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Measuring Development Prospects by Greening the National Accounts

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Introduction

The principal aggregates of the System of National Accounts – GDP or GNI – are essential indicators for measuring economic performance and guiding macroeconomic policy-making. Almost from the inception of modern systems of national accounting in the 1940s by Kuznets and Stone, however, there have been vigorous debates about the extent to which the accounts can or should measure social welfare. The elevation of environmental issues in the policies of the developed world in the 1970s helped to fuel these debates along several dimensions.

The chief environmental criticisms of standard national accounting, as voiced in Ahmad *et al*. (1989), fall under two main headings: (i) standard measures of income and product do not account for the depletion of natural resources; (ii) national income measures the goods but not the 'bads' (polluting byproducts, for example) inherent in economic activity. The publication of the Brundtland Commission report in 1987 added a third dimension to the environmental critique: standard national accounts, because they ignore depletion and degradation, do not provide indications of the sustainability of economic development.

Since the 1980s there has been a concerted effort by economists and national statisticians to clarify the conceptual issues linking environmental resources to national accounting, and to construct empirical estimates of environmental stocks and flows within or in parallel to the System of National Accounts. This effort is motivated first by a supposition that environmental factors unmeasured or obscured in the national accounts are significant, and secondly by the belief that more complete national accounting systems will support better management decisions concerning the environment and natural resources and their inter-linkages with the broader economy.

This chapter briefly reviews income and welfare measurement, then moves to the central topics of assets and sustainability, appraising the key conceptual and theoretical literature. Methods of asset accounting are outlined, followed by presentation of selected empirical results from greening the national accounts. Linkages to policy are explored, followed by broad conclusions on some basic questions: To what extent has the promise of environmental accounting been realized? Which approach has the greatest policy significance? And where is environmental accounting likely to be most useful?

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Income or welfare?

The canonical definition of income was by Hicks (1948), who defined ‘Income No. 1’ as:

> “Income … is thus the maximum amount which can be spent during a period if there is to be an expectation of maintaining intact the capital value of prospective returns…; it equals consumption plus capital accumulation.”

From this it is clear that income is a net concept – we can measure gross income in an economy as the sum of all payments to production factors, for example, but to arrive at the true measure of income we need to net out the depreciation of assets that has occurred over the accounting period.

The extension of Hicksian notions of income to environmental accounts is straightforward. All that is required is to extend the range of assets whose value is being maintained in aggregate to include natural resources or, as an example of a ‘bad,’ pollution stocks. ‘Green’ national income is therefore regular national income less the value of depletion of resource stocks and the disamenity value of growth in pollution stocks.

It is worth asking why, if income is a net concept, the key indicator used by policymakers and reported in the press is Gross Domestic Product, or growth in GDP. There are two answers. First, because there are no direct measures of depreciation of assets (these are usually modeled by statistical agencies), there is a question of the accuracy of measurement of Net Domestic Product – the national accounting identity no longer constrains the range of estimates. Secondly, many of the key macro variables which are the target of policy (inflation and unemployment, to name the most obvious) correlate well with gross activity measures or the growth rates of these measures.

For those concerned with measuring economic progress there remains, however, the question of measuring welfare versus measuring income. Because national income measures both consumption and the net change in assets, it is clear that it cannot be a direct measure of the welfare derived from consumption. The more difficult problem with national income as a welfare measure concerns what is excluded – healthfulness, for example, or the enjoyment of natural amenities. Moreover, there may be productive activities in an economy that, because they occur outside of the market, are not captured in the accounts. Household work is one such example, and we will look briefly at harvesting of timber and non-timber products in the empirical section below[2].

The most comprehensive attempt to extend the national accounts is the work of Robert Eisner, summarized in Eisner (1988). The ‘Total Income System of Accounts’ (TISA) imputes non-market production, including that in households, re-defines government expenditures on police and defense as intermediate consumption (as well as

[2] This is sometimes termed ‘environmental income.’

commuting and other costs associated with work), and expands measures of investment to include R&D, education and health. The TISA measure of income for the US in 1981 exceeds the standard measure of GNP by about 60%.

Nordhaus and Tobin (1973) were the first to include adjustments for changes in the environment and natural resources in their Measure of Economic Welfare. Their approach has much in common with Eisner, including adjustments under the three broad headings of imputing non-market production, redefining intermediate production, and expanding measures of investment.

An important point to bear in mind is that measuring income is not the same as measuring sustainability. This is the topic of the next section.

Income, assets and sustainability

The year 1989 was a watershed in terms of work in greening the national accounts. Repetto *et al.* published their landmark study on adjusting the GDP of Indonesia to include resource degradation and depletion, the United Nations and World Bank started research on applied environmental accounting in several countries (reported in Lutz (1993)), and a symposium volume by Ahmad *et al.* presented conceptual work dealing with the environment in the national accounts.

What is striking about the papers in Ahmad *et al.* (1989) is the extent of disagreement about quite fundamental issues. To give just one example, different papers in the volume suggest (i) increasing the measure of gross product by the value of environmental degradation, (ii) decreasing the value of net product by the difference between current levels of 'defensive' expenditures and the cost of restoring the environment to the level of quality at the beginning of the accounting period, and (iii) modifying gross product to account for services provided by the environment. These are very different approaches to dealing with the issue of environmental degradation in national accounts.

The key to eliminating conceptual confusion in green accounting lay in Weitzman (1976). This paper made the critical link between growth theory and national accounting when Weitzman asked why we measure national product as consumption plus investment when the economic goal, at its simplest, is to consume. The answer lies in Weitzman's proof that the present value of current NNP (held constant) is just equal to the present value of consumption along the optimal growth path for a simple economy – NNP is the 'stationary equivalent of future consumption.' The first environmental applications of the growth-theoretic approach to national accounting appeared in Hartwick (1990) and Mäler (1991). These papers examined a variety of pollution and natural resource problems, and showed what adjustments were required to NNP to reflect these issues.

While the growth-theoretic approach provided clear guidance on income measurement, the link to sustainable development remained to be explored. Pearce and Atkinson (1993) made a first attack on the problem by employing basic intuitions concerning assets and sustainability. They argued that sustainability can be equated to non-declining values of all assets, including natural resources. The consequence of this conceptualization is that changes in asset values, measured by net saving, should signal whether an economy is on a sustainable path. Pearce and Atkinson presented empirical results on net saving for a range of developed and developing countries using values published in the green accounting literature. This approach was used in World Bank (1997), which estimated total wealth and genuine[3] saving (net saving adjusted for resource depletion, CO2 damages and human capital formation) for nearly 100 countries.

More recent theoretical work on income and savings has firmly established the linkage between net savings, social welfare and sustainable development. The saving link, explored further below, was established in Hamilton and Clemens (1999)[4] for an optimal economy, and Dasgupta and Mäler (2000) for non-optimal economies (with suitable definition of shadow prices). Asheim and Weitzman (2001) show that growth in real NNP (where prices are deflated by a Divisia index of consumption prices) indicates the change in social welfare in the economy.

The basic theoretical insight of Hamilton and Clemens (1999) is to show that genuine saving *G*, utility *U*, social welfare *V*, marginal utility of consumption λ, and pure rate of time preference ρ are related as follows:

$$V = \int_t^{\infty} U(C,...) \cdot e^{-\rho(s-t)} ds$$

$$G = \lambda^{-1} \frac{dV}{dt}$$

This just says social welfare is equal to the present value of utility, and that genuine saving is equal to the instantaneous change in social welfare measured in dollars. The utility function can include consumption C and any other set of goods and bads, while genuine saving must include the change in all stocks (assets) in the economy valued at current prices. Assets can include bads such as stocks of pollution.

This result says that the path for social welfare can be determined by policies aimed at altering genuine savings levels in an economy. If policy-makers wish to ensure continuously increasing social welfare, then the policy prescription must ensure positive genuine saving. By implication, policies affecting net investment in all the assets of an economy, including produced capital, natural resources, pollution stocks, and human capital, can play a role in achieving increases in social welfare.

Hamilton and Clemens (1999) go on to show that negative levels of genuine saving must imply that future levels of utility over some period of time are lower than

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[3] The term 'genuine' was applied in order to distinguish this aggregate from the traditional measure of net saving in the national accounts, which accounts only for depreciation of produced assets.

[4] A longer exposition of many of these issues is in Atkinson *et al.* (1997).

current levels – i.e. negative genuine saving implies unsustainability. Similar implications hold for the approaches of Dasgupta and Mäler (2000) and Asheim and Weitzman (2001).

These approaches to greening the accounts, and the models that underpin them, are agnostic on the question of the degree of substitutability between different assets, in particular between produced and natural assets. An important strand of the sustainability literature, dating back to Pearce, Markandya and Barbier (1989), looks at the question of *strong* versus *weak* sustainability. Weak sustainability assumes that there are no fundamental constraints on substitutability, and it is clear that the recent literature on saving and changes in real NNP is consistent with weak sustainability. If, however, some amount of nature must be conserved in order to sustain utility – the strong sustainability assumption – then these models need to be modified to incorporate the shadow price of the sustainability constraint.

A formal approach to the strong vs. weak sustainability problem has been explored in the 'Hartwick rule'[5] literature. Dasgupta and Heal (1979) and Hamilton (1995) show that if the elasticity of substitution between produced capital and natural resources is less than 1, then the Hartwick rule is not feasible – eventually production and consumption must fall, implying that the economy is not sustainable under the rule.

On the question of thresholds, it is clear that the saving approach to measuring sustainability and changes in social welfare is applicable under certain assumptions. A typical example of this problem is the potential existence of ecological thresholds – crossing a certain boundary may produce catastrophic results, such as the re-routing of the Gulf Stream as a result of global warming, or the death of most plankton in the ocean as a result of ozone layer destruction. As long as marginal damages are smooth and unbounded as a threshold is approached, the saving approach will give correct signals concerning sustainability, since approaching the threshold will eventually result in negative savings. If the marginal damage curve is not smooth and becomes vertical at the threshold, then the saving rule may not indicate unsustainability as the threshold is approached. There is clearly an important question of the science of threshold problems, since we do not know *a priori* what the shape of the marginal damage curve is for many important problems[6].

The theoretical literature on national accounting has yielded important insights into the proper way to construct green national accounts, and has elucidated the linkages between expanded national accounting systems and questions of social welfare and sustainability. It has not, however, eliminated some of the practical difficulties in constructing green national accounts, which is the subject of the next section.

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[5] Hartwick (1977) showed that consumption is sustainable (in fact constant) in a fixed technology economy with an essential exhaustible resource if: (i) net saving is everywhere 0; (ii) the elasticity of substitution between resources and produced capital is 1; and (iii) the elasticity of output with respect to produced capital is greater than the corresponding elasticity for the resource.

[6] See also Pearce *et al.* (1996).

Asset accounting

A lot has been learned since 1989 on how to actually construct greener national accounts. The main problems in environmental accounting revolve around the fact that many of the relevant asset values are not observed in the marketplace. For the most part natural resources are owned by governments and there is no market in resource assets. For issues like pollution damages, the effects of many of these damages are already reflected in the national accounts – human health damages reduce productive working days, for example – but they do not appear explicitly.

In the absence of market information, the analyst is reduced to constructing estimated accounts built upon two foundations: (i) measuring shadow prices for resources and pollutants – i.e. the net contribution to dollar-valued social welfare resulting from an extra unit of the asset in question; and (ii) making assumptions about the future stream of benefits from the assets in question. We examine the accounting issues for specific assets below, focusing on the general principles rather than detailed formulae.

Exhaustible resources

The value of an exhaustible resource stock is the present value of the total resource rents generated by the stock up to the point of exhaustion. To actually calculate this, however, assumptions about future prices, extraction costs and the path of extraction must be made. A real market for resource assets would, in effect, embody an agreed set of assumptions on these factors.

The value of resource depletion is directly linked to assumptions about the future as well. Assuming some physical quantity q of a resource is depleted then the value of depletion is the change in the asset value of the resource stock before and after q is extracted. The literature contains what are more or less polar cases in terms of valuing depletion, as Hartwick and Hageman (1993) show. If extraction is optimal, so that scarcity rents (price minus marginal extraction cost) rise at the rate of interest – the Hotelling rule – then the value of depletion is just the current unit scarcity rent times q. This reduces to the valuation used by Repetto *et al.* (1989), unit total rent (price minus average cost of extraction) times q if marginal and average costs of extraction are equal. If q is constant to the point of exhaustion and unit total rents are also constant, then the El Serafy (1989) formula results – depletion equals the present value of the final quantity q extracted valued at the unit total rent.

If resource stocks are large relative to extraction, or if the discount rate is high, these two approaches to valuing resource stocks and depletion will yield very different results. On the other hand, if resource lifetimes are less than 20 years (a typical number) and social discount rates of 3-4% are used, the divergence is smaller. Underlying each approach, however, is a very different assumption. The Repetto *et al.* alternative requires optimality, and so we should observe resource prices rising at near-exponential rates (which we do not) if we wish to apply this approach. The El Serafy approach eschews optimality, and so underestimates the value that a profit maximizing owner would place on the resource stock. The two alternatives presumably bracket how a functioning market would value resource stocks.

If the value of resource depletion is 'model-dependent,' this is equally true for the treatment of resource discoveries. Hartwick (1992) presents one of the main approaches. If it is assumed that the cost of resource discovery is an increasing function of both the quantity discovered and cumulative discoveries (so that resource discovery becomes progressively more expensive), then resource discoveries should be valued at their marginal discovery cost. The assumed dependence of discovery cost on cumulative discoveries ensures that this marginal discovery cost will be less than the scarcity rent. As a practical matter, standard national accounting practice is to treat most discovery costs as investment – as long as there is no large divergence between marginal and average discovery costs, therefore, no explicit adjustment need be made to net saving to reflect resource discoveries.

Living resources

Setting aside for the moment the question of the age structure of stocks of living resources, simple models of living resources yield accounting approaches that are not fundamentally different from the approach to valuing exhaustible resources. The key differences are that living resources grow, and that they do not need to be discovered. The value of living resource stocks is equal to the present value of net harvest (harvest minus growth) over a potentially infinite time horizon. If optimal management is assumed, then the value of depletion of living resources is equal to unit scarcity rent times net harvest. In practice, many studies assume no wide divergence between marginal and average harvest costs, and so value assets and their depletion on that basis.

Note that, rather than depletion, there may be a net augmentation of the value of living resource assets if harvest is less than growth. From an accounting perspective, it is important to be sure that the regions where net growth is occurring are in fact regions where the resource has commercial value – this can be an issue with forest accounting in particular. If harvest exceeds growth, and can be assumed to continue to do so, the forest accounting problem reduces to the exhaustible resource problem.

Since living resource stocks have distinct cohorts of individuals born or germinated in a given year, this can introduce complications for accounting if, for example, only individuals within a given range of ages have commercial value. Vincent (1999a) shows how to account for forest depletion in such a situation. In addition to accounting for the harvest of commercial cohorts, it is necessary to account for the increasing value of younger cohorts according to how many years they are from having commercial value.

Deforestation

Deforestation offers a particular challenge in green accounting because it requires estimation of land values under alternative uses – first, when land is under forest (and can be assumed to remain so), and second, when the land is cleared for alternative uses such as crops or livestock. The difference between these two land values represents the net creation or destruction of wealth as a result of deforestation – destruction can occur, of course, when there are significant externalities or market or policy failures which distort private decisions to deforest.

The basic approach to the valuation of deforestation is to compare the total economic value of the land under the alternative uses. For agriculture this can be measured as the commercial land value or, where there are market distortions, the present value of land rents under agriculture. For forests, as Vincent (1999b) shows, this entails valuing local and global willingness to pay for standing forests, external benefits provided by these forests, net carbon sequestration, plus the value of rents generated by sustainable harvest of timber and non-timber products or non-extractive uses such as tourism.

Pollution

The principles of accounting for pollution in environmental accounts are clear enough, but practical issues abound. The main distinction that needs to be made is between flow pollutants, which cause instantaneous damage to assets (such as human lungs in the case of particulate emissions), and stock pollutants, which cause damage to assets over time and which typically dissipate naturally. The valuation approach for stock pollutants involves taking the present value of damages to assets over the period of time that they are exposed to the stock of pollution.

Valuing pollution in the national accounts is in some aspects different from how total pollution damages are valued in the environmental health literature. An accounting of total pollution damages from acid rain, for instance, would include damage to assets (human lives, buildings, soils, lakes, etc.), willingness to pay to avoid health damages, and lost production (from human illness, crop damages, and so on). Environmental accounting would consider only the damage to assets, in part because this is what theory suggests, but in part because many of the other values are already reflected in GDP – GDP is already *lower* than it would otherwise be because of the lost production.

Damage to human health dominates most accounting estimates of pollution damages (see, for example, Hamilton and Atkinson (1996)). Valuing these damages involves several difficult and controversial steps. Typically a dose-response function needs to be specified (linking how many deaths and illnesses are associated with a given pollution exposure). Then illness has to be valued on the basis of willingness to pay[7], an area where there is still relatively little research. And then deaths have to be valued. Two approaches to the latter are typically applied, the ‘human capital’ approach which values lost wages as a result of premature death, and the willingness to pay approach, which employs an estimated ‘value of a statistical life.’

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[7] An accounting approach would value only chronic illness, since this is notionally the depreciation of a stock of healthfulness, part of human capital.

Another difficulty in dealing with pollution concerns trans-boundary effects. Here the question arises as to which assets are damaged, and who owns them? The solution to the accounting problem lies in assumptions about property rights.

If countries have the right not to be polluted by their neighbours, then pollution damages can be accounted for *as if* each country had to pay compensation for damages caused to all their neighbours. Thus there would be a deduction from saving corresponding to the damage that domestic pollution does to domestic assets plus the value of damage done to assets in other countries. In other words, damage to domestic assets from foreign pollution is assumed to be completely offset by compensatory payments by the foreign countries emitting the pollution.

Alternatively, if no such property right exists and compensation for pollution damages is not owed, then accounting for pollution consists simply of accounting for total damage to domestic assets associated with both domestic and foreign emissions. Depending on the nature of the pollutant (regional or global), on whether a country is up-wind or down-wind of major emissions, and on whether the pollutant is harmful or beneficial to a given country (some northern countries may benefit from global warming, for example), these two accounting approaches can clearly lead to very different values of adjustments to savings.

Exogenous change

Many economic variables affecting individual countries are determined exogenously – the classic example of this is the small exporting country, where world prices for the country's exports are determined by a global market which the country cannot influence in any substantial way.

Vincent *et al.* (1997) explore the accounting issues for a small resource exporter. The basic conclusion of their analysis is that saving should be adjusted to reflect exogenous price change by including the present value of future *changes* in world prices times the quantity of resource produced. This presents an obvious problem to the green accountant, since it requires a forecast of world prices. Possible approaches to this problem include extrapolating world prices based on past trends, but this is clearly fraught with large uncertainties.

Weitzman and Löfgren (1997) show how exogenous change in technology, as measured by total factor productivity, could be treated similarly in adjusted national accounts.

Conclusions on asset accounting

A major resource for practitioners has been provide by the United Nations (2004) in their handbook on *Integrated Environmental and Economic Accounting*. This presents a full set of asset and flow accounts in physical and value terms and deals with issues beyond what are presented above, such as linking physical flow data to input-output accounts.

The main conclusion to be drawn on asset accounting is that the lack of market prices for environmental assets makes virtually all environmental accounting results model-dependent. This was mentioned above, but requires emphasis. Practitioners need to specify their assumptions about the future. Some assumptions may be viewed as biasing valuations above or below what 'real' markets would produce – as argued above the Repetto *et al.* (1989) valuation of resource depletion is probably biased to the high side, while the El Serafy (1989) approach is probably low. *But all valuations of environmental assets and changes in asset values must be considered to be contingent upon the assumptions made – there are right approaches but no 'right answer.'*

Empirical experience

The empirical literature on green national accounting is by now enormous, and it would be fruitless to try to summarize the work that has been carried out to date. Hamilton and Lutz (1996) present an overview of the work accomplished by the middle of the last decade. What this section offers is, first, a critical examination of the seminal empirical work by Repetto *et al.* (1989), second a sampling of cross-country empirical results based on the World Bank (2003) data base, and finally an example of the application of green accounting in southern Africa, a region where environmental accounting can have a real impact on policies.

Repetto *et al.* (1989) was the first comprehensive attempt to include natural resource and environmental issues in national accounts. They studied Indonesia, a country with a high degree of resource dependence. The analysis focused on oil depletion, forest depletion and soil degradation as shown in Table 1.

Table 1. Comparison of Indonesian GDP and NDP, constant 1973 Rupiah (bn.)

Year	GDP	Petroleum	Forestry	Soil	Net change	NDP
1971	5,545	1,527	-312	-89	1,126	6,671
1972	6,067	337	-354	-83	-100	5,967
1973	6,753	407	-591	-95	-279	6,474
1974	7,296	3,228	-553	-90	2,605	9,901
1975	7,631	-787	-249	-85	-1,121	6,510
1976	8,156	-187	-423	-74	-684	7,472
1977	8,882	-1,225	-405	-81	-1,711	7,171
1978	9,567	-1,117	-401	-89	-1,607	7,960
1979	10,165	-1,200	-946	-73	-2,219	7,946
1980	11,169	-1,633	-965	-65	-2,663	8,506
1981	12,055	-1,552	-595	-68	-2,215	9,840
1982	12,325	-1,158	-551	-55	-1,764	10,561
1983	12,842	-1,825	-974	-71	-2,870	9,972
1984	13,520	-1,765	-493	-76	-2,334	11,186

Average Annual Growth	7.10%	4.00%

Source: Repetto et al. (1989). Note that NDP excludes depreciation of fixed capital.

The results are striking, and helped to establish the empirical significance of green national accounting. In peak years, when oil prices were high, the value of depletion and degradation as a share of regular GDP was over 20%. Soil degradation exceeds 1% of GDP for many years, while forest depletion approached 7%. The results are clearly dominated by petroleum depletion, and here the results are particularly sensitive to the choice of accounting methodology.

Because Repetto *et al.* (1989) count oil discoveries as additions to product (see the discussion of this issue in the preceding section), NDP actually exceeds GDP from 1971 to 1974. This in turn has a significant impact on calculated growth rates from 1971 to 84, as reported in Table 1. If we exclude the data from 1971 to 1976, a period when petroleum discoveries were particularly strong in Indonesia, the growth rates in GDP and NDP from 1977 to 1984 are virtually identical.

The 'headline' result in this study, the divergence in growth rates reported in Table 1, is therefore highly dependent on the choice of accounting methodology. Alternative assumptions yield very different results. If depletion and degradation are roughly constant as a proportion of GDP, as they were from 1977 to 1984 in Indonesia, then GDP and NDP growth rates are indistinguishable.

Quite aside from this question of model-dependence in the Indonesia results, it is also worth reflecting on questions of sustainability as derived in the paper by Asheim and Weitzman (2001). These authors show that the instantaneous change in real NDP, using a Divisia price index, is the correct indicator of sustainability, rather than any longer run growth rate in NDP, or indeed any comparison of NDP and GDP growth rates.

Cross country patterns of saving

The World Bank has been publishing estimates of genuine saving for roughly 150 countries since 1999 in the *World Development Indicators*. As an example of this work, Table 2 shows the composition of genuine saving in Latin America in 2001.

Table 2. Composition of saving in Latin America, 2001, % of GNI

	Gross saving	Education	Depreciation	Energy Depletion	Mineral Depletion	Net Forest Depletion	CO2 Damage	Genuine saving
Argentina	12.8	3.2	12.0	2.6	0.1	0.0	0.3	1.0
Bolivia	9.4	5.5	9.3	7.3	0.7	0.0	1.0	-3.4
Brazil	17.0	4.8	10.9	2.3	1.0	0.0	0.4	7.2
Chile	20.3	3.4	10.0	0.3	4.8	0.0	0.6	8.0

Colombia	14.7	3.1	10.3	6.6	0.1	0.0	0.5	0.3
Costa Rica	15.1	5.1	5.8	0.0	0.0	0.4	0.3	13.7
Ecuador	22.9	3.2	10.6	19.0	0.0	0.0	0.9	-4.4
El Salvador	14.9	2.2	10.3	0.0	0.0	0.6	0.3	5.9
Guatemala	10.4	1.6	9.9	0.8	0.0	1.0	0.3	0.0
Honduras	26.0	3.5	5.6	0.0	0.1	0.0	0.5	23.3
Mexico	18.1	4.6	10.6	5.2	0.1	0.0	0.4	6.4
Panama	24.3	4.8	7.9	0.0	0.0	0.0	0.6	20.6
Paraguay	10.6	3.9	9.5	0.0	0.0	0.0	0.4	4.6
Peru	16.8	2.6	10.3	1.0	1.2	0.0	0.3	6.6
Uruguay	10.9	3.0	11.5	0.0	0.0	0.2	0.2	2.0
Venezuela	22.4	4.4	7.2	23.1	0.3	0.0	0.6	-4.4

Source: World Bank (2003)

These estimates are based on some necessarily crude assumptions, given data limitations. Current education expenditures are treated as gross investment in human capital and there is no depreciation of human capital. Depreciation of produced assets is as reported by the United Nations, with some modeling of missing values. Energy and mineral depletion are estimated as total resource rents (price minus average extraction costs times quantity extracted). Cost data are derived from a variety of sources (Hamilton and Clemens (1999) list the principal sources) and regional average costs are often used to fill in gaps. Net forest depletion is calculated as average unit rent times the excess of harvest over natural growth – if growth exceeds harvest, then net depletion is set to 0 on the assumption that much of this growth is in non-economic (remote or inaccessible) forest stocks. CO2 damages are really a place-holder for other pollutants, and represent the present value of global damages incurred by each ton emitted.[8]

Genuine saving is calculated as gross saving plus education expenditures (these are in effect re-classified from consumption to investment) minus depletion and CO2 damages.

The results in Table 2 show, first, that negative genuine saving is more than a theoretical possibility. The big energy exporters all display negative saving rates. Second, the adjustments to saving are sizable in many countries, particularly the mineral and energy producers. Finally, large resource endowments do not automatically lead to lower saving rates – sound policies, such as in Chile, lead to relatively robust levels of genuine saving (and therefore wealth creation) in spite of heavy dependence on minerals.

The next three figures display different aspects of the distribution of genuine saving across countries. Figure 1 scatters genuine saving as a percent of GDP against income measured by GDP per capita. The first point to note is that in 1999 there were many countries with negative genuine savings rates. Some of the observed negative

[8] The approach taken by the World Bank is to assume that countries have the right not to be polluted by their neighbors – under this regime compensation for damages would be paid by emitters, and genuine saving would be adjusted to reflect the value of these payments to other countries, as well as the damage done to the country’s own assets from its own emissions.

savings rates are a result of extremely low rates of gross saving, rather than any environmental adjustments *per se*. There is a clear upward trend in the scatter – the rich are getting richer while the poor are getting poorer. It is also notable that roughly half the countries under $1000 per capita income have negative saving rates. The results are even more striking when population growth is factored into the analysis, the subject of Figure 2.

Figure 1. Genuine saving vs. GDP / capita, 1999

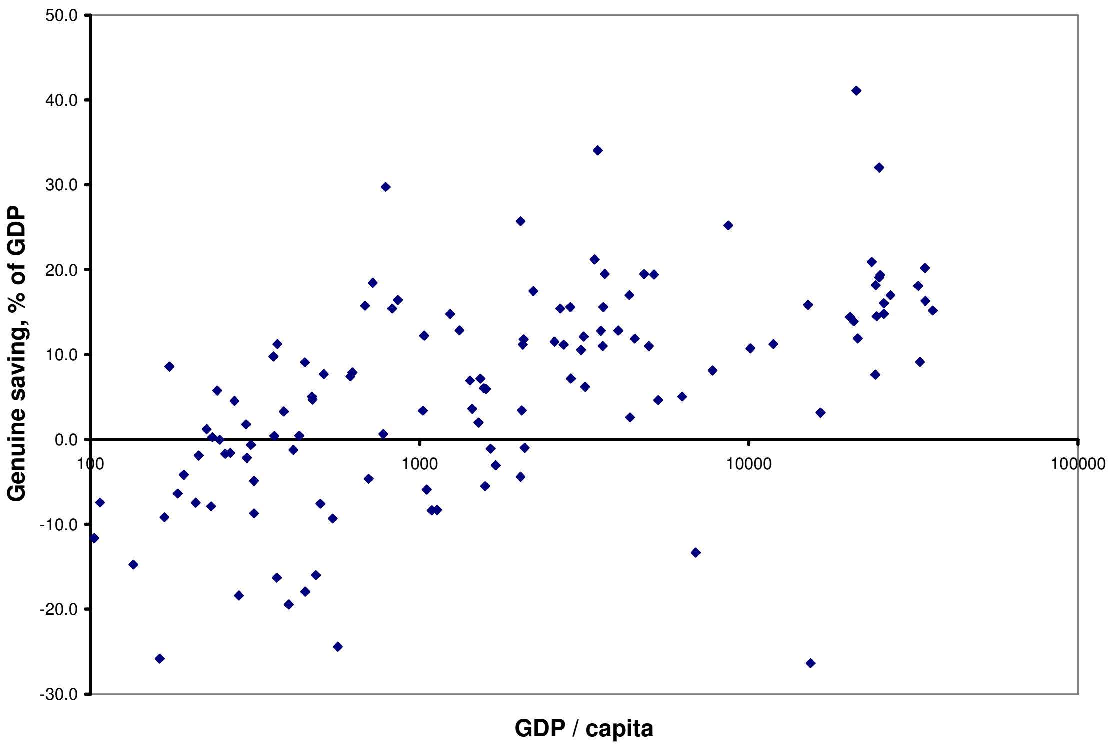
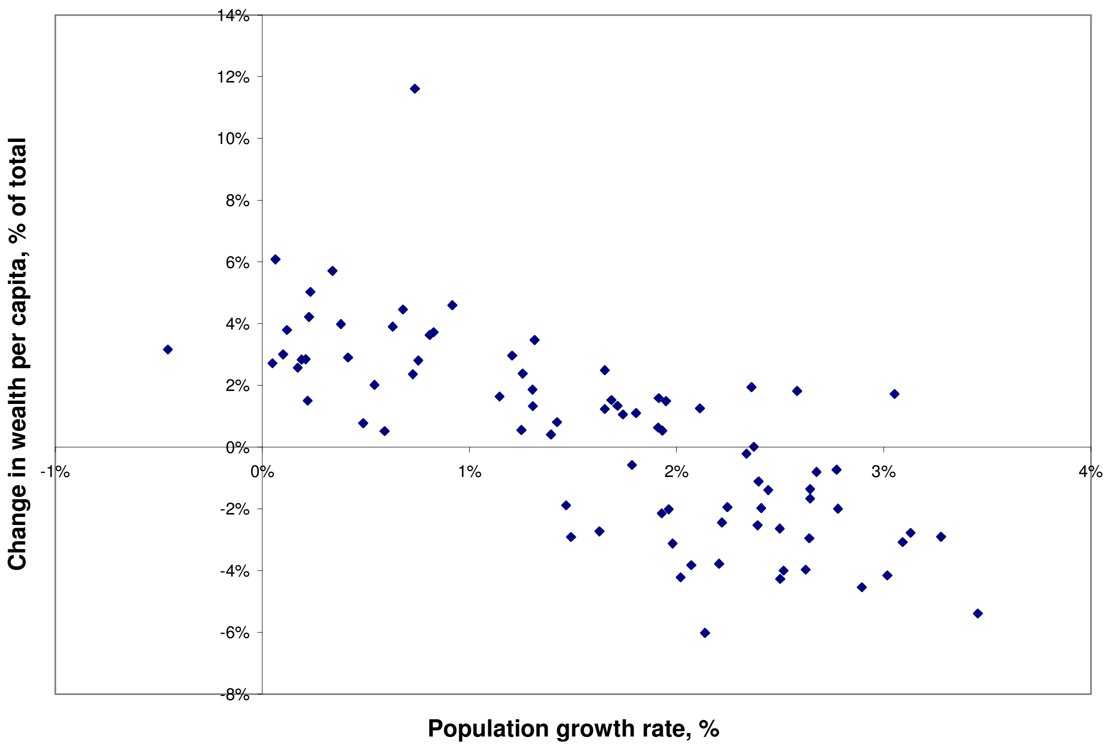


Figure 2. Change in wealth / capita vs. population growth rate, 1999



Population growth introduces a Malthusian aspect to environmental accounting. The fact that there are x% more people in a country in a given year as a result of population growth means that existing assets, including environmental assets, must be shared with these new citizens. Hamilton (2002) extends the World Bank saving data set to examine the effects of population growth. The basic insight is that, for exogenous population growth rate g, population P and total wealth W, genuine saving per capita is measured as,

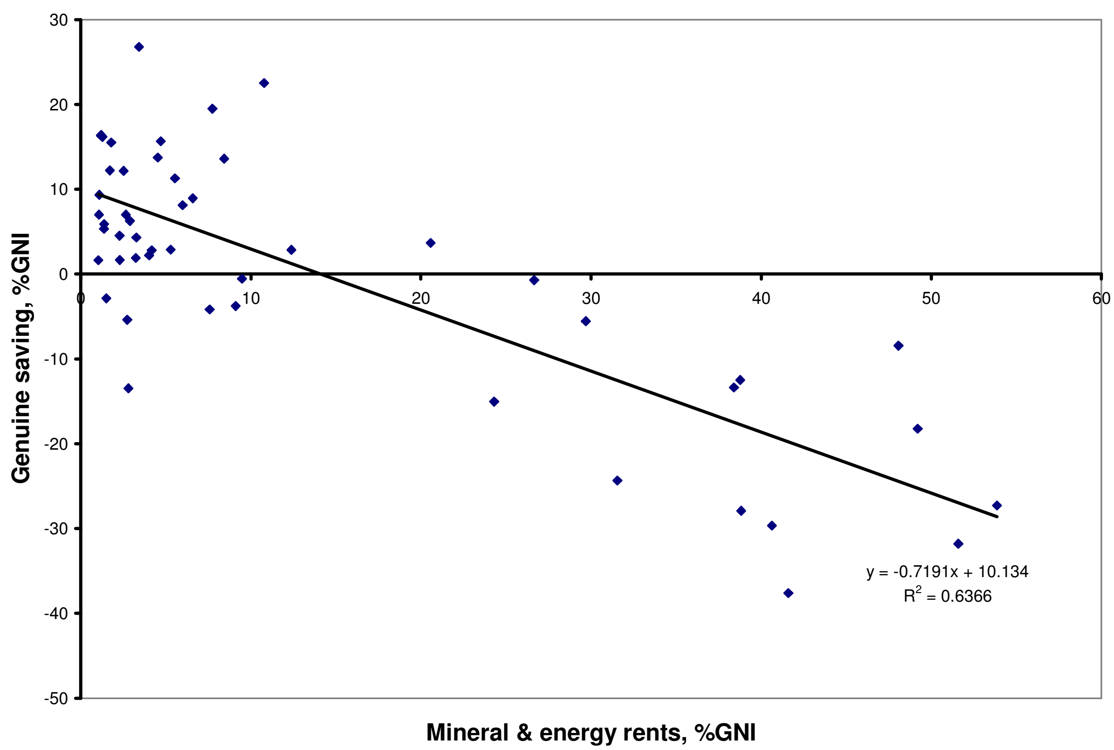
$$\Delta\left(\frac{W}{P}\right) = \frac{\Delta W}{P} - g \cdot \frac{W}{P}$$

This says that the total change in wealth per capita equals genuine saving (ΔW) per person minus the Malthusian term represent the sharing of total wealth over the enlarged population.

Figure 2 shows the result of this calculation as presented in Hamilton (2002), scattering the change in total wealth per capita against the population growth rate. It is empirically the case that the great majority of countries with population growth rates greater than 1.5% per year are actually on a path of declining wealth per capita. To put this in context, the average population growth rate in low-income countries in 2001 was 2.1%, 2.6% in the Middle East and North Africa, and 2.7% in Sub-Saharan Africa. However, it is important to note that there is a not-insignificant number of countries with high population growth rates where sound policies are leading to increases in wealth per capita.

Figure 3 explores the question of whether countries are consuming or investing natural resource rents by scattering genuine saving rates against the share of mineral and energy rents in GNI[9]. The Hartwick rule states that a sustainable constant consumption path is possible in countries with exhaustible resources if resource rents are invested in other productive assets. If countries were in fact following such a sustainability rule, the scatter in Figure 3 should exhibit no trend. In fact we observe a distinct downward trend, and the fitted line suggests that, looking in cross-section, for each additional per cent of GNI that is derived from exhaustible resource rents, roughly 0.72 of this is being consumed. A very significant proportion of the marginal resource endowment is therefore not being invested. It should be noted, however, that this result is largely driven by the countries with very large resource dependence, typically the oil states.

Figure 3. Genuine saving vs. exhaustible resource share, 2000



Finally, while the theory on genuine saving is very clear, there is the important empirical question of whether genuine saving rates do in fact predict changes in social welfare. Ferreira, Hamilton and Vincent (2003) derive a means to test this using the World Bank's genuine saving data base. They show that saving in the current period

[9] Only countries where exhaustible resource rents make up more than 1% of GNI are shown.

should just equal the difference between current consumption and a weighted average of future consumption[10]. This is then tested over rolling 10 year periods and over a 28 year period. The conclusions are that (i) for some specifications of the test, more comprehensive measures of saving (including natural resource depletion) increase the ratio of current saving to future consumption; (ii) looking across countries and using a 28 year time horizon, each dollar of genuine saving is in fact converted into an incremental dollar of average future consumption; and (iii) looking along time paths of individual countries over 10 year time periods, genuine saving is a good predictor of future consumption for poor countries but not for rich – for rich countries it seems that something more than capital deepening is determining future consumption.

Recent empirical results from Southern Africa

The past few years have seen major efforts to apply environmental accounting in selected countries in Southern Africa, which analysed critical aspects of sustainable management and exploitation of natural resources. A number of studies were carried out to evaluate the experiences and performance of Namibia, Botswana and South Africa (SA) in managing their natural resources in pursuit of economic expansion and growth (Lange et al., 2003). While these studies focused mainly on the performance of key resource sectors, they have also produced preliminary assessments of changes in the level and composition of total wealth and hence aggregate welfare. This section provides a critical review and syntheses of the results and experiences documented in these studies.

Dependence on natural resource endowments

The extent of dependence on natural resources in Botswana, Namibia and SA can be seen from the fact that primary production (agriculture, forestry and fisheries) and processing of primary products (food, timber and minerals) contribute about one third of total value added (VAD) and more than 70% and 40%, respectively, of the total value of exports in Namibia and Botswana and SA (Lange et al., 2003). While the three countries have rich mineral endowments, mining is the mainstay of the economy of Botswana as it supplies 33% of GDP and 74% of exports, compared to shares of less than 6% of GDP and less than 34% of exports in SA, which has a more diversified economy. Namibia falls between these extremes. Prudent exploitation and management of these natural assets is accordingly critical for the future wellbeing of the people of the three countries.

Performance in managing key resource sectors

Physical and monetary asset accounts have been constructed for a number of key natural resource sectors to examine the state of these resources and trends in their exploitation and development in Namibia, Botswana and SA. In addition to generating detailed accounts of the physical state and trends in extraction and consequent changes in stocks, these studies produced very valuable information and analyses of the way that resource rents from liquidating these natural assets have been managed to compensate present and future generations for depletion of their natural wealth. This is of crucial importance

[10] To be precise, the weighted average is equal to the interest rate times the present value of consumption.

particularly in the case of exhaustible resources such as subsoil assets, which constitute a significant share of total wealth and provides the main source of income and foreign exchange for financing investment and economic growth in the three countries.

Experiences With Managing Subsoil Assets in Southern Africa

While all three countries are endowed with rich mineral resources, interesting variations exist between them in the type, reserve levels and historical patterns in the extraction and use of these assets. Gold and coal contribute more than 70% of the mining income in SA while more than 90% of mining VAD come from diamonds in Botswana. On the other hand, diamonds and recently uranium are the major minerals produced by Namibia. Mining is relatively older in SA and Namibia dating back to the 19th century, compared to Botswana where development of commercial mining only started in the 1960's. Accordingly, mining made significant contributions to financing early investments in diversifying economic activity through the development of the manufacturing, services and other sectors that currently dominate the economies of SA and Namibia, whereas the economy of Botswana remains highly dependent on diamond mining (Lange and Hassan, 2003; Blignaut and Hassan, 2002).

The physical asset accounts indicate that extraction of diamonds has been on a steady increase in Botswana over the past 20 years growing by four fold, from 5.1 to 20.7 million carats production per year between 1980 and 1999. As a result, about 25% of known diamond reserves in Botswana have been extracted over the past 20 years, which appears to be relatively rapid. On the other hand, SA has slowed down its gold extraction over the same period by about 30%, dropping from 675 to 464 ton production per year by 1998. At the same time, SA has increased its extraction of coal by 150% over the same period from 115 to 290 million tons production per year by 1998. In spite of that, SA remains with about 80% and 90% of its gold and coal reserves, respectively (Figure 4). Extraction of diamonds fluctuated around one million carats and uranium production dropped from 5.5 to 3.3 tons per year in Namibia between 1980 and 1998 (Lange and Hassan, 2003).

Considerable resource rents have been generated in the three countries during the 20 years of extraction described above. Generated rents have reached highs of more than US$ 3 billion in the mid eighties but dwindled to low levels of less than $ one billion in the nineties in SA as world gold prices declined. On the other hand, mineral rents in Botswana continued to rise, reaching more than $ 2 billion by the late 1990s with increased extraction of its diamond resources. Mineral rents in Namibia fluctuated around $ 150 million per annum during the period as the countries high value diamond resources have been depleted and the recent revival through gold and offshore diamond discoveries.

How the generated rent was managed and used is critical to assessing progress toward sustainability in these countries. The first question in this regard is who received the generated mineral rent? The Botswana government was the most successful of the three countries in recovering minerals rent through taxes and royalties, which averaged about 76% over the reported period, followed by Namibia where rent recovery fluctuated around 50% (Figure 5). Least successful in minerals rent recovery was SA, which only after the 1980s managed to recover an average of 45% of the rent compared to almost zero rents in the 1970s. This is in part a reflection of the variation in minerals' property rights regimes in the three countries as the state has been the owner of subsoil assets in Botswana and Namibia, whereas private rights dominated mining in SA in the past, a situation revised in the new mining policy (RSA, 1998) to vest all minerals rights in the state (Blignaut and Hassan, 2002).

Figure 4. Mineral reserves in Botswana and South Africa 1908-1998 (Index 1980=1)

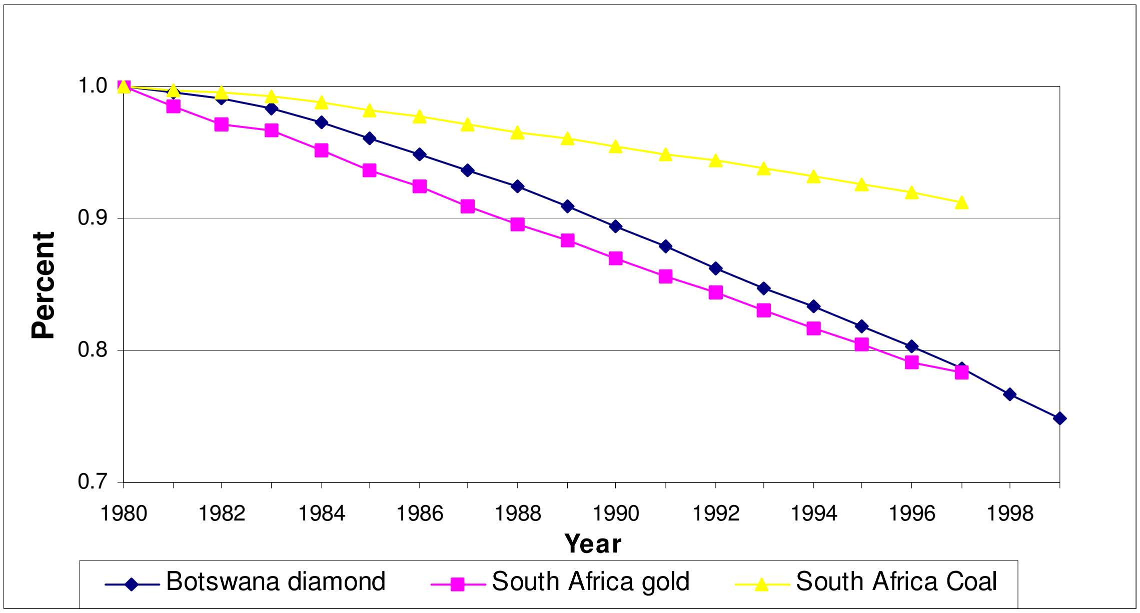
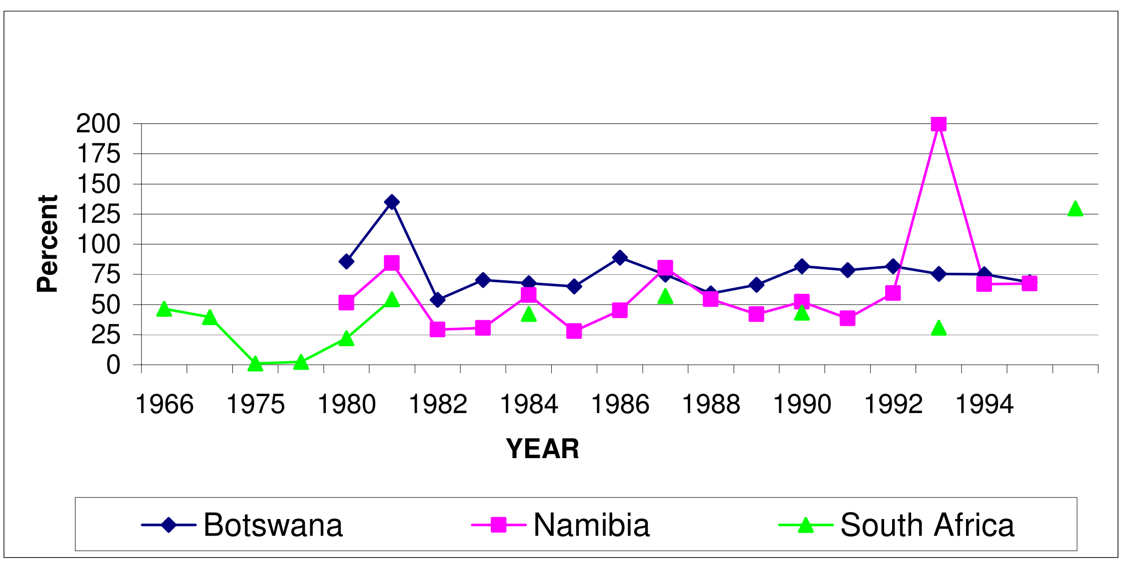


Figure 5. Recovery of Mineral Rent 1996-1996 (Percent)



While success in recovering rents is certainly a necessary prerequisite, it is not a sufficient condition for sustainable management and exploitation of natural resources. Sustainability requires that sufficient shares of the recovered rent be reinvested in other forms of capital to compensate current and future generations for liquidation of their natural capital. When rent recovery by the state is low, private extractive companies enjoy a windfall in rents, which often forms an incentive for overexploitation and sub-optimal extraction regimes. On the other hand, the private sector is often considered more efficient than the government in investing the generated rents. However, the nature of public and private investments generally differs as public investment targets social development (infrastructure and basic services) while private investment builds commercial and industrial capital. Nevertheless, both forms of capital add to total wealth and hence the more relevant question becomes what shares of the rent accruing to public or private hands are reinvested (i.e. public versus private saving rates) and in what forms of capital?

Although it was possible to estimate public and private shares in total minerals rent, data were inadequate to allow calculation of rates of reinvestment of minerals rent by private or public sectors. Nevertheless, a few indicators were constructed to evaluate progress toward sustainability in managing mineral resources in these countries. The first indicator was the Sustainable Budget Index (SBI) used by Botswana to monitor the manner in which revenues from liquidation of its mineral resources have been converted into other forms of capital assets (Lange and Hassan, 2003). The SBI calculates the ratio of non-investment spending to recurrent non-mineral revenue.

If the SBI is less than one, this indicates that all current government consumption is financed from non-mineral revenues and hence all mineral revenues are invested, ensuring sustainability. A value of SBI greater than one thus means that part of current consumption is financed from mineral revenues, an indication of unsustainable consumption. According to the SBI, Botswana has performed well in reinvesting minerals rent with a SBI value of less than 1 up to the late 1990's when SBI began to approach the value of 1 (Lange and Hassan, 2003).

The other indicator of sustainability in managing subsoil assets was constructed for SA based on El Serafy's 'user cost' approach for calculating resource depletion (El Serafy, 1989) described in an earlier section. The user cost of mineral extraction was accordingly calculated for the 1996-1993 period and compared to capital formation in the mining industry (total mining investments) of SA. The results indicated that the mining sector in SA invested more than twice the user cost of mineral extraction, which means that the user cost has been fully reinvested in alternative forms of capital (Blignaut and Hassan, 2002).

The forest and woodlands of SA

While the arid lands of Namibia and Botswana support few forest resources, SA manages extensive forest plantations and other woody resources. Forests cover about 2% of the land in SA, one third of which is under natural forests and the rest is cultivated plantations (Hassan, 2002). Natural forests are relatively small in SA compared to the extensive forest plantations, which make about one fifth of the total land under industrial plantations in Africa (Hassan, 2002). Based on its cultivated plantations SA has developed an advanced timber industry that currently supplies a large share of the world's pulp and paper products. More over, woodlands and thicket occupy about 40% of the total land area in the country. The economic contribution of these resources however, is seriously underestimated in the current national accounts, as only the commercial output of cultivated forests is reported. This is especially true for measures of wealth, which currently exclude the value of all forest assets including cultivated plantations (Hassan, 2000).

Comprehensive physical and monetary asset accounts recently constructed for SA revealed that forests and woody resources contribute significantly to the country's total wealth. The official measure of SA's NDP for 1998 increased by more than 2% when adjusted for the missing value of net accumulation of carbon and timber stocks in standing forest and wooded land resources (Hassan, 2002). This 'environmental income' is important in South Africa.

The Fisheries of Namibia

Unlike Botswana and SA, fisheries represent an important sector in Namibia that contributes significant shares of GDP, exports and employment. During the 1960's, before fish stocks began to collapse in Namibia, fisheries contributed about 10% and 15% of GDP and exports, respectively (Lange, 2003a). As a result of the predominantly open access to foreign fleets before independence, the stock of the country's main commercial species were seriously depleted, falling from 14 million tons to about 2 million tons by late 1980's. This was reflected in the much lower production and hence smaller contribution of only 2% to GDP and exports by 1980.

Namibia however, introduced new policy and control measures over the exploitation of its fisheries after independence in 1990. The new measures were successful and effective in halting the decline of the country's fisheries, which has since then seen stable stocks and was set on a recovery course. By 1998 fisheries contributions to the national economy have significantly improved reaching levels of 9% and 30%, respectively of GDP and value of exports. However, the government has been relatively unsuccessful in recovering the resource rent from fisheries as private companies continue to collect about 75% of the rent (Lange, 2003a). At the same time, this situation indicates the huge potential for fisheries to contribute to future revenues and fiscal improvements in Namibia, with better rates of recovery and prudent use of the resource rent. The contribution of fisheries to the total wealth of Namibia after corrections made through fisheries resource accounts starting 1990 is discussed in the next section (Figure 6.C).

Aggregate performance and measures of national wealth in Southern Africa

In addition to assessing the performance of Namibia, Botswana and SA in managing selected natural resource sectors, environmental accounts were developed and used to correct aggregate measures and indicators of sustainability. The conventional asset accounts of these countries do not include any of the above natural resource assets as part of national wealth and hence provide misleading information on the performance in managing the total asset portfolio and consequently sustainability of the path of development. Natural resource asset accounts have been compiled for minerals, forests and fisheries and used to correct measures of total wealth in the three southern African countries. Table 3 shows the extent by which conventional measures of national capital may underestimate actual total wealth. The magnitude of miss-measurement is very high in the case of Botswana where subsoil assets alone account for close to half of actual total wealth. For a country that has diversified its asset portfolio away from natural resource endowments like SA, natural capital (in this case only minerals and plantation forests) constitutes a relatively smaller portion of total wealth, but nevertheless large in magnitude (about 4% of total wealth of more than R trillion). The exclusion of minerals and fisheries alone reduces total wealth in Namibia by more than 10% in recent years.

The preliminary resource asset accounts of the three countries also reveal the degree of relative dependence and hence vulnerability of the different countries to careful exploitation and management of their natural capital. Botswana provides a typical case of very high dependence on the natural component of its total wealth. The country however, has significantly reduced its reliance on its mineral wealth in the recent past by converting that wealth into alternative forms of capital, namely investments in produced and financial assets (Lange and Hassan, 2003). On the other hand, the share of natural capital in Namibia's total wealth has increased over the past few years, mainly due to new discoveries of additional mineral wealth and recognition of the value of the country's important fisheries resources in the mid 1990's.

Figures 6.A to 6.C show how the value of total wealth has changed in the three countries over the past two decades. Again the dependence of Botswana on its mineral wealth is evident from the fact that change in total wealth has closely followed the pattern of change in mineral wealth (Figure 6.A). It is also clear from Figure 3.A that Botswana has managed to top its mineral wealth with a build up of a significant share of other forms of capital. SA displays a similar pattern, although with a significant slowdown of building alternative forms of capital (Figure 6.B). This is also observed in Namibia, apart from erratic patterns of asset values in the late 1980's and early 1990's (Figure 6.C).

Results of the above reviewed efforts to green the national accounts in southern Africa indicate the high margin of error in measuring economic performance and developing sustainability indicators when environmental values and depletion of natural capital are not properly accounted for. Valuable insights were also gained into the varied experiences of the studied countries in managing their natural wealth in pursuit of economic growth and how successful were their different resource use regimes and policies in keeping them on a sustainable development path. A major lesson is that, while high dependence on natural resource endowments, especially non-renewable assets such as diamonds in Botswana is a source of economic risk and vulnerability, prudent resource use policies in terms of adequate recovery and reinvestment of resource rents provide critical insurance against future declines in social welfare.

Table 3. Components of total wealth in Namibia, Botswana and South Africa (1981-1996)

Year	Botswana (Billion 1993 Pula)		South Africa (Billion 1993 Rand)		Namibia (Billion 1990 N$)	
	Total Wealth	% Natural capital	Total Wealth	% Natural capital	Total Wealth	% Natural capital
1981	15.2	53.1	1028	2.4	25.0	7.1
1982	20.0	62.1	1079	2.8	25.3	6.4
1983	25.4	67.2	1120	2.8	25.3	6.1
1984	29.8	68.6	1160	3.0	25.1	5.8
1985	31.7	63.2	1188	3.0	25.6	7.5
1986	34.1	60.1	1201	3.1	26.2	10.3
1987	36.5	57.5	1213	3.2	26.6	11.4
1988	41.9	57.4	1226	3.2	27.2	13.1
1989	44.9	53.6	1245	3.1	27.6	14.1
1990	50.8	53.5	1272	3.8	29.0	17.3
1991	52.5	49.4	1279	3.5	28.5	15.7
1992	53.2	47.1	1293	3.9	28.9	15.5
1993	53.2	43.7	1302	4.2	29.1	14.8
1994	56.2	43.5	1313	4.2	29.4	13.7
1995	59.4	44.2	1330	4.3	28.9	10.3
1996	64.5	42.7	1221	4.9	29.7	10.6

Figure 6.A. Change in Value of Assets in Botswana (1980-1998)

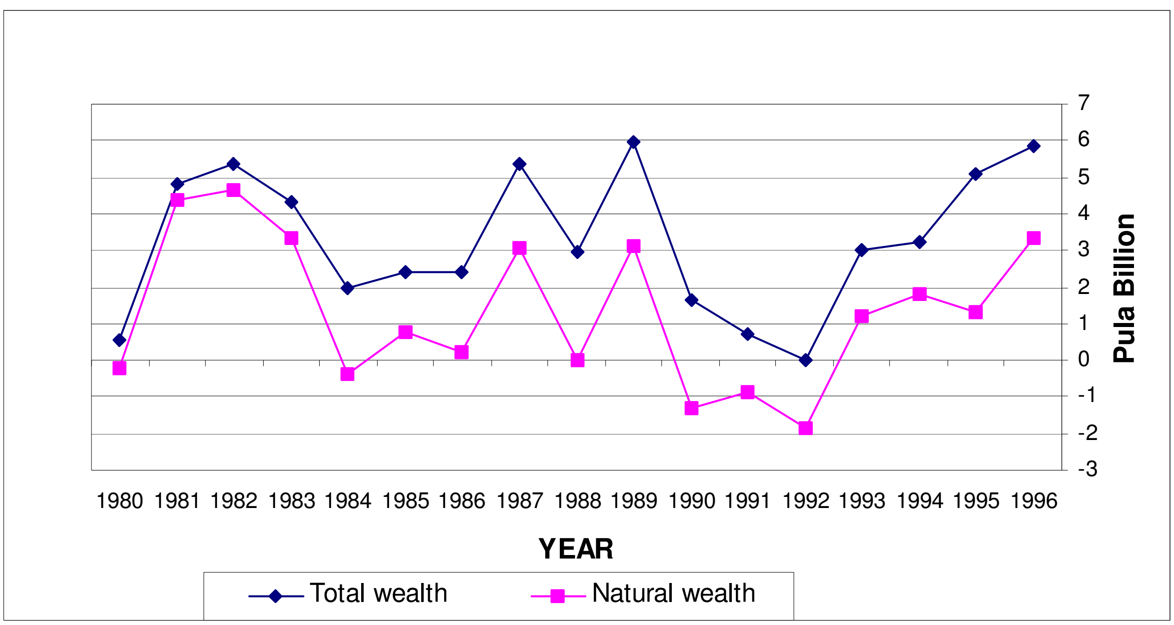


Figure 6.B. Change in Value of Assets in South Africa (1981-1994)

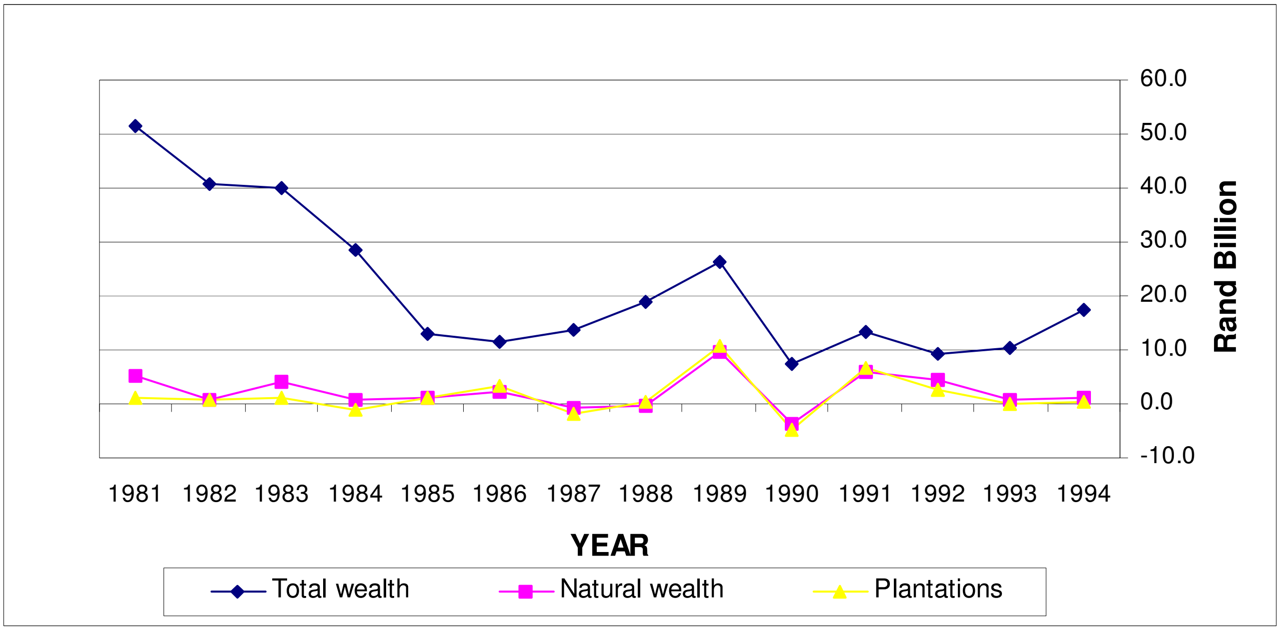
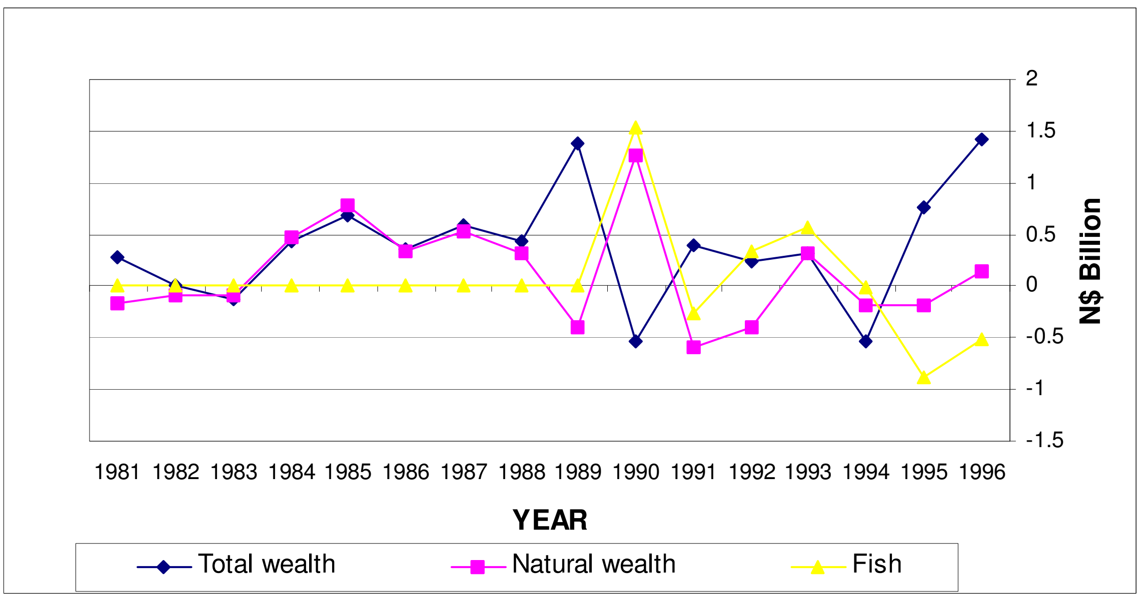


Figure 6.C. Change in Value of Assets in Namibia (1981-1996)



Policy linkages

The 1980's literature on environmental national accounting embodied a more or less explicit assumption that measuring a greener NDP would lead to better, more environment-friendly, policymaking. The development of both the theory and the practice of environmental accounting casts some doubt on this question.

The practical issue is that a green NDP is simply an adjustment in the level of measured income. From this information alone it is difficult to draw any policy conclusions, particularly with regard to sustainability. As the discussion of the Repetto *et al.* (1989) study hints, there is no information with regard to sustainability in the relative growth rates of adjusted and unadjusted NDP. If depletion and damage to the environment were constant from year to year, then the growth rate of green NDP would be greater than regular NDP; if depletion and damage were the same proportion of NDP from year to year, the growth rates would be precisely the same.

Asheim and Weitzman (2001) show that for a particular NDP deflator, a Divisia price index, the growth rate of real NDP indicates whether social welfare is rising or falling. While this is elegant in theory, in practice there do not seem to be examples of empirical application. Regarding the policy linkages of this approach, there is the thorny problem of trying to link policy levers to the *rates of change* of individual components of real NDP.

As an alternative to greener NDP, the analysis of genuine saving offers a more direct route to policy issues. First, the sign and magnitude of genuine saving offers a clear indicator of the extent to which social welfare is increasing, and whether the economy is on an unsustainable path. Second, the decomposition of genuine into its component parts permits relatively direct linkages to be established between saving and particular policy levers.

If a country experiences low or negative net saving at a point in time, policy responses to the effect that 'we need to boost saving' are clearly not operational. Decomposition of genuine saving permits a more practical response, falling into two broad categories: (i) what policies will boost gross saving, and (ii) what policies will affect the series of additions and subtractions that comprise genuine saving?

The determinants of gross saving can in turn be broken down into two broad components, public sector and private. For the public sector the level of government dissaving is typically the issue, and this is directly amenable to alteration by fiscal policies. Policies linked to private saving tend to be more indirect, involving tax incentives, maintenance of positive real interest rates, and the depth and stability of the financial system. For many developing countries a focus on government dissaving is likely to be the most important issue.

The other components of genuine saving are linked to specific sectors. Policies to boost these components of saving include: increasing education expenditures and other investments in human capital; reducing incentives to over-exploit natural resources by, for example, ensuring rent capture and enforcing concessions and quotas; and reducing excess pollution emissions through monitoring, enforcement and provision of economic incentives. For natural resources and the environment the key is not to stop exploitation or completely eliminate pollution, but rather to ensure efficient use of these resources. Since natural resources are often over-exploited in developing countries, and pollution emissions excessive in the newly-industrializing countries, better resource and environmental policies in the developing world will generally boost genuine saving.

The theory presented in the section on 'Income, assets and sustainability' shows that the policy rule for increasing social welfare is to maintain positive genuine saving. For countries that are exploiting natural resources, this implies that the value of resource depletion is being offset by other investments, which in turn are, notionally at least, financed by the resource rents being generated. This raises an important question about the effectiveness of public investment. If resource rents are being invested in 'white elephant' projects with low social returns, then increases in social welfare cannot be guaranteed, even if the policy rule is being followed.

Conclusions

There is by now a decade and a half of experience with environmental accounting, and the theoretical underpinnings of this work are firmly established. Most OECD countries, and many developing countries, are carrying out work on resource and environmental accounts. The United Nations (2004) has codified the methodologies to be employed in practical environmental accounting. This is a good time to ask whether the promise of environmental accounting has been realized.

Lange (2003b) provides an exhaustive description of the potential and actual uses of a range of environmental accounts. This chapter highlights some of the applications in southern Africa, including the Sustainable Budget Index in Botswana. But, as the previous section noted, there was a sense in the 1980's literature that if we could just 'green' GDP, then better policy would automatically follow. Certainly these expectations have not been met. It may be that the earlier emphasis on adjusting income, rather than accounting for changes in asset values, was a blind alley, both in terms of policy application and links to sustainability. Simply handing a Finance minister an adjusted measure of income does not answer two critical questions – is there a problem? and what should be done about it? This is not to deny, however, that better measures of income are important.

This chapter has argued, and the literature largely supports this, that adjusted measures of saving have the greatest policy significance. Savings measures are also quite sensitive to environmental adjustments: if gross saving is 15% of GDP, and resource depletion 1.5% of GDP, then net saving will be reduced by 10% when the environment is taken into account. In many instances the adjustments made to savings will be large – as Table 1 suggests, the Finance minister of Ecuador presumably thinks that the country's saving rate is nearly 23% of GNI, whereas in net terms it is actually less than –4%. For the most resource-dependent countries the standard national accounting aggregates may be seriously misleading.

The empirical evidence on environmental accounting strongly suggests that this work will be of greater importance in developing than in developed countries. The greatest significance will be observed in low income resource exporters, 'oil states,' and rapidly industrializing countries.

It is important to note that the decision to consume resource wealth, which will manifest itself in low or negative genuine saving rates, represents an opportunity not taken. Resource assets represent a sort of frozen development finance which some countries (Malaysia, Botswana) have used to good effect. Other countries choose to consume resource rents, which, while it boosts short-run welfare, does so at the cost of future welfare. The starting level of income is relevant in this instance. It is one thing for Saudi Arabia, at $8500 per capita GNI, to choose to forego future welfare; it is another matter entirely for Nigeria at $290 GNI per capita.

Sustainability rules may seem like an irrelevance for low income countries under stress, such as the Democratic Republic of the Congo. In extreme circumstances consuming wealth is the correct policy option, when the alternative is starvation. But this should serve as a clear signal to the international community that some of these countries are not only poor but getting poorer.

While this chapter has emphasized the greening of national accounts, it is worth noting in conclusion a key insight from the theoretical literature on income and asset accounting: it is the change in value of *all* assets that determines the prospects for social welfare and sustainability. This implies that, beyond greening, a series of further adjustments to saving – human capital accumulation, both in terms of knowledge and healthfulness, reclassifying R&D as investment, net accumulation of social and institutional capital – are ideally required in order to assess development prospects.

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