ANALYSIS

Assessment of the performance and sustainability of mining sub-soil assets for economic development in South Africa

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Abstract

A natural resource accounting approach was applied in this study to evaluate the performance and sustainability of mining practices and strategies in South Africa (SA). The study showed that except for a brief period during the 1980s, rent capture was very low and almost all the resource rent from minerals dissipated to private companies. Recently, however, user costs have appeared to have been reasonably recovered by taxes and institutional royalties and the capital component of the rent (user cost) has fully been reinvested by mining companies. While adequate reinvestment of recovered user costs in alternative forms of capital might imply sustainable management, this can only hold under the assumptions of perfect substitution between human-made and natural capital of the weak sustainability (WS) paradigm. However, even if one adopts WS, the present analysis could not provide adequate evidence in support of the prudence of mining activities in the country. This is due to a lack of adequate information on the proportions of royalties and taxes reinvested collected by the government and private landowners. Moreover, the fact that this study does not account for the environmental impacts of mining is another important limitation on the ability of the present analysis to conclude that mineral resources have been prudently exploited in SA.

Keywords: Natural resource accounting; Mineral depletion; Resource rent; Resource valuation; User cost (economic royalty); Institutional royalties; Resource management

1. Introduction

The early stages of economic expansion and industrialisation in South Africa (SA) were primarily financed from the commercial exploitation of the country's rich mineral resources. Although mining is still an important economic activity in SA, its role and relative importance has diminished over the years compared with other sectors of the economy. Although industrial diversification has taken place in SA, exhaustible mineral resources have been depleted with continued mining and liquidation of mineral assets for income generation. The arising question is how this income is utilised. The record and experiences of most mineral-rich African countries with economic growth raise several questions about the way in which mineral resources have been developed and managed. The so-called 'curse of the mineral-rich' and the fact that, in general, with the exception of a few, resource rich countries have generally experienced lower growth rates than resource poor countries are the cause of concern (Sachs and Warner, 1995; Auty and Mikesell, 1998). For most mineral-rich African countries the 'genuine savings' measure of net accumulation in aggregate capital (produced and natural) is negative, indicating disinvestment and unsustainable consumption (WB, 1997). One should note, however, that non-negative net accumulation of aggregate capital does not automatically imply sustainable consumption levels unless perfect substitution between human-made and natural capital is assumed.

The negative net accumulation in aggregate capital suggests that as natural capital is being liquidated, the biggest share of the resource rent from resource extraction is financing current consumption rather than being reinvested in replacement forms of capital. Such a pattern of resource extraction must be considered unsustainable since at least part of the proceeds from their sale (especially non-renewable resources) needs to be recovered as a capital consumption or depreciation allowance and not as current income (El Serafy, 1989; Hartwick and Hageman, 1993). It is also an indication of possible over-extraction. Recent research in the southern Africa region, however, shows more rational patterns of mineral extraction and rent capture in

Namibia and Botswana (Lange and Motinga, 1997; BNRAP, 1999). This study applies a natural resource accounting approach to investigate how mineral resources have been managed and exploited in SA over the years. It also attempts to measure the extent of rent recovery from the liquidation of the country's vast mineral assets.

The rest of the paper is organised as follows: Section 2 introduces general concepts related to optimal extraction and management of natural resources, resource rent and sustainable income/ consumption. An overview of the importance of mining in the economy of SA is given in Section 3. Results of the physical and monetary accounts for minerals and resource rents estimations are presented and discussed in Section 4. Section 5 derives and compares rent capture and user cost ratios with capital formation in the mining sector to evaluate the sustainability of mining extraction practices and management strategies in SA. Conclusions and implications are distilled in Section 6.

2. Consumption of natural capital, sustainable income and resource rents

One of the main premises of natural resource accounting is Hicks (1946) definition of sustainable income and the concept of wasting assets. Sustainable income is understood as the level of consumption that can be sustained indefinitely without diminishing the asset stock. This, however, does not necessarily mean that stocks of natural assets are maintained constant, but rather their capacity to generate the same stream of income in the future remains intact. With substitution allowed between the various forms of capital under the weak sustainability (WS) paradigm, sustainable income can be understood to require that the total stock of assets (including produced, natural and human capital), not that of its individual components, remain intact. The role of technological progress and the degree of substitution between natural and other assets (manufactured and human capital) are critical assumptions in support of this concept of sustainable income (WS).

On the other hand, advocates of the strong sustainability (SS) paradigm believe that Hicksian income can only be maintained if natural as well as human-made capital is kept intact because they are complements (Daly, 1996). This requires some of the proceeds from the extraction of exhaustible resources to be invested into the cultivation of additional renewable resource stocks (Lawn, 1998).

Unlike the case of renewable resources, where optimal resource use programs can be designed for sustainable rates of harvesting (e.g. steady states), existing stocks of exhaustible resources that are fixed, such as minerals, decline with extraction (in absence of new discoveries). Consequently, their capacity to generate the same stream of income and employment for future generations is reduced with depletion. It is therefore important to compensate future generations for the consumption of natural assets with fixed stocks by reinvesting at least part of their value in other forms of capital assets (e.g. manufactured capital) that are capable of providing at least the same stream of economic benefits in the future. This implies that net receipts from the sale of exhaustible assets contain an element of capital consumption that needs to be set aside (or reinvested) to compensate for depletion in the stock of the asset. The said consumption allowance (user cost), which represents depreciation in the stock of an exhaustible natural resource, must then be deducted from the Systems of National Accounts (SNA) measure of Net National Product (NNP) to derive the true indicator of sustainable income and consumption (El Serafy, 1989; Hartwick, 1990). This is similar to Keynes (1936) treatment of the depreciation of equipment and to Hotelling (1925) economic royalty on the extraction of finite resource stocks. User costs (economic royalties) on exhaustible natural assets were also recognised in the mining economic literature long before Hicks's definition of sustainable income, as a charge for reducing the value of a mine through extraction (Marshall, 1936).[2]

The resource rent, which is considered a measure of the scarcity value of extractive resources such as minerals, is calculated using El Serafy (1989) formula. This formula is: $X_t = R_t \times (1 - (1/(1+r)^{N+1}))$. This measure of value decomposes total resource rent (R_t) into its capital component $(R - X_t)$, which is the proportion that needs to be reinvested, and its income component *(X)*, which is the portion that can be

[2] The same rule was shown to also apply to the depreciation of stocks of renewable resources (Hartwick, 1994; Vincent and Hartwick, 1997; Vincent, 1997). Similar arguments and results were derived for the case of depletion of environmental quality stocks through pollution (Vincent and Hartwick, 1997).

consumed, r is the rate of return and *N* is the number of years in which extraction can take place at the current rate.

Following the 1993 SNA definition (United Nations, 1993), resource rents are calculated in the present study as the value of output (at producer prices) less production costs. Production costs include the cost of intermediate inputs in mining, the compensation of employees, the consumption of fixed capital, plus a normal rate of return on invested capital. The normal rate of return on fixed capital investments represents the opportunity cost or economic value of financial capital that may be invested in alternative profit-making economic activities. This paper uses the average long-term interest rate (or bond rate) less the prevailing inflation rate (in other words, real interest rate) as the rate of return to capital, which is multiplied by the fixed capital stock in mining to derive estimates of normal profits. The average rate used for the period 1966-1998 was 3%.[3] The use of average rather than marginal costs in calculating resource rents is expected to introduce an upward bias in rent estimates, as average costs are generally lower than marginal costs. Unit rents are calculated as total rent divided by the volume of depletion for a specific year.

3. Mining and the South African economy

Mining has always been a very important economic activity in SA, especially during its early stages of economic development. Despite its importance also to downstream economic activities, the contribution of mining to national income and employment followed the general trend of decline in primary sector activities observed worldwide.

This does not imply the unimportance of the primary sector (Daly, 2000, 1-2). The contribution of mining to GDP fell from 13.2% in 1970 to only 6.5% by 1998 (Fig. 1). Similarly the contribution of mining to employment declined from 14.2% of employment in the formal non-agriculture sector in 1970 to 8.8% in 1998.

On the other hand, the share of mining in the revenue of the country's total exports remained very high in spite of the steady decline in its share since the early 1980s. SA is ranked first in both platinum and titanium extraction, third in world phosphate rock and fluorspar extraction, seventh in asbestos, eighth in aluminium, lead and cobalt and 12th in copper extraction. SA has 35% of the world's gold resources and is the main producer of this commodity, and is also the fifth largest producer of coal (DME, 1999).

Concerning mining's contribution to government revenue, only information on the share of the contribution of gold mines is readily available, as there are no time series data on tax revenue from other (i.e. non-gold mines) or all mines. During the period of high gold prices in the early 1980s, gold mining contributed as high as 18.4% of total government revenue. However, this figure dropped substantially to only 0.2% in 1998. From the above, it is clear that since the mid-1980s, except for its contribution to the current account of the balance of payments (exports), the mining industry has lost its position of dominance in the South African economy.

[3] This rate is slightly lower than the rates in other studies worldwide (see also Lange and Gaobotse, 1999), but can be attributed to the peculiar political dispensation and application of monetary policy in SA, leading to low (and even negative) real interest rates during the period under consideration. Under SS the discount rate should effectively be set at the regeneration rate of the renewable resource substitutes that needs to be cultivated to keep the stock of natural capital intact (Lawn, 1998).

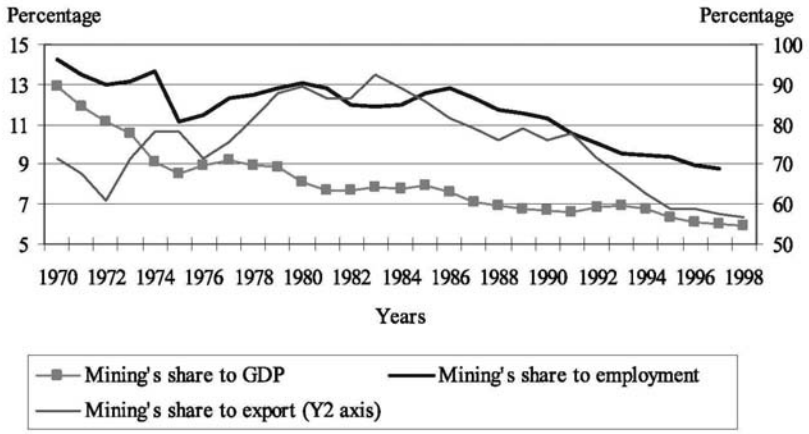

Fig. 1. Contribution of mining to GDP, employment and exports in SA, 1970–1998. Source, South African Reserve Bank (2001) Quarterly Bulletin, various issues.

Within the sector itself, gold and coal contributed about 70% of total income from all mining activities in 1993 (the latest year for which detailed financial and extraction figures are available). The dominance of gold and coal, coupled with the major problems faced in the definition of other mining categories in various financial data sets, led to the decision to focus the monetary analysis only on gold and coal mining activities for the remainder of the paper. Accordingly, in terms of financial data, all other mining activities were treated as being a residual item (the difference between all mining and the sum of gold and coal mining).[4] Other minerals include precious metals and minerals such as diamonds, platinum and silver, semi-precious minerals such as Tiger's-eye and non-ferrous metals and minerals such as cobalt, copper, lead and titanium and ferrous minerals, which include chromium, iron ore, manganese, silicon and vanadium. In virtually all of these minerals, SA is ranked among the ten top producing countries in the world.

4. Resource rents from mining in South Africa

4.1. Gold

According to the derived physical accounts for gold (Blignaut and Hassan, 2001), it is clear that gold reserves had continued to decline since 1966 from the level of approximately 59 000-35 877 tons in 1998. This constitutes a reduction of economically proven gold reserves by about 40% over the period of 33 years at an average rate of extraction of about 0.7 tons/year. As no information is available for new discoveries, the only difference between closing and opening stocks in the calculations pertains to extraction and net changes in inventory. Accordingly, the estimates of the proven reserves may be biased downwards as new discoveries may have occurred over the period. Nevertheless, extraction data, which represents published (actual) information, shows a steady but relatively small decline as well, especially after 1973. Gold extraction in 1966 was 960 tons, 855 tons in 1973, 619 tons in 1993 and 464 tons in 1998.

[4] It should be noted that the primary source of financial information has been mining censuses conducted by Statistics South Africa (2001) (SSA). These censuses commenced in 1966 and are done approximately every 3 years with the latest available census being for 1993. Data on physical extraction figures are obtained from the Department of Minerals and Energy (DME) with the latest of these being available for 1998.

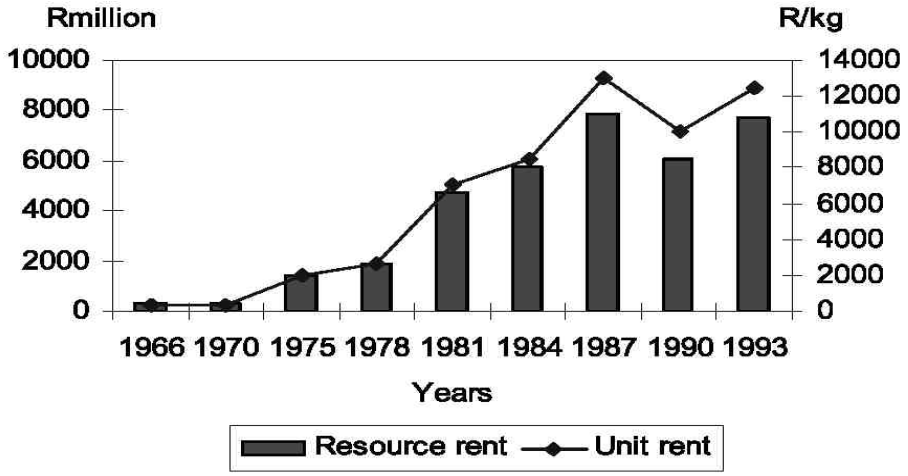

Fig. 2. Resource and unit rent from gold in SA, 1966–1993. Source, own calculations.

At current extraction rates gold reserves in SA can last for another 76 years.

The resource rent could only be calculated for those years for which detailed financial data were available for gold. As can be seen from Fig. 2 the unit rent increased substantially in 1981 due to the high price of gold that year[5] and continued to increase during the 1980s and early 1990s.

4.2. Coal

Coal reserves decreased from over 40 billion tons to about 36 billion tons over the 33 years between 1966 and 1998, showing an average annual rate of extraction of about 150 million tons. However, the extraction of coal grew steadily over the period from about only 53 million tons in 1966 to close to 300 million tons in 1998 at an average rate of growth of 7 million tons/year (Blignaut and Hassan, 2001). This increase in coal extraction is due to an increase in both local and foreign consumption. The domestic use of locally produced coal remained more or less constant between 1989 and 1998 at approximately 75% of total coal consumption. The largest single domestic consumer is ESKOM (the electricity generating utility), consuming 60% of all local sales. However, the fastest growing consumer of coal is SASOL (the fossil fuel producing corporation), currently consuming 29% of all locally produced coal. Metallurgic industries comprise 3.7% of the local market compared with other industries, which consume 4% of the local market. At current extraction rates SA's coal resources can last for approximately 122 years after 1998.

Like in the case of gold, the resource rent could only be calculated for coal for a selected number of years between 1966 and 1993 (Fig. 3). From these calculations it is clear that the resource rent continued to increase throughout the period with a particularly sharp jump between 1987 and 1990. This is mainly due to the growth in output from R4 825.3 million in 1987 to R8 164.9 million in 1990, which represents a growth of almost 70% over the period.

[5] The average gold price in 1978 was $6 370.5 and $14 874.6 per kg in 1981 with an all time high of $19 811.1 per kg in 1980.

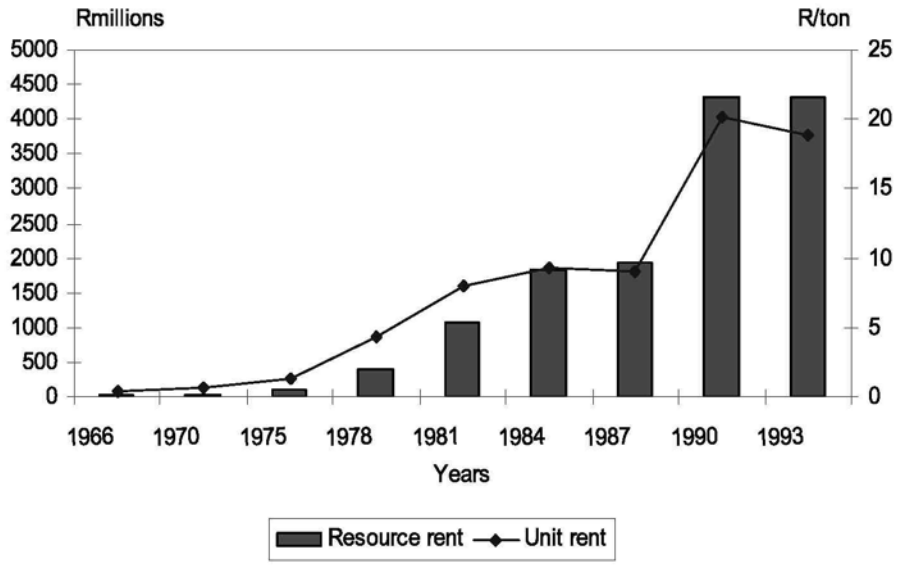

Fig. 3. Resource and unit rent from coal in SA, 1966–1993. Source, own calculations.

4.3. Other and total mining

Physical and monetary accounts for the other mining activities could not be compiled due to the unavailability of physical data on reserves and extraction of these minerals. However, the financial data necessary for calculating the resource rent are available and hence resource rents for all other minerals and for total mining are calculated. Extraction values of minerals other than gold and coal had increased over time from R391 million in 1966 to reach R9 billion in 1993, showing an average annual growth of over R3 million per year. The main activities contributing to this increase in the other mining are platinum and diamonds—both of which are produced especially for the export market. Fig. 4 shows a steady growth trend in mining rents except for the sharp dip in 1984 due to the weak performance of diamonds.

5. Appropriation of the resource rents of minerals and the question of sustainability

To evaluate the performance in terms of rent capture from mineral extraction, the fraction of the rent collected as institutional royalties by government is calculated and compared with the economic royalty or user cost, which is the capital component of the resource rent that needs to be reinvested. The user cost is calculated using El Serafy formula given in Section 2 above. The results of the calculations, using two different discount rates (3 and 5%), are presented in Table 1. *X* gives the income component that can be consumed whereas the capital component (or user cost) that needs to be reinvested is the remainder of the resource rent *{R — X).* Table 1 indicates that the capital depreciation factor *((R — X)/R)* was 15.5% for gold and 0.9% for coal in 1993.

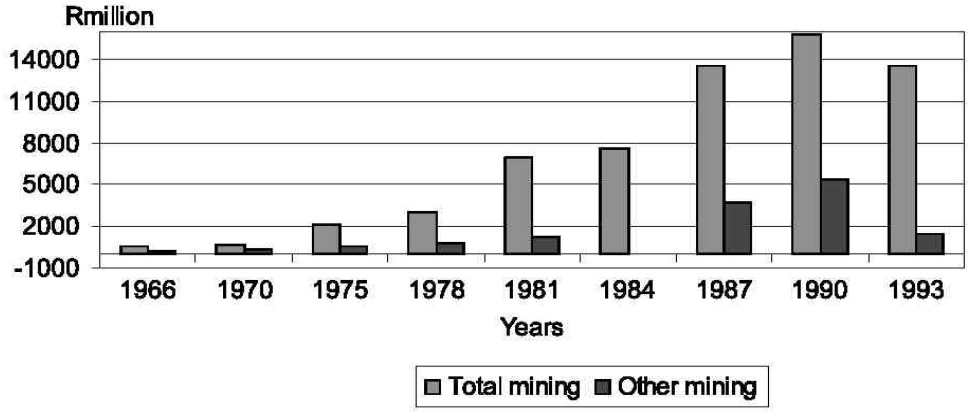

Fig. 4. Resource rent for other and total mining in SA, 1966–1993. Source, own calculations.

The derived capital consumption (user cost) ratios are then compared with the institutional royalty of the resource rent collected from gold and coal. Like all other governments in the world, the South African government collects some revenue from mining activities. Prior to 1992 a profit-sharing system had prevailed in which mining companies were required to contribute a share of their profits to the government. The calculation of the share had been based on a particular formula that varied between companies depending on many factors. The rule had applied to both private and government land leased to mining companies. After 1992, ownership of right to mining was revised, leading to a new dual system of institutional royalties. In the new system, profit sharing applies only on public (government) land leased to companies, and government collects no institutional royalties from companies on privately owned land. However, a system of institutional royalties prevails on private land leased to companies based on a free agreement between the private landowners and the companies. The most recent policy (RSA, 1998) has proposed a change in rights to minerals to be vested in the state, with a system of institutional royalties similar to the current one to continue. Institutional royalties on private (collected by private owners) and public (paid to government) land are to be calculated as percentage of gross revenue rather than of profit, as used to be the case under the previous profit sharing system. Due to lack of factual information, surveys of the opinions of experts have been carried out to estimate the distribution of ownership in the minerals' sector (personal communication: Conradie, 1999; Prevost, 1999; Handley, 1999). The investigation indicates that about 70% of the land on which gold mines are operating, which is concentrated in Gauteng and the Free State provinces, is privately held. Also, more than 80% of the land used for coal mining (concentrated in Mpumulanga and Kwazulu Natal) is in private hands.

In some countries (Norway, Denmark, Sweden, USA, Botswana) institutional royalties and special taxes are targeted and used to manage the extraction of natural resources through appropriate environmental policies and fiscal arrangements for development and conservation within the sector. However, it can also be argued that profit taxes, being a fiscal instrument used to collect tax from all economic activities, may not be considered as an institutional royalty directed towards managing the resource under question. This is mainly because profit tax revenues typically go into the general purse of the government (as do institutional royalties in SA) and are not necessarily spent on the management of the specific natural asset that is the source of the proceeds. They are usually spent on the basis of the broader national economic policy objectives and priorities.

Table 1
Resource rent for gold and coal divided into their income and capital components in R million at current prices, 1966–1993

	Resource rent (R)		Discount rate = 3%						Discount rate = 5%					
			Income (X)		Capital ($R-X$)		($R-X$)/R (%)		Income (X)		Capital ($R-X$)		($R-X$)/R (%)	
	Gold	Coal	Gold	Coal	Gold	Coal[a]	Gold	Coal	Gold	Coal	Gold	Coal[a]	Gold	Coal
1966	299	23	251	23	48	0	16.1	0.0	284	23	15	0	5.0	0.00
1970	314	38	253	38	61	0	19.4	0.0	293	38	21	0	6.7	0.00
1975	1422	95	1250	95	173	0	12.2	0.0	1379	95	44	0	3.1	0.00
1978	1857	393	1618	393	240	0	12.9	0.0	1794	393	63	0	3.4	0.00
1981	4705	1065	4120	1065	585	0	12.4	0.0	4554	1065	151	0	3.2	0.00
1984	5768	1835	4937	1829	831	5	14.4	0.3	5532	1835	236	0	4.1	0.00
1987	7841	1940	6870	1930	971	10	12.4	0.5	7591	1939	250	0	3.2	0.00
1990	6098	4310	5270	4286	828	24	13.6	0.6	5872	4309	226	1	3.7	0.02
1993	7713	4319	6517	4282	1196	37	15.5	0.9	7357	4318	356	2	4.6	0.05

Source, own calculations.
[a] 0, does not indicate nil, but is significantly less than R1 000 000.

Table 2
Taxes and institutional royalties as a percentage of resource rent for both gold and coal, 1966–1993

	Gold		Coal		Total mining	
	Royalties	Taxes and royalties	Royalties	Taxes and royalties	Royalties	Taxes and royalties
1966	3.3	35.0	3.0	19.4	2.6	25.2
1970	0.8	28.8	4.9	19.1	1.3	22.3
1975	0.7	0.7	3.7	3.7	1.1	1.1
1978	1.7	1.7	2.3	2.3	1.8	1.8
1981	4.5	52.1	1.5	8.4	3.6	37.7
1984	4.1	40.4	0.4	3.5	3.5	34.0
1987	6.3	41.8	1.3	6.1	4.1	28.7
1990	4.9	23.7	0.6	3.4	2.5	19.8
1993	4.2	12.7	0.8	1.7	4.8	12.6

Source, own calculations. Note, the data for 1975 and 1978 concerning taxes are extremely unreliable due to a different method of disclosure during those 2 census years.

To appreciate the magnitude of the resource rent in comparison to the institutional royalties and taxes collected, Table 2 and Figs. 5-7 display these variables for gold, coal and total mining. Fig. 5 shows that total tax collections (institutional royalties and profit taxes) captured approximately 13% of the resource rent of gold in 1993. However, with institutional royalties alone it is clear that virtually all the resource rent from gold dissipated as a windfall profit to private companies. The government's share in the resource rent, even under the total tax scenario, began to decline after 1987. The decline in revenue from taxes and institutional royalties is mainly due to the decline in the profitability of gold mining companies and the changed profit-sharing regime after 1992, described earlier.

In the case of coal the picture is different, where almost all the rent (98%) accrued as a windfall profit to private owners (Fig. 6), providing a strong incentive for over-extraction. The very low royalty charges coupled with the fact that coal is a major source of negative environmental externalities in the country, the social costs of which are not born by the mining industry, suggests that coal resources may not have been managed sustainably and are probably being extracted above socially optimal levels. One can accordingly

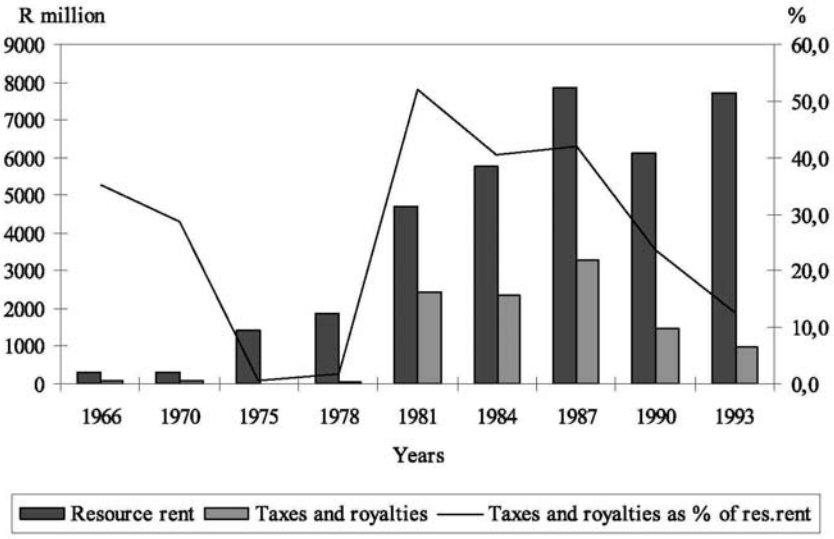

Fig. 5. Resource rent and taxes and institutional royalties from gold in SA, 1966–1993. Source, Blignaut and Hassan (2001).

argue that SA has overproduced electric power and over-polluted the domestic environment (above socially optimal extraction and pollution levels). This is because more than 90% of the electric power supply in SA is generated in coal-fired power plants. The electric power sector is currently not charged for the social costs of atmospheric pollution externalities (emissions) associated with the burning of coal for power generation. If we also take the social costs of pollution into account, the portion of the proceeds from coal mining to be recovered as a capital consumption allowance should also contain an allowance for maintenance of ecological balances. In other words, some of the proceeds from mining need to be invested not just to keep capital intact, but also to minimise and offset the environmental impacts of the use of coal. Due to the dominance of gold, total rent captured from all mining follows the same pattern as the rent captured from gold mining (Table 2 and Fig. 7). The low level of rent capture from minerals observed in Table 2 can be attributed to a number of factors. Prior to 1992, the profit-sharing system had highly underestimated the capital consumption component of the rent. The fact that institutional royalties have been collected only from minerals on government-owned land after 1992, estimated to be less than 30% of the total, partially explains the decline in rent collection during recent years (Conradie and Prevost, personal communication).

The 12.7% total institutional royalties share in the resource rent from gold (Table 2) compares well with the 15.5% user cost or economic royalty (the capital component) calculated in Table 1 for 1993. On the other hand, the government collected twice the user cost on coal (0.8% according to Table 1) in total institutional royalties and taxes (1.7% according to Table 2) from coal mining in 1993. If one considers that after 1992 institutional royalties have been collected only from public land (representing 30% of total gold and 25% of coal), this means that the 1993 figures of institutional royalties of Table 2 may be under-estimating total rent capture. This is because the institutional royalties and taxes collected by the government do not include institutional royalties collected by private owners from mining companies. If one assumes that private owners of mining lands collect institutional royalties from mining companies, then the total rent capture from minerals in SA will probably be higher than El Serafy's user cost of Table 1. On the other hand, if one assumes that only institutional royalties as captured by government (excluding other taxes) represent the true share of the rent, then the rent captured would be much lower than the user cost estimates of Table 1.

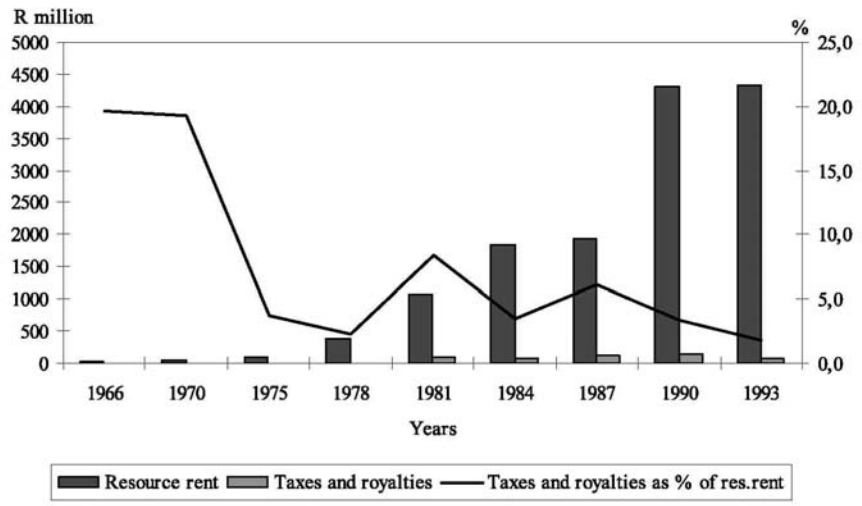

Fig. 6. Resource rent and taxes and institutional royalties from coal in SA, 1966–1993. Source, Blignaut and Hassan (2001).

As this study could not establish estimates of royalties collected by private landholders, it is hard to say how total royalties collection (from both private and public land) compares with the user cost. Moreover, it is important to note that while the share of royalties alone seems to have been stable over the period of study, the share of taxes fell away dramatically in the 1990s (Table 2). This may be attributed to the way royalties (based on gross revenue) and general taxes (based on profit) are determined. However, it raises serious concerns about using general taxes on mining as the appropriate indicator of and policy instrument for sustainable management of this resource sector compared with royalties, which indicate low rent capture.

According to the user cost (capital component) calculations, owners of gold mines needed to reinvest 15.5% and coal mines 0.8% of the resource rent in other forms of capital assets. To address the question of how resource rents have been used, this study compared the capital component of the resource rent *(R — X)* with actual investments made by the gold and coal industries, especially private sector investment spending where the biggest share of the rent accrues (more than 70%).

The answer to the question of how the economic rent of mineral resources has been used depends on the nature of property rights to the resource and the system of institutional royalties and levies in place for its exploitation. While private capital owners also invest their profits from productive activities (and usually more efficiently), the nature of public and private investments differs. Public investments usually target social development projects, which mainly include investment in public works, infrastructure and basic services such as health and education. On the other hand, private investments typically go to forms of assets that support private economic activities such as mining, manufacturing, agriculture and services, and are mainly in the form of equipment and construction.

The ratios of the total resource rent of minerals and its capital component to capital formation in the mining industry are depicted in Fig. 8. Although total minerals' rent is more than double the rate of capital formation in mining, the reverse is true for the capital component of the rent (user cost). According to Fig. 8, the mining sector in SA had invested in alternative forms of capital more than twice the user cost. The user cost contributed 40% of total mining investments in 1966 and its contribution then declined to fluctuate around an average of 25% for the rest of the period under study. While the capital component of the minerals' rent appear to have been fully reinvested by the mining companies, this does not necessarily imply that mineral resources have been sustainably managed and exploited in SA.

Many factors limit the ability of the present investigation to reach the conclusion that mineral resources have been prudently exploited in SA. First, a lack of information on how the government has spent royalties and taxes collected from mining is one factor. Also, no data are available on the magnitude of royalties collected by private landowners and the manner in which those royalties have been spent. It is

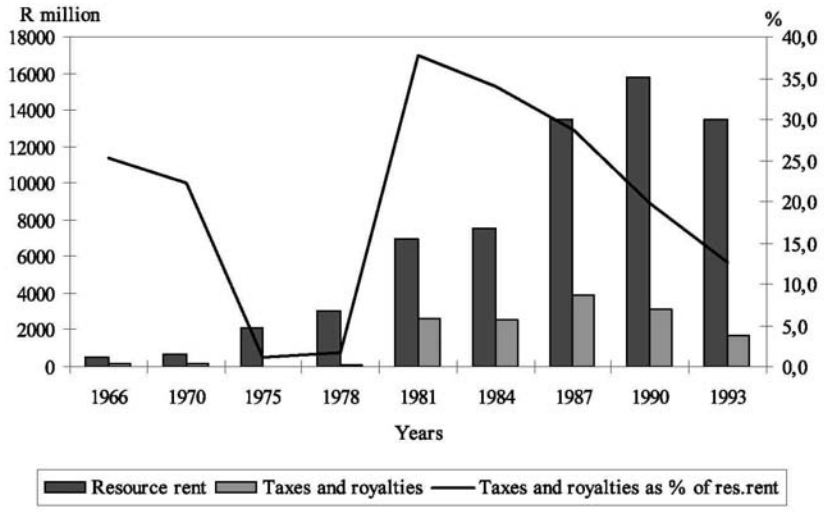

Fig. 7. Resource rent and taxes and institutional royalties from all mining in SA, 1966–1993. Source, Blignaut and Hassan (2001).

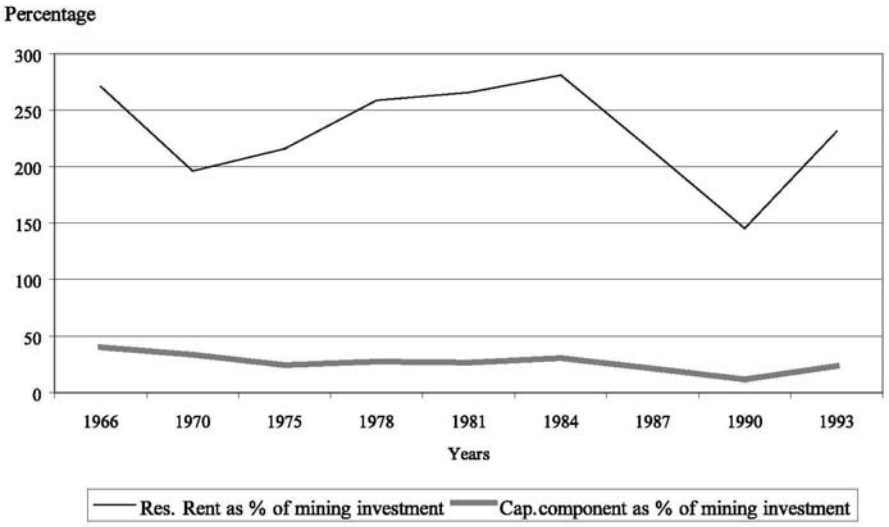

Fig. 8. Resource rent and the capital component of the rent as percentage of gross capital formation in the mining sector at current prices, 1966–1993. Sources, Blignaut and Hassan (2001). South African Reserve Bank (2001) Quarterly Bulletin, various issues.

possible that significant portions of the royalties collected by the government and private landowners are spent on publicly-provided and private consumption expenditure or accumulated debt repayment. Moreover, the fact that the impact of mining on the environment and the social costs associated with its pollution externalities have not been considered represents another limitation of the present analysis.

6. Conclusion

Although SA was heavily dependent on the extraction of minerals for primary capital formation and economic growth, this is no longer the case. The contribution of minerals to GDP is currently only approximately 6%. This, however, does not mean that the resource should not be managed properly. On the contrary, as for all other exhaustible resources, as mineral assets become increasingly scarce and depleted, the more important it becomes to substitute income from alternative productive assets for income generated by liquidation of the resource. This requires the adequate capturing of rent and the reinvestment of its capital consumption allowance component in alternative forms of capital assets to compensate for depletion.

Prior to 1981, almost all the minerals' rent had accrued to mining companies in SA. Rent capturing through institutional royalties and taxes began to improve during the 1980s to reach about 30% of total rent by the late 1980s, when it started to decline again with the change in mining policy. The most recent mining policy, however, proposes changes in defining rights to minerals that are expected to improve rent capture by the public agency. This study shows that the share of total taxes and institutional royalties in total rent compares well with El Serafy's capital component (user cost) that is to be recovered and reinvested. However, rent capturing through royalties alone was very low compared with the user cost estimates.

The results of this study also indicate that the mining industry in SA has fully reinvested the capital component of the resource in alternative forms of capital to compensate for the depletion in mineral assets. Under the WS hypothesis, which assumes that human-made and natural capital are perfect substitutes, the levels of rent captured could suggest that mineral resources have been sustainably exploited in SA. Nevertheless, even under the WS hypothesis the results of the present analysis fell short of adequately supporting such a conclusion. The lack of information on how taxes and royalties collected by the government have been spent, as well as unavailability of data on the size of royalties collected by private landowners and how they have been spent, is one major limitation of this study. It is also important to note that a more prudent strategy of reinvestment of rent from non-renewable resources would be to plough a high portion of the rent into the development and maintenance of renewable natural assets. Without better information on the nature of the reinvestment of rents collected from mining by private and public sectors it is difficult to properly evaluate the sustainability of mining activities in the country. Another major limitation of the study is the fact that impacts on ecological balances and the social costs associated with environmental damages caused by mining have not been accounted for. This is critical from both WS as well as SS points of view.

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