

Is platinum paying its rent?

L.C. STILWELL* and R.C.A. MINNITT†

**Read, Swatman & Voigt (Pty) Ltd, Johannesburg*

†*Department of Mining Engineering, University of the Witwatersrand, Johannesburg*

The paper will attempt to identify the threats, however obscure, that could confront the South African platinum industry.

South Africa has the largest reserves of platinum group metals in the world, and is the largest producer of those metals. This situation is no different from that which existed in the gold sector fifty years ago. Since then South Africa's share of world gold production has dwindled, and the gold mining industry has lost its dominance.

Unlike gold, platinum has widespread use as an industrial commodity. Its investment value is a minor portion of its total value. It is therefore subject to different market forces.

The sheer magnitude of the industry in South Africa obscures the fact that it is a wasting industry, and that South Africa exports almost all its production as a refined metal in the form of autocatalyst.

Since Hotelling published his seminal work *The economics of non-renewable resource* in 1931, the science of mineral economics has developed exponentially. The paper will present a background of mineral economic theory and compare to this the development of the South African platinum industry. Of particular concern to a mineral exporting country is the question of mineral rent—its definition and employment. This will be the main theme of the paper.

Introduction

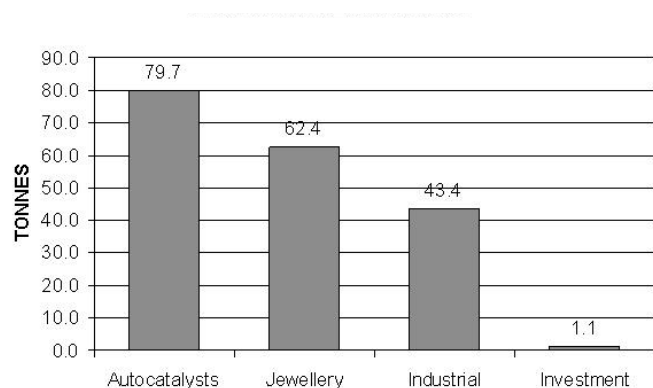
The identification and determination of the size of the rents flowing from mineral developments has been somewhat elusive. Understanding these two aspects of mineral rents is essential for they provide the only sure way of capturing the rent, something both investors and government alike want to do, but for different reasons. The objective of this paper is to investigate, using empirical data, the matter of resources rent in the South African platinum industry. We also draw comparisons between the resource base and the life expectancy for the gold and platinum industries to highlight the lessons for the platinum industry learnt from the rise and decline of the gold industry. In addition, it is possible to illustrate the similarities in exhaustibility that exist between the gold and platinum industries in South Africa.

Relative to the rest of the world, South Africa enjoys particularly rich mineral endowments, having the largest resource base of platinum group metals (PGMs) in the world, and being the largest producer of these metals. The extent of exploitation of the platinum deposits relative to the size of the resource base means that the industry could be described as youthful, a situation similar to that which existed for the gold mining sector fifty years ago. Although South Africa is still the world's largest producer of gold, depletion of the deposits over the last century has meant that this country now accounts for 13.8% of world production, or 341 tons, in 2004, as opposed to 1 000 tons, or approximately 66%, in 1970. This gold earned the country approximately R32 billion in 2004 money and R830 million in 1970 money.

Unlike gold, the principle use of platinum is as an industrial commodity in the manufacture of autocatalysts, with only a minor portion of output used for investment

purposes (Figure 1). Because of the highly specialized application for which the metal is used, it is subject to different, highly complex market forces, which dramatically and suddenly affect the industry.

The paper uses data from a variety of sources, which include the Department of Minerals and Energy (DME), the Department of Trade and Industry (DTI), Statistics South Africa (StatsSA) and the South African Revenue Service (SARS). In many cases, data obtained from one source does not agree with that from another. This is understandable, given the magnitude and diversity of the South African mining industry and the difficulty of retrieving historical data from different sources. This disparity is not critical to the objective of this paper, which is to illustrate general trends, and not to provide a definitive analysis.



Source: Johnson Matthey 2005

Figure 1. Platinum demand by use in 2004

The sheer magnitude of South Africa's platinum resources (Figure 2) obscures the fact that mining is a wasting industry, and that the resources must eventually become depleted, however distant this may appear to the present generation.

A perspective of the South African gold and platinum industries

Statistics South Africa, the government agency charged with compiling and publishing official statistics, publishes the resource base and estimated life for the gold and platinum industries (shown in Figures 3 and 4) in the Natural Resource Accounts for South Africa (RSA 2004). The Natural Resource Accounts contain data on the opening stock and estimated life of production for the period from 1980 until 2001.

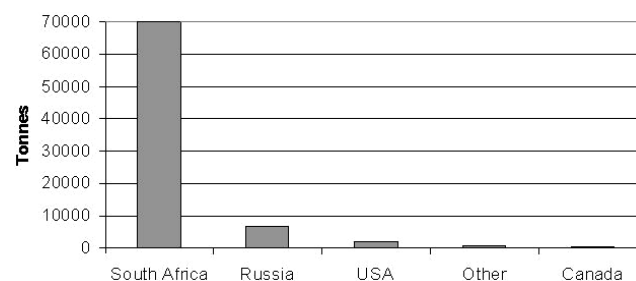
The resources remaining in the ground are increasingly difficult and expensive to recover, and it is very unlikely that it will be possible to convert all the resources into reserves, or to exploit them; some will remain *in situ* forever. However, this paper does not aim to be an exact balance sheet account of platinum resources, but rather to give a broad understanding of mass balances and what the consequences of current exploitation rates could be. We base our arguments on estimated resources, as the conversion from a resource into a reserve would involve many modifying factors, and is not the purpose of this paper. The National Accounts, however, do refer to 'gold reserves' and 'proven economic reserve for platinum' (RSA 2004, pages 10 and 11).

Between 1980 and 2001 the platinum resource base decreased by 4%, from 65746 tons to 62966 tons, while the remaining life has decreased by 15% from 575 years to 485 years (see Figure 4). During the same time gold resources have decreased by 25% (from 47 828 tons to 35 446), but the remaining life has increased by 27%, from 71 years to 90 years (see Figure 3).

This decrease in annual gold production is due to a significant decline in the rate of extraction, which is in turn due to a variety of factors, not least of which is the expense and difficulty of accessing and mining the remaining reserves.

Figure 5, constructed from data published by the Department of Minerals and Energy and its predecessor, the Government Mining Engineer, shows the vagaries of Life of Reserves projections. In 1921, for instance, at the ruling production rate, the estimated life was 354 years. In 1948, when South Africa had gold reserves of 70 000 tons¹, the same as present platinum reserves (RSA 2005, page 36), the calculated life was 189 years. In 1970, when gold production reached its peak, the life of reserves had dropped to 50 years. Between 1976 and 1996, the calculated life remained steady in a narrow band between 69 and 76 years. Since 1996, however, the life of the gold industry has steadily increased, and at the end of 2004 it is over 100 years, while the reserves appear to be flattening out at around 30 000 tons.

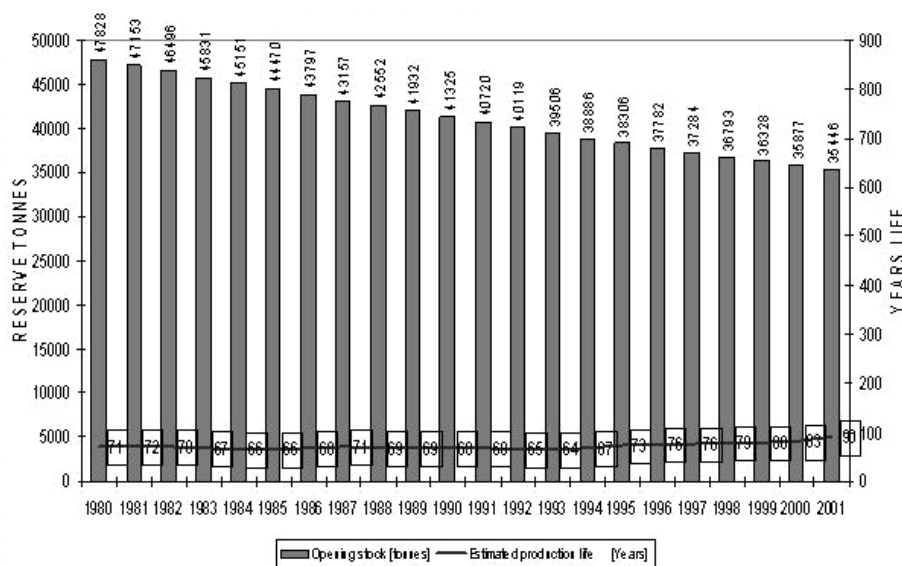
Mining of PGMs in South Africa started in 1926. The estimated 2004 reserve, published by the Department of Minerals and Energy (RSA 2005) is 70 000 tons, whereas the National Resource Account published a figure of 62 966 tons. Using production data supplied by the DME it is possible to estimate the size of the reserve base in 1927 as



Source: RSA 2005

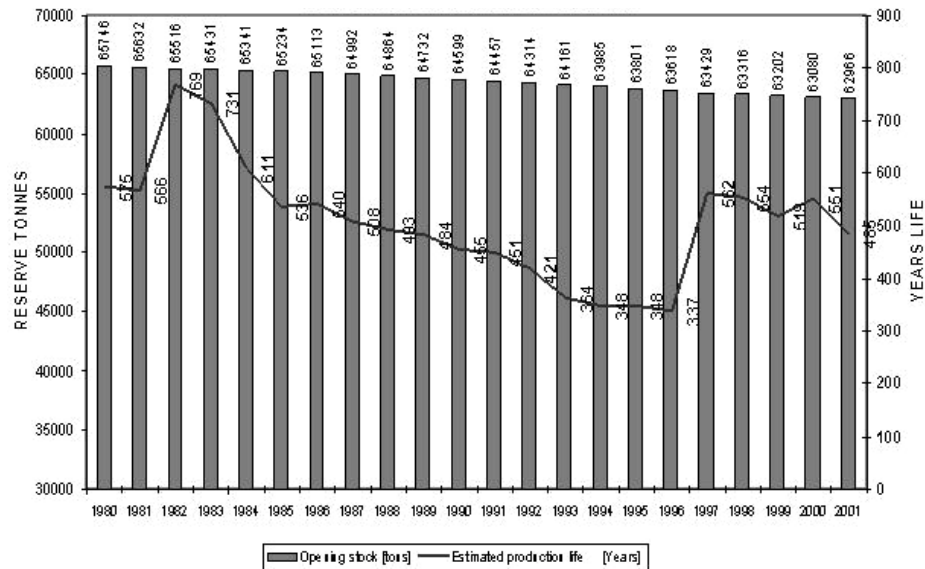
Figure 2. Platinum group metals worldwide resource base

¹This figure is obtained by adding annual published production data to the 2001 opening stock given in the National Resource Accounts (RSA 2004, page 10)



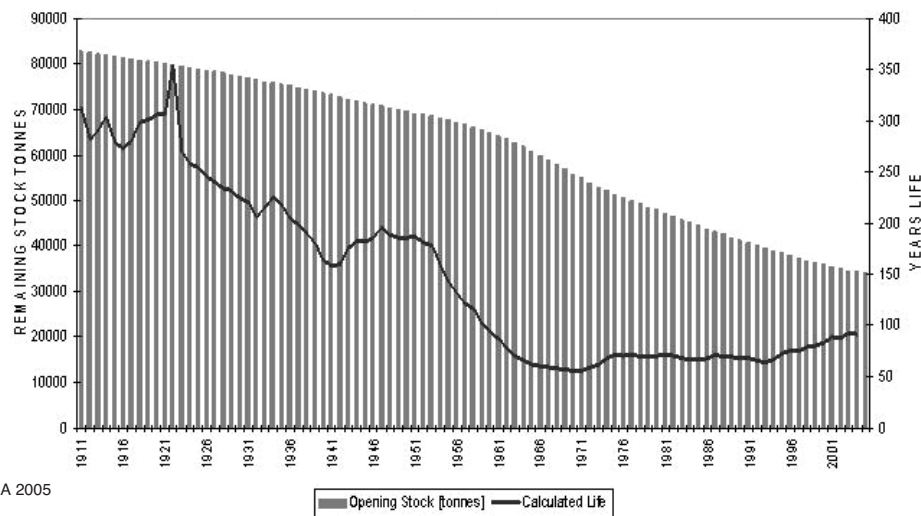
Source: RSA 2004

Figure 3. Declining South African gold resource base and estimated production life



Source: RSA 2004

Figure 4. South African platinum resource base and estimated production life



Source: RSA 1910–1990; RSA 2005

Figure 5. South African gold production and estimated production life

well as an estimate of the life of the reserve based on the ruling production rate (see Table I). In 1926, at the start of operations, the calculated life was 28 000 years, and in 1933, when production dropped to a mere 74 kilograms, the calculated life was over a million years.

Figure 6 shows the calculated reserve base and the estimated remaining life from 1970 onwards, the year the calculated life dropped below two thousand years. Between 1970 and 2004 the estimated life has declined from 590 years to 253 years (-84%), the stock has decreased by 6% from 74 571 tons to 70 000 tons, while annual production has increased 489% from 46 904 kg to 27 6401 kg (see Figure 7).

The 0.4% fall in PGM stock from 75 187 tons in 1927 to 74 848 tons in 1970, is truly negligible, but the 6% drop since 1970 should be noted with concern.

Figure 7 shows the historical annual production of platinum between 1970 and 2004, with a linear trend line imposed. Using this trend line the projected production in 2026, i.e., in twenty years' time, would be 373 tons, and the estimated life would be 170 years (see Figure 8).

This dramatic change in estimates of the size of the resource base should serve to warn against complacency in its exploitation and the use of the benefits that flow from it. Provided other materials do not replace platinum, demand is likely to outstrip supply; even if the reserves are extremely large, they will eventually run out, very possibly sooner than in 253 years.

South Africa's natural resource account²

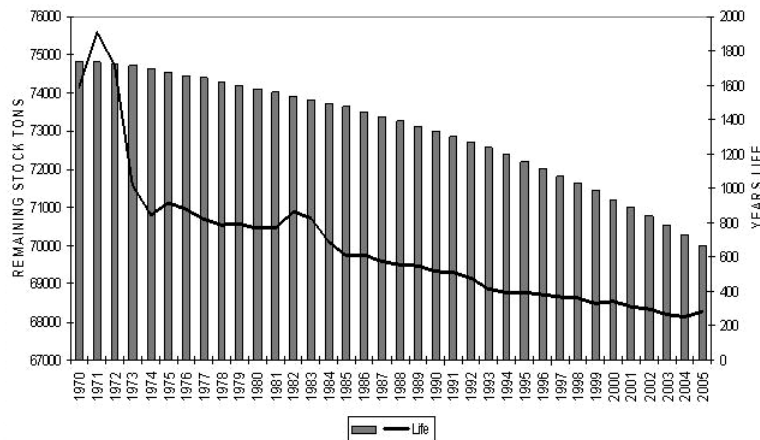
Natural Resources Accounts are satellite accounts to South Africa's System of National Accounts, or SNA. SNA is a 'coherent, consistent and integrated set of macro-economic accounts, balance sheets and tables, based on a set of internationally agreed concepts, definitions, classifications and accounting rules' (United Nations, 1993).

²Note: sales, or output, values are as published in the National Resource Accounts. We assume these are in current terms, but have found some discrepancy with the data published by the Department of Minerals and Energy. We have not resolved this difference.

Table I
Platinum production

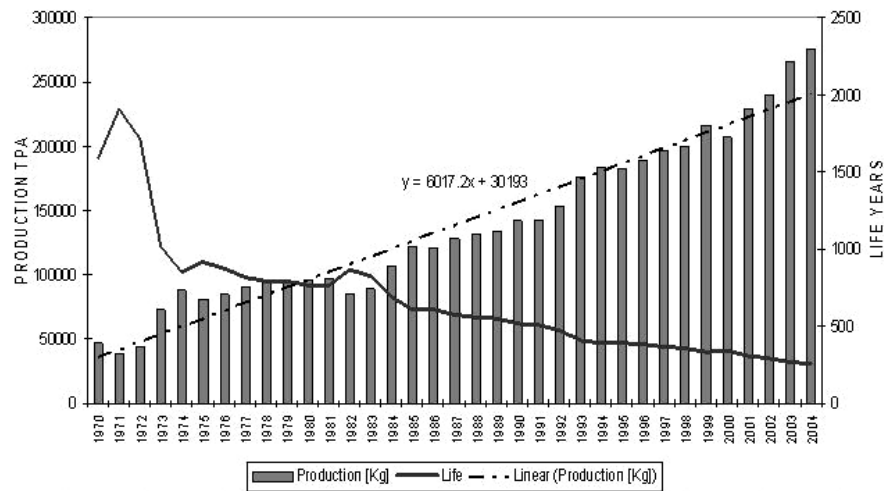
Year	Production (kg)	Remaining stock at beginning of year (tonn)	Life years	Year	Production (kg)	Remaining stock at beginning of year (tons)	Life years
1926	328	75187	229230	1976	84997	74475	876
1927	609	75187	123460	1977	91082	74390	817
1928	736	75186	102155	1978	94290	74299	788
1929	927	75186	81106	1979	93800	74205	791
1930	1721	75185	43687	1980	96330	74111	769
1931	1467	75183	51249	1981	96702	74015	765
1932	288	75182	261047	1982	85245	73918	867
1933	74	75181	1015962	1983	89466	73833	825
1934	1174	75181	64038	1984	106956	73743	689
1935	973	75180	77266	1985	121728	73636	605
1936	1024	75179	73417	1986	120542	73514	610
1937	1232	75178	61021	1987	127980	73394	573
1938	1660	75177	45287	1988	131722	73266	556
1939	1714	75175	43859	1989	133684	73134	547
1940	1863	75173	40351	1990	141913	73000	514
1941	2036	75172	36921	1991	142861	72859	510
1942	2116	75169	35524	1992	152891	72716	476
1943	2028	75167	37065	1993	176167	72563	412
1944	2556	75165	29407	1994	183926	72387	394
1945	2094	75163	35894	1995	183097	72203	394
1946	1985	75161	37864	1996	188636	72020	382
1947	2013	75159	37337	1997	196604	71831	365
1948	2310	75157	32535	1998	199953	71634	358
1949	3366	75154	22327	1999	216479	71434	330
1950	4486	75151	16752	2000	206770	71218	344
1951	5938	75147	12655	2001	228747	71011	310
1952	7232	75141	10390	2002	239585	70782	295
1953	9305	75133	8075	2003	266458	70543	265
1954	10713	75124	7012	2004	276401	70276	254
1955	11873	75113	6326	2005	246811	70000	284
1956	15072	75101	4983	2006	252828	69753	276
1957	18777	75086	3999	2007	258846	69500	269
1958	9331	75068	8045	2008	264863	69242	261
1959	11644	75058	6446	2009	270880	68977	255
1960	12638	75047	5938	2010	276897	68706	248
1961	10886	75034	6893	2011	282914	68429	242
1962	9331	75023	8040	2012	288932	68146	236
1963	9331	75014	8039	2013	294949	67857	230
1964	18622	75004	4028	2014	300966	67562	224
1965	23328	74986	3214	2015	306983	67261	219
1966	33780	74962	2219	2016	313000	66954	214
1967	25261	74929	2966	2017	319018	66641	209
1968	26142	74903	2865	2018	325035	66322	204
1969	29719	74877	2520	2019	331052	65997	199
1970	46904	74848	1596	2020	337069	65666	195
1971	39135	74801	1911	2021	343086	65329	190
1972	43519	74762	1718	2022	349104	64986	186
1973	73468	74718	1017	2023	355121	64637	182
1974	88085	74645	847	2024	361138	64282	178
1975	81465	74556	915	2025	367155	63921	174
				2026	373172	63553	170

Source: Electronic communication from Department of Minerals and Energy
Projected = Figures in bold



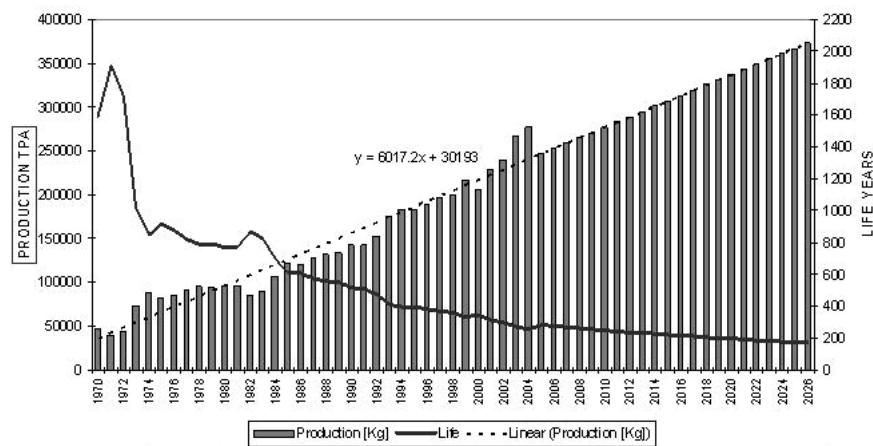
Source: Table I

Figure 6. South African resource base since 1970



Source: Table I

Figure 7. South African platinum production 1970–2004



Source: Table I

Figure 8. Projected South African platinum production and life of mining operations 1970–2026

Statistics South Africa constructs National Resource Accounts according to the United Nation’s System of Integrated Environmental and Economic Accounting, SIEEA, which defines Natural Resources Accounts as

An accounting system that deals with stocks and stock changes of natural assets, comprising biota (produced or wild), sub-soil assets (proven reserves), water, and land with their aquatic and terrestrial ecosystems. It is frequently used in the sense of physical (environmental) accounting as distinguished from monetary accounting. (RSA 2004).

During the years from 1980 to 2001, South Africa produced more than fifty different minerals but the 2004 National Resource Accounts examines only three, namely gold, platinum, and coal.

Resources rent

South Africa exports almost all its platinum production as a refined metal in the form of autocatalysts and a limited range of other platinum and palladium products produced at two refineries, Johnson Matthey and Degussa. Of particular concern to the South African economy should be the question of what is happening to the mineral rent associated with the exploitation of these resources.

While people have paid rent in one form or another through the ages, Smith (1776) defined it as: ‘the price paid for the use of land’ (page 145).

Ricardo (1817), who examined the differential productivity of various lots of agricultural land and the revenues returned to the farmers of better land compared to less fertile land, defined economic rent as:

The value of the difference in productivity between a given piece of land and the poorest, most costly piece of land producing the same goods under the same condition’.

More recently, Davis (1994) states that

Rents represent the true value of a mineral endowment, contained in the revenues received when the mineral is extracted and sold.

According to Statistics South Africa resource rent is:

A measure of the scarcity value of extractive resources, such as minerals, as their finite stocks are reduced with extraction. (RSA 2004, page 1).

StatSA quantifies rent as: $R = V - C$

where:

R = Rent

V = Value of output at producer’s prices³. (on page 6)

C = Production costs⁴. (on page 6)

Mining land has a value related to the surface, and a value related specifically to the non-renewable mineral assets below the surface. As mining depletes this asset, its value declines. However, the surface value of the land may increase or decrease, depending on how it is used.

Davis (1994) links rent to sustainable development by stating: ‘Only by extracting and selling mineral endowments will they generate income. However, the income will decline and eventually cease with depletion of the deposits. To offset this, the rent portion of the revenues should be used to purchase other assets with the same or higher ability to generate income.’

In a study that focused on the magnitude of rents generated in the gold mining industry, Minnitt, Blignaut and Cawood (2002) calculated rent paid by the gold mining industry as:

$$R = V - \{T + D + O\}$$

where:

R = Rent

V = Value⁵ of gold produced

T = Total working costs

D = Depreciation costs

O = Opportunity costs

Unit rent

Unit rent is total calculated annual rent divided by the annual depletion mass.

Figure 9 is a graphical representation of the unit revenue received and the unit rent paid by the gold mining industry since 1910 (Minnitt, Blignaut and Cawood 2002).

Between 1910 and 1973 (Figure 10), the relationship between gold revenue and rent appeared to be generally direct, i.e., as revenue increased, so did rent, except for the years 1934 to 1948 and 1960 to 1964, when the relationship appears to be inverse. Since 1980, however, rent paid by the gold industry has not increased at the same rate as revenue

Unlike gold, since 1980 there has been a general and increasing divergence between platinum revenue and rent (Figure 11), although the unit platinum rent is greater than the unit gold rent (Figure 12). Until 1997, there was a close correlation between the two, but since then the difference has increased. In 2001, the unit rent for platinum (R15 432/kg) was almost three times that of gold (R5 286/kg)

The difference between rent and profit

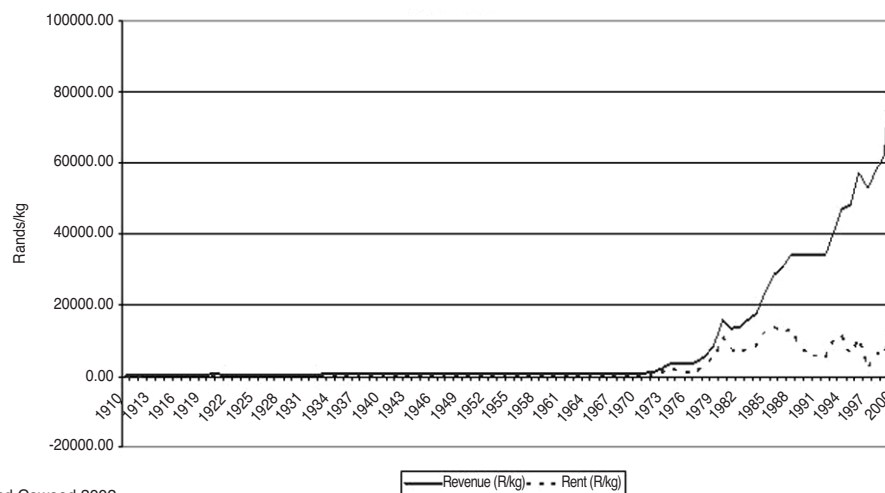
The 1993 System of National Accounts defines rent as the difference between value at producer’s prices and production costs, i.e.,

$$\text{Rent} = \text{Value at producer’s prices} - \text{Production costs}$$

Profit is generally defined as the difference between revenue and costs, i.e.,

$$\text{Profit} = \text{Revenue} - \text{Costs}$$

The difference between the two is the inclusion, in ‘production costs’ used in the rent calculation, of an allowance for consumption of capital and a normal rate of return on financial capital invested. Rent allows for the investors returns, whereas profit does not, and is therefore a profit over and above that which investors should normally expect. Some have referred to the rent as the additional return required by an investor to compensate for the risks associated with mineral developments. This could also be the amount taxable by the government as responsible stewards of the national patrimony. Removal of these rents should affect neither the rate of extraction nor the levels of investment, provided the individual stakeholders know the size and nature of the mineral rents.



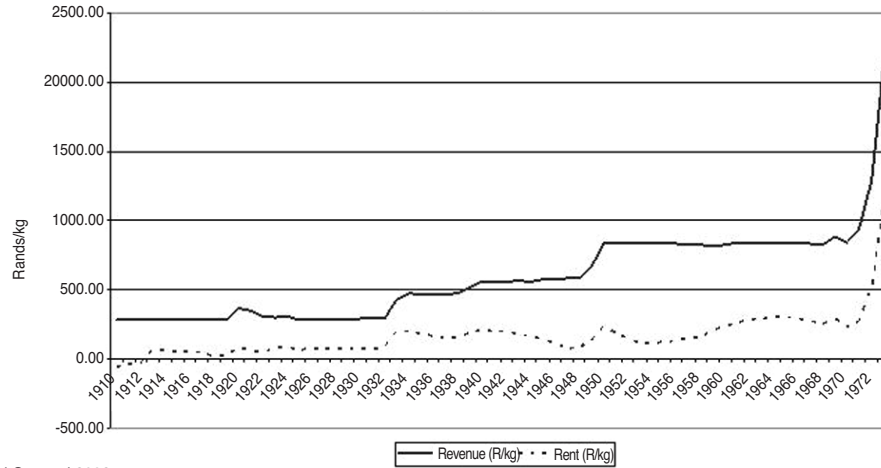
Source: Minnitt, Blignaut and Cawood 2002

Figure 9. Revenue received and rent paid by the South African gold industry, 1910 to 2000

³Producer’s price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any VAT or similar deductible tax invoiced to the purchaser. It excludes any transport charges invoiced separately by the producer (RSA 2000)

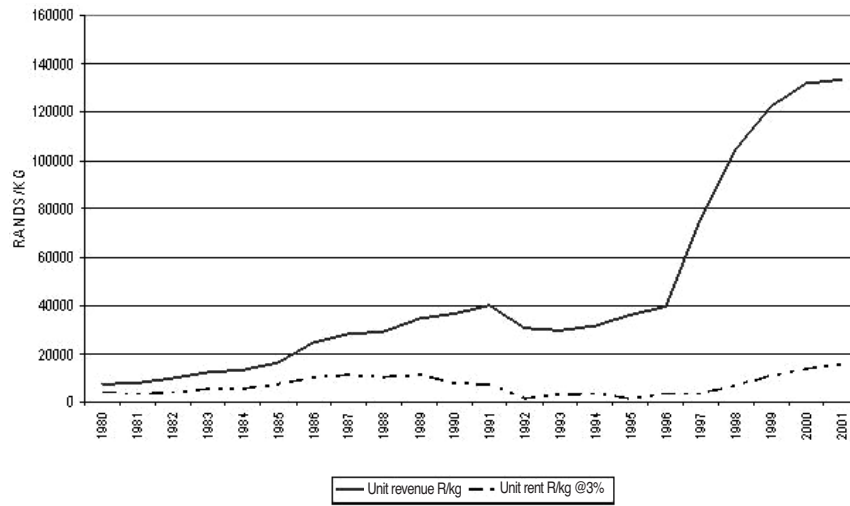
⁴Production costs include the cost of intermediate inputs in mining, compensation of employees, consumption of fixed capital, and a normal rate of return on investment capital. The normal rate of return on fixed capital investments is the opportunity cost or economic value of financial capital that may be invested in alternative profit-making activities. StatsSA uses a social discount Rate of 3% and an alternative discount rate of 5% to calculate resource rent (RSA 2004).

⁵Value is the current, or money-of-the-day, rand monetary value



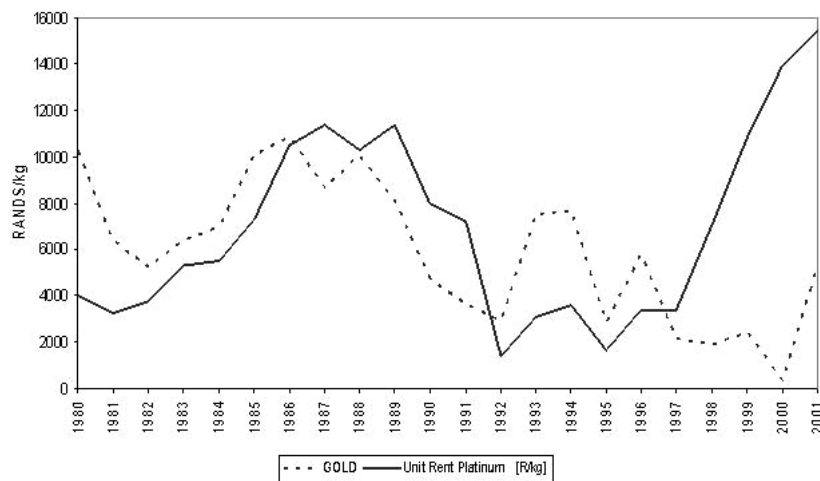
Source: Minnitt, Blignaut and Cawood 2002

Figure 10. Revenue received and rent paid by the South African gold industry, 1910 to 1973



Source: RSA 2004

Figure 11. Revenue received and rent paid by the South African platinum industry, 1980 to 2001



Source: RSA 2004

Figure 12. Unit rent in the South African gold and platinum industries

Conclusions

It is clear from the data published in the National Resource Accounts that the platinum industry is generating rent. The main problem is that, because it is not possible to correctly identify and earmark these rents, it is not possible to know their final destination. The question 'Where does the rent go?' needs an answer.

- Does the rent go into the National Treasury, and if so what is the Treasury doing with it? Requests to the South African Reserve Bank and the National Treasury for information on the taxes paid by the platinum industry remain unanswered.
- Is the industry using the rent to ensure a current supply

of the resource, i.e., is it funding geological exploration? The data suggests otherwise, as the opening stocks diminish each year. However, given the enormity of the stock, is this important?

- Is the State using the rent to purchase other assets with the same or higher ability to generate income as suggested by Davis (1994)?

Given the magnitude of the South African platinum reserves and the current seemingly insatiable demand, it may seem pointless to plan for its depletion. Prudence, however, is always a virtue.

In 1948, when the gold stock was just over 70000 tonnes (Table II), South Africa produced 90% of the world's gold.

Table II
Gold production 1884 to 2004

Year	Fine oz	Kg	Opening stock (tons)	Calculated life years	Year	Fine oz	Kg	Opening stock (tons)	Calculated life years
1884	2302	74	84880	1147027	1945	12224629	393031	71429	182
1885	1369	44	84880	1929088	1946	11927165	383467	71036	185
1886	7900	254	84880	334173	1947	11200281	360097	70652	196
1887	38568	1240	84880	68451	1948	11584849	372461	70292	189
1888	220337	7084	84878	11982	1949	11705048	376326	69920	186
1889	339495	10915	84871	7776	1950	11663713	374997	69544	185
1890	425807	13690	84860	6199	1951	11516450	370262	69169	187
1891	666019	21413	84847	3962	1952	11818681	379979	68798	181
1892	1034222	33251	84825	2551	1953	11940616	383899	68418	178
1893	1248183	40130	84792	2113	1954	13237119	425583	68034	160
1894	1746213	56142	84752	1510	1955	146011404	469446	67609	144
1895	1951993	62758	84696	1350	1956	15896693	511090	67139	131
1896	1959676	63005	84633	1343	1957	17030737	547551	66628	122
1897	2654248	85336	84570	991	1958	17656447	567668	66081	116
1898	3698922	118923	84485	710	1959	20065515	645121	65513	102
1899	3519392	113151	84366	746	1960	21383019	687480	64868	94
1900	337535	10852	84253	7764	1961	22941561	737588	64181	87
1901	250103	8041	84242	10477	1962	25491993	819586	63442	77
1902	1662078	53437	84234	1576	1963	27431956	881957	62623	71
1903	2874648	92422	84180	911	1964	29111524	935957	61741	66
1904	3648161	117291	84088	717	1965	30553874	982329	60805	62
1905	4748416	152665	83971	550	1966	30880000	992814	59823	60
1906	5604446	180187	83818	465	1967	30533000	981658	58830	60
1907	6242006	200685	83638	417	1968	3109400	999695	57849	58
1908	6827218	219500	83437	380	1969	31281000	1005707	56849	57
1909	7059157	226957	83217	367	1970	31116470	1000417	55843	56
1910	7531386	234252	82991	354	1971	30366254	976297	54843	56
1911	8251240	265283	82756	312	1972	28292708	909631	53867	59
1912	9108792	292854	82491	282	1973	26599060	855179	52957	62
1913	8798713	282885	82198	291	1974	23593840	758559	52102	69
1914	8396068	269940	81915	303	1975	22190699	713447	51343	72
1915	9096410	292456	81645	279	1976	22188926	713390	50630	71
1916	9296964	298904	81353	272	1977	21768935	699887	49916	71
1917	9018389	289948	81054	280	1978	21910829	704449	49216	70
1918	8418379	270657	80764	298	1979	21880472	703473	48512	69
1919	8331651	267869	80493	300	1980	20928768	672875	47809	71
1920	8158455	262300	80225	306	1981	20396276	655755	47136	72
1921	8128710	261344	79963	306	1982	20610081	662629	46480	70
1922	7009858	225372	79702	354	1983	21084316	677876	45817	68
1923	9149073	294149	79476	270	1984	21148887	679952	45139	66
1924	9575040	307844	79182	257	1985	20862828	670755	44459	66
1925	9597592	308570	78874	256	1986	19845495	638047	43789	69
1926	9954762	320053	78566	245	1987	18717309	601775	43151	72
1927	10122491	325445	78246	240	1988	19213223	617719	42549	69
1928	10354264	332897	77920	234	1989	18831490	605446	41931	69
1929	10412326	334764	77587	232	1990	18755379	602999	41326	69
1930	10716351	344538	77253	224	1991	18637031	599194	40723	68
1931	10877777	349728	76908	220	1992	19010086	611188	40123	66
1932	11558532	371615	76558	206	1993	19262398	619300	39512	64
1933	11013712	354099	76187	215	1994	18046251	580200	38893	67
1934	10479857	336935	75833	225	1995	16292013	523800	38313	73
1935	10773991	346392	75496	218	1996	15498874	498300	37789	76
1936	11336214	364467	75149	206	1997	15259377	490600	37291	76
1937	11734575	377275	74785	198	1998	14466238	465100	36800	79
1938	12161392	390998	74408	190	1999	14033899	451200	36335	81
1939	12821507	412221	74017	180	2000	13399388	430800	35884	83
1940	14046502	451605	73604	163	2001	12285883	395000	35453	90
1941	14407649	463216	73153	158	2002	12394745	398500	35058	88
1942	14126852	454188	72690	160	2003	11607826	373200	34660	93
1943	12804379	411670	72235	175	2004	11594327	372766	34286	92
1944	12279629	394799	71824	182					

Source: Chamber of Mines 2005, RSA 1910 to 1993, RSA 2005

Production, at a rate of 11 584 849 fine ounces, or 372 461 kilograms, per annum, was projected to continue for another 189 years. Between 1948 and 2004 production reached a maximum of over 1000 tons (in 1969), and the projected life dropped to 57 years. At the end of 2004, South Africa produced 13.8% of the world's gold, and the projected life was 92 years at an almost identical production rate to that prevailing in 1948 (372 766 kg per year). In 1948 the production rate was increasing, but in 2004 it was declining, and the remaining gold is proving increasingly difficult and expensive to recover.

Minnitt, Blignaut and Cawood (2002) found that 'The exploitation of South Africa's gold deposits has not been undertaken in a fashion that is consistent with the tenets of sustainable development, and that surplus rents have flowed to the investors at the expense of income and employment opportunities of future generations'.

We conclude with the question: Is this happening in the platinum industry?

References

- CHAMBER OF MINES 2005. 'South African gold output since start of operations.' Website <http://www.bullion.org.za>
- DAVIS, G.A. *South African Managed Trade Policy: The wasting of a Mineral Endowment*. Praeger, Connecticut, USA. 1994.
- HOTELLING, H. 'The economics of exhaustible resources'. *The Journal of Political Economy*, vol. 39, no 2, 1931. 1931.
- Johnson Matthey Platinum 2005—20th Anniversary*. Johnson Matthey, London, 2005.
- MINNITT, R.C.A., BLIGNAUT, J.N., and CAWOOD, F.T. Gold in the National Resource Accounts. Paper presented at a Forum for Economics and Environment, Cape Town, 2002.
- REPETTO, R., MAGRATH, W., WELLS, M., BEER, C. and ROSSINI, F. *Wasting Assets: Natural Resources in the National Income Accounts*. World Resources Institute, 1989.
- RICARDO, D. *On the Principles of Political Economy and Taxation*. John Murray, London, 1817.
- RSA 1910 to 1990. Government Mining Engineer's Annual Reports. Department of Mineral and Energy Affairs. Pretoria, 1910 to 1993.
- RSA 2004. National Resource Accounts. Statistics South Africa, Pretoria, 2004.
- RSA 2005. South African Mineral Industry. Department of Minerals and Energy, Pretoria, 2005.
- SMITH, A. *An Inquiry into the Nature and Causes of the Wealth of Nations*. Oxford World Classics, Oxford University Press, Oxford, 1776.
- UNITED NATIONS 1993. The 1993 System of National Accounts. United Nations Statistics Division, New York Web address: <http://unstats.un.org/unsd/sna1993/toctop.asp>

