over the period 1976–1980 to 6 per cent in the past decade. A substantial part of this budget category is actually transfer payments related to drought relief, which is clearly not an investment. Such spending has been included in the development budget in part to help attract funding from donors, who look more favourably at cooperating on one-off rather than recurrent expenditures.

Traditionally a pastoral society, *agriculture* continues to play a major social and cultural role in Botswana and an average of 7 per cent of the development budget has gone to agriculture. But, despite heavy government investment, agriculture's contribution to GDP has declined over the past 25 years and is now less than 4 per cent. Over the period 1973–1996, public sector expenditure in support of agriculture averaged more than 40 per cent of agricultural GDP. Moreover, the spending is unbalanced in favour of crops where the spending appears to have well exceeded the value of output, in which case no conventional calculation can yield a positive return. Possibly recognizing this, the government has undertaken to review the effectiveness of its various agricultural assistance programmes. Like defence spending, however, public investment in agriculture is declining, averaging only 4–5 per cent of the capital budget over the past five years (table 2).

Another disturbing trend is an increasing tendency for development spending to be in the form of 'monuments', although this is not a phenomenon that can be easily quantified. Acquiring a new headquarters building seems to be a major objective of government ministries, their departments, and the various bodies that they support. At the same time, there is little evidence that the public service is becoming increasingly productive as a result of this. With the attention focused on new construction, maintenance of the existing infrastructure has been given less priority. Recognizing this, in November 2001 a total of 670 million pula was approved for the remainder of NDP 8 (that is until March 2003) to help clear the backlog of maintenance of government buildings; however this

was included in the development budget and as such will also be classified as investment.

The second qualification about Botswana's capital budget concerns the clear potential for diminishing returns to set in as the stock of public infrastructure expands. Public sector investment has grown at an average annual rate of over 11 per cent since 1980, which is very rapid indeed. Over the same period, private sector capital has grown about 7 per cent annually. Leith (1997) has argued that continuing dominance of government investment has contributed to a slowdown in total factor productivity growth, although data weaknesses make this conclusion far from certain (Wright, 1999).

Certainly, some tendency to overinvest with public spending can be expected because users rarely face the full costs, as their counterparts in the private sector do. This tendency is likely to be pronounced in Botswana where the budget constraint is particularly soft: the costs of the development programme being met from mineral asset sales and increasingly, from interest earned on foreign financial investments.

The process of designing and implementing the capital budget adds to the concerns about low productivity. Government has expressed its concern that development projects are not subject to sufficiently rigorous economic analysis before approval (Government of Botswana, 2000). To compound this problem proper attention to sequencing of project implementation has not been applied, again due in part to the surplus of financial resources.

Weakness of public investment processes is a problem common to all countries and this discussion is not intended to suggest that Botswana's problem is especially serious. On the contrary, Botswana's long-lasting economic success and political stability attest to the strength of its processes. However, these common weaknesses, even in one of the most successful countries, suggest that rules for managing revenues from minerals, such as the SBI, need to be examined carefully if they are truly to provide a guide for sustainable management of resource rent. A more conservative and realistic adjustment of the SBI would take out of the capital budget and add back into the recurrent budget only those categories that are (1) clearly transfer payments rather than true investments (for example food and social services) and (2) clearly non-productive investments (for example defence and agriculture).

These adjustments provide a somewhat different picture of the transformation of minerals into other forms of wealth. If capital expenditures for defence are removed from the public investment budget, as IMF guidelines recommend, the SBI still remains under the 1.00 point until 1994, at which point it surpasses it by 10 per cent, and remains above 1.00 for all years after 1997 (figure 6). Spending for food, social welfare, and community programmes is a small part of the capital and development budget and concentrated at particular times, especially times of severe drought, notably 1984–1986 and 1993–1995.

This category of spending has grown rapidly since 1998, and a revised SBI would reach a value of 1.19 in 2001 if these expenditures were also excluded. Finally, considering agriculture as a non-productive investment

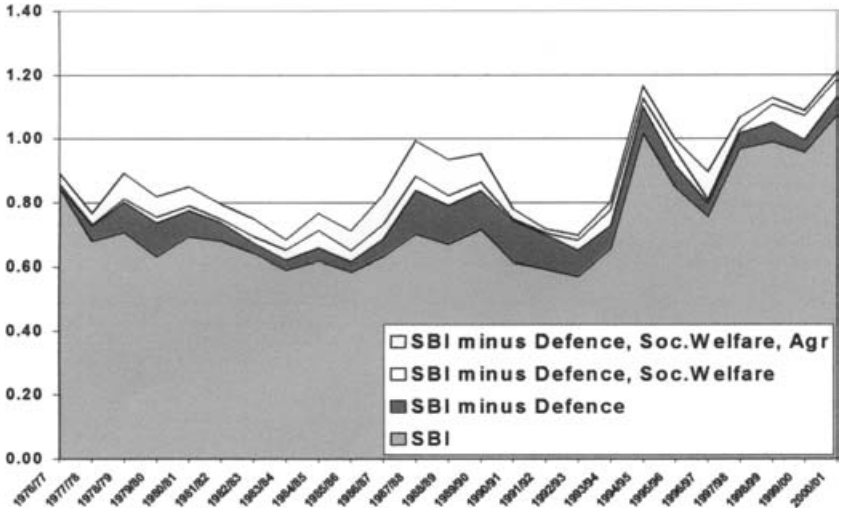

Figure 6. *Sustainable Budget index revised for unproductive capital expenditures*
Source: Authors' calculations based on method described in text and Government of Botswana, various years.

would further erode the sustainability index, which would reach 1.21 by 2001.

5. Conclusions and policy implications

One of the world's poorest countries at independence in 1966, Botswana has done remarkably well in using mineral wealth to transform its economy, joining the World Bank's category of upper-middle-income countries in the 1990s. Botswana is an excellent model for resource-rich economies, escaping the 'resource curse' through prudent macroeconomic management. It devised its own rule-of-thumb for reinvestment of mineral revenues to offset depletion, the Sustainable Budget Index, which requires that all mineral revenues be reinvested, approximating Hartwick's Rule. In the process Botswana has achieved remarkable improvements in infrastructure, human capital, and the basic services supplied to its population.

Despite its economic transformation, per capita income in 2000 was around US$ 3,500 and the most recent available data indicate that in the mid-1990s 38 per cent of households (equivalent to 47 per cent of the population) still lived in poverty (Jefferis, 1997). Botswana naturally aspires to a higher standard of living and reduced poverty.

Increasing per capita wealth is part of the solution and, given the overwhelming importance of mineral wealth, reinvestment of much of the mineral rent is clearly the key.

The SBI has served Botswana well in the past, but may be less useful for the future. There is evidence that not all of public sector investment has been productive, and that a better allocation of mineral revenues might improve the sustainability of the economy. Some investments may even

be harmful, leading to the depletion of other natural capital. For example, overinvestment in water supply infrastructure, for which the user is charged only a nominal, if any, tariff, encourages depletion of fossil groundwater.

HIV/AIDS has further complicated the problem of efficiently allocating public investment funds. The *ex-post* impact of HIV/AIDS has been to lower the productivity of a significant amount of public infrastructure. For example, infrastructure investment for each village such as schools, clinics, water supply, roads, etc. was based on past projections of village populations, which have now radically changed due to HIV/AIDS (BIDPA, 2000).

Botswana faces a number of options for reinvestment of mineral rent: it can allocate rents among financial assets, public sector capital, and human capital. It could also choose to disburse some of the rent to citizens to allow a greater degree of consumption, particularly of the poorest citizens. Indeed, the emphasis on saving resources for investment in the future has been questioned at a time when so many currently live in conditions of poverty. If more were invested in financial assets, it might be useful to establish a dedicated revenue fund, like the Alaska Permanent Fund (Warrack and Keddie, 2000), which takes some of the funds out of the hands of politicians. On the other hand, Botswana's high rate of HIV/AIDS infection has made investment in human capital increasingly important. The Government of Botswana has made a bold and highly commendable commitment to provide medicines to all its people.

A major problem with the transformation of mineral wealth into other forms of wealth is that the policy rule for reinvestment of Botswana's mineral revenues, the SBI, is not based on an objective with a well-defined target, such as a given percentage increase in per capita GDP, against which the action could be measured. Consequently, there are no criteria for optimizing the allocation of mineral revenues among alternative investments, or between current and future consumption. It seems clear that this is an issue that needs to be revisited.

Botswana's six-year National Development Plans address medium-term, but not long-term, objectives. Government has recently engaged in longer-term strategic planning exercises, such as Vision 2016 (Presidential Task Group, 1996 and 1997), which are more appropriate for designing an optimal long-term investment strategy. Vision 2016 has identified long-term goals for GDP growth, poverty alleviation, and other objectives, but these objectives have not been related to utilization of Botswana's most important source of finance: mineral rents. Clearly, to make the longer-term strategic panning more effective, and, to ensure sustainable development, Botswana would benefit from paying closer attention to the transformation of mineral wealth into other forms of wealth, starting with an assessment of the long-term objectives that the SBI is intended to achieve.

References

Auty, R. (2001), 'The political state and the management of mineral rents in capital-surplus economies: Botswana and Saudi Arabia', *Resources Policy* **29**: 77–86.

Auty, R.M. and R. Mikesell (1998), *Sustainable Development in Mineral Economies*, Oxford: Clarendon Press.

Bank of Botswana (1994), *Annual Report 1993*, Gaborone, Botswana.
BIDPA (Botswana Institute for Development Policy Analysis) (2000), 'Macroeconomic impacts of the HIV/AIDS epidemic in Botswana', BIDPA: Gaborone, Botswana.
Central Statistics Office (CSO), (various years), *Statistical Bulletin*, Central Statistics Office, Gaborone, Botswana.
Central Statistics Office (2000), *Environment Statistics*, Central Statistics Office, Gaborone, Botswana.
Dasgupta, P. and K.-G. Mäler (2000), 'Net national product, wealth, and social well-being', *Environment and Development Economics* **5**: 69–94.
DeBeers (2001), *Annual Report*, Available from website: www.debeersgroup.com
Department of Mines (various years), *Annual Report*, Ministry of Mines, Energy and Water Resources, Gaborone, Botswana.
Government of Botswana (1994), *Budget Speech 1994*, Gaborone: Government Printer.
Government of Botswana (2000), *Mid-Term Review of NDP 8*, Gaborone: Government Printer.
Government of Botswana (2001), *2001/02 Estimates of Expenditure from the Consolidated and Development Funds*, Gaborone: Government Printer.
Government of Botswana (various years), *Financial Statements, Tables and Estimates of Consolidated and Development Fund Revenues*, Gaborone: Government Printer.
Hamilton, K. and M. Clemmens (1999), 'Genuine savings rates in developing countries', *World Bank Economic Review* **13**: 333–356.
Hartwick, J.M. (1977), 'Intergenerational equity and the investing of rents from exhaustible resources', *American Economic Review* **67**: 972–974.
Isham, J. and D. Kaufmann (1999), 'The forgotten rationale of policy reform: the productivity of investment projects', *Quarterly Journal of Economics* **114**: 149–184.
Jefferis, K.R. (1997), 'Poverty in Botswana', in Salkin *et al*. (eds), *Aspects of the Botswana Economy: Selected Papers*, Oxford: James Currey.
Kunte, A., K. Hamilton, J. Dixon, and M. Clemens (1998), 'Estimating national wealth: methodology and results', Environment Department Papers, Environmental Economics Series No. 57, The World Bank, Washington DC.
Lange, G.-M. (2001), 'The contribution of minerals to sustainable development in Botswana: natural resource accounts for minerals', Final Report to the Botswana Natural Resource Accounting Programme, Gaborone, Botswana.
Lange, G.-M. (2002), 'Alternative measures of the value of natural capital in constant prices', paper presented at the workshop, Putting Theory to Work: The Measurement of Genuine Wealth, 25–26 May 2002, Stanford University.
Lange, G.-M., R. Hassan, and K. Hamilton (2003), *Environmental Accounting in Action: Case Studies from Southern Africa*, Cheltenham, UK: Edward Elgar.
Leith, J.C. (1997), 'Growth and structural transformation in Botswana,' in Salkin *et al*. (eds), *Aspects of the Botswana Economy: Selected Papers*, Oxford: James Currey.
Leith, J.C. (2001), 'Botswana's macroeconomic stability: institutions, policies and shock absorbers', unpublished working paper of BIDPA.
Ministry of Finance and Development Planning (1991), *Annual Economic Report*, Gaborone, Botswana.
Ministry of Finance and Development Planning (1994), *Mid-Term Development Plan Review*, Gaborone, Botswana.
Pearce, D. and G. Atkinson (1993), 'Capital theory and the measurement of sustainable development: an indicator of "weak" sustainability', *Ecological Economics* **8**: 103–108.
Pezzey, J. (1992), 'Sustainable development concepts: an economic analysis', World Bank Environment Paper No. 2, World Bank, Washington DC.
Presidential Task Group (1996), *A Framework for a Long Term Vision for Botswana*, Gaborone, Botswana: Government Printer.

Presidential Task Group (1997), *Towards Prosperity for All: Long Term Vision for Botswana*, Gaborone, Botswana: Government Printer.
Pritchett, L. (1997), 'Mind your p's and q's: the cost of public investment is *not* the value of public capital', World Bank Policy Paper No. 1660, Washington DC.
Pritchett, L. (2000), 'The tyranny of concepts: CUDIE (Cumulated, Depreciated, Investment Effort) is *not* capital', *Journal of Economic Growth* **5**: 361–384.
Sachs, J. and A. Warner (1995), 'Natural resource abundance and economic growth', Development Discussion Paper No. 517a, Harvard Institute for International Development, Cambridge.
Salkin, J.S. (1994), 'A brief review of the central government budget, 1966/67–1994/95', *Barclays Botswana Economic Review*, February.
Solow, R. (1974), 'Intergenerational equity and exhaustible resources', *Review of Economic Studies* **41**: 29–45.
Solow, R. (1986), 'On the intergenerational allocation of natural resources', *Scandinavian Journal of Economics* **88**: 141–149.
Temple, J. (1999), 'The new growth evidence', *Journal of Economic Literature* **37**: 112–156.
United Nations (1993a and 2001), *System of National Accounts*, New York: United Nations.
United Nations (1993b and 2003), *Integrated Environmental and Economic Accounting*, Studies in Methods, Handbook of National Accounting, Series F, No. 61, New York: United Nations.
Warrack, A. and R. Keddie (2000), 'Albert Heritage Fund vs. Alaska Permanent Fund: a comparative analysis', draft paper obtained from the website of the Alaska Permanent Fund Corporation website: www.apfc.org
World Bank (1994), *World Development Report 1994: Infrastructure for Development*, Washington DC.
Wright, M. (1995), 'Reservation principle in sustainable budgeting: the case of Botswana', *The Research Bulletin of the Bank of Botswana* **13**: 1–21.
Wright, M. (1997a), 'Fiscal policy in Botswana: challenges for public sector finance in the mid-1990s', in Salkin *et al*. (eds), *Aspects of the Botswana Economy: Selected Papers*, Oxford: James Currey.
Wright, M. (1997b), 'The use of mineral revenues in Botswana: super caution vs. pragmatism', *The Research Bulletin of the Bank of Botswana* **15**: 35–47.
Wright, M. (1999), 'Some problems with measuring total factor productivity: the case of Botswana', *The Research Bulletin of the Bank of Botswana* **17**: 16–38.