THE VALUATION OF ADVANCED MINING PROJECTS & OPERATING MINES:
MARKET COMPARABLE APPROACHES

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ABSTRACT

While various methods are available to estimate a mining project’s value, value is only established through a transaction. Comparable methods allow the value estimated for a mining project to be benchmarked against mining project values established in the market. Comparable methods thus are a key tool for ensuring value estimates are congruent with what the market would actually pay. For example, if the value estimated for a mining project using discounted cash flow analysis differs significantly from the value implied using comparable market methods, the valuator may be using metal price or discount rate assumptions that differ significantly from those the market is currently willing to pay for.

The paper provides an overview of market comparable valuation approaches, and discusses some of the difficulties and limitations that arise in using these approaches. The types of market values that are typically utilised are discussed, including asset sale prices, share prices (market capitalisations), and values established in corporate mergers and acquisitions. Topics discussed include methods used in estimating a mining project’s value based on the market value of the company that holds the asset, and limitations that arise because of unique features of mining projects and of companies that hold them.

It is concluded that market comparable and fundamental (e.g. NPV) approaches to project valuation should not be viewed as alternative approaches to estimating project value, but rather can and should be integrated to derive a single value estimate based on both market and fundamental data. A method for integrating these approaches is discussed, and illustrated by example.

INTRODUCTION

My topic is the valuation of mining projects using market comparable approaches. I have been asked to focus on the use of this technique in the valuation of advanced mining projects or operating mines, not earlier stage exploration projects (this topic is addressed in other presentations in this session). While there is no easy dividing line between early stage and advanced projects, I have assumed that a project can be considered “advanced stage” at the point where reserve estimates, mining methods, metallurgical characteristics, plant layout, infrastructure requirements, capital costs, operating costs, etc have been developed to a sufficient level of confidence to allow preparation of a discounted cash flow analysis that reasonably reflects the probable project cash flows (given an assumed set of economic assumptions, including metal prices, exchange rates, interest rates, inflation rates, etc). In this paper, I refer to both advanced mining projects and operating mines as “mining projects”. All dollar amounts are US dollars, unless otherwise noted.
OVERVIEW OF MARKET COMPARABLE APPROACHES

I would like to start with a definition of “market comparable approaches” to mining project valuation:

*In market comparable approaches to project valuation, market values for one or more selected comparable mining project(s) are applied to a project of interest to estimate its value.*

*Market comparable valuation approaches* can be contrasted with *fundamental valuation approaches*, where value is estimated directly from basic project information, the dominantly used method being the calculation of a net present value (NPV) from estimated project cash flows. In this paper, I will assume that an NPV approach is used to determine value from fundamental project information, although the same discussion could generally apply to other fundamental valuation approaches.

To illustrate the basic market comparable approach by example, if the project of interest is a gold project with an estimated recoverable reserve of 1 million oz, and if data indicates that comparable projects are valued in the market at an average of $50 / recoverable reserve oz, then a project value of $50 million could be inferred. Similarly, if an industrial minerals project of interest generates $5 million in annual cash flow, and if comparable industrial minerals projects are valued at an average of 5 times annual cash flow, then a project value of $25 million could be inferred.

To allow market values to be compared among projects, they are generally expressed (or normalised) as ratios of the form:

\[
\text{market value / fundamental project parameter},
\]

as in the above examples (market value / recoverable reserve oz, and market value / $ of annual cash flow).

Note that the market values of the comparable projects can generally be assumed to take account of all fundamental project information, through investors basing investment decisions on NPV and other forms of analysis. For the above example valuation of a gold project, however, *the only project specific information taken directly into account in valuing the project in this example is the ounces of mineable reserve (and importantly not tonnes and grade, only resulting reserve ounces)*. Clearly, all ounces are not created equal (for example, cash cost per ounce might vary from say $50 for a robust project to $260 for a marginal project), and the success of this approach in predicting the value of this project depends crucially on whether the comparables, on average, have values per ounce approximately equal to the underlying value of the project being valued.

While the stand-alone application of the market comparable approach has its applications, in this presentation I will argue against the use of either fundamental (e.g. NPV) or market comparable approaches as stand-alone valuation methods for any rigorous valuation of advanced mining projects or operating mines, and argue instead that market and fundamental approaches can and should be combined into an integrated valuation procedure.
ESTIMATING THE FUNDAMENTAL & MARKET VALUE OF PROJECTS & COMPANIES

Before proceeding with that discussion, I think it is useful to start by reviewing how market and fundamental values of both mining projects and mining companies are measured or estimated, and the terminology and acronyms that are used in describing these values. Table 1 below summarises the terminology typically used to distinguish between fundamental and market value, and between project and corporate value:

<table>
<thead>
<tr>
<th>Fundamental Value</th>
<th>Market Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Value</td>
<td>Adjusted Market Capitalisation (AMC) or Enterprise Value or Asset Transaction Price</td>
</tr>
<tr>
<td>Corporate Value</td>
<td>Market Capitalization or Corporate Transaction Price</td>
</tr>
</tbody>
</table>

Table 1. Value Matrix

Note that:

- The market value of a mining company’s project(s) (adjusted market capitalisation (AMC) or enterprise value (EV)) is estimated from the market value of the company (market capitalisation) that holds the project(s), or from corporate transaction value (merger or acquisition value), as follows:

  Market value of company (Market capitalisation or corporate transaction value)
  - Working capital
  - Value of other investments
  - Value of hedge book
  + Liabilities
  [+ Capital to production]
  = Implied market value of mining projects (AMC or EV)

The basic principle here is that in addition to giving value to the projects held by a mining company, the market also takes account of corporate items such as working capital, debt, hedge book value, other investments, etc in deciding what to pay for the company as a whole. The company’s market value must therefore be adjusted by the value of these other items to estimate the value attributed by the market to the mining projects themselves. Note that if a company has an advanced project not yet in production, the company value may be adjusted by the capital required to achieve production, if the valuator wants to estimate and compare project values on an in production basis. Alternatively, mining project values may be estimated and compared pre the expenditure of the capital required for production. In this case for comparables with producing projects, an estimate of the capital required to reach production must be subtracted to estimate the value the market would attribute pre- the expenditure of capital. Note that this approach does not take into account the risk associated with the capital cost of a new project – presumably the market will pay a premium once the capital risk has been removed.
• A company’s net asset value (NAV) is calculated from the estimated aggregate net present values (NPV’s) of the company’s projects, by essentially the reverse of the above calculation, as follows:

\[
\text{Aggregate net present value of company’s projects} \\
+ \text{Working capital} \\
+ \text{Value of other investments} \\
+ \text{Value of hedge book} \\
- \text{Liabilities} \\
= \text{Net asset value of the company}
\]

• By comparing the implied market value of a company’s mining projects (AMC or EV) to the estimated fundamental value (NPV) of its projects, a valuator can assess whether the estimated fundamental values are above or below the values that would likely be realised in the market.

• Similarly, by comparing a company’s market value (market capitalisation) to its estimated fundamental value (NAV), an analyst can calculate the premium or discount the market is paying to a particular fundamental value (NAV) estimate.

**COMBINED MARKET COMPARABLE / FUNDAMENTAL PROJECT VALUATION**

As noted, I will argue in this paper that market and fundamental analysis are best not used as alternative, stand-alone valuation approaches, but rather should be used together as two legs of a single valuation procedure. Consider Table 2 below:

**Table 2. Hierarchical ordering of comparable market value ratios according to sequence of project net cash flow and NPV estimation**

The left hand column of this table represents the typical sequence of calculation of a project’s net cash flow and NPV. Note that as we move down the table, *an increasing amount of project information is taken into account*, to the point where the estimated NPV takes into account all quantifiable project data that affects value. Each line in the cash flow calculation cumulatively incorporates all information in the previous lines. Looking at the corresponding market to fundamental valuation ratios in the right hand column, the ratios lower down in this table include all the information in the higher up (more primitive) ratios, plus information these more primitive ratios don’t take into account. For example, an AMC / recoverable oz ratio includes all the information in an AMC / insitu oz ratio, plus additional project information relevant to
project value (in this example, metallurgical recovery). These ratios thus become increasingly accurate measures of value as one moves through the sequence of cash flow and NPV calculation. At the bottom, the AMC / NPV ratio incorporates all relevant quantifiable information for each project comparable into a single market to fundamental value ratio for that comparable.

If the market comparable approach is used as a stand-alone method, the higher up the market to fundamental value ratio is in this table, the less information is incorporated, and the greater the potential error. Valuing an advanced mining project or operating mine using a comparable method on contained metal ignores the impact of a host of known project specific information. Figure 1 illustrates where the gross reserve metal value is lost in the estimation of NPV for an example polymetallic project:
Clearly the NPV per unit reserve of selected comparables and of the project being valued will vary considerably, depending on metallurgy, smelter terms, operating costs, etc. Estimating the market value per dollar of NPV for the comparables will provide a much more reliable estimate of the subject project’s value than will a more primitive estimate, such as market value per unit of reserve.

Thus for each comparable, we have an estimate of market value, of NPV, and of the market to fundamental value ratio. This ratio tells us what the market is willing to pay per dollar of NPV for each comparable project, based on a particular set of economic assumptions (metal prices, discount rate, inflation rate, interest rate, exchange rates, etc).
Returning to the example of a 1 million recoverable oz gold project, lets assume that:

1) the valuator sets up a cash flow model, and based on certain gold price and discount rate assumptions, estimates a project value of $40 million.
2) using the same gold price and discount rate assumptions, the valuator estimates NPV’s for each of the comparable projects. Market value (AMC) estimates for each of the comparables are also prepared, and the ratio of market to fundamental value (AMC / NPV) for each of the comparable projects is then estimated and averaged. Assume the average ratio is 1.67.
3) the valuator then applies this “market multiple” to the estimated NPV of the project being valued, resulting in a “market adjusted” value estimate of $67 million.

Is $67 million a better estimate of project value than the $40 million NPV? I would argue that it is. There could be various reasons for the market valuation of the comparable projects being significantly higher than their estimated NPV’s, including that the market is assuming a higher gold price and/or a lower discount rate than the valuator. By applying the AMC / NPV multiple, the valuator is calibrating the measured value to the value the market is attributing to the comparables.

As an alternative to applying the AMC / NPV multiple, the valuator could determine a gold price / discount rate combination such that the estimated NPV’s of the comparables on average equal their estimated AMC’s. This higher gold price and/or lower discount rate could then be used to estimate a revised (higher) NPV for the project being valued. Of course, the number of gold price / discount rate combinations available to yield an average AMC / NPV for the comparables of 1.0 is infinite, and each combination would result in a different revised NPV estimate for the project being valued. Further, it is unlikely that a single gold price / discount rate combination would equalise AMC and NPV for each comparable project. Adjusting the gold price / discount rate assumptions is therefore not necessarily a more accurate method of adjustment than simply applying the estimated AMC / NPV ratio of the comparables to the estimated NPV of the project being valued.

While I wouldn’t argue strongly which is the better alternative for adjusting the estimated project NPV, the key point is that any significant difference between the estimated market and fundamental values of the comparables strongly implies that the estimated NPV of the project derived with the same economic assumptions should be adjusted to more accurately estimate the value the market would be willing to pay.

Having reviewed the framework in which market comparable approaches are used in the valuation of advanced mining projects and operating mines, I would now like to turn to a discussion of issues that arise in implementing market comparable valuation analysis. In particular, I will discuss sources of market value data for mining projects, and selection of the comparables.

**SOURCES OF MARKET COMPARABLE VALUATION DATA**

Sources from which the market value of mining projects can be derived include:

1) Value paid in a direct asset transaction
2) Value paid in a corporate acquisition transaction
3) Value implied in a merger transaction
4) Current trading value of a company

**Value paid in a direct asset transaction**

The value paid in a direct asset transaction has the advantage that provides a direct measurement of project value, since there are no corporate considerations to impact value. Unfortunately for the valuator, most transactions are at the corporate level, particularly those for which value data is publicly disclosed. Also, as with all transaction data, it is applicable to a particular point in time, and is likely to have diminished
validity if market conditions have changed from the date of the transaction. Obviously, the more recent the
data the better.

**Value paid in a corporate acquisition transaction**

The value paid in a corporate acquisition transaction can be almost equivalent to a direct asset transaction in the case of the acquisition of a junior company holding a single significant asset, where the dominant interest of the acquirer is this single asset. Thus more junior companies with fewer or ideally only one project may be better sources of comparable market value data for particular project types, but since these juniors may attract lower market values than more senior companies for a variety of reasons (lower liquidity, market capitalisation, etc), market values derived from these companies may be less than the values the same projects would attract in the portfolios of senior companies, unless the market is anticipating an acquisition of the junior company.

For transactions involving the acquisition of larger mining companies, multiple projects may be involved, and these projects are likely to be diverse (e.g. in various geographic locations, open pit, underground, heap leach, milling, etc). While this diversity may limit the comparability to a particular project type, some senior companies, for example some of the large South African gold producers, may have less project diversity and may thus provide valuation data in aggregate that is still applicable to specific project types. For transactions involving larger companies, uncertainty in underlying project value is also more likely to arise because of the impact of corporate level considerations (management, financial structure, etc) on transaction value.

Again, transaction value data may have reduced validity because it is dated and does not fully represent current market conditions.

**Value implied in a merger transaction**

Often the line between an acquisition and a merger transaction is grey, and many of the comments above regarding project values derived from transaction values apply here as well. In merger transactions, corporate issues may play an even greater role in determining transaction value. Again, transaction date is an issue.

**Current trading value of a company**

Two key advantages of using the *current trading value of a company* are that:

1) market value estimates so derived represent *current* market value, and
2) the amount of data is greater, with all public mining companies being continually valued in the market through their share price.

Disadvantages include the fact that a current share price represents a marginal market value, which may differ significantly from the total value that would be realised in a full project transaction (by the transaction premium).

**THE SELECTION OF MARKET COMPARABLES**

The selection of closely comparable projects is key to ensuring that the basis for adjusting the estimated NPV of the project being valued (i.e. the estimated market to fundamental ratio of the comparables) is valid. At least two key areas need to be addressed in selecting comparables:

1) the comparability of the projects themselves
2) for comparable projects held within public companies, the impact of corporate level considerations on the estimated market value of the projects.

**Project Comparability**

Given NPV estimates for a variety of gold projects in a variety of locations, estimated using the same economic assumptions (metal prices, discount rates, etc), would the market pay the same or similar value per dollar of estimated NPV for all of these projects? I think the answer is no. The market may pay a premium for lower cost production, for a more stable political jurisdiction, for a producing asset versus a development asset, etc. Below is a partial list of considerations that may lead to significant differences in the value markets will pay per dollar of estimated project NPV.

**Commodity or product**

As is well known but probably less well explainable, gold projects attract a considerable premium to estimated NPV versus other projects. Projects that produce marketed products rather than commodities may attract a different premium or discount to NPV. Generally speaking, comparable projects should produce the same commodities or products as the project being valued.

**Date of the valuation data**

As noted above, if the valuation is based on a merger or acquisition transaction, the premium or discount to estimated fundamental value the market is willing to pay varies over time, even after adjusting for changes in metal or product prices. Figure 2 below indicates the variation of the price to NAV valuation of senior gold producing companies since 1986. A similar variation in the AMC / NPV ratios of the underlying projects could be expected.
Location
A market premium or discount may be applied due to political stability and risk, economic stability, environmental sensitivity, etc. An October 1999 study by Deutsche Bank Securities, for example, indicated that at a $318 gold price and a 6% discount rate, senior North American gold producing companies were trading at an average 53% premium to NAV, versus 17% and 19% discounts for senior Australian and South African producers respectively. While these are company values, presumably the conclusion would be similar for the underlying projects. Note that these differences in market valuation may be due to differences in the location of the projects, to the domicile of the companies, or to the location of the markets in which share of these companies trade. Ideally, the comparables should have operations in proximate locations, have corporate offices domiciled in the same jurisdiction, and be valued in the same markets.

Reserve size
Projects with larger reserves may attract a market premium. It is thus preferable that comparables have reserves of similar size, at a grade that will result in similar margins.

Deposit type, mining method
The market may pay a premium for particular deposit types. For some time open pit bulk mineable gold deposits were favoured, more recently high grade underground projects are perhaps viewed more
positively by the market. It is preferable that comparables have similar deposit types and mining methods.

Process method
Free milling projects, for example, may attract a premium versus refractory projects. Comparables with similar metallurgy and plant design are preferable.

Cost of production / grade / margin
Projects with low cost production (high grade) may attract a market premium, and vice versa.

Capital cost / infrastructure requirements
Projects with lower relative capital costs, typically implying lower infrastructure costs, may attract a market premium, and vice versa.

The following matrix classifies mining projects according to their relative capital costs and operating margins. The comparables and the project being valued would ideally be similarly categorised.

<table>
<thead>
<tr>
<th></th>
<th>High Margin</th>
<th>Low Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low capital</td>
<td>Low risk - Robust economics</td>
<td>High operational risk, typical of a restart</td>
</tr>
<tr>
<td>High capital</td>
<td>High capital risk, Good operational sustainability</td>
<td>Probably not economic</td>
</tr>
</tbody>
</table>

Table 3. Project categorisation by capital cost and operating margin

As illustrated by the above examples, there are many issues to consider in searching for valid comparables. All projects are in some ways unique, and thus there are generally no perfect comparables. A systematic consideration of issues such as those listed above will help to filter-out the best comparables.

It should also be recognised that in some cases, even the best available comparable(s) may have features that differ significantly enough from the project being valued to make any conclusions drawn from comparable analysis of limited or questionable validity. In such cases, the valuation exercise is obviously more difficult, and the valuator will have to recognise a greater degree of uncertainty in the derived value estimate. I would therefore suggest that the valuator include an assessment of the comparability of the projects selected in any valuation report.

Corporate considerations

If the project(s) are held in a corporate entity, various corporate level issues can have a significant impact on a company’s market value, and thus on the estimated market value (AMC) of the company’s project(s). Since the valuator does not necessarily know in what corporate entity the project being valued will reside, I would suggest that it is preferable that the impact of corporate considerations on market value be relatively neutral.
Relative project to corporate value

Companies whose mining project(s) comprise only a small portion of total corporate value are generally not good candidates as comparables, since small changes in the market’s assessment of non-project value may significantly impact the estimated adjusted market capitalisation of the project(s).

Management strength

Investors may pay a significant premium for companies with strong management, capable in strategic operational, technical, financial management, and corporate communication. Conversely, a significant discount may apply where management is viewed negatively.

Balance sheet

Companies with a strong balance sheet, including adequate working capital and reasonable leverage, generally attract a premium in the market. Conversely, companies with high relative debt levels and difficulties with financial liquidity generally trade at a significant discount.

Hedging program

Given recent events, the market will pay close attention to a company’s hedging activities, particularly for gold companies. Depending on the market’s outlook with regard to the commodity being produced, a company’s hedge position may attract a significant premium or discount in the market.

Market capitalisation and liquidity

Companies with higher capitalisation and greater liquidity generally attract a premium in the market.

Clearly, identifying good comparables can be challenging. If a variety of reasonably comparable projects are used, then hopefully some of the non-comparability of individual projects is averaged out. While finding good comparables may be difficult, I believe a systematic and as comprehensive as possible analysis of the potential comparables with regard to issues such as those listed above can help define an appropriate set of comparables, and assist in achieving confidence in the market comparable analysis.

CONCLUSIONS

Market comparable approaches to valuation involve estimating the market value of selected comparable projects, relating this estimated market value to a reference fundamental project variable (e.g. ounces in reserve), and then applying this market to fundamental value ratio to the same reference variable of the project being valued.

A project’s fundamental data can be ordered hierarchically, however, according the how much information it incorporates, with the fundamental value estimate (e.g. NPV) cumulatively incorporating all quantifiable fundamental project information. The ratio of market (e.g. AMC) to fundamental value (e.g. NPV) is thus the most comprehensive value ratio to use, and allows the integration of fundamental and market value estimates into a single combined value estimate.

By estimating both market and fundamental values for the comparables, rather than only the market value of the comparables, the valuator is able assess how the market is really valuing projects relative to their estimated fundamental value. Using a fundamental (e.g. NPV) approach alone will not take account of available market information, and using a market comparable approach alone will not take account of all known specific information regarding the project being valued, except when benchmarked against fundamental value (NPV). In the end, fundamental methods estimate value, but value is established by markets. We therefore need to calibrate fundamental value estimates against values established in actual market transactions.

Implementing market comparable analysis involves a number of challenges, for example in selecting valid comparables, and in estimating the market value of comparable projects from the companies that own those projects. Confidence in the project value estimate can be gained through a detailed and documented
consideration of comparability, and the recognition of circumstances where comparables are of questionable validity.