

# Simplified method of assessing the value of a South African gold mine

## 1 INTRODUCTION

The primary objective of establishing any mining operation in a capitalist economy is to produce metals or minerals at a profit. Without the expectation of sufficient reward in the future there can be no incentive to divert substantial sums of money into relatively risky ventures, particularly as these have the additional investment drawback of a long development and construction phase before the cash flow becomes sufficiently large to provide a return on the capital invested. The value of any mine to an investor is determined primarily by the magnitude of the profits which can be earned and these, in turn, are dependent upon the annual metal output, operating life, commodity price, capital and working costs, and taxation.

When a new mine is to be established it is accepted practice for the technical consultants to disclose in the published prospectus of the company concerned a summary of the sampling data from the prospecting programme and to indicate the anticipated production, life and costs. Such disclosure is essential if the public is to subscribe the working capital. It is then left to the individual investor to decide on the significance of these data and to estimate the future trend of commodity prices, in order to assess the profit earning capability of the mine. In practice, the conscientious analyst will use a number of production rates and price trends to measure the attractiveness of the new mine under different circumstances.

Within a few years of the initial output being attained, it will be possible for the consultants to assess whether the mineral content is high enough to justify further expansion and, if so, whether this ought to be financed from existing profits or the raising of loans.

## 2 CORRELATION OF SAMPLING RESULTS WITH ACTUAL RECOVERY

Each quarterly report from a producing gold mine discloses results of sampling undertaken from the tunnels which are developed into the unmined blocks of reefs. Certain of the mining groups present figures for each individual shaft while others are reticent and give the data only for the mine as a whole though it is difficult to justify the lack of disclosure on investment grounds.

Where possible, each shaft should be valued separately and each year's sampling results should be added to those of preceding years for the purpose of calculating averages. In practice there will be little purpose in retaining the figures for those portions of a mine which have already been worked out and a 'moving average' for, say, a five year period will usually provide an adequate base from which to project future recovery grade. The quarterly figures may, for example, indicate that 500 metres were sampled, containing 36 grams of gold per ton over a 40 centimetre reef width, equivalent

to 1 440 centimetre grams (cmg). If the five year moving average of the cmg value is 1 850 cmg, dividing this figure by the official ore reserve width, as published annually, say, 120 centimetres will give an *in situ* reef value of 15,4 grams per ton over a practical mining width. However, it is generally found that the official ore reserve value is less than this calculated figure and that it, in turn, has to be adjusted further in a downward direction to allow for losses of gold in mining and treatment.

Were the official ore reserve figure to be 12,5 grams per ton and the actual recovery (i.e. after losses) to be 10,0 grams per ton:

the ratio of ore reserve value to sampling value would be

$$\frac{12,5}{15,4} = 0,81$$

and the ratio of actual recovery to sampling value would be

$$\frac{10,0}{15,4} = 0,65$$

It is necessary to calculate these ratios separately for each mine because the circumstances of each will vary; nevertheless, some inter-mine comparisons may sometimes be of value.

Obviously were the sampling values from year to year to show a persistent uptrend, a period of rising gold production would be indicated and vice versa unless it was also expected that an improvement in the gold price would result in a utilization of lower grade ore.

By studying the production records of a number of adjacent mines, as well as available geological reports, a reasonable knowledge of the value distribution of a mining area can be built up. Such knowledge is essential to an intelligent projection of future gold recovery trends and no effort should be spared acquiring it.

## 3 RATE OF MINING, QUANTITY OF METAL PRODUCED AND LIFE

The prospectus of a mining company will indicate its anticipated milling rate but this may well be enlarged if sufficient payable ore becomes available in subsequent years. A number of mines in South Africa indicate each year their anticipated production rate and this is of great help to the shareholder and analyst. However, if no such forecast is given, it is reasonable to assume that current production tonnages will be milled in future years provided operating conditions are expected to remain stable.

If operating conditions are changing, the analyst must make his own estimates based on the information

available to him. (See Appendix I.) If 2 million tons is to be milled (line 9) with an average recovery of 10,0 grams per ton (line 15) then the mine will produce 20 000 kilograms or 20 tons of gold.

The remaining life of an existing operation can be determined to a reasonable degree of accuracy by using the shareholders' plan of the underground workings to determine the unmined area of reef remaining, e.g. 2 500 hectares (line 3), which when multiplied by the published ore reserve width (e.g. 1,20 metres, line 4) gives a volume of 30 million cubic metres, or 78 million tons (line 6) at a flat dip or 85 million tons if the reef dips (i.e. slopes) at 25 degrees. From this plan, too, it should also be possible to estimate the percentage extraction of the ore body that has been obtained, say, 70% (line 7), leaving an effective 54,6 million tons for a flat reef (line 8) and a life of about 27 years (line 10) at a constant mill rate.

#### 4 METAL PRICES

Since there is no realistic way of accurately predicting metal prices, the analyst must make his own assumptions. For the purpose of this study, a starting gold price of \$130 per ounce is made for 1977, escalating thereafter at 2½% per annum compound. It is then a simple matter to convert this to rand per kilogram, e.g.

\$130

$\times 1\ 000 = R3\ 635$  per kilogram

$\frac{1,15^* \times 31,1^\dagger}{*R1,00} = \$1,15$

†31,1 grams per troy ounce

Our theoretical mine, producing 20 000 kilograms of gold each year would then earn revenue of R72,7 million in 1977 (line 16), figures for all future years over the life of the mine being calculated in a similar manner subject, of course, to the allowance made for the gold price escalation.

#### 5 WORKING COSTS AND CAPITAL EXPENDITURE

For 1977, working costs are assumed to escalate by 15% over those for 1976, giving a figure of R20,00 per ton milled (line 11). Although no further cost rises are assumed for the sake of simplicity, it is obvious that allowance would have to be made for these if they were considered to be likely.

Capital expenditure even on a fully equipped mine varies considerably from group to group. The need to improve working conditions generally saw a vast surge in spending in the past three years. For 1977, again for simplicity, a figure of 10% of total working costs will be assumed, i.e. 10% of line 17, viz R4 million (line 18). The analyst should endeavour to ascertain whether major spending is contemplated in the future with regard to this figure as it would affect profits available for distribution. Unfortunately there is no empirical way of computing such expenditure for the years ahead and guidance from the mines is not always available.

Capital spending can be regarded as a cost item for all practical purposes and is deducted directly from revenue to arrive at a figure for profit at the mine (line 19).

#### 6 LEASE AND TAXATION PAYMENTS

Although mining companies own their mineral rights, the right to mine for precious metals is vested in the

State which cedes this right in exchange for a proportion of mining profits. A typical lease formula might take 15% of profits (reduced, however, by a revenue allowance, traditionally 6% for those mines established in the 1950's — line 20). A relatively unimportant surcharge is added to the lease formula which is ignored in this example.

The standard rate of gold mining taxation is 60% of profits, again reducing these by an appropriate revenue allowance such as the 6% indicated above and after deducting lease payments (line 24).

Lease payments are irrevocably fixed for normal mining operations but the scale of mining taxation, as with other company taxation rates, does change from time to time with an overall upward bias.

In the March 1976 Budget the Minister of Finance increased the surcharge on the taxation of mining companies to 10% (line 25) and raised the loan levy applicable to them to 15% of the taxation payable excluding the surcharge — see line 26. As this loan levy is returnable no later than seven years after payment it should, theoretically, be regarded as a sum which will ultimately revert to shareholders. However, given the persistence of current inflation rates its purchasing power then would be relatively modest and it is, thus, reasonable to regard it as a cost.

#### 7 NET PROFIT ATTRIBUTABLE TO SHAREHOLDERS

The net profit after all deductions (line 27) belongs to shareholders given that nothing needs to be retained to finance major projects in future years and that there are no loans that require repayment.

If it is assumed that the company we are considering has 15 million shares in issue, a distributable profit of R9,5 million (line 27) would make possible the payment of a 63 cent dividend.

In section 4, it was assumed that the gold price would escalate by 2½ per cent annually. Were the gold output to remain constant each year, revenue would rise by only 2½ per cent annually. The net profit (line 27) would rise slightly more rapidly (Appendix II, line 11), permitting a gradual increase in the dividend (lines 12 and 13).

Appendix II summarises the production and financial situation for each of the next five years and then shows the position as it would be in the 10th and 27th year.

In the remaining 27 years of its life, our theoretical mine would pay out to its shareholders a large aggregate amount of dividends. However, as this money would be received in instalments, and much of it after the lapse of a great many years, its worth would be much less to the investor than were he to receive it all immediately.

#### 8 DISCOUNTING FUTURE DIVIDENDS BACK TO THE PRESENT

To calculate the present value of the expected income from a mine each anticipated dividend payment needs to be discounted at a specified rate of interest subject to the lapse of time before it is received. This can be done easily enough by using a set of compound interest tables.

The rate of discount that should be used has been argued interminably by various authorities. For the purpose of

this exercise a suitable starting point in the debate may be a consideration of the interest rates on low risk building society shares of about 10 per cent. Government and Escom stocks yield  $1\frac{1}{2}$  to  $2\frac{1}{2}$  per cent more and unsecured bonds from high class companies yield  $13\frac{1}{2}$  per cent. To the extent that any mine has certain inherent technical and ore value risks, a shareholder may consider  $13\frac{1}{2}$  per cent to be a minimum. However, if he expects the gold price to rise in real money terms, he may be prepared to lower his yield expectation slightly.

To curtail discussion at this point, we assume a discount rate of 12 per cent. Each year's dividend is then adjusted downwards by the discount factor and these annual discounted dividends are then totalled to arrive at the so-called present value — usually on a per share basis. (See Appendix II.)

Note how rapidly the present value falls as the interval increases before the dividend is received and how significant are the first few years as far as present value is concerned.

This total present value can be compared with the share price as quoted on any stock exchange. The discounted value may be greater than, equal to, or less than the price depending both on the assumptions made about the future of the mine and the mood of all investors, both local and foreign. At this juncture, an investor or potential investor will need to know whether the company which he has analysed in so much detail represents the best available investment in the gold share market and his only recourse then is to analyse a number of other mines for comparative purposes.

Under no circumstances should comparisons be made between short life mines and long life mines, or between highly profitable mines and marginal mines unless the analyst has a vast accumulation of data and experience.

Thus, comparisons should only be effected by the novice where mines are similar in most important aspects, such as annual output of metal, life and total expenditure (including both working and capital costs).

The price placed on shares by buyers and sellers changes from time to time, particularly if there is thought to be an imminent change in the profit earning capacity of the company. Thus, if the metal price is expected to rise sharply or if the gold output is expected to jump as mining moves into a high grade area, buyers will strive to secure the shares ahead of the expected increase in dividends and the share price will escalate.

Another factor affecting share prices is a change in the dividend yield requirement if interest rates in general change.

## 9 AMORTISATION

The total present value of the future flow of dividends, discounted at an appropriate rate, will give a net yield greater than the discount rate if the share price is less than the present value (assuming all the input assumptions are correct). The net return is less than the discount rate if the present value is less than the share price.

Thus, if the present value of an assumed investment is, say, 550 cents per share, the share price is 400 cents and the discount rate is 12 per cent, the net yield would be somewhat higher than 12 per cent but the actual yield would need to be determined by discounting at a

variety of slightly higher rates until, by trial and error, the correct one was found — a tedious procedure.

This net yield takes into account the fact that every mine has a finite life and that dividends will cease when the ore-body is finally depleted. It recognises the necessity for the investor in a mine to replace the capital he spent on acquiring his shares by buying a new investment in the place of the one that is being mined out. In practice, such amortization can be effected by reinvesting a proportion of each dividend and allowing the capital sum to be enlarged by accumulating all dividends or interest received on a compound basis. The annual reinvestment can be determined simply from the basic compound interest formula.

$$C = D (I + R)^n; \text{ transposing, } D = \frac{C}{(I + R)^n}$$

where C — capital (equivalent to share purchase price)  
D — annual reinvestment  
R — annual interest rate (say 10%)  
n — number of years before mine shuts down.

It is important to note, however, that amortization of the kind described above, does involve a complication for investors subject to a significant rate of tax.

Although the dividends they receive from the mine effectively contain an element of capital repayment, the revenue authorities tax their dividend receipts at the full rate applicable to dividend income.

## 10 GENERAL

The factors which have the greatest influence in determining profits and hence the value of the investment are the recovery grade and the metal price. These are the two most difficult to quantify over the full life of a mine.

The simplified valuation technique has the merit of being within the capacity of anyone who is prepared to study the basic geology, the mineral distribution patterns and the regular reports issued by mining companies. However, there is no short cut to success and a good analyst will be prepared to study the subject and the industry concerned conscientiously.

Before deciding that a given share or group of shares is relatively attractive (or unattractive) on the basis of his calculations, the novice would be well advised to compare his findings with those of other analysts. Regard should also be paid to the tax status of the particular investor.

The use of a computer makes it a relatively simple matter to analyse the whole gold mining industry, using a number of parameters for the input data.

## APPENDIX I

### The valuation of a South African gold mine

1	Original lease area	3 000	hectares
2	Mined to date	500	hectares
3	Unmined	2 500	hectares
4	Ore reserve width	1,20	metres
5	Relative density	2,6	
6	Reef tons (3.4.5)	78,0	million
7	Overall extraction rate	70	per cent
8	Mineable tons	54,6	million
9	Annual milling rate, tons	2,0	million
10	Life (8 divided by 9)	27	years
11	Cost per ton milled	20,0	rand
12	Gold price, per ounce	130	dollars
13	Gold price, per kilogram	3 635	rand

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14 Annual milling rate, tons	2,0	million
15 Recovery grade, per ton milled	10,0	grams
16 Revenue (13.14.15)	72,7	rand millions
17 Total costs (11.14)	40,0	rand millions
18 Capital expenditure	4,0	rand millions
19 Profit at mine (16-17-18)	28,7	rand millions

Taxation calculated — one decimal place

19 Profit at mine	28,7	rand millions
20 Revenue allowance, 6% of (16)	4,4	rand millions
21 Profit subject to lease payment (19-20)	24,3	rand millions
22 Lease at 15% of (21)	3,7	rand millions
23 Balance of profit (21-22)	20,6	rand millions
24 Taxation @ 60% of (23)	12,4	rand millions
25 Surcharge at 10% of (24)	1,2	rand millions
26 Loan levy @ 15% of (24)	1,9	rand millions
27 Net profit after lease, tax, surcharge and levy (19-22-24-25-26)	9,5	rand millions

### APPENDIX II

#### Profit, dividend and present value

1 Year	1	2	3	4	5	10	27
2 Cost, RPT	20,0	20,0	20,0	20,0	20,0	20,0	20,0
3 Price, \$ per oz	130	133	136	140	143	166	253
4 Mill, MTPA	2,0	2,0	2,0	2,0	2,0	2,0	2,0
5 Grade, GPT	10,0	10,0	10,0	10,0	10,0	10,0	10,0

The financial figures are rounded off to the nearest R million in table below:

6 Revenue	73	74	76	78	80	93	142
7 Costs	40	40	40	40	40	40	40
8 Capex	4	4	4	4	4	4	4
9 Profit at mine	29	30	32	34	36	49	98
10 L & T*	20	20	22	23	25	34	71
11 Net profit	9	10	10	11	11	15	27
12 Dividend	9	10	10	11	11	15	27

The dividend and value below are based upon the actual financial figures as calculated and not on the summarised figures above.

13 Dividend, cps	63	67	70	73	77	99	183
14 PV† each dividend, cps	57	53	50	46	44	32	9

\*Includes surcharge and loan levy

†Discounted @ 12,0%