

An Investor's Perspective: Long-Term Risk Assessment and Value Drivers for Mining Investors with Varying Time Horizons

Jason M. Siegel
Columbia University
Natural Resources Private Equity

ABSTRACT

Environmental sustainability factors related to mining operations can have significant impacts on both short and long term financial performance of mining companies. Some of these impacts may emerge slowly over time, while others could manifest as an impact at any time and hence translate into a near term financial risk. This note discusses some salient aspects of an investor's perception as to both short and long term risk associated with mining enterprises, with water related risks as the environmental context. Elements needed for a reporting or disclosure framework that improves investor understanding of and response to long term risk factors are discussed.

INTRODUCTION

Every mining investor has a targeted time horizon during which time it aims to recover capital invested plus a rate of return. These time horizons can range from fractions of a second (for high-frequency technical investors) to decades (for longer term fundamental investors that are less focused on exploiting temporary inefficiencies in the market and more focused on long-term value creation and wealth preservation). Each of these investors has its own unique set of investment objectives and therefore takes a slightly different approach to risk and valuation of mining assets. This note specifically focuses on the inherent differences in risk assessment and the importance of different value drivers to shorter term mining investors relative to longer term mining investors. Water related factors are integrated throughout this section in terms of how they may influence some of the topics discussed below.

The key issues discussed in this note are:

- Commodity price;
- Foreign exchange;
- Environmental impact;

- Social conflict / community relations;
- Natural disasters;
- Labor relations;
- Cost management;
- Infrastructure development;
- Offtake; and,
- Health and safety.

COMMODITY PRICE

The commodity price is often considered the key determinant of a mine's profitability as it is the basis for the revenue derived from each quantity of a given commodity produced. Short term investors and long-term investors look at commodity price risk very differently.

Short term investors are often focused on temporary fluctuations in supply and demand. They react to data on temporary production stoppages and look at metrics such as warehouse levels as a determinant of how saturated the current market is for a particular commodity. Market announcements on growth in China, new housing starts, or unemployment can in the course of a given moment change a short-term investor's outlook on a given commodity sector. The spot market and forward curve are often the most widely used reference prices for predicting how successful a mine will be on a short-term (temporary) basis from selling its product.

Longer term investors are more concerned with the structural nature of a particular commodity and how long-term supply and demand imbalances will change over time. They look at new mines coming online and fundamental drivers of demand of both the commodity and the refined products for which each commodity is an input. They carefully examine things like cash-cost and grade and consider how evolving technologies and substitution (of alternative, lower cost commodities) may shape the sector over time. Long-term durability of demand is examined on the basis of the end consumers and temporary blips in consumption are not materially impactful.

To long-term investors, water related factors such as scarcity (which may result in requiring desalination) can increase mine capex and result in fewer new mines being built (as the economics may not work at given prices). In addition, changes in environmental regulations can impact operating costs associated with ongoing monitoring and remediation. This can result in an industry-wide shift in the cost curve, which can impact the pricing dynamics of a given commodity (if it costs more to produce a single unit). Given the large portion of global production of certain commodities that is located in highly concentrated areas (for geological reasons), even local changes that influence capital expenditures and operating expenses in a place such as Chile can have a profound effect on the global market.

US thermal coal is a good example a commodity that suffers from fundamental structural problems. The emergence of hydraulic fracturing technology has allowed a large amount US

natural gas to be produced which was previously inaccessible, which has resulted in a sharp decline in the US natural gas price. As a cleaner and cheaper form of energy, natural gas has made many coal mines uneconomic and an undesirable fuel source. Many long-term investors therefore believe that US thermal coal is a dying industry. However, from a short-term investor's perspective there is potentially an opportunity to exploit economic mines in areas where natural gas has not been discovered (or pipelines have not yet been built) until US natural gas infrastructure grows in such a way such that these mines can no longer economically produce.

FOREIGN EXCHANGE

Foreign exchange is an important factor that influences a mine's profitability. Most commodities are sold to the international market in US dollars, however a material portion of a mine's costs is often denominated in local currency. For example, local workers and local supplies are often paid in the currency where a given mine is located. When the local currency appreciates, it costs more to compensate a mine's workers for the same amount of work and therefore a mine's profitability goes down (revenues remain constant and costs go up).

Short-term investors will look at temporary changes in emerging market economies as an important element in evaluating an investment decision. Higher cost mines will make less money and therefore are less desirable to own. Short-term mining investors will tailor their portfolios around mine's that will report positive news (e.g. good earnings) in the near-term and therefore having a view around currency fluctuations can impact their perspective which companies are more likely to make more money (and report to the market that this is the case).

Longer term investors will try to understand the long-term trends of a given foreign currency. They will ask questions such as whether long-term wage rates are fundamentally increasing and try to consider as a trade-off whether the work force is becoming more skilled and productive. The economy of a given country is often structurally examined and a long-term exchange rate will be assumed based on factors like anticipated population growth, quality of life improvements and foreign direct investment and less so on short term changes to interest rates and temporary macroeconomic indicators. It is important to note that many of the largest commodity producing countries have foreign exchange rates that are highly correlated to commodity prices, as commodities represent such a material portion of a given country's gross domestic product and exports. As it relates to water, it is therefore likely that an across-the-board increase to operating costs and capital expenditures can drive up both the price of a given commodity and also strengthen the currency of those countries who produce that commodity. However, to the extent the water related impact is very local, it is possible that the resulting effect may solely be that a particular country's production becomes less competitive or that the economics make it less attractive to develop a mine in that particular location. This can be detrimental to a commodity driven economy and currency.

ENVIRONMENTAL IMPACT

Mining investors are concerned about the environmental impact of a mine mainly because it can impact profitability through increased monitoring costs, the permitting process and potentially cause production disruptions in the event of pollution or a reported violation. While both short-term and long-term investors are concerned with any sort of environmental impact that can lead to increased costs, a delay to the production timeline or either a temporary or permanent production stoppage, they view these risks very differently.

For example, an investor who is looking at a project with a 30-year time horizon may be less concerned with whether a mine's feasibility study or permit is delayed by one year, while a one-year permitting delay might be reason alone for a short-term investor to exit a particular position. What is more important to a long-term investor is that the mine design is done properly and that over the life of the mine, the project produces efficiently and without material interruption. Investing in slightly more costly monitoring programs and preventative maintenance is worthwhile to long-term investors while shorter term investors may view these costs as wasteful.

A typical example of this is the stability and construction parameters of tailings ponds. While over time a number of jurisdictions have required that tailings ponds be lined, many countries in the world do not have any regulations requiring lining to be installed in order for a mine to receive its permit to operate. Longer term investors may see the potential implications of depositing the mine's acidic tailings into an unlined facility, however shorter term investors are likely to prefer that a mine pursue the most cost effective route to reach positive cash flow that complies with local laws and regulations.

If the market was perfectly efficient, these risks would be priced into project and company valuations. Companies with poorer monitoring programs that have less regard for the long-term implications of their actions would be less valuable (as their valuations would take into consideration the higher risk associated with investing in them). In reality however, there is a mismatch in how short-term and long-term investors view these risks given their objectives. If a mining company misses earnings as a result of increased spending on preventative measures (whose impact might not be felt for 10 years), a short term investor might view these expenses as simply a cost, while a long-term investor would look at this as an investment.

There is also often a misalignment with management, who tend to be rewarded based on short-term performance rather than continued preventative risk-avoidance. Investors have limited mine specific data available to them to assess how companies and management is doing preventing long-term risks. The issue is not data collection; we are convinced that mines collect and report this data internally (often, so it can be looked at after the fact in a high impact event). The problem appears to be consolidating mine-by-mine data and making it available to investors in a usable form. The result is a lack of incentive (especially for smaller companies in

need of capital) to do anything beyond what is required to mitigate longer term risk because investors cannot quantify the resulting impact into their valuation analyses.

SOCIAL CONFLICT / COMMUNITY RELATIONS

Maintaining good relationships with surrounding communities is essential for a mine to be successful over the long run. Local people often represent a material portion of the local work force and if not satisfied with the way a mining company is treating them, can cause social unrest, which can influence local regulations.

A long-term investor will place an emphasis on a given mining company building long-term relationships with the local people and their elected officials. Shorter term investors will often be more concerned about the current costs of operating locally and the potential immediate impact of any sort of disturbance on a mine's bottom line.

Water is most often consumed in mines in mineral processing, mine cooling systems, washing of equipment and transportation of ore in slurries. Some mines are located in areas where water is particularly scarce and a given mine's consumption may impact water availability for human consumption and agriculture. Longer term investors will often try to find a solution for water use that satisfies the needs of the local people as well as that of the mine as a foreseeable conflict over water may likely take place over the longer term. Shorter term investors will likely be focused on simply finding the lower cost water access, irrespective of its potential long term impact on the surrounding population.

To protect certain investors, as a condition to providing financing, it is often required that a given mine will adhere to Equator Principles or IFC standards, which set out international guidelines by which mining companies must follow when interacting with local communities. There are several pieces of literature which suggest that mines that adhere to IFC performance standards have significantly better engagement with local communities and lower resulting impact than those that do not. This relates to both water and other potential activities that can impact people located nearby to a given mine site.

NATURAL DISASTERS

Every country has its own regulations that mines must adhere to in order to protect a given mine and the surrounding communities from natural disasters. These include earthquakes, floods and epidemics among other naturally occurring impactful events. Some companies strive to go above and beyond the minimum that is required by law and some investors insist that they do so. For example, each country has its regulations regarding the stability of tailings ponds based on the likelihood of flooding and seismic activity. While many companies simply adhere to the minimum local regulations, there are some companies that pride themselves on going above and beyond those requirements in order to reduce the risk of a low-probability

high-impact event affecting any particular one of their assets having a larger monetary and reputational impact on the entire corporation.

A shorter term investor may not be concerned about protecting against such events because the probability of a natural disaster occurring during their holding period is significantly less. Longer term investors have a significantly higher probability of owning a mine during a period in which it is impacted by a natural disaster and therefore are more focused on protecting against these risks. A good example of this is to examine the policies and procedures of a large mine with 50+ years of reserves that is likely to be producing for decades to come relative to a narrow vein gold mine in Peru for example that may have less than a year of remaining reserves, but has been operating for 50+ years and continuously replenishes reserves as it is mined. The larger mining company will almost always invest significantly more money in preventing low-probability high-impact events, as the impact is both more easily quantifiable and more likely to occur (given the available information). The impact on the smaller company may in fact be greater, but it is uncertain given the mine could stop producing at any given time.

LABOR RELATIONS

A large portion of mines globally are unionized and every several years, a mine will need to renegotiate terms with the local workforce. These negotiations often place restrictions on the ability for a mine to downsize and also set wage rates. Over the past decade, labor rates have put increasing cost pressure on mining companies as commodity prices have risen. Strikes have also caused production stoppages, which can cause a material impact to a mine's earnings in a particular period. Governments have also implemented "workers participation" regulations which mandate that companies must pay a minimum portion of their earnings to the local workforce.

Short-term investors will often be particularly sensitive to the impact of rising wage rates on a mine's cost as well as the impact of any sort of production stoppage that directly impacts a mine's bottom line. Longer term investors are often more focused on the fundamental impact of the relationship between a given mining company and its workers as well as any sort of long-term impact on wage rates relative to productivity.

COST MANAGEMENT

Every mining company has various cost controls that have been implemented to try to ensure that the company and its assets are operated as efficiently and cost effectively as possible. Major mining companies have entire departments focused on implementing improvements to key performance metrics, with a major focus on cost. In some cases, this may include confirming that environmental monitoring (for example of water pollution) is not superfluous and that its assets are operating with the minimum number of people and resources as possible. Mergers and acquisitions in the industry (particularly in the private equity space) are

frequently predicated on the ability to create value through more cheaply operating a given asset, thereby increasing profitability.

Short-term investors are often more concerned with a company's short-term performance and how that translates to immediate value creation, while longer term investors are often focused on whether cost cutting measures are sustainable and how any such changes may impact the mine's ability to produce in the long run.

A typical example of this is whether a mine invests in reserve replacement. Many underground mines need to continuously drill and define more reserves as ore is produced. An easy way to improve near-term profitability is to focus less on extending a given mine's life, which will reduce costs in the short term but cause a mine to run out of defined reserve more quickly. This is a frequent trade off that mine management needs to consider, about whether investing in the asset's future is worthwhile while partially sacrificing near term profitability.

INFRASTRUCTURE DEVELOPMENT

Mining companies are frequently placed with the dilemma of whether to invest in long-term infrastructure such as building roads, rail, pipelines for water access or relying on more costly temporary means for the project to operate (such as utilizing trucks as the main means for transporting supplies and the finished product). For example, many mines during the development phase of a project (while they are trying to determine whether there are ample reserves and resources in the ground for a mine to be constructed) will truck water from local wells to the mine site. Once reserves are proven and studies are sufficiently bankable that demonstrate a mine should be built, only then will a mining company consider putting in a costly pipeline or desalination plant. Infrastructure investments can cost billions of dollars and take years to complete. These investments require a long-term commitment to production from a particular region and often a belief that a given geographic area will thrive in the long term.

Long term investors have the ability to look at a project from an entirely different perspective in that they can evaluate a region's geology and then make a determination about whether a means to easily access the area will likely be necessary and cost-effective over the long run. Shorter term investors are often focused on nearer term profits and whether a given investment will result in visible value creation during their shorter investment horizons.

OFFTAKE

The physical metal that a mine produces can have significant strategic value to industrial consumers and metals traders. A mine's production is ultimately sold to an end user that will turn a given commodity into a finished product. These downstream consumers value security in their supply chain and are therefore often to pay a premium or provide financing to mines willing to provide them with certainty of supply.

Shorter term investors are more likely to be willing to sell a mine's long-term physical production to enhance a mine's short term cash flow or to cater to a mine's near term financing needs. Longer term investors tend to be much more reluctant to give away the rights to a mine's physical production because they realize the importance of this to a long-term strategic purchaser and would prefer to sell on a competitive basis to the open market with more leverage and keep the value associated with the physical supply of their finished product to themselves.

HEALTH AND SAFETY

Mines in every jurisdiction are required by law to operate safely and take certain minimum necessary precautions, however different companies go to different lengths to ensure this is the case. Unsafe mines are subject to being shut down and can result in sizable lawsuits and settlements against the companies operating them.

Longer term investors will often be focused on ensuring that proper monitoring and preventative programs are in place to ensure there are no systematic issues over the long run. There include monitoring air pollution, water pollution as well as direct monitoring of the ongoing health of the company's employees. A poor safety record can result in bad publicity for a mining company and poor community and governmental relations. Short term investors can be less concerned for example about a mine's performance preventing respiratory infections that can take years to become evident. Longer term investors need to consider the financial implications of being continuously burdened with worker lawsuits later on down the line which will ultimately impact a company's profitability and valuation.

SUMMARY / CONCLUSION

Long-term and short term investors have different investment objectives and therefore take different approaches to value mining assets and mitigate risk. On each of the key issues discussed above, the time horizon that the given investor is targeting fundamentally influences the actions each of them prefer to be taken by the companies they invest in.

Value Driver and Risk Assessment Summary Table

Issue	Examples of Short-term Focus	Examples of Long-term Focus	Examples of Potential Additional Disclosure
Commodity Price	Warehouse levels, mine labor strikes, current industry cash costs, TCRCs, current demand for refined products / from end users, current performance of key demand markets / key economic indicators, weather conditions that impact supply, natural events that cause production stoppages	New mining technologies, long-term cost / grade trends, availability of substitutes for replacement in end market, changes in environmental regulations / monitoring costs	More detailed breakdown of mine-specific costs, more detailed estimates of mine development timelines, more disclosure on demand from end users / trade flows
Foreign Exchange	Changes in year-to-year inflation, interest rates, government debt levels, recession indicators, export / trade	Political stability, improving labor force / education rates, durable demand for a country's products and labor	Mine-specific disclosure on cost and capex denominations in local currency versus US dollars
Environmental Impact	Permitting delays, increased monitoring costs, production disruption as a result of pollution, stronger (higher cost) legislation to protect against high-impact events	Lack of environmental monitoring, weak environmental monitoring program, lack of preventing measures in place to protect against high-impact events, clean-up costs	Mine-specific monitoring costs, estimates impact of environmental incidents

<p>Social Conflict / Community Relations</p>	<p>Higher costs as a result of agreements with local communities, higher costs associated with water use, stricter local compliance requirements leading to higher development costs</p>	<p>Poor relationship with local communities, social conflict over water use, lack of compliance with international standards</p>	<p>Mine-specific social and community costs, capex and cost implications on a mine-by-mine basis of complying with improved international standards</p>
<p>Natural Disasters</p>	<p>Earthquakes, floods, epidemics that cause production stoppages, increased costs associated with protecting against low-probability high-impact events</p>	<p>Lack of preventative measures to protect against natural disasters, lack of investment to put at risk value of reserves / resources</p>	<p>Mine specific design parameters, ongoing costs and capex associated with protecting against high impact events</p>
<p>Labor Relations</p>	<p>Rising wage rates, implementation of workers participation legislation, labor strikes</p>	<p>Fundamental lack of training, lack of education / skilled labor necessary to mine, relationship between workers / unions and mine management / corporate</p>	<p>Impact of yearly union negotiations on cash costs, timing of contract renegotiations, better disclosure on productivity / performance measures</p>
<p>Cost Management</p>	<p>Increased environmental monitoring costs, lack of cost cutting / operational efficiency measures</p>	<p>Fundamental increases in baseline costs, long-term increase in supplies and materials</p>	<p>Mine specific, categorized breakdown of costs</p>
<p>Infrastructure Development</p>	<p>High capex, capex overruns, financing risk</p>	<p>Inability to produce at targeted production levels, lack of expansion capacity, high cost transportation as a result of lack of infrastructure</p>	<p>Trade-off study analysis of infrastructure solutions performed at the mine level</p>

Offtake	Potential financial source from strategic investors	Strategic value in a mine's product	Detailed mine offtake terms, contractual commitments, annual P&L made by offtakers
Health and Safety	Temporary production stoppages due to injury, higher health and safety / training costs	Bad publicity that can cause long-term brand damage, major lawsuits, labor claims	Better disclosure of contingent liabilities and mine-level health and safety statistics

In a perfectly efficient market, long-term and short-term investors would be aligned as the securities would be priced taking into consideration all of the risks perceived to exist in the market based on the information available. However, there is a lack of available mine specific information which limits investors abilities to assess and quantify risk and the potential resulting impact, which likely leads to certain risks being mispriced.

The issue is not related to collection – mines collect ample information that would enable these risks to be analyzed (an example mining reporting framework is included in Exhibit A). The problem pertains to making the necessary data available to the public and presenting it in a way that is easy to understand. Without a greater incentive for companies to do so or regulation that mandates that things be done a certain way, there is not a mechanism in place to protect investors against the risks they cannot evaluate. Better disclosure would enable investors to more easily identify those companies whose practices match their investment objectives. The companies themselves could choose whether trying to carry out the actions necessary to meet the needs of those investment objectives is worthwhile to them.

The onus of making sure companies are mitigating risks lies both with government regulators and investors (who are trying to mitigate financial loss for themselves and the companies they invest in), however without the necessary information to assess probability or impact, there is little that can be done.

EXHIBIT A

Example Mining Reporting Framework

