The corporate cost of capital

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Synopsis

Equity investors and project sponsors have divergent views about expected or minimum returns that should be generated by a mineral project. Irrespective of their views, the fundamental estimation of the corporate cost of capital remains singularly determinable, with additive components of risk and uncertainty often incorporated in the final analysis. This paper discusses and details the fundamental, numerical determination of the corporate cost of capital.

Introduction

The corporate cost of capital is used by valuators to discount future flows of income from an entity in order to derive a present-day, forward-looking value of that entity. This cost of capital represents the total cost to the entity or company that will be incurred in order to raise and/or secure funding in order for it to acquire, develop and maintain its future sources of income (Lilford and Minnitt, 2002). The cost of capital is therefore determined as the weighted cost of the various sources of funding, being typically equity, debt and preference instruments. This weighted funding cost is known in economic and finance theory (Van Horne, 1977) as the weighted average cost of capital (WACC) (Van Horne, 1977, Hull, 1989), which proxies as the minimum rate at which future cash flows should be discounted so that the capital raised by the company generates a return at least equivalent to the cost associated with securing those funds. Naturally, companies desire investment returns in excess of their WACC, otherwise the continuation of existing projects may be compromised and future projects may not be developed.

The Gauntlet

Now, what of equity risk and a risk premium? Over time, plausible equity premiums within variable statistic ranges have been determined to be acceptable from 7 to 8 per cent (Commodities Research Unit (CRU) Financial Performance, Prices and Cost (FinPAC), CRU FinPAC 2001, page 6 (http://www.precious-metals.crugroup.com)). Of course, even historical trends and averages have their limits. Historical premiums may have little relevance to the current world as we know it. Probably of equal importance, stock returns tend to be volatile and, therefore, over short periods of time, it is highly likely that much higher equity premiums will be applicable. According to the CRU report, this premium was 19 per cent over a five-year period from 1994 to 1998.

A notable challenge to those trying to determine the cost of equity applicable to a mining entity is the forward-looking equity risk premium. A suggestion is to conduct a survey of expert opinion, such as a recent survey of 226 academic financial economists. A summary of the survey forecasts a premium of 7 per cent per year over durations of 10 and 30 years, and a premium of 6 to 7 per cent over one to five years.

Applying economic and finance theory and the above comments to the determination of the cost of equity for listed mining companies seems to be a simple proposition. What, however, of the individual assets constituting

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the listed company, or mineral projects and mineral properties that are, in isolation, not listed and for which market betas cannot be determined?

To answer this, let's first understand what a beta represents. The beta coefficient used in the capital asset pricing model (CAPM) (Van Horne, 1977) calculations reflects the volatility of a company's listed shares, being its equity, relative to the market as a whole. Therefore, a company that reflects a non-diversifiable risk that is higher than the market average will have a beta coefficient of more than 1 while, conversely, a company that reflects a lower-than-average non-diversifiable risk will have a beta coefficient of less than 1.

A number of important results were noted in the CRU survey mentioned above, conducted in the third quarter of 2001 (CRU FinPAC 2001, 2nd quarter issue, page 6 (http://www.precious-metals.crugroup.com)) (Lilford and Minnitt, 2002). The survey considered a period covering 10 years. When compared with the S&P 500 Index, the major listed American metals and mining companies reflected a consolidated beta of 0.88 (these were the base metal companies in the market). A number of American precious metals listed shares showed significantly lower betas. This was probably a direct function of their respective abilities to mitigate volatility associated with price risks, since they entered forward/hedge positions to mitigate this component of risk. In the Canadian market over the same survey period, generally higher betas were reflected for similarly listed shares. The determined average in Canada was noted at a coefficient of 1.14 for base metal companies and 1.15 for precious metal companies. In the southern hemisphere, the average in Australia was determined at 1.14 for base metal companies and 0.91 for precious metal companies.

From the survey, it was proposed that there appeared to be a downward trend in the betas of base metal companies over time, whereas no trend could be deduced for the betas of precious metal companies. As a result of the gradual decline in the cost of equity over the last decade, applicable discount rates have commensurately declined. The declines are typically a function of the fall in interest rates or yields on 30–year maturity Treasury bonds.

The previous considerations allude to certain flaws associated with the use of the CAPM theory in determining the cost of equity, due largely to the application of historical information in the derivation of a forward-looking cost of equity. The past, in this case, cannot accurately predict the future, as Long Term Capital Management discovered in 1998 when it lost over US$4 800 million of capital in a few months (*When Genius Failed*, by Roger Lewenstien). This loss had a notional or marked-to-market negative value of US$1 400 000 million when Long Term Capital Management was haemorrhaging.

Moving away from WACC temporarily, an alternative approach to determining the cost of equity is the Dividend Growth Model (DGM). This attempts to alleviate the problem of relying on the past to predict the future in terms of the cost of equity by comparing the streams of projected future dividends with current share prices. The method estimates the equity risk premium for a whole market and then, with the use of CAPM, calculates the cost of equity for an individual company. If the company's dividends are forecast to improve indefinitely at a rate of i per year, it is proposed that the cost of equity can be calculated by the following formula:

$$R_e = \left(D_o/P_o\right) + i$$

where:

D_o = dividend paid at time 0 (retrospective from end of period)

P_o = company's share price at time 0

The obvious uncertainty in this calculation is the determination of the anticipated future dividends from one period to the next, being the dividend growth rate or i. It is generally impossible to accurately forecast an infinite stream of future dividends, especially for operators reliant on price-cyclical commodities. That is, since numerous commodity prices and hence the relevant equities demonstrate cyclicity, the calculated cost of equity varies considerably with changes in the share price. This uncertainty is enhanced by the fact that many mining companies reinvest their distributable income into capital growth assets and therefore do not pay dividends at all or certainly not over extensive periods. A company's gearing will also impact on whether it pays dividends or whether it uses free cash flows for its desired debt reduction profile.

From a debt financing perspective, a company has a specific cost of debt dependent on its credit rating. Typical blue chip corporate debt in the minerals industry generally commands a risk premium above the risk-free rate of between 0.5 and 1.25 per cent. For example, at the end of 2001 AngloGold Ashanti secured a revolving credit line with a syndicate of banks for US$500 million at a rate of only 70 basis points (0.7 per cent) above LIBOR (London Inter Bank Offer Rate).

The Minerals Industry Competitor Database (MICA), updated by the CRU (http://www.precious-metals.crugroup.com), indicates that the historical post-tax cost of debt to the precious metals sector over 10 years to 2001 was 7.6 per cent in North America, 6.6 per cent in Australia and 11.3 per cent in Africa. Considering the base metals sector, the 10-year figures read at 5.9 per cent across all three regions. Again, as with the cost of equity, there is a general downward trend in the cost of debt in the minerals industry, compounding the influences on declining discount rates.

Naturally, there is a tax shield associated with debt, since the interest payable on a company's outstanding debt facility can be offset against its taxable income. It is therefore important to calculate the after-tax cost of debt. That is, the cost of debt has to be reduced by the value of the tax credits that are associated with the deductibility of the interest accruing due to the outstanding debt balance.

The actual weighting that applies to the derivation of the WACC is determined as the debt to equity split that is applied to the post tax cost of both the debt and the equity. It is equally correct to use either the market or the book value of the debt and equity amounts, with the industry in general preferring equity. Alternatively, medium-term target gearing ratios can be used. However. to complicate the calculations, debt levels vary with time as this borrowed capital is repaid (or redrawn), meaning that the equity to debt ratios used in the calculation of the WACC varies continuously.

Enough confusion has been put forward in the above discussion. The next section will propose a relatively simple means of actually calculating discount rates.

Discount rates

From the outset, a number of questions are posed in this discussion.

How important are discount rates in cash flow valuations? Does a discount rate take into account all of the risks associated with a project, being technical and economic, including systematic risks, or does it in fact ignore project-specific risks and hence demonstrates the returned value to the investor above the project's total cost of capital? The cost of capital reflects the cumulative cost associated with the costs of equity, preferential shares and debt. Consequently, what are the limitations of a discount rate?

This section will address the above uncertainties and the next section will present the ways in which discount rates are calculated. It will demonstrate the importance associated with discount rates being calculated in the correct, consistent terms, being either in real (uninflated, constant) or nominal (inflated, current) terms.

Other than for systematic risk, do riskless portfolios actually exist wherein discount rates equate exactly to the risk free rate? The purpose of a portfolio of investments is to ensure that specific risks are diversified away through the portfolio effect. This does not assist a valuator when looking at an individual asset.

For a specific asset, is it fair to assume that the more marginal that asset, the higher the applicable discount rate should be? According to Sorentino and Barnett (1994), the answer is 'no' on the basis that operating risks or pure project risks should not be factored into a discount rate. Operating risks or the risk associated with not achieving a forecast plan must be factored into the asset or company's value through its cash flows using other valuation tools. These risk-mitigating tools include:

- sensitivity analyses incorporating weightings on probable outcomes
- real options
- binomial and polynomial tree analysis
- Monte Carlo simulation (Hull, 1997)
- other available option pricing valuation methods, such as Black-Scholes's theories and formulae (Hull, 1997).

In the first instance, it is necessary to consider the definition, role and function of a discount rate.

A discount rate can be described as a company's cost of capital or the opportunity cost of supplying capital to the company (Belli and others, 2001). It is the return or consumption power that the capital provider could expect to earn, typically pre-tax, from the next best investment. Further, it is the minimum rate of return a company that allocates share capital should expect from its own investment decisions. The discount rate must be applied when calculating the market value of an expected flow of operating surpluses. Therefore, a company should invest capital in only a specific project when the expected internally generated returns from that project are anticipated to exceed the company's cost of capital.

An applicable discount rate suggested for use in considering a mining property will typically depend on a number of important components. The first three points below are fundamental to its determination, but the fourth point must be addressed independently of discount rates. The components are:

- the long-term risk-free interest rate
- country or sovereign risk
- market premium
- the mineral property or project risks, incorporating technical and techno-economic risks.

The long-term risk free rate

The long-term risk-free interest rate is obtainable from numerous sources including business newspapers, live screen trading sites or government's economic sites and publications. For South African bonds, the figures quoted in these sources indicate the pre-tax yield on government bonds, being the guaranteed, pre-tax, risk-free return on money invested in the acquisition of that specific bond.

Some South African bond yields, dependent on the bond's time to maturity, are indicated below, dated on 3 November 2005. They are given in nominal and pre-tax money terms and therefore the current inflation rate will have to be deducted from the percentage returns to obtain the risk-free rate in real terms. In addition, if post-tax (vs pre-tax) cash flows are discounted, they must be discounted at the post-tax (vs pre-tax) cost of capital. The figures in brackets indicate the time to maturity of the bond.

- R153$_{(2009)}$ 7.815%$_{nominal}$
- R157$_{(2015)}$ 8.025%$_{nominal}$
- R186$_{(2026)}$ 7.735%$_{nominal}$.

Unfortunately, South Africa's long-term government bond, the R186, is held tightly by seven major institutions. It is therefore highly illiquid and cannot be used reliably in the determination of discount rates. Hence, for South Africa's long-term risk-free rate, the R157, maturing in 2015, is the financial instrument that is used in most cases.

Calculating the discount rate

Preamble

Economic and finance theory can be used to help determine an applicable discount rate (Belli and others, 2001). It is possible to determine an applicable discount rate for a specific operation based on industry expectations in terms of a number of factors. These include an operator's expected internal rate of return (IRR) or project return, the non-technical risk factors governing the potential impact on the IRR of that specific operation and possibly project risks.

Economic and finance theory offers mathematical tools for the determination of discount rates through the calculation of the WACC and determining the cost of equity through the use of the CAPM (Van Horne, 1977). The theory proposes the use of the corporate cost of capital to determine an applicable discount rate for an operation. It represents the weighted average cost of funds available, and is expressed as a percentage rate based on the following:

$$r_{WACC} = r_e p_e + r_d p_d + r_p p_p$$

where:

r_{WACC} = weighted average cost of capital (WACC)

$r_{e,d,p}$ = proportional costs of equity, debt and preferred stock (all as %)

$p_{e,d,p}$ = proportions of equity capital, debt and preferred stock that make up the corporate capital, the sum of which is 1.00 (i.e. $p_e + p_d + p_p = 1.00$)

In determining the cost of equity of a company, the CAPM formula will determine, for potential investors, the return equal at least to that return that should be obtained in the event that the investor places his capital in an investment with the same level of risk. Of course, it is necessary to choose real markets to benchmark companies against. In addition, the equity risk premium (the risk premium of market returns over the long-term risk-free rate), being critical in determining discount rates, is very difficult to determine and even more complex to forecast.

On an all-equity basis, only the cost of equity needs to be considered, which gives rise to the application of the CAPM method for determining the cost of equity capital. This assumes that the return on any one listed stock can be related to the attained return of the entire market by the following formula:

$$r_e = f + R\beta$$

where:

r_e = expected return on the stock

f = risk-free return

R = risk premium of market returns over long-term risk-free rates

β = Beta factor for the stock (coefficient of systematic risk) (Hull, 1989)

and therefore:

$$r_{WACC} = p_e(f + R\beta) + r_d p_d + r_p p_p$$

It is important to ensure that either pre-tax or post-tax calculations are being performed. That is, if the cash flows being discounted are on a pre-tax basis, then the WACC and CAPM models must be performed similarly on a pre-tax basis. Therefore, the contributing components to the determination of the cost of capital must be on a pre-tax basis too, such as the risk-free rate and the costs of debt and equity. The reciprocal applies.

Market risk

Total market risk is ascertained by determining the volatility of each of the share price histories of all of the listed stocks on the securities exchange. Typically three-month, six-month and one-year volatilities are determined. The volatility to be used is generally the one calculated over the longest period, as long as it does not incorporate periods of extreme unnatural or event-specific volatilities.

To clarify the concept of total market risk, the beta coefficient of a particular asset is a measure of the systematic risk relating to such an asset, which is that portion of total risk that cannot be eliminated by holding a fully diversified investment portfolio. A beta coefficient reflects the sensitivity of an asset's value to economic variables that affect the values of all risky assets, including economic growth rates, interest rates, exchange rates and inflation rates.

A beta coefficient of greater than 1 implies that a particular asset bears more systematic risk than the market portfolio of risky assets, while a beta coefficient of less than 1 implies the converse. The beta coefficient for a company listed on a public stock exchange is usually derived from historic share price movements in the company's shares relative to share price movements for the stock market as a whole. In the case of an unlisted asset, its beta coefficient is determined by manipulating the beta coefficients of comparable listed companies. This will be discussed later in this report.

There are inadequacies regarding the use of the market-based beta for the valuation of mineral projects (Lilford, 2004). These shortfalls include:

- betas indicate the volatility of a share price and not of a specific asset within a listed company, such as a mineral property or specific mining operation
- betas of a specific listed entity vary as the market varies and not independently of the market
- betas vary over time so that the value of a project will also vary over time through a changing discount rate
- owing to the cyclicality of the different minerals' prices (supply and demand balances vary differently for each mineral), relative betas will vary so that a perfect correlation becomes improbable.

In addition to the above factors, the assumptions supporting CAPM cannot be overlooked. These include that:

- investors make choices on the basis of risk versus commensurate return
- all investors emulate each other's expectations of risk versus return
- returns are measured by the mean
- risks are measured by the variance.

Another criticism limiting the reliance on the CAPM for determining discount rates is that the CAPM is a one-period pricing model. It therefore estimates a one-period risk premium. This single period representation of risk or uncertainty tends to be inappropriate for mineral projects. This is because mineral projects generally have economic lives over many cyclical periods of varying growth and decline, acquisitive or disposal modes and continuously varying debt and equity levels. Over these numerous periods, for the model to remain applicable, future conditions must be known and must remain constant. These conditions include:

- the term structure of the modelled interest rates
- the prices of risk
- other country-specific macro-economic influencing factors
- certain aspects of project risk
- socio-political country factors.

Project risk

In reality, the inherent risks associated with the above factors are never constant and are never known for all periods. They will change idiosyncratically to variations in the sources and magnitudes of the influences underlying the mineral project, which will be evidenced by a changing project profile. This profile change will manifest as:

- varying grades
- varying production rates
- changing unit cost profiles
- new project developments
- dynamic exploration rates
- primary development rates
- hedging philosophies
- various other lesser alterations (recoveries, dilution, efficiencies, expansions and partial closures).

Specifically, the period-by-period changes to the risk structures must be considered and given an appropriate weighting in the long-term cash flows (Laughton and Jacoby, 1991b). In any event, a constant discount rate can bias project alternatives.

The previous discussion on discount rates alludes to the difficulties in assigning a specific discount rate to a mining operation or, with greater difficulty, to an undeveloped, feasible mineral property. Contradictions exist in numerous texts on the application of discount rates (Davis, 1995). In order for mineral deposits being exploited to be compared across country borders, discount rates should, in the first place, reflect the opportunity cost of using capital in that specific country. That is, the discount rates need to reflect the cost of capital associated with the project so that comparative investments get the opportunity to attract the capital.

Country or sovereign risk

Country risk can be determined by considering a number of factors such as international credit ratings (as conducted by, say, Moody, Standard and Poors or Fitch, all being international rating agencies), civil stability/unrest, economic policies, country's leadership and their principles and other factors. The components of country risk, according to Smith (1995), are categorized into four main sections, each hosting sub-sections. See Table I

Taxation and government bonds

Unlike T-Bills in the United States on which the returns are tax-free, using South African government bonds as the basis of determining discount rates must reflect that the returns on these bonds are taxable in the holder's hands. This is an important factor when ascribing a discount rate to a cash flow that has been based on a government bond, since the

Table I

Components of country risk

Risk category	Specific risk component
Political risk	Government stability Political parties Constitutional risk Quality of government Foreign ownership policy Foreign policy Government crisis Taxation instability Environmental policy/protectionism Land claims and protected areas
Geographic risk	Transportation Climate
Economic risk	Currency stability Foreign exchange restrictions
Social risk	Distribution of wealth Ethnic or religious differences within the indigenous population Corruption Labour relations

Source: (Smith, 1995)

cash flows to which the discount rate are to be applied are generally after-tax cash flows, or distributable cash flows, and the quoted local government bonds are stated in pre-tax terms. Therefore, the risk-free rate of return on a government bond should factor in the effects of tax in order to be applied to an after-tax cash flow. Alternatively, the unadjusted discount rate derived from a bond rate should be applied to the pre-tax cash flows of the project.

When considering the above, there must be cognizance of the different tax rates that are applicable to:

- corporate entities (29% and secondary taxation on companies (STC), the latter being 12.5% of the distributed after-tax amount)
- gold mining entities ($y = 45 - 225/x$, where x = profit / revenue, which must be greater than 5, and no STC is applicable)
- other gold mining entities that elected STC ($y = 35 - 175/x$, with STC on distributable cash payable at 12.5%)
- for mining operations, non-mining income taxed at 38%
- for mines other than gold, 29% of taxable income and STC is payable at 12.5% of distributed profits
- tax rate applicable to the rate at which tax will be paid on the return of a government bond, normally the corporate rate (29%), but it may be a personal rate for an individual investor.

Each scenario listed will result in a different tax-adjusted risk-free rate based on government bonds. An alternative to government bonds in establishing the risk-free rate is the use of debenture rates, since these are already adjusted for tax.

Calculating a discount rate

In general, the determination of a discount rate can be calculated as indicated in Table II. Reviewing the table, not only does the above discussion on tax rates have to be factored in, but in terms of economic and finance theory as it relates to the calculation of discount rates, the debt, equity and preference shares ratios must also be included. The table demonstrates the impact of varying levels of debt and equity over the life of the asset and the impact that this variation has on the calculated discount rate.

In Table II, it is assumed that the beta applies to a listed company that carries a specific level of debt. Therefore, the obtained geared or relevered beta has been calculated from the ungeared or unlevered beta based on the debt to equity ratio and the applicable taxation rate. Therefore, the following applies:

$$\text{Relevered } \beta = \beta_{unlevered}\left(1 + \tfrac{p_d}{p_e}\,(1 - \text{tax rate})\right)$$

and

$$\text{Cost of equity, } r_e = f + R\beta$$

Looking at pure project risk, some literature details the incorporation of project risk into discount rates (Davis, 1995), while others consider this practice incorrect (Sorentino, 1993). Both sides of the argument carry substance. However, the cost of capital and cost of equity must not be confused with project risk. To factor the two discounts separately, the following solution is put forward.

Not all project risks can be taken into account and/or mitigated through sensitivity or scenario analyses, but equally many risks cannot be valued in a discount rate adjustment. Consequently, the discount rate used for a cash flow analysis can be split into its constituent parts, as follows:

Table II

Periodic discount rates—calculations

	Units	Start	Peak	Steady-state
Debt level	R'000	800	1 200	100
Equity level	R'000	200	200	200
Debt/equity ratio	%	80	86	33
Effective tax rate	%	0.00	29.00	37.88
Borrowing cost	%	7.14	7.14	7.14
Unlevered beta		0.85	0.85	0.85
Equity risk premium	%	6.00	6.00	6.00
Risk free rate	%	5.12	5.12	5.12
Relevered beta		4.25	4.47	1.11
Cost of equity	%	30.62	31.94	11.80
Proportional cost of equity	%	6.12	4.56	7.87
Proportional cost of debt	%	5.71	6.12	2.38
WACC nominal	%	11.83	10.68	10.25
WACC real (at 5.5% CPI)	%	6.33	5.18	4.75

- the cost of capital (WACC), including the cost of equity (CAPM)
- project risk.

Therefore, for any cash flow, the valuer will firstly discount the free (after-tax) cash flows at the determined cost of capital and equity discount rate. The value of the project will be calculated at this discount rate to reflect a zero-project-risk value. Once this has been obtained, an applicable project risk that ignores political, country and other macro-economic risks, which are already factored into the first discount rate, must be determined. Now the discounted cash flow must be discounted again, but at the project risk discount rate to yield an overall discounted cash flow. The first and second cash flows and associated values can now be compared. The difference between the two values is the value adjustment resulting from project risk. The following formula applies.

$$NPV_{RADR} = NPV_{CC\&R} - NPV_{CC}$$

where:

NPV_{RADR} = value associated with project risk

NPV_{CC} = value accounting for cost of capital and equity

$NPV_{CC\&R}$ = value after discounting for cost of capital and project risk

For clarity, consider the after-tax cash flow in Table III, given in real January 2005 money terms. Assume that the discount rate to be used is 15 per cent and that the project risk is an additional 3 per cent.

Expanding on Table III, the following formulae determine the discount factors and results attained:

$$DF = \frac{1}{\left(1 + DR_{\%}\right)^{n}}$$

where:

DF = discount factor

DR = discount rate

n = elapsed period in years, where 2005 is year 1, 2006 is 2, etc.

and

$$NPV_{risk} = Value_{(RADR)} - Value_{(CC)}$$
$$= \sum\left(DCF_{CC}\right) - \sum\left(DCF_{RADR}\right)$$

Therefore, from Table III, the discounted value of the project has been determined at R13,797 million, commensurate with a project risk value of R1,645 million, reducing the overall value to R12,152 million.

If valuations are set out as in Table III, then using differential discount rates becomes simple. This is critical if the discount rates determined for the cost of capital and equity are anticipated to change at any point over the life of the project and, more importantly, if the project risk is deemed to vary from any one period to the next over the life of the project.

Differential discount rates

The previously tabled calculations of WACC, in Table II, demonstrate discrete points in the life cycle of a mining project. These discrete points manifest as points at which debt and equity levels have changed. Naturally, and specifically with absolute debt amounts, the ratio of debt to equity levels is a continuously changing variable implying that discrete discount rates for a mining project is an inaccurate assumption.

Consequently, owing to the inaccuracy placed on the derivation of an explicit discount rate, it is proposed that differential discounting at a varying discount rate profile should be considered. That is, a mineral project's cash flow can be broken down into finite durations representing certain periods or durations (typically in years). Excluding debt: equity ratios, in the event that, say, a high level of confidence can be placed on all factors contributing to a mineral project's

Table III

Cash flow analysis at specific discount rates (R'000)

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Free cash flow	1 500	2 750	3 500	3 500	3 500	3 500	3 500	3 000	1 800	200
Discount factor (CC) * (15%)	0.8696	0.7561	0.6575	0.5718	0.4972	0.4323	0.3759	0.3269	0.2843	0.2472
Discounted cash flow	1 304	2 079	2 301	2 001	1 740	1 513	1 316	981	512	49
$Value_{(CC)}$	13 797									
Project risk factor (RADR)* (3%)	0.9709	0.9426	0.9151	0.8885	0.8626	0.8375	0.8131	0.7894	0.7664	0.7441
Risk-adjusted discounted cash flow	1 266	1 960	2 106	1 778	1 501	1 267	1 070	774	392	37
$Value_{(RADR)}$	12 152									
NPV_{risk}	1 645									

CC *—cost of capital
RADR *—risk adjusted discount rate

cash flow over the first six years, these years will be attributed a discount rate of '*x*'%. If the level of certainty regarding the same input factors covering the next five years is lower, then a discount rate of '*x*% + *y*%' should be applied, where *y* may be any number greater than zero and include fractions of a per cent (within reason). Again, the parameters driving cash flows beyond year 11 may be treated with even greater skepticism and therefore a discount rate of '*x*% + *y*% + *z*%' may be applicable, and so on.

Is it more accurate to apply a higher discount rate in the line of increased uncertainty in, say, commodity prices, working costs or mining risks, cumulatively representing the key value drivers, or should a greater weighting be applied to the sensitivity result that introduces a similar discount rate effect? That is, should technical and techno-economic uncertainty be factored into the discount rate, or should these uncertainties be considered in terms of the inability to achieve a mining plan and therefore be factored into the cash flow through increasing forecast costs or capital expenditure?

Prudence and past experience suggests that the uncertainty relating to the inability to achieve a mining plan should not be factored into the primary discount rate but rather be applied to the resulting cash flows that have already been discounted at the project's WACC.

Enhancing concerns on the above issues, another fact that must be considered in the determination of a discount rate is that if an operation forecasts expending significant capital during its life in order for whatever reason, cognizance must be taken of the timing of the incorporation of a new discount rate (due to debt:equity changes, differing costs of debt and equity, etc.). This must be considered bearing in mind that a lag exists between expenditure and production. To clarify, a risk lies in that the capital outlay could be discounted at one rate whereas the generated cash flows could be discounted at a modified rate, creating an incorrect application of differential discounting.

Considering the non-technical influences impacting on a discount rate, we must now consider the more likely case where a mineral project is funded through debt and equity. Over the project development period and the first few years of operation, the debt level and hence the ratio of debt:equity will vary considerably. Initially, debt draw-down will increase the debt:equity ratio and once debt repayment commences, this ratio will decrease. Over this period while the mineral project has outstanding debt, the debt:equity ratio will impact on the calculated discount rate applicable to the mineral project. Logically, therefore, since the ratio is continuously changing, the attributable proportional cost of debt and cost of equity will also vary and hence the WACC will continuously vary. In addition, since interest on debt can be offset against taxable income, the applicable tax rate will also vary, additionally impacting on the calculated discount rate. Ideally, continuously compounding variable discount rates should be used in mining project cash flow valuations.

Concluding comment

The cash flow methods of valuing mineral properties rely on the derivation of a number of critical inputs. The use of an appropriate discount rate is of significant importance, owing to its impact on cash flow values. The discount rate can be determined based on the risk-free rate of interest added to the equity risk associated with the project or company.

Economic and finance theory provides valuers with the necessary tools to calculate discount rates. However, blind use of these tools will inevitably lead to errors and possibly more severe consequences. In the calculation of a discount rate, cognizance must be taken of the gearing associated with a beta, pre- or post-tax determinants, real (uninflated) or nominal (inflated) applications and how technical risks associated with a project are dealt with.

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