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THE VALUATION-DRIVEN ACQUISITION THEORY IN MINING M&As: are post-acquisition value write-downs indicative of target overvaluation?

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A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Science in Engineering.

Johannesburg 2018

DECLARATION

I declare that this research report is my own, unaided work. It is being submitted in partial fulfilment for the degree of Master of Science in Engineering in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.



Angela Kapapilo (nee Kharuxas)

9 day of November 2021

ABSTRACT

This research sought to find evidence of the "valuation-driven acquisition theory" and its possible relationship with post acquisition impairments in mining mergers and acquisitions (M&As) over between 2010 and 2012. The "valuation-driven acquisition theory" was defined by financial economics scholars such as Schleifer & Vishny (2003) and Rhodes-Kropf & Viswathan (2005) who studied market- and accounting-data derived valuations of companies involved in M&As and concluded that managers' decisions to participate in M&A activities and M&A Target selection were driven by stock market misvaluations. The "valuation-driven acquisition theory" proposes that Bidders should limit their offer values to their own valuations to avoid potential post acquisition losses. Based on this, scholars such as Gu & Lev (2011) extended the "valuation-driven acquisition theory" by finding correlations between Bidder company valuations, Target company overpayment and post-acquisition impairments.

Following examples from financial economics research, the Price-to-Book (PB) and Risk-adjusted Excess Returns (ER) valuation metrics for mining companies were derived using stock market data and accounting data so as to test M&A transactions for at least some of the propositions of the "valuation-driven acquisition theory". Analysis of the PB and ER valuation metrics resulted in the following conclusions with respect to the "valuation-driven acquisition theory" propositions: (1) according to the ER metric analyses, Target and Bidder companies were overvalued relative to the industry; however the PB metric found the opposite to be true: Target and Bidder companies were undervalued relative to the industry valuations; (2) Both the ER and PB metrics found that Bidder companies had higher valuations than Target companies; and (3) there was no relationship between overall ER and PB industry valuations and M&A deal volumes. Based on these results, mining M&A activities show only mild support for the "valuation-driven acquisition theory", and do not appear to be driven by trends in stock market misvaluations. It appears that average Target and Bidder company valuations differ from each other and from the overall average industry valuations, but the differences depend on the valuation metric used. Although based on a substantially small data set because annual impairments data was not available for all companies participating in M&A, comparison of valuation metrics to reported impairments and relative overpayment ratios resulted in the following conclusions: on average, Bidder companies with lower valuations reported more significant negative impairments and higher relative Target overpayment ratios. This group of Bidder companies and their respective Target companies appeared to have similar valuations. On average, Bidder companies with higher valuations reported positive impairments, had lower overpayment ratios and their Target companies had

lower valuations than the Bidder companies. This analysis therefore found some correlation between valuations, target overpayments and reported impairments, and suggests that Bidder companies that bid for Targets with lower valuations report lower levels of impairments.

In summary, the results of this research do not show strong evidence of the "valuation-driven acquisition theory" therefore it cannot be concluded that decisions by Mining Managers to participate in M&A activities and their Target selection strategies are driven by stock misvaluations. The main reason for this lies in the fact that the valuation methods used mimicked the methods prescribed in the financial economics literature which rely purely on stock market and accounting data for valuating industrial assets; however, the assets acquired during mining M&A activities are mineral resources which form the basis for the valuation of mining companies. The attractiveness of a mineral asset for selection as a potential M&A Target is based on factors such commodity prices, mineral resource characteristics, geographical location, development costs and/or operating costs. Only three valuation approaches are recognised by the mineral asset valuation codes, namely the income approach, cost approach and the market approach, and each of these are based on the underlying mineral resource. The conflicting results obtained by the valuation methods used in this research indicate that they are not suitable for determining the "misvaluation" of mining companies as the underlying mineral assets are not taken into consideration. Attempts to link the trends in the valuation metrics to impairments are therefore, by extension, futile.

This research could be improved by conducting an analysis of mining acquisitions using mineral asset attractiveness factors to rate all mining acquisitions, study the history and details around each M&A transaction, and do a comparative analysis of impaired and non-impaired acquisitions to identify trends that cut across all impaired acquisitions. The results of such an analysis would be meaningful to the minerals industry, as the method would be directly related to factors that are actually relevant to the industry.

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List of Equations

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Equation 3.2 $(PB)_{it}$ Misvaluation = $[(P/B)_{it} – (P/B)_{jt}]/(P/B)_{it}$

$(PB)_{it}$ = Price to book ratio of the company under consideration

$(P/B)_{it}$ = Median Price to book ratio of the overall industry

Equation 3.3 RIM Misvaluation = Market $Price_t$ – (Fair $Value_t$/Market $Price_t$)

Equation 3.4 Fair Value = Book $Value_{t0}$ + Sum(Residual $Incomes_t/(1+r)^t$)

Equation 3.5 $m_{it} - b_{it} = [m_{it} - v(\Theta_{it}); \alpha_{jt})] + [v(\Theta_{it}); \alpha_{jt}) - v(\Theta_{it});\alpha_j)] + [v(\Theta_{it}); \alpha_j) - b_{it}]$

m_{it} = market value

b_{it} = book value

$m_{it} - v(\Theta_{it}); \alpha_{jt})$ = difference between market value and fundamental value

$v(\Theta_{it}); \alpha_{jt}) - v(\Theta_{it});\alpha_j$ = sector-specific valuation differences

$v(\Theta_{it}); \alpha_j) - b_{it}$ = difference between long-run fundamental value of a company

Θ_{it} = company accounting information

Equation 3.6 $R_t – R_f = \alpha_i + \delta_1 MKT + \delta_2 SML + \delta_3 HML + \delta_4 MOM + \varepsilon i$

R_t = monthly stock returns

R_f = risk-free rate (US treasury bill rate)

α_i = intercepts per company

δ_i = historical risk premia per factor for each company

MKT = market factor

SML = size factor

HML = book-to-market factor

MOM = momentum factor

εi = residuals per company

Equation 3.7 $R_t - R_f = \alpha_j + \gamma_1\delta_1 + \gamma_2\delta_2 + \gamma_3\delta_3 + \gamma_4\delta_4 + \varepsilon j$

R_t = monthly stock returns

R_f = risk-free rate (US treasury bill rate)

A_j = cross-sectional intercepts

δ_i = historical risk premia per company

γ_i = sectional risk premia pre-M&A

εj = cross-sectional risk premia

Equation 3.8 $\text{WRITE-OFF}i,t = \alpha + \beta 1\text{PREM}i,A + \beta 2\text{BID}i,A + \beta 3\text{GW\%}i,A + \beta 4\text{STOCK}i,A + \beta 5\text{ANRET}i,A + \beta 6\text{ROA}i,n + \beta 7\Delta\ \text{ROA}i,n + u\ i,t$

WRITE-OFFi = predicted goodwill write-offs

βi

PREMi = premium paid

BIDi = presence of multiple Bidders

GW%i = percentage of goodwill over purchase price

STOCKi = percentage of stock in payment

ANRETi = abnormal returns

ROAi = return on assets

A

Equation 3.9 $\text{ILOSS}i = \beta 0 + \beta 1\text{GWEV}i + \beta 2\text{STOCK}i + \beta 3\text{PREM}i + \beta 4\text{BVPREM}i + \beta 5\text{FOCUS}i + \beta 6\text{CHALL}i + \beta 7\text{CROSS}i + \beta 8\text{SIZE}i\ \text{þ}\ \varepsilon$

ILOSSi = goodwill write downs prediction

β0

βi

GWEVi = percentage of goodwill over purchase price

STOCKi = percentage stock used for payment

PREMi =premium paid

FOCUSi = diversification

CHALLi = presence of multiple Bidders

CROSSi = geographic location

SIZEi = Target size

Equation 3.10 Total accruals = EBIDTA – Total Assets

EBIDTA = Earnings Before Interest Depreciation Taxation and Amortisation

Equation 3.11 Normal accruals = Sales X [Total Accruals/Sales (previous 5 years)]

Equation 3.12 Equity issuance = log [(Market Value)t/(Market Value)t5] – log [(Stock returns)t5 to t1

List of acronyms/Definitions

M&A Mergers & acquisitions

Bidder Company making a bid to acquire another company

Target Company being acquired in the M&A transaction

PWC PriceWaterhouse Cooper Ltd

EY Ernst & Young Ltd

FASB Financial Accounting Standards Board

IFRS International Financial Reporting Standards

ER risk-adjusted excess return valuation metric

PB Price-to-book misvaluation metric

P/B Market-to-book/Price-to-book ratio

RIM Residual income model

CAPM Capital Asset Pricing Model

TFPM Three-Factor Pricing Model

FFPM Four-Factor Pricing Model

Q ratio Tobin's Q ratio (book equity-to-market)

LOM Life of Mine

TSX Toronto Stock Exchange

TSXV TSX Venture Exchange

JSE Johannesburg Stock Exchange

LSE London Stock Exchange

AIM LSE Alternative Investment Market

NYSE New York Stock Exchange

AMEX American Stock Exchange

SAMREC The South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves

JORC The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves

NI 43-101 The Canadian National Instrument 43-101 Standards of Disclosure for Mineral Projects

SAMVAL The South African Code for the Reporting of Mineral Asset Valuation

CIMVAL The Canadian Institute of Mining, Metallurgy and Petroleum Valuation of Mineral Properties

VALMIN The Australasian Code for Public Reporting of Technical Assessments and Valuations of Mineral Assets

1 Introduction

1.1 Purpose of the study

The purpose of the research was to determine whether stock market misvaluations played a role in mining Mergers & Acquisitions (M&A) activities and eventual impairments of some mining acquisitions. Following the example of the financial economics research, valuation metrics for mining companies were derived using stock market data and accounting data, to test M&A transactions for at least some of the propositions of the "valuation-driven acquisition theory", namely: (1) M&A Target and Bidder companies are overvalued in relation to their markets; (2) M&A Bidder companies are more overvalued than Target companies; and (3) periods of high M&A activity correspond to periods of a high number of undervalued stocks. Following the example of Gu & Lev (2011), the research also looked into whether there is a correlation between Bidder and Target company stock overvaluation and the likelihood of post-acquisition goodwill impairment.

1.2 Research Motivation

Interest in this research was triggered by numerous reports of post-M&A impairments in the mining industry, after a surge in M&A activities between 2010 and 2012. Various financial economics studies of M&A activities in general industries found evidence of the "valuation-driven acquisition theory" and its possible relationship with post acquisition impairments. The "valuation-driven acquisition theory" was defined by financial economics scholars such as Schleifer & Vishny (2003) and Rhodes-Kropf & Viswathan (2005) who studied market- and accounting-data derived valuations of companies involved in M&As and concluded that managers' decisions to participate in M&A activities were driven by stock market misvaluations. The "valuation-driven acquisition theory" proposes that Bidders should limit their offer values to their own valuations to avoid shareholder losses. Other scholars such as Gu & Lev (2011) extended the "valuation-driven acquisition theory" by finding correlations between Bidder company valuations, Target company overpayment and post-acquisition impairments. This research sought to determine whether similar evidence could be found in mining M&A transactions.

1.3 General Overview

Mergers and acquisitions (M&A) in the mining and metals industry account for 0.65 to 5% of global M&A on average and since 2010, amount to about US$92 Billion on average annually (www.statista.com/statistics). In addition to organic business growth strategies, M&A is an

accepted and often necessary corporate strategy to generate wealth for shareholders by expanding and/or diversifying revenue streams and replacing diminishing mineral reserves to meet growing demand, particularly in the emerging economies (Bogden, 2002; Ericsson, 2002; PWC, 2011 & 2012; Ernst & Young, 2012 & 2013; Harding *et al.*, 2014). There are numerous reports of post-acquisition value write-downs or goodwill impairments on some mining acquisitions. About 90% of M&A deals driven by the major mining companies that took place since 2007 have been written off, with the top mining companies writing off US$85 Billion between 2007 and 2015 alone (Riseborough, 2015; Mineweb). Between 2007 and 2013 Rio Tinto, the world's third-largest mining company, spent about US$49 Billion on M&A, but had to write off US$34 Billion of that by early 2013 in post-M&A goodwill impairments (Benoit, 2013). Over the 2007 and 2015 period, Rio Tinto wrote off about 34% of its asset base, while Anglo American wrote off about 23% of its total asset base (Riseborough, 2015; Mineweb). Overall, about US$ 200 Billion was impaired during the period 2010 to 2015, with about 32% of capital expenditure over the same period having been impaired (PWC, 2016).

A high-level assessment of the trends in M&A activities in the mining sector indicates periods of intensive activity, and periods of significantly reduced M&A activity, indicative of merger waves. In the financial economics literature the onset of M&A waves are explained either by the valuation-driven acquisition theory or the neoclassical theory of M&As. The neoclassical theory of mergers explains merger waves at an industry level, and posits that high rates of mergers occur in response to industry shocks such as changes in technology, supply/demand dynamics, legislature and operating costs, which are best dealt with by some form of industry restructuring or M&A (Gort, 1969; Mitchell & Mulherin, 1996; Harford, 2005) provided that there is high capital liquidity in the markets (Harford, 2005). Valuation- or market-driven acquisition theory is an alternative theory for explaining merger waves, and it best explains which companies are likely to engage in M&A activities. It is premised on the assumption that markets are generally inefficient, therefore some stocks are likely to be misvaluated. Hence, M&As are highest in industry sectors that have a high proportion of overvalued stocks; that bidders tend to be overvalued relative to their markets and their targets; that undervalued targets are purchased with cash, but overvalued targets are purchased with stock (Jovanovic &Rousseau, 2001; Shleifer & Vishny, 2003; Rhodes-Kropf *et al.,* 2005; Dong *et al.,* 2006; Ang & Cheng, 2006). According to Shleifer & Vishny (2003), M&A can generate positive value for shareholders as long as overvalued bidder stock is used to acquire less overvalued targets. There is a theory among analysts that the high level of post-2010 M&A activity in the mining industry were partially driven by an increase in the

number of undervalued stocks relative to their respective markets (e.g., Ernst & Young Ltd, 2011; PricewaterhouseCooper, 2013).

Reports of post-M&A value write-downs raise the suspicion that at least some acquisition targets are overvalued by bidders. The Financial Accounting Standards Board (FASB) suggests that goodwill impairments are likely when a significant premium was paid relative to the purchase price; when multiple-bidders were competing for the same target; when stock was used for the acquisition; and when a large portion of the purchase price was ascribed to goodwill (FASB, 1999). Multi-industry studies into the relationship between M&A transaction characteristics and goodwill impairments found correlations between the likelihood of post-M&A goodwill impairments with high bidding premiums, and with the amount of goodwill in the total purchase price (Olante, 2013). Specifically, Gu & Lev (2011) found that overvalued bidders are likely to overpay for acquisitions and hence incur goodwill impairment losses. These studies suggest that goodwill impairments are likely to occur when bidders overestimate the value expected from some of the M&A and thus pay excessive premiums for some acquisitions.

This study follows the example of financial economics research and uses valuation metrics that are based purely on the accounting and market data of mining companies. It is, however, acknowledged that the mineral resource industry differs from other industry sectors in that the assets that are being acquired in mining M&A and that underpin the value of the company being acquired are the mineral resources. The quantification of mineral assets differ significantly from other industry sectors, therefore the valuation of mineral resources are strictly governed by mineral asset valuation reporting codes which recognise three valuation approaches to assign a value to mineral assets for the purpose of determining (SAMVAL, CIMVAL, VALMIN codes). This study does not seek to calculate the saleable value of mining companies, but rather uses valuation metric to assess stock market “misvaluation” of mining stocks relative to each other, and relative to the overall mining industry, and not relative to the intrinsic value of the mineral assets of each mining company.

1.4 Research Limits

The analysis is limited to 2000-2013 M&A involving bidding and target companies designated as mining & metals companies on the S&P Capital IQ’s database at the time of data downloading in 2014. Only transactions involving targets and bidders trading on the major global stock exchanges, namely the TSX, TSXV, ASX, NYSE, AMEX, LSE, AIM and JSE are

included due to accounting data requirements. This research was limited by the availability of data for analysis due to the cost of data access.

1.5 Framework

This report is structured as follows: Section 2 provides a literature overview which covers general M&A theory, as well as mining target selection strategies. Section 3 summarises the test hypotheses, data and the methodology. The results of the analyses are detailed in Section 4, followed by a discussion and conclusions relative to the test hypotheses in Sections 5 and 6 respectively.

2 Literature Review on Mergers and Acquisitions

2.1 Introduction

Mergers & acquisitions describe financial activities in which company ownership is transferred or consolidated (Investopedia, 2017). In a merger a new entity is created form the assets of the involved companies and new stock is typically issued. An acquisition involves usually a larger company buying all the assets of another company (US Legal Inc, 2017).

The Financial Accounting Standards Board (FASB) Concept 6 (1985) defines assets as "probable future economic benefits obtained or controlled by a particular entity as a result of past transactions or events". They are economic resources through which economic activities such as consumption, production and exchange can be conducted. Further to that, assets have a capacity to contribute to future cash flows and their ownership can be transferred between different entities through a financial transaction (FASB, 1985) such as M&A activities.

This Section summarises the general M&A literature by explaining the different types of M&A (Section 2.2), theoretical objectives of M&A activities (Section 2.3) and provides a summary of what the literature reports on whether M&A achieves the objective of adding value for shareholders (Section 2.4). Further to that, this section provides a summary of mining M&A activities and how they differ for M&A in other industries in Section 2.5 and factors that make mineral assets attractive as M&A targets (2.6). Apart from the valuation-driven acquisition theory which is being examined in the mining M&A in this research, the financial literature proposes the "neoclassical acquisition theory" to explain industry-scale M&A waves; both these theories are explained and contrasted in Section 2.7. Section 2.8 discusses goodwill impairments in general, and includes a summary of major mining goodwill impairments, and concludes with a discussion of the link between the misvaluation of companies and post-M&A goodwill impairments. A conclusion of the literature review is provided in Section 2.9.

2.2 Types of M&A

In general, there are three types of M&As: horizontal M&A, vertical M&A and conglomerate M&A, each with different strategic intents (Hughes *et al.,* 1980).

Horizontal mergers occur when bidding companies acquire companies within the same industry sector. The purposes of horizontal M&As may be to grow a company's output without expanding its existing production capacity, to increase a company's market reach by capturing the target company's market. Often, in the mining industry, a horizontal acquisition would entail consolidation of assets, where a major corporation increases its existing stake in a company to majority ownership.

Vertical M&As largely occur when a bidding company acquires a company that either provides it with raw products or logistical services that are key inputs to its existing supply chain. The main purpose of vertical M&A, or vertical integration, is to ensure a secure supply of raw materials, especially when supply constraints are experienced or anticipated. Acquisition of logistical service companies ensures steady supply chain process, with minimal interruptions to both raw material delivery and shipment of final product to end-users.

Conglomerate M&A occurs when bidding companies acquire companies in different industry sectors. Conglomerate mergers occur mainly so as to reduce the risks to company profits, and this can be achieved by entering an industry sector with different market factors, which can balance off market-related poor performance in other held businesses.

2.3 Theoretical Objectives of M&A

According to finance literature, the primary objective of M&A is to grow shareholder wealth, and this is achieved by expanding either the asset base, sales or market share of the business (Sudarsanam, 1995), but most importantly also by increased profitability (Steiner, 1975). It has been theorised that as a secondary motive, managers would want to grow the sales of the business if their earnings potential is directly related to revenue generation (Sudarsanam, 1995; Depamphilis, 2001; Mueller, 1980). Numerous scholars (e.g., Lajoux, 1998; Rock & Sikora, 1994; Ansoff *et al.*, 1971), have studied the motives for M&A by surveying company executives, and the results of these were summarised in books by Depamphilis (2001), Goldberg (1983), and Sudarsanam (1995). In general, the rationale for M&A can be divided into motives for "Real Changes" and "Speculative or Behavioural Motives", following Hughes *et al.* (1980).

2.3.1 Real Changes

Synergies

Managers believe that more value can be realised from merged companies, and which can be achieved by exploiting synergies to reduce combined fixed costs and improved efficiencies through economies of scale (Depamphilis (2001); Sudarsanam (1995); Goldberg (1983)). However, research into post-merger costs has found that costs were not necessarily reduced for most merged companies (Lictenberg & Siegel, 1987). Another potential synergy identified is that of "economies of scope" where one asset, for instance, could be used for the production of several related or similar products (Depamphilis, 2001). Mergers may also aim at taking advantage of potential taxation and accounting opportunities presented by a merged company, such as reduced cost of capital if investors believe the newly merged company has lower risk (Nielsen & Melicher, 1973; Steiner, 1975).

Diversification

All studies found that business executives believe diversification through M&A reduces risk to shareholders, especially if a company operating in a mainly cyclical industry merges with a company that operates in an industry with a more stable market (Sudarsanam, 1995; Depamphilis, 2001). Goldberg (1983) argues that adoption of diversification as a strategy has more to do with spreading risk, as opposed to minimising risk. Diversification is also a strategy to move a company towards growth industries if the market for their current product is shrinking (Ansoff *et al., 1971;* Depamphilis, 2001; Sudarsanam, 1995). However, the benefits of diversification appear to be inconclusive. Some research has shown that shareholders do not necessarily benefit from diversification as investors perceive this to be a risky strategy (Morck *et al.*, 1990; DeLong, 2011), and this perception is supported by some empirical research (Kaplan & Weisbach, 1992; Berger & Ofek, 1995). Yet other research found that diversified companies outperform concentrated companies in industries like mining (Bogden, 2002).

Strategic Re-allignment

The theory also suggests that M&A may occur when companies need to align themselves with other companies that possess the technology and skill required to achieve production efficiencies (Ansoff *et al.,* 1971*;* Sudarsanam, 1995), e.g. production equipment suppliers. On the other hand, changes in the local regulatory framework, such as the Black Economic Empowerment (BEE) policy of South Africa might also trigger some M&A (Depamphilis,

2001), where shareholding is offered to BEE or local companies so as to comply with national industrialisation policies.

Availability of free Cash flow

Availability of free cash flow also appears to play a role in the level of M&A activities (Sudarsanam, 1995; Harford, 2005). If companies have large amounts of available free cashflow, managers might attempt to maximise shareholder value by funding M&A to diversify and expand output, instead of settling debt or increasing dividend payout rates.

Tobin's Q ratio

The Tobin's Q ratio is a multiple of the market value of a company over its book asset value. If a company wants to expand production, instead of buying new capital assets, it would choose the option of buying into a company with a Q ratio below one; i.e., whose market value is lower than the cost of replacing capital assets (Depamphilis, 2001; Servaes, 1991). Hence, a company can acquire the additional assets needed to expand output at a price closer to the low market price. The Tobin's Q ratio explains why there might be an increase in the acquisition of undervalued companies during periods of high inflation, where the cost of purchasing new capital assets escalate beyond their benefits.

2.3.2 Speculative and Behavioural Motives

Gort's theory of Economic disturbance

Gort's theory of economic disturbance (Gort, 1969) says that the likelihood of M&As occurring is driven by the difference in opinion between holders and non-holders of stock regarding the potential future performance of a company and its stock. For example, if a non-stockholding company expects the stock to gain significant value due to expected future performance, and that forecast of performance exceeds the forecastof the stockholders, holding company's shareholders and management, then an offer for takeover or merger might be made. Alternatively, if the existing stockholders' forecasts of future earnings decrease rapidly to levels below those of non-holders, the stock price will decrease at a rapid rate to an extent where the stocks become takeover targets. Hence, under Gort's theory, M&As should be expected during both periods of rapidly decreasing and increasing stock prices, provided that the potential bidder's expectation of future performance exceed that of the target owners. However, evidence suggests that mergers occur mostly during periods of market price

upswings, which suggests that speculators and promoters push for M&As during market upswings due to premiums they stand to earn from large capital gains (Hughes *et al.).* Alternatively, the low M&A during market price depressions might have to do with management's personal motives driving M&A decisions (Hughes *et al.*), but such motives would not be discernable from investigating financial market performance data.

Managers' self-interest "Hubris"

Most authors allude to the suspicion that management self-serving objectives for personal power and stature play a significant role in M&As, and this is therefore referred to as the "Hubris" motive (Depamphilis, 2001; Morck *et al*., 1990). The hubris hypothesis is used to explain why some managers would overpay for targets at a rate far above the normal market-premium, especially when there are multiple bidders. In this case, managers' personal needs to lead large corporations might blind them from rational decision-making during merger waves (Gregoriou & Renneboog, 2007).

Agency Problems

Agency problems occur when there is a disparity between shareholder and management interests. If managers hold stocks in the company they are leading, they might be tempted to acquire another company in the hope of increasing their own company's stock prices (Hughes *et al.*). Managers might also adopt this strategy to avoid potential takeovers due to rapidly depreciating market value, and in this way would be attempting to guarantee their own job security, earnings and ownership in the company (Depamphilis, 2001). It is also suggested that managers would push for M&As in order to grow the size, hence revenue generation, of the business (Mueller, 1969; Depamphilis, 2001; Hughes *et al.*). Research has found conflicting evidence of this, however, as some results showed that managers' earnings are strongly related to profitability and not revenue (Lewellyn & Huntsman, 1970), while other evidence showed a mildly positive relationship with revenue and executives' salaries (Sudarsanam, 1995; Depamphillis, 2001). Fu *et al.* (2013) have found evidence of the agency problem in research where they showed that M&A does not lead to synergy gains. Rather, the only post-M&A gain they found was a strong correlation between the number of acquisitions completed and executives' post-M&A compensation.

2.4 Do Mergers & Acquisitions Add Value for Shareholders?

Empirical studies based on pre- and post-M&A stock returns show that in the long term, M&A activities have a neutral impact or destroy value from a bidder shareholder's perspective (Sudarsanam, 1995). Evidence shows that target shareholders benefit the most from M&A as they can expect to earn a bid premium of up to 45% above the market value. Additionally, target stock prices experience an increase around the time of M&A announcement, whereas bidder stock prices reduce in value around the same time (Hackbarth & Morellec, 2008). Studies also showed that target returns dissipated in the long-term. It has been found that bidder returns are also depreciating in recent years due to the increase in M&A premiums (Sudarsanam, 1995).

Several studies have looked at the pre- and post-merger accounting and other performance measures, 3 to 5 years after the M&A transactions, and conflicting conclusions can be drawn from these. Some of the studies (e.g. McKinsey & Company, 2010; Christensen *et al.*, 2011) found that between 50-80% of the merged entities underperformed relative to their industries. Other studies (e.g. Mueller, 1985; Ravenscraft & Sherer, 1986; Bradley & Jerrel, 1988) found that merged companies' performance were on average similar to their respective industries. Yet other studies (e.g. Healy *et al.*, 1991; Kaplan & Weisbach, 1992; Rau & Vermaelen, 1998) found that the merged companies exceeded industry performance. In evaluating stock returns of companies involved in M&A, Loughran & Vijh (1997) found that gains in stock mergers were highest at the time of merging; however, the gains disappeared within the first 5 years of M&A.

Studies have looked at the causal factors for post-M&A underperformances. It was found that the likelihood of negative returns was highest when stock was used to purchase a company (Smith, 1986; Travlos, 1987), but companies that were acquired with cash experienced positive returns (Nielsen, 1972). Nielsen (1972) also found a strong positive relationship between cash acquisition, return on capital and earnings per share. Other researchers found that when large companies acquire targets whose sales are less than 5% of its own sales, then negative returns to shareholders are likely (e.g., Kitching, 1967; Biggadike, 1979). The security market appears to react negatively to diversification leading to negative stock returns, whereas horizontal and vertical mergers are favoured (John & Kusewitt, 1985; Kitching, 1967; Poindexter, 1970; Montgomery, 1982). A study showed that the higher the premium paid for a target, the higher the likelihood of low profitability (Hogarty, 1970), however, another study found no significant relationship between the price paid and post-M&A performance (John & Kusewitt, 1985). Positive returns were reported for the

following observations: when acquisitions were made during periods of market lows; when bidders had a long history of M&A participation; and when M&A targets had above average profitability and growth potential (John & Kusewitt, 1985; Rockwell, 1968; Lubatkin, 1983). However, other studies have shown that highest M&A activities actually occur during bull markets and are lowest during bear markets (e.g., Beman, 1973; McCarthy, 1963) and that many targets were in fact loss-making entities before M&A (John & Kusewitt, 1985).

Because some M&A do actually generate value for shareholders, wealth-destroying M&A are often ascribed to poor post-M&A integration (Rau & Vermaelen, 1998) or agency problems (Sudranam, 1995). M&A can also fail to realise expected gains if weak acquisition strategies were employed and if there were poor bid dynamics (Sudranam, 1995). Overestimation of synergies, mistakes on target evaluation, and inadequate due diligence could also lead to M&A failure (Chapman *et al.*, 1998; Bradley *et al.,*1998).

2.5 Mining M&A

2.5.1 Mineral assets

In mining M&A, the assets that are being transferred or consolidated are mineral resources, and these differ from assets in other industries, because they are a concentration of solid material of economic interest originating within the Earth's crust and have a finite quantity. The definition and reporting of mineral resources are regulated by mineral resource reporting codes such as the South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves (SAMREC), the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC) and the Canadian National Instrument 43-101 Standards of Disclosure for Mineral Projects (NI 43-101). These codes protect investors by ensuring consistency in the reporting of mineral resources of mining or exploration companies registered on the JSE, ASX, TSX and TSXV. Only the parts of the mineral resource that have reasonable prospects for eventual economic extraction are reported based on the technical and economic assumptions at the time of reporting. The codes require that the "reasonable prospect for economic extraction" should be demonstrated through the application of an appropriate consideration of the potential viability of the mineral resources. Such an assessment would be based on what are termed "modifying factors", which are the geological, mining engineering, processing, metallurgical, legal, infrastructure, environmental, marketing, socio-political and economic assumptions which the relevant

Competent Person deems likely to influence the prospect for economic extraction (SAMREC, 2016; JORC, 2012).

Quantifying mineral resources requires a definition of their form, grade (concentration), spread, quality, amongst others, so that a determination can be made about their prospect for future economic extraction (SAMREC, 2016; JORC, 2012). In order for a mineral asset to be defined as a mineral resource their location, quantity, grade, continuity and other geological characteristics are known, estimated and interpreted from specific geological evidence and knowledge (SAMREC, 2016; JORC, 2012). Mineral resources are subdivided and reported as Inferred, Indicated or Measured in order of increasing confidence based on available geological evidence (Figure 2.1). Inferred mineral resources are the lowest confidence mineral resources, and are the part of the mineral resource for which the quantity, grade and quality are estimated based on limited geological evidence, but the sampling and geological evidence is sufficient to imply but not verify the continuity of geological, grade and quality characteristics. Indicated mineral resources have a higher confidence level than Inferred mineral resources and the available geological evidence suggest continuity due to being derived from adequately detailed and reliable exploration, sampling and testing activities. The quantity, grade, quality, density, shape and other physical characteristics are estimated with sufficient confidence to allow for the application of modifying factors in sufficient detail to support mine planning. Measured mineral resources are quantified from detailed and reliable exploration, sampling and testing which is sufficient to confirm the continuity of geological, grade and quality features between observations. For this reason, the quantity, grade, quality, density, shape and physical characteristics are estimated with sufficient confidence to allow the application of modifying factors for detailed mine planning and evaluation of the economic viability of the mineral resource ((SAMREC, 2016; JORC, 2012).

Mineral reserves are defined as the economically mineable parts of the Measured and Indicated mineral resources (SAMREC, 2016; JORC, 2012). They are identified and quantified at the pre-feasibility and feasibility stages of a mining project, during which extraction should be reasonably justified. Dilution, ore loss and other modifying factors mentioned above are applied to the Measure and Indicated resources to obtain mineral reserves. Mineral reserves are divided into the Probable and Proved categories, based on the level of confidence in the modifying factors (Figure 2.1). Probable mineral reserves are the economically mineable parts of the Indicated mineral resources and, in some case also the Measured mineral resources, for which the confidence in the modifying factors are lower than the Proved mineral reserve. Proved mineral reserves are the economically viable parts

of the Measured mineral resource to which modifying factors with a high degree of confidence have been applied (SAMREC, 2016; JORC, 2012).

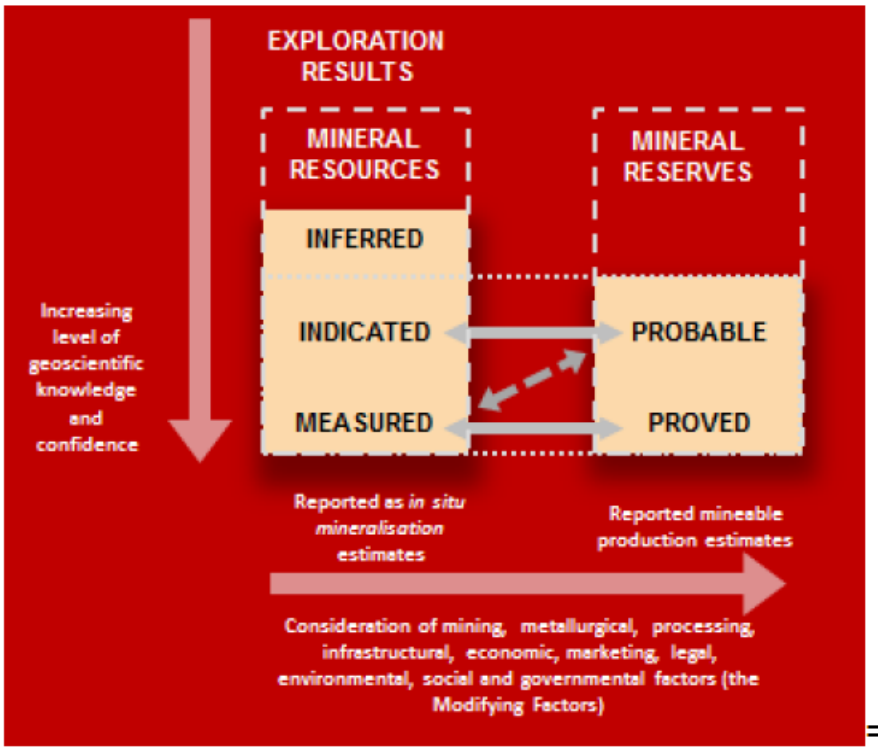


Figure 2.1 Classification of mineral resources as Inferred, Indicated or Measured based on increasing geological knowledge, and relationship with mineral reserves (SAMREC, 2016).

In the USA, mineral resource reporting guidelines for the reporting of mineral assets for companies registered on USA stock exchanges exist, namely the US Security and Exchange Commission's Mineral Resource Reporting Standards "Industry Guide IG7" (SEC), but prescribes that only the Proved or Probable reserves should be reported (National Mining Association, 2012).

2.5.2 Trends in mining M&A

M&A in the mining sector have increased significantly from less than 500 announced deals in 2000, up to 2 693 announced deals in 2010 (Valente, 2011; PricewaterhouseCooper, 2011). Total announced deals reduced to 2 605 deals in 2011, with total deal value at US$149 Billion of which US$18 Billion was spent on the top 25 deals (Business Vancouver, 2012). In 2012, 1 803 deals were announced with total deal value at US$110 Billion

(PricewaterhouseCooper, 2013). In 2010, 72% of deals were in the gold, copper and iron ore sectors and accounted for 54% of total deal value; however, by 2012, these top 3 commodities represented 48% of total deals and 34% of total deal value (PricewaterhouseCooper, 2013). The total number of completed M&A deals reduced to similar levels of as the 2000 to 2003 period between 2015 and 2017 (Statista (2018) (Figure 2.2).

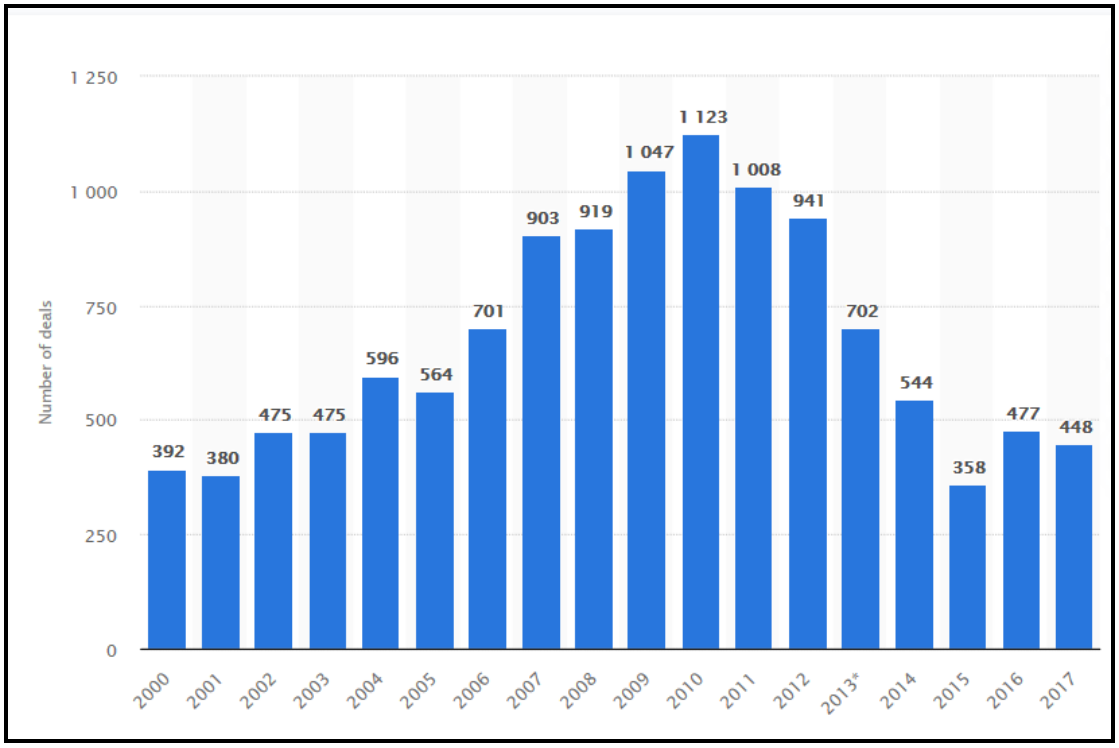


Figure 2.2 Total completed mining & metals M&A volumes 2000-2017 Statista (2018)

As evidenced in the early 2000s and post-global financial crisis, the cyclical nature of mining M&A activities are not entirely explained by the economic cycle or metal price cyclicity (Figure 2.3 – rebased to 2017). Although the global commodity index experienced a sharp decline in 2008 and 2009 due to the global financial crisis, mining M&A had rebounded by 2010 despite the ongoing financial woes in Europe and North America. Figure 2.3 shows good correlation between the number of annual M&A and both the global commodity price index (CRB) and the Base Metal Index for most of the 2000 to 2007 period. However, it is notable that in the 2008 to 2009 period, the M&A trends were opposite to both the CRB and the Mining Index: while both indexes experienced declines, M&A volumes continued to increase. This shows that mining M&A are also driven by factors such as political changes, macroeconomic factors and company-specific strategies for growth (Erricsson, 2002). In general, however, M&A in

the mining industry are driven by similar motives explained in the financial economics literature, although there are some differences.

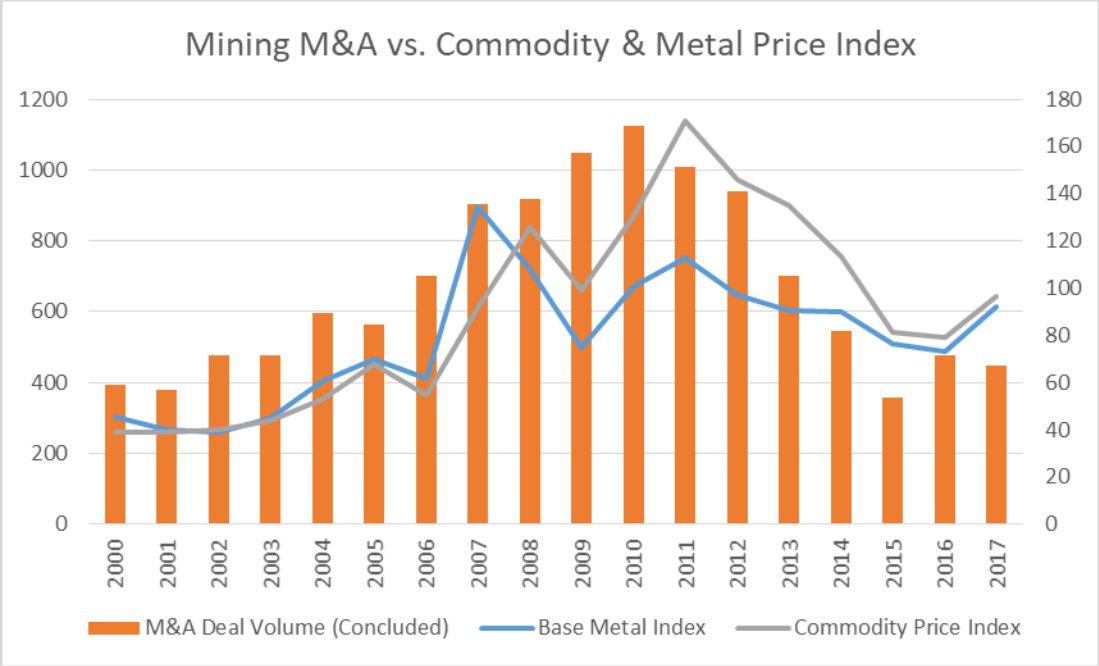


Figure 2.3 Total annual M&A volumes 2000-2017 (Statista, 2018) compared to the global commodity price index (CRB) and the Base Metal Mining Index (Reserve Bank of Australia, 2018)

Mining M&As have been employed as strategies for profit maximization, increasing company market capitalization, cost reduction, reserve replacement, consolidation of assets and supply diversification, in response to growing demand especially in China, fluctuating political & macroeconomic conditions and fluctuating commodity prices (Bogden, 2002; Ericsson, 2002; PWC, 2011 & 2012; Ernst & Young, 2012 & 2013; Harding *et al.*, 2013). High market capitalisation appears to attract investor and pension fund capital more successfully. There is evidence that mining companies which experience significant increases in size achieve higher post-merger trade volumes, which give credence to the M&A objective of growing a companies' market capitalization (Bogden, 2002). Diversified mining companies appear to have more consistent positive returns to investors despite commodity price fluctuations in comparison to concentrated companies (Bogden, 2002). Motives for mining M&A differ from other industries with regards to achievable synergies and influences over prices. Mining commodity prices are only supplier-influenced in the iron ore and tin sectors, where ownership is highly concentrated; hence mining mergers are not necessarily driven by a desire to exert influence over commodity prices. Bogden (2002) found that consolidations in

the mining industry do not necessarily result in economies of scale synergies, nor do they lead to influence over commodity prices. Also, costreduction through economies of scale in consolidated mining companies is not achievable for geographically distant mining operations; however there could be cost benefits from increased purchasing power for supplies, joint R&D expenditure and access to better financing (Erricsson, 2002).

2.6 Mining M&A: Mineral asset attractiveness factors

A synthesis of mining analysts' views shows that the main criteria for target consideration are resource characteristics, potential synergies, operating costs, risk minimization, potential for expansion, target size, manager characteristics, potential returns and valuation (Besler, 2013a & 2013b; Casey Research LLC, ; Hargreaves, 2014; The Business of Mining). Characteristics that make M&A Targets attractive are summarised below.

Resource Characteristics

- High-quality mining projects with high levels of resource confidence, and project stages at high level of investor confidence.

Potential for Expansions

- Mining projects that have a potential for expanding their resources beyond reported levels;
- Producing targets that have the potential to expand their production output and therefore their earnings;

Synergies/Economies of scale

- Mining projects that are within close proximity of bigger producing companies, so that potential for economies of scale with regards to joint ore processing and joint exports can be exploited.

Risk Minimisation

- Potential targets in politically stable countries, with investor-friendly mining legislation. However if the target resources are of sufficiently high quality, then high political risk might be acceptable;
- Potential targets with similar geology as the potential bidders would allow for a transfer of engineering and processing technology, hence reducing the technical risk to the potential acquirer;

Development and Operating Costs

- Mining projects that require relatively low capital cost to advance into production are attractive targets especially in a capital constraint environment;
- Potential targets with low operating costs relative to similar operations are attractive, especially in depressed commodity price conditions;

Returns to Investors

- Potential targets that promise short payback periods and high internal rates of return are attractive;
- Targets that produce commodities with positive long-term price outlooks;

Valuations

- Targets that have a low market valuation relative to their book value are attractive, as this makes paying the expected premium of up to 60% more achievable in capital constraint market conditions;
- Targets that have higher value reserves per share relative to their share price;

Target Managers/Owners

- Exploration projects that are managed by managers that are known to be resource generators and not mine developers, will more likely be available for acquisition;
- Target shareholders that are financially constrained are more likely to sell a part of their equity so as to raise capital to advance their projects toward productivity;

Rarity

- Targets that are developing rare and low supply commodities are especially attractive to raw product end users;

Target Size

- Large mining companies tend to acquire companies that are about 10% of their market capitalisation; smaller mining companies tend to acquire companies that are about 28% of their market capitalization.

2.7 Causes of M&A waves: Neoclassical vs. Valuation-driven theory

Scholars of financial economics propose mainly two possible theories to explain the merger waves of the last 100 years. Arguments for the *neoclassical theory of mergers* are largely based on studies of US M&A, which found significant correlation between merger waves and "industry shocks" such as changes in regulation, increased capital liquidity, technology changes, changes in supply and demand conditions, and changes in economic factors (Gort, 1969; Mitchell & Mulherin, 1996; Harford, 2005, Gregoriou & Renneboog, 2007). For example, the merger waves of the 1890s, 1920s, 1980s and 1990s are also ascribed to technological changes by some scholars (Jovanovic & Rousseau, 2001 and 2002) who see technology changes as a trigger for high Tobin's Q ratios, resulting in the targeting of companies with low Tobin's Q ratios. In contrast, the merger wave of the 1980s are ascribed to corporate governance issues (Holstrohm & Kaplan, 2001), and the merger wave of the 1990s are ascribed to deregulation (Andrade *et al.*, 2001). The neoclassical theory assumes that managers always seek to maximise shareholder wealth and that the market is efficient. Therefore, when industry level shocks occur, rational managers undertake restructuring activities in response, so as to ensure long-run profitability of the business (Jovanovic & Rousseau, 2002; Mitchell & Mulherin, 1996; Harford, 2005). M&A are considered to be the least cost approach for restructuring as opposed to injecting capital into an already owned company for organic growth (Mitchell & Mulherin, 1996; Gort, 1969). Proponents of the *valuation-driven acquisition theory*, which is sometimes referred to as the "behavioural theory of mergers", find that merger and acquisition waves correspond to an increase in the proportion of overvalued stock during bull equity markets (Shleifer & Vishny, 2003; Rhodes-Kropf, *et al.*, 2005; Dong *et al.*, 2006; Ang & Cheng, 2006). In this theory, managers of overvalued companies are aware of this overvaluation and know that market valuations are volatile and temporary. Hence they use their overvalued stock to acquire less overvalued firms so as to expand their companies' capacity for profit generation. At the same time, managers of less overvalued targets willingly accept the more overvalued stock as tender, so as to cash out (Shleifer & Vishny, 2003), or because they overvalue the potential synergies from a merger (Rhodes-Kropf *et al.*, 2004). The differences between the two theories for merger waves are summarised below.

2.7.1 Valuation-driven acquisition theory

Nelson (1959) inferred that the rate at which M&A occurred could not only be explained by economic cycles, but also by the state of the capital market. He found that merger waves occurred at a time of high stock valuations and that stock was mainly used to purchase

targets. Valuation-driven acquisition theory extends Nelson's observation, and is premised on the fundamental assumption that financial markets are inefficient, and therefore some stocks would be overvalued or undervalued at different periods of time (Polk & Sapienza, 2004). Managers are fully aware of this, and therefore time M&A to take advantage of mispricings (Shleifer & Vishny, 2003). Essentially, bidders want to profit by buying known undervalued targets with cash at a price below the targets' fundamental value, and bidders would buy overvalued targets with stocks as long as the targets are not more overvalued than the bidder (Dong *et al.,* 2006). Rhodes-Kropf *et al.* (2005) argue that the degree of stock misvaluation affect the level of merger activity, explains which companies are most likely to be involved in M&A as bidders or targets, and what the medium of payment for the acquisition would be.

Several scholars advanced models for the valuation-based theory which were based on empirical studies covering over 40 years of US M&A (most notably Shleifer & Vishny, 2003; Rhodes-Kropf, *et al.*, 2005; Dong *et al.*, 2006; Ang & Cheng, 2006). They used different metrics and models as proxies for misvaluation, most commonly the Market-to-book (or Price-to-book) metric and the residual income model (Shleifer & Vishny, 2003; Rhodes-Kropf, *et al.*, 2005; Dong *et al.*, 2006; Ang & Cheng, 2006), the Price-to-Earnings (P/E) ratio and less commonly the risk-adjusted excess-returns approach (Tobler, 2007). Their findings were similar in most aspects, and provide the basis for the main principles of valuation-driven acquisition theory as first described by Shleifer & Vishny (2003) and Rhodes-Kropf & Viswanathan (2004), and these are summarised below.

With regards to findings on which companies are bidders vs. targets, and medium of payment (Shleifer & Vishny, 2003; Rhodes-Kropf, *et al.*, 2005; Dong *et al.*, 2006; Ang & Cheng, 2006; Tobler, 2007):

a) Overall merger and acquisition activity is highest in industry sectors with a higher proportion of overvalued stock;
b) On average, companies in these overvalued markets would use stock to acquire companies in less overvalued sectors; companies in less overvalued sectors would use cash for acquisitions;
c) The higher the dispersion in stock valuations in an industry sector, the higher the likelihood that stock would be used for acquisitions;
d) On average, cash-acquired targets are more undervalued than stock-acquired targets, and stock-acquired targets are overvalued relative to cash-acquired targets;

e) In general, bidders are overvalued relative to targets; however cash-bidders are less overvalued than stock bidders;
f) Increased levels of misvaluation increases the likelihood that a company is involved in mergers, is a bidder, and uses stock as a method of payment;

With regards to findings on the reaction to bids by targets, and premiums (Dong *et al.*, 2006):

a) Targets that are overvalued are less likely to be hostile to takeover bid, and the takeover bid is likely to be successful;
b) More overvalued bidders are likely to make an offer for a merger rather than a takeover offer;
c) Overvalued targets are likely to receive lower bid-premium;
d) Bidders with high price-to-book ratios tend to pay a higher premium, especially those who have paid with stock.

Regarding post-M&A performance, the following were the findings (Shleifer & Vishny, 2003; Dong *et al.,* 2006; Ang & Chen, 2006; Tobler, 2007):

a) Cash targets earn low returns after announcement of the merger and acquisition;
b) Stock bidders earn higher returns before the announcement of M&A;
c) Stock bidders experience negative long-run returns after the merger;
d) Cash bidders experience positive long-run returns after the merger;
e) Stock acquisitions benefit long-term bidder shareholders despite negative returns;
f) Acquisitions of firms in a different industry yields higher long-run returns than targets in the same industry;
g) Overvalued stock targets are likely to earn lower announcement date abnormal stock returns;
h) Shareholders of stock bidders whose overvaluation far exceed the overvaluation of targets achieve sustained wealth gains from the first day after announcement to three years thereafter, in comparison to similar but non-acquiring companies;
i) Long-run post-merger returns are lower for the newly merged entities in comparison to non-merged companies;
j) Within-industry cash bidders perform better that stock bidders.

2.7.2 Neoclassical acquisition theory

The earliest examination of the neoclassical acquisition theory linking technological shocks to M&A intensity was by Coase (1937) and then later Gort (1969). Gort (1969) proposed the "economic disturbance theory", which relates the rate of M&A to economic forces. In this theory, high dispersions in the forecast of future incomes between holders and non-holders of stock lead to rapid variations in stock valuations. He proposed that M&As will occur if the non-holders of a stock forecast of future earnings of a target company are above the forecasts of the existing stock holders and managements, and when the acquisition of the target company will give the bidding non-stock holders higher investor's surplus than any other potential equivalent investment. Using the P/E ratio as a proxy for overvaluation, Gort (1969) refutes the valuation-driven hypothesis for M&A because he found no significant difference between buyer and seller P/Es, and he found no relationship between P/E ratio and premiums paid for targets.

In Gort's model, the economic disturbance could result from the following:

a) **Changes in technology** which make it difficult to predict future operating costs, future demand and therefore potential future revenue generations, with an acceptable level of confidence;
b) **Rapid movements in stock prices** which may lead to M&A, particularly rapid increases in stock prices where target managers are likely to receive a premium above market capitalisation for their stock;
c) **Barriers to entry** that are set very high are likely to result in high valuation differences, and therefore a high rate of M&A. This is because, in order to qualify for listings, new companies' capitalised value of futures earnings would likely be set to far exceed the value of tangible assets. In such a case valuations would range widely between the value of tangible assets and the valuations based on uncertain expectations of future earnings;
d) **High industry growth rates** cause upward movements of asset prices and therefore an increase in the dispersion of stock valuations, which could lead to high rates of M&A. In growing economic sectors, mergers would be the cheapest route for firms to expand their output. If a large number of firms need to expand, then valuation differences would occur even more rapidly, leading to even higher rates of M&A.

Jovanovic & Rousseau (2002) also argued for technological changes as being a trigger for M&A waves, but they relate the M&A activities with the Q ratios of bidding and target firms. The Q ratio is calculated as a company's Market Capitalisation over the Book Value of

Capital Assets. Jovanovic & Rousseau (2002) asserted that improvements in technology would lead to improved profitability, high stock market valuations, and therefore an increase in the q ratio of some companies. When the range between high Q ratio and low Q ratio companies widen, then companies with Q ratios of above 1 would attempt to acquire companies with lower Q ratios as a means for expansion. This type of expansion would be considered to be more cost-effective than investing in new capital assets for the existing operations.

According to Mitchell & Mulherin (1996), the structure of an industry is dependent on economic conditions, technology, supply/demand factors, and the prevalent regulatory environment; hence, any sudden change or "shock" in any of these variables would lead to industry-wide restructuring activities, resulting in merger waves. The evidence for this was found in their study of 1980s M&A records (Mitchell & Mulherin, 1996), where they argued that both macroeconomic and industry-level factors should be considered when explaining M&A.

Harford (2005) took the above propositions further by arguing that not only must there be significant shocks in any of the factors advanced by Mitchell & Mulherin (1996), but there must also be overall capital liquidity (Maksimovic & Phillips, 2001) to finance the high rate of M&A at low cost. Harford (2005) stressed that low transaction costs are critical to generating large volume of transactions as observed in merger waves. He postulated that the higher capital liquidity experienced during expansive economic conditions is a better explanation for the apparent high valuations observed during merger waves, as he found no significant correlation between merger rates and degree of misvaluation (Harford, 2005).

The results of the studies into the neoclassical theory by Mitchell & Mulherin (1996) and Harford (2005) may be summarised in the following hypothesis, as appeared in Harford (2005):

a) Merger waves occur when industries react to shocks which could result in full or partial takeovers;
b) Observable economic or regulatory shocks will occur just before an M&A wave
c) Payment will either be with cash or stock;
d) Partial acquisitions will be acquired predominantly with cash;
e) Companies could be involved in both stock swaps and partial-cash transactions at the same time;
f) Credit constraints will be low and/or asset values will be high;

g) The performance of the combined companies would be better than the two separate companies, however not better than the pre-industry shock performance of the separate companies.

2.7.3 Alternative Explanation for M&A waves

In order to determine whether the neoclassical theory or valuation-based theory better explain M&A waves, Gugler *et al.* (2012) examined the difference in M&A rates in listed and unlisted companies in the US, UK and continental Europe. Their argument was this: if industrial shocks were the predominant reason for M&A, then M&A waves would be observed both in listed and unlisted companies at the same time. The findings were more in support of the valuation-driven theory and contradicted the neoclassical theory in that differences in M&A rates were observed between listed and unlisted companies during the periods of industry shocks defined by Harford (2005). The findings of Gugler *et al.*(2012) were:

a) Total value of M&A deals of listed companies exceeded non-listed companies by a factor of six (6);
b) No relationship was found between M&A activity of listed and unlisted companies in the same industries;
c) No strong indication for M&A waves was found in the unlisted companies group;
d) They refute the argument that lower M&A occurs in unlisted firms due to less access to capital market financing was refuted, based on the finding that the majority of listed companies made use of cash or debt for acquisitions;
e) No evidence of an increase in M&A with for unlisted companies with higher P/E ratios, i.e., higher valuations;
f) Listed companies continue to experience high M&A rates even during periods of high-interest rates, whereas M&A activities were subdued among unlisted companies when interest rates were high;
g) Found evidence of the agency theory: the likelihood that managers would pursue value-destroying M&A reduces with an increase in manager shareholding. Also, the higher the percentage of shares owned by managers, the higher the likelihood that overvalued stocks would be used to acquire less overvalued stocks.

In examining the impact of the neoclassical theory's industry shock hypothesis in relation to the valuation-driven theory, Rhodes-Kropf *et al.* (2005) found that misvaluation accounted for a smaller proportion of the M&A waves in relation to the industry shocks defined by Harford (2005) in their sampled data. However, they still found that companies that fell in the most

misvalued quintile accounted for more than 50% of M&A transactions, and for more than 65% of overall M&A deal value during periods of economic shocks.

Fu *et al.* (2013) studied whether acquisitions driven by stock overvaluations generate value. They found that overvalued bidders tended to overpay for targets, but that less overvalued targets did not necessarily provide synergy gains in contrast to Shleifer & Vishny (2003). Additionally, their study showed that overvalued bidders displayed sub-optimal target selection strategies, and were not able to use their overvalued stock to their own advantage when setting M&A terms. Since they found that post M&A performance or returns benefits of overvalued acquirers were worse than overvalued non-acquirers for up to 5 years after the M&A, they argue that the main driving force behind M&A of overvalued acquirers is the "agency problem". This was supported by the evidence of increased CEO options-based compensation after M&A.

While the neoclassical theory probably provides a better explanation for the advent of M&A waves at an industry level, the valuation-driven theory helps to explain which companies are involved in M&A, which companies are the likely bidders and which companies are the likely targets (Rhodes-Kropf *et al.* (2005). And for this reason, the valuation-driven hypothesis will be tested, since this research seeks to understand the M&A target selection strategies within the mining industry.

2.8 Post-M&A Value write-downs/Goodwill impairments

2.8.1. Goodwill impairments

Several post-M&A value write-downs or goodwill impairments have been reported in the minerals industry, which might point to certain levels of overvaluation of some target stocks and destruction of value to bidder shareholders. For example, in 2010 Kinross Gold Corp spent about US$7.8 Billion on acquiring the Tassiast Mine in Mauritania from Red Back Mining Inc., but has since had to devalue the property by about US$4.6 Billion which it said was an excess amount or "good will" spent on acquiring the mine (Pulp, 2008). Following the US$54 Billion merger of Glencore and Xstrata in 2012, the new merged entity reported a value write-down of US$ 7.7 Billion in August 2013 (Wilson, 2013). In 2013, Rio Tinto reported value write-down to the tune of US$3 Billion on the Mozambican coal mine acquired for US$4 Billion from Riversdale in 2011 (Mining MX). Given such expensive losses incurred

by mining shareholders, the question is whether the price paid for these acquisitions were perhaps excessive and whether the eventual impairments could have been predicted.

When the amount paid for an acquisition exceeds the fair value of the "tangible assets minus liabilities", the excess amount is captured on the balance sheet as an intangible asset called "goodwill". Goodwill in essence captures the estimated value of the anticipated synergies that the acquisition is expected to realise for the acquirer shareholder (Olante, 2013). The potential value of a target company is determined from the life-of-mine (LOM) model, forecasts of potential market conditions and economic factors and normally worst-case scenario testing would be part of the sensitivity analysis during the target value estimation process (Lee & Yuan, 2012). According to valuation-driven acquisition theory as proposed by Shleifer & Vishny (2003), regardless of what the valuation of a target is, an acquirer should never pay more for an acquisition than its own price or the value of the expected synergies from the mergers. Doing so would result in long-term losses to investors. This essentially provides the maximum value that should be spent for acquisitions; hence even if a bidder is purchasing an "overvalued" target, impairment of goodwill should not necessarily occur (Gu & Lev, 2011). Accordingly, Gu & Lev (2011) summarise the reasons why goodwill impairments will occur as follows:

a) Synergies were overestimated;
b) the degree of overpayment far exceeds the synergies;
c) Managers do not limit the purchase price to the maximum as determined by Shleifer & Vishny (2003), i.e. the maximum purchase price should be the value of the Bidder company;
d) If there is a decline in expected synergies in response to unexpected market or economic conditions, or if the project scope was changed after acquisition

2.8.2. Mining Goodwill impairments

In the mining sector, post-acquisition goodwill impairments have been necessitated because falling metal prices, increased capital costs, escalating operating costs, and delays in project development timelines have significantly eroded the M&A synergies determined at the time of acquisitions (PWC, 2007). There is also more uncertainty in macroeconomic conditions, a high number of valuable projects situated in countries with water and energy supply constraints and poor levels of infrastructure development, increased country risks such as unstable taxation policies and threats of resource nationalisation (e.g. Deloitte, 2014).

Rio Tinto wrote down about US$14 Billion in the 2012 financial year, some of it related to the group's acquisitions of Alcan Aluminium in the US and the Riversdale Mining's coal projects in Mozambique (Campbell, 2013; Garvey, 2016). At the time of acquiring Alcan in 2007, Rio Tinto expected that smelter and refinery capacities would be expanded in response to market demand. However these projects had to be deferred given deteriorating economic conditions and commodity prices, strong currencies in some regions, high energy costs and high raw material costs Goodwill impairment was recorded for Riversdale in response to unexpected infrastructure constraints and downward revisions of recoverable coking coal reserves (Rio Tinto).

Barrick Gold's write-down of about US$5.5 Billion on its acquisition of Pascua Lama, was mainly necessitated by declining gold prices, which forced a delay in the development of the mining project. Negative investor sentiment further led to declining market capitalisation while escalating mining costs further put pressure on the group to record write-downs (Jamasmie, 2013). Barrick also wrote down US$4.2 Billion on its Zambian Lumwana Copper Mine, in response to working capital costs and operating costs that were above expectations determined at the time of the acquisition (Jamasmie, 2013).

Kinross Gold acquired the Mauritanian Tassiast mine in 2010 for US$7.99 Billion, however in 2011 it posted a US$2.49 Billion write down, and another US$3.09 Billion write-down in the 2012 financial year on this acquisition. These write-downs were necessitated due to a revision in the project development plan following depressed gold prices and increased operating costs (Hill, 2013).

Glencore acquired Xstrata for US$44.6 Billion in 2012, but by the end of the 2012 financial year, US$7.7 Billion was written off as goodwill impairment on this acquisition, in response to low commodity prices (Ausick, 2013).

Between 2012 and 2016, total recorded mining impairments were valued at about 40% of total capital expenditure, with a maximum impairment of US$57 BilIlion in 2013 and a minimum impairment of US$19 Billion in 2016 (PWC, 2017) (Figure 2.4). The majority of the 2015 impairments were in the energy, gold, nickel and copper sector, whereas the 2016 impairments were concentrated in the energy sector (63%). BHP and Freeport incurred impairments of US$7.3 Billion and US$4.3 Billion, respectively (PWC, 2017).

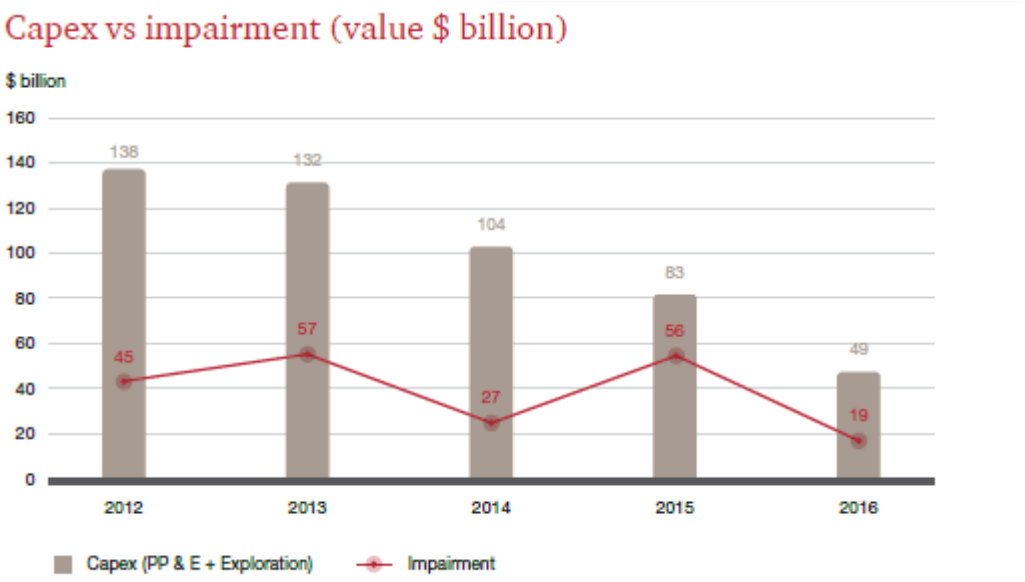


Figure 2.4 Total value of impairments vs. capital expenditure from 2012 to 2016 (PWC, 2017)

The reasons behind the goodwill impairments are valid and the impairments are inevitable when market conditions are unstable, and cost factors remain unpredictable. IFRS annual financial reporting guidelines require that mining companies test reported goodwill against the assumptions on which the goodwill was originally based, e.g. long-run downward trends in commodity price forecasts, the consistent downward trend in market capitalisation (PWC, 2016). However, the scale of the write-downs and the fact that not all acquisitions result in goodwill impairment raises the question whether some of the acquisitions were incorrectly timed, and perhaps heavily overpaid relative to similar acquisitions.

2.8.3. Valuation-driven acquisition theory and Goodwill impairments

Several empirical studies have looked at the relationship between eventual impairments and some acquisition factors, to ascertain if there are indicators at the acquisition stage that could signal eventual impairments. While it is likely true that goodwill impairments are mainly driven by the deterioration of goodwill values in reaction to unexpected market or economic factors, the scale of impairments could be the result of target overpayment (Olante, 2013) above the overall value of possible synergies (Vishny & Sheifer, 2003). Given the features of valuation-driven acquisitions, the question is whether there is a relationship between the degree of bidder overvaluation and the propensity to overpay for targets, and hence

consequential impairments? Or is there a relationship between target overvaluation relative to its market and eventual impairment?

According to the FASB (1999), payment of significant premiums above purchase price; multiple bidders competing for a target; use of bidder stock for acquisitions; and a high proportion of goodwill relative to the total purchase price are good indicators of the likelihood of eventual impairments. In this regard, authors such as Hayn & Huges (2006) found that the premium paid was positively correlated to impairment losses, and Li *et al.* (2011) showed the bigger the difference between the purchase price and the targets book value, the higher the likelihood of impairments. Olante (2013) and Gu & Lev (2011), tested the correlation between acquisition characteristics and goodwill impairments by examining US M&As in multiple industries over the period 1999-2007 and 1990-2006, respectively. Olante (2013) examined the premium paid; the presence of multiple bidders; percentage stock used for payment; percentage goodwill versus overall purchase prices; book value premium; diversification; geographic location and target size as proxies to examine the relationship between acquisition characteristics and goodwill impairment. She found a strong positive correlation between goodwill impairment and both the percentage of stock used for acquisitions and the percentage goodwill versus total purchase price variables. She found no relationship between goodwill and the other variables tested, which is more in support of Li *et al.* (2011). Gu & Lev (2011) used the industry-adjusted P/E ratio, discretionary accruals, and prior equity issuance as proxies to examine the relationship between share overvaluations and eventual goodwill impairments. They found a strong positive correlation between bidder share overpricing and the amount of goodwill paid, although not all overpriced bidders necessarily recorded impairments. Additionally, their results showed a strong monotonic correlation between the overpriced bidders and the likelihood of post-acquisition goodwill impairments. In their tests into whether goodwill impairments have a negative impact on company share price, they found that goodwill impairments lead to negative stock returns.

2.9 Conclusion

M&A activities occur in all sectors of industry as a means to increase a company's future cash flows by increasing its asset base. The assets being acquired in mining M&A are mineral resources which are quantified differently than assets transferred or consolidated in other industries. Defining and reporting of mineral assets are governed by mineral resource reporting codes, and this protects investors who may have interests in acquiring ownership of mining or exploration companies by ensuring consistency in what is regarded as mineral

resources and reserves. M&A activities observed in multiple industries seem to occur in waves. While the neoclassical theory probably provides a better explanation for the advent of M&A waves at an industry level, the valuation-driven theory helps to explain which companies are involved in M&A, which companies are the likely bidders and which companies are the likely targets (Rhodes-Kropf *et al.*(2005). And for this reason, the valuation-driven hypothesis will be tested, since this research seeks to understand the M&A target selection strategies within the mining industry. The valuation-driven acquisition theory and methods used to define it was based on studies of M&A activities in common industries, however, observations made in this research should be considerate of the unique nature of mineral assets.

3. Data and Methodology

3.1 Introduction

As summarised in Chapter 2, research into the valuation-driven theory for M&A have shown that there is a relationship between the overvaluation and undervaluation of companies and the level of M&A, which companies are likely to be bidders or targets, whether cash or stock is used for acquisitions, and the likelihood of post M&A positive performance (Shleifer & Vishny, 2003; Rhodes-Kropf *et al.* 2005; Dong *et al.*, 2006; Ang & Cheng, 2006; Tobler, 2007) . Therefore, examining the valuation-driven theory in the most M&A active mining sectors should allow for a test into whether increased levels of M&A in the mining sector are driven by an increased amount of undervalued and overvalued stock. Beyond this, some research has also shown that there is a relationship between the level of stock overvaluation and the propensity for goodwill impairment. Hence, the examination of the valuation-driven theory in these mining sectors will also allow for a test into whether post-M&A value write-downs in the mining sector are predictable based on features of the companies involved in M&A.

Hence, the test hypotheses are phrased as follows:

(The Null hypothesis) H_0: M&A activities in select mining sectors do not show evidence of market-driven/valuation-based acquisition theory. Here, some of the main premises of the valuation driven theory will be tested.

H_1: If the null hypothesis is rejected, then periods of high M&A are positively correlated to high numbers of undervalued mining stocks, in comparison to periods of low M&A activities.

H_2: There is a positive relationship between the degree of over/undervaluation, and the likelihood of post-M&A value write-downs

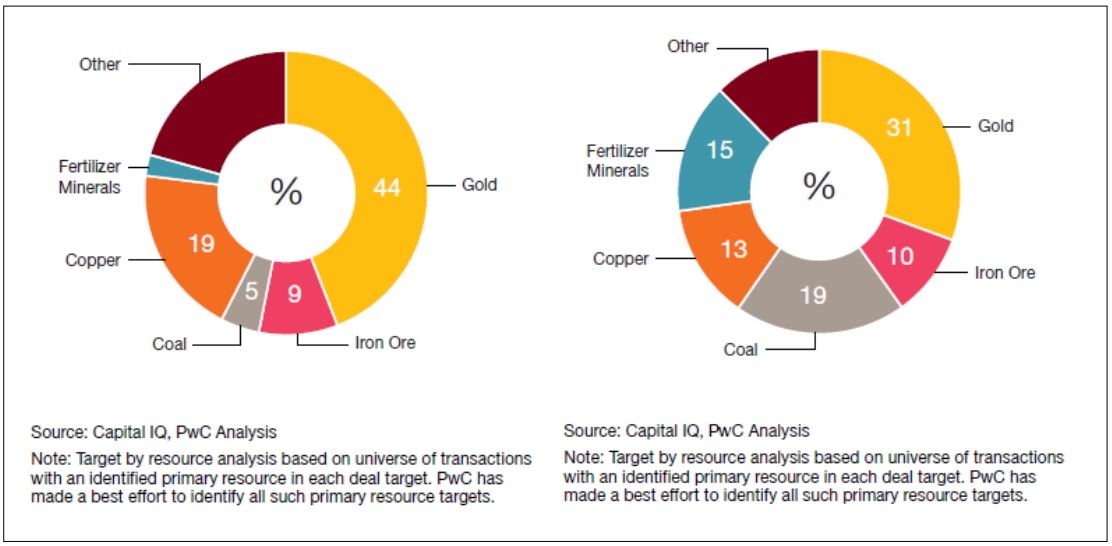
Mining corporations have specified target selection strategies regarding the physical characteristics of potential M&A targets as explained in Section 2.6. This research uses the valuation-driven acquisition theory to look into whether stock market based misvaluation plays a role at all in which mining companies are selected as M&A targets, and whether there is a link with post-M&A goodwill impairments.

This section is arranged as follows: Section 3.2 discusses the sample data limits based on the available data; Section 3.3 provides a synthesis of the valuation metrics typically used in the valuation-driven acquisition theory to identify misvaluation, and explains the proxies scholars have used to test the correlation between the valuation-driven acquisition theory.

Section 3.4 provides a brief summary of valuation methods that are for valuation of mineral assets which are not used in this research. Finally, Section 3.5 defines the data used in the research.

3.2 Sample data limits

In order to test the hypotheses, this study initially focused on mining commodity sectors that were expected to provide sufficient annual sample data across the sample period of 2000 to 2013. The study initially focused on M&A in the gold, copper, iron ore and coal mining sectors, because global mining industry statistics showed that between 2000 and 2012, these mining sectors consistently experienced the largest amount of M&A in terms of deal volume and deal value (Figure 3.1) and accounted for 73% of overall deal value by 2010 (PWC, 2011).



Source: Capital IQ, PwC Analysis
Note: Target by resource analysis based on universe of transactions with an identified primary resource in each deal target. PwC has made a best effort to identify all such primary resource targets.

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Figure 3.1 Total Mining & Metals M&A volume (left) and total deal value (right) by commodity, 2010 (PWC, 2011)

The M&A intensity in these commodities was largely driven by demand outlook related to the infrastructure development needs of the emerging economies, particularly China, and consequently a drive by the bigger mining corporations to replenish depleting reserves by acquiring junior or mid-tier companies with long LOM.

By 2013 and 2014, total M&A transactions were in decline, however more than 50% of the M&A deal values came from the steel and alluminium sectors (Figure 3.2) with diversified

miners like BHP and Rio Tinto being key sellers while Russian and Kazak companies being key buyers (PWC,2015).

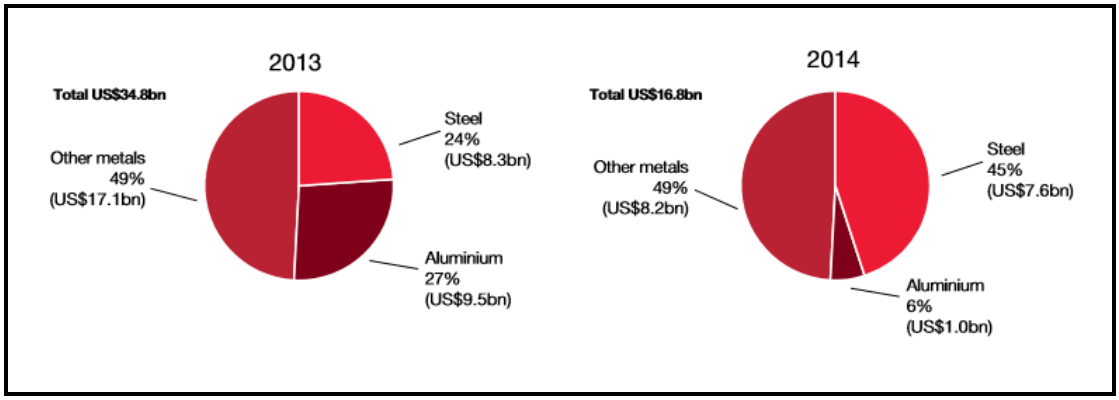


Figure 3.2 Total 2013 & 2014 Mining & Metals total deal value (right) by commodity (PWC, 2015)

The lack of full data required for calculating the chosen valuation metrics for both companies involved in the M&A transactions forced a revision of the selected sectors, so that in the end, the analysis was based on the overall mining sector, but focused on transactions involving gold, copper and diversified target companies. The study period is 2000-2013 because the available study data was downloaded in 2014 via a restricted Rio Tinto S&P Capital IQ database license. The cost of private access is prohibitive.

3.3 Valuation metrics

3.3.1 Proxies for misvaluation

There is no consensus on which valuation metric is the best for determining stock mispricing or misvaluation. Some literature on which the valuation-driven acquisition theory is based appear to favour a combination of the price-to-book or market-to-book(P/B) and residual income model value (RIM) metrics, or some version of these metrics, to estimate whether stocks are either undervalued or overvalued (e.g. Ang & Chen, 2006; Dong *et al,* 2006; Rhodes-Kropf *et al*., 2006). Other metrics that have been employed as proxies for mispricing are the Price-to-Earnings (P/E) ratio (e.g., Gort, 1969; Lu & Gev, 2011) and long-run stock returns (e.g., Rau & Vermaelen, 1989; Tobler, 2007).

The market-to-book (P/B) ratio is widely used as a measure for overvaluation or undervaluation of a stock relative to its industry or market (Chen & Jindra, 2001) as it compares fundamental performance data to market performance data, and it can be used to

predict M&A related abnormal returns (Barberis & Huang, 2001). The traditional market-to-book (P/B) ratio is defined as Equation 3.1 below, where the Market Value of Equity is the product of the stock price and the outstanding shares, and the Book Value of Equity is the book value as reported in the most recent financial reports of a company. Using the book value helps to reduce the impact of company size when comparing different companies of various sizes (Dong *et al.*, 2006). Following Ang & Cheng (2006), this study used the altered form of the P/B metric, which is denoted as "PB" in this report (Equation 3.2). A company that has a Market Value of Equity that far exceeds the Book Value of Equity will have a big positive P/B ratio and will thus be considered to be overvalued.

Equation 3.1 P/B = Market Value of Equity/Book Value of Equity

Equation 3.2 $(PB)_{it}$ Misvaluation = $[(P/B)_{it} - (P/B)_{jt}]/(P/B)_{it}$

The misvaluation metric (PB) is calculated using the P/B of the company under consideration $(P/B)_{it}$ minus the median P/B of the mining industry $(P/B)_{it}$ one month before the transaction was announced, and uses the reported book value reported in the previous financial year.

It has been showed that the market-to-book ratio has a significant correlation with profitability, growth (Hunter & Wall, 1989) and is also used as a measure of value creation and managerial effectiveness (Dong *et al.*, 2006). Walking & Edmister (1985) have used the original P/B ratio as part of a set of accounting multiples to assess the importance of merger motives and bargaining in bid-pricing, while Martin (1996) have used the same metric as a proxy for the degree of information asymmetry. And herein lies one of the disadvantages of using the market-to-book ratio as a proxy for mispricing: it is used as a proxy for many different corporate finance research that have nothing to do with stock mispricing (Dong *et al.*, 2006). Another disadvantage of the P/B method is that it does not effectively filter out forward-looking information about growth which inevitably influences market pricing (Dong *et al.*, 2006). Also, the P/B ratio's reliance on the book value makes it vulnerable to biases introduced due to differences in how companies calculate their book values (Tobler, 2007).

In order to overcome some of the shortcomings of the P/B method, and to confirm the results obtained from using the P/B method, some scholars employ the residual income model (RIM) method (Ang & Cheng, 2006; Dong *et al.*, 2006; D'Mello & Shroff, 2000) (Equations 3.3 and 3.4).

Equation 3.3 RIM Misvaluation = Market $Price_t$ – (Fair $Value_t$/Market $Price_t$)

Equation 3.4 Fair Value = Book $Value_{t0}$ + Sum(Residual $Incomes_t/(1+r)^t$)

The Market Price is the market equity as explained above, and the Fair Value is the sum of the current book value of equity, and the discounted future earnings in excess of the returns (r) expected by the investors (Ang & Cheng, 2006 ; Dong *et al.,*2006). The cost of equity is derived from the capital asset pricing model (CAPM) or the Fama-French three-factor pricing model (TFPM). The RIM is considered to be a superior method for estimating misvaluation, as it reduces the influence that the market and managerial agency problems have over future growth forecasts by using analysts' earnings forecasts to estimate the Fair Value (Dong *et al.*, 2006); it is also more superior than the P/B method in predicting one-month ahead returns (Lee *et al.*, 1999) and 1-year ahead returns (Frankel & Lee, 1998). Additional advantages of the RIM is that it is less sensitive to the differences in accounting treatments (Ohlson, 1995), and it includes both backward- and forward-looking information about company performance. However, the RIM method's disadvantages lie mainly in its reliance on analysts' forecasts which generally tend to have a positive bias and could also be diluted by market sentiment about future growth (Dong *et al.*, 2006). For the purposes of this study, however, the greatest disadvantage of using the RIM method is that it significantly reduces the number of samples available for analysis, as not all companies have analysts' forecasts for future earnings/share (Ang & Cheng, 2006). Most studies of the market-driven acquisition theory encompass all industry sectors, however, given that this study focuses solely only specific M&A in the mining industry, it was important to use misvaluation methods that are robust enough to provide the answers to the hypotheses by using as much of the available data as possible.

Rhodes-Kropf *et al.* (2006) argue that the difference between the market value (m) and the fundamental value (v) of a company is influenced by both firm-specific factors and industry- or market-specific factors. They, therefore, decomposed the traditional P/B ratio into Equation 3.5 below, so as to account for both sector-wide and firm-specific misvaluation. In their model, the fundamental value is a function of the companies accounting information (Θit), and a vector of conditional accounting multiples (α), and they use both time-specific and long-run trends in these variables in the function.

A B C

Equation 3.5 $m_{it} - b_{it} = [m_{it} - v(\Theta_{it}); \alpha_{jt})] + [v(\Theta_{it}); \alpha_{jt}) - v(\Theta_{it});\alpha_{j})] + [v(\Theta_{it}); \alpha_{j}) - b_{it}]$

Part A refers to the difference between market value and fundamental value based on time and sector specific valuation effects; part B captures the sector specific valuation differences which do not change over time; and part C is the difference between the long-run fundamental value and the book value. This equation attempts to capture how the

fundamental value of a company changes as accounting information changes, and how differences in fundamental values of companies change due to differences in accounting data over time. The firms' fundamental value is derived by using a version of the RIM explained above, however, they assume that a company's fundamental value is a linear function of the book value of equity, net income and leverage over time (Fu *et al.,*2013). Other scholars have since also adopted the decomposed market-to-book approach such as Fu *et al.* (2013). The advantage of the decomposed P/B method is that it does not depend on analysts' forecasts to estimate the residual income, and it is considered to be superior to the RIM which is based on several assumptions such as the earnings growth rates that influence the magnitude of mispricing (Rhodes-Kropf *et al.*, 2005; Ritter & Warr, 2002). The disadvantages of the decomposed P/B method is that it needs to assume a constant relationship between return-on-equity and expected future discount rates, and it also assumes that book value of equity grows at a constant rate (Rhodes-Kropf *et al*., 2005).

The industry-adjusted Price-to-Earnings (P/E) ratio is another valuation metric that is widely used by investment analysts as a proxy for misvaluation and is calculated as a multiple of the firm-specific P/E and the industry or sector's median P/E (e.g. Lu & Gev, 2011). P/E itself is a multiple of the share price and the earnings per share as determined from the fiscal year-end financial statements. However, some scholars do not consider the P/E ratio as a good as the traditional P/B ratio in identifying misvaluation, as it is not a strong predictor of month-ahead returns, and it is severely influenced by short-term fluctuations in share price (Dong *et al.*, 2006).

Lastly, long-run abnormal earnings have also been employed to determine whether company stock prices are misvalued, and different approaches are used. For example, Rau & Vermaelen (1998) use a sequential-sort procedure to study the post-acquisitions earnings differences based on company size and P/B factors. However, abnormal returns after M&A might be the result of synergy gains, so they do not necessarily reflect misvaluation (Dong *et al.*, 2006), hence Tobler (2007) developed a two-stage regression technique to use long-run abnormal returns to test the valuation-driven acquisition theory (Equations 3.6 and 3.7). He used the Carhart (1997) four-factor pricing model (FFPM) in the first regression (Equation 3.6), where each company's monthly excess returns ($R_t - R_f$) are regressed against the market factor (MKT), size factor (SML), book-to-market factor (HML) and momentum factor (MOM) for each industry, to obtain the historical risk premia (δ) for each factor, per company. The MKT, SML, HML and MOM factors are calculated using the Fama-French approach explained on their website (*mba.tuck.dartmouth.edu/pages/faculty/ken.**french**/Data_Library/f-f_factors.html*).

Equation 3.6 $R_t - R_f = \alpha_i + \delta_1 MKT + \delta_2 SML + \delta_3 HML + \delta_4 MOM + \varepsilon i$

Equation 3.7 $R_t - R_f = \alpha_j + \gamma_1\delta_1 + \gamma_2\delta_2 + \gamma_3\delta_3 + \gamma_4\delta_4 + \varepsilon j$

The four-factor regression model (Equation 3.6) used to calculate excess returns was developed by Carhart (1997), after Fama and French (1993), and is generally referred to as the four-factor pricing model (FFPM) or the Carhart Four Factor Pricing Model. This model is an advanced form of the capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965), and an improvement of the Three-Factor Pricing Model (TFPM) of Fama & French (1993). Fama-French derived the TFPM from market analyses that showed that the performance of a security is influenced by more risk factors in addition to the market factor in the CAPM. The additional TFPM factors are the size factor (SML) and the book to market factor (HML). The momentum factor (MOM) was subsequently identified and explained by Carhart (1997) and added to the TFPM, thus creating the FFPM (Carhart, 1997). The size factor was derived by Fama & French (1993) based on observations that there were differences in securities returns based on the size of the firm. The book to market factor was incorporated as an important explanation for securities' performance as it was shown that a group of securities with a big book to market factor generally outperform a group of securities with a low book to market factor (Fama & French, 1993). Securities belonging to the latter group of securities are considered to be overvalued as their market values are not supported by strong book values. Lastly, the momentum factor was introduced by Carhart (1997) because of the observation that stocks that have experienced short periods of high returns continue to do so for a considerable period of time, and the same applies for stocks with short periods of low returns.

The second stage of the estimation (Equation 3.7) regresses the excess returns against the historical risk premia (δ) derived from Equation 3.6 cross-sectionally by month, for each company in the industry. The δs are factor loadings which represent historical risk premiums of each factor in relation to a companies' return relative to the industry factors. To calculate risk-adjusted excess returns (ERs) for each firm and industry for the 12 months before the acquisition announcement, the intercepts (α_j) from the second-stage of the regression are added to the residuals (ε_i) derived from the first regression per company (Tobler, 2007). The advantage of the long-run returns methods is they do not rely heavily on accounting data to estimate misvaluation.

In conclusion, each of the possible proxies for misvaluation has disadvantages, however studies that employed both the traditional P/B method and RIM method found that these two metrics give complimentary information about misvaluation (Ang & Cheng, 2006; Dong *et al.*,

2006). Also, the conclusions drawn from the decomposed market-to-book method (Rhodes-Kropf *et al.*, 2005), the risk-adjusted excess returns method (Tobler, 2007) and the industry-adjusted P/E method (Gu & Lev, 2011) were all largely supportive of the market-driven theory of Shleifer & Vishny (2003), Ang & Cheng (2006) and Dong *et al*. (2006). It is clear that whichever proxies used will likely be imperfect measures of misvaluation (Dong *et al.*, 2006; Gu & Lev, 2011), hence this study used the PB misvaluation approach of Ang & Cheng (2006) (Equation 3.2) and the risk-adjusted excess returns (ER) approach of Tobler (2007) (Equations 3.6 and 3.7) which do not depend on any subjective assumptions on future income or earnings growth rates. Results from both metrics were analysed to assess whether evidence of the valuation-driven acquisition theory is discernable in Mining M&A.

3.3.2 Proxies to test the correlation between goodwill impairment write-off and misvaluation

Based on the FASB (1999), several proxies can be used to estimate whether there is a correlation between acquisition characteristics and the likelihood of eventual goodwill impairment, such as the premium paid; the presence of multiple bidders; percentage stock used for payment; percentage goodwill versus overall purchase prices. In their studying of goodwill write-offs in Jordan, Al-Khadash & Salah (2009) used a goodwill write-off prediction model (Equation 3.8) developed by Hayn & Hughes (2005), with the dependent variables premium paid (PREM); presence of multiple bidders (BID); percentage stock used for payment (STOCK); percentage goodwill versus overall purchase prices (GW%); abnormal returns (ANRET); return-on-assets (ROA); change in ROA (∆ROA). The Hayn & Hughes (2005) model extends the parameters prescribed by the FASB by adding performance indicators to the transaction characteristics:

Equation 3.8 $WRITE\text{-}OFF_{i,t} = \alpha + \beta 1PREM_{i,A} + \beta 2BID_{i,A} + \beta 3GW\%_{i,A} + \beta 4STOCK_{i,A} + \beta 5ANRET_{i,A} + \beta 6ROA_{i,n} + \beta 7\Delta ROA_{i,n} + u_{i,t}$

Al-Khadash & Salah (2009) found a significant correlation between goodwill write-offs and the percentage goodwill versus overall purchase price, but no significant relationship with the other dependent variables.

Olante (2013) created a new model (Equation 3.9) and also added more parameters than prescribed by the FASB (1999) to predict goodwill write-downs (ILOSS): premium paid (PREM); presence of multiple bidders (CHALL); percentage stock used for payment (STOCK); percentage goodwill versus overall purchase prices (GWEV); book value premium (BVPREM); diversification (FOCUS); geographic location (CROSS) and target size (SIZE).

As summarised in Section 2.6.3., Olante (2013) found strong correlations between the likelihood of goodwill impairment write-downs and the proxies: percentage stock used for payment and percentage goodwill versus overall purchase prices but found no relationship between the likelihood of goodwill impairment and the other proxies used.

Equation 3.9 ILOSSi = β0 + β1GWEVi + β2STOCKi + β3PREMi + β4BVPREMi +β5FOCUSi + β6CHALLi + β7CROSSi + β8SIZEi þ ε

Gu & Lev used several measures of share mispricing - the industry-adjusted P/E; discretionary accruals and prior equity issuance (Equations 3.10 and 3.11) - to study the correlation between the likelihood of goodwill impairment and acquisition transaction characteristics (Gu & Lev, 2011). Discretionary accruals are defined as the difference between a company's total accruals and normal accruals deflated by total assets (Chan *et al*., 2006; Polk & Sapienza, 2009).

Equation 3.10 Total accruals = EBIDTA – Total Assets

Equation 3.11 Normal accruals = Sales X [Total Accruals/Sales (previous 5 years)]

Equity issuance is the calculated as follows:

Equation 3.12 Equity issuance = log [(Market Value)t/(Market Value)t5] – log [(Stock returns)t5 to t1 (Daniel & Titman, 2006).

Gu & Lev (2011) created composite mispricing indexes from the three proxies they used and sorted all companies in the industries into 5X5 quintiles according to the calculated proxy values. They found a significant correlation between their mispricing proxies and the acquisition intensity and change in goodwill after acquisition.

In this research report, the ER and PB misvaluation metrics were used to conduct an analysis of the relationship between stock misvaluation and goodwill impairment. The Gu & Lev (2011) approach was followed where transactions were sorted based on valuation, after which firm characteristics and impairments were compared. While Olante (2013) and Al-Khadash & Salah (2009) expanded on the requirements of the FASB parameters by inserting additional parameters in their models, their results gave no support for the additional parameters. Both found that the proportion of goodwill over the purchase price was a more important predictor of eventual goodwill impairments. These findings were used to guide the analysis of goodwill impairments in this research report.

3.4 Valuation of Mineral Assets

Mineral resources are the assets which form the basis of for the valuation of mining companies. The valuation of mineral assets are guided by mineral resource-specific valuation standards, which have the purpose of ensuring consistency in the methods used for reporting mineral resource valuations by providing minimum standards that need to be applied (SAMVAL, 2016; CIMVAL, 2003; VALMIN, 2015). They limit unprincipled valuations of mineral assets which may end up in compromising the interests of investors and potential investors. Several mineral asset valuation codes exist, and are affiliated to the mineral resource reporting codes. The South African Code for the Reporting of Mineral Asset Valuation (SAMVAL) is associated with the SAMREC code, the Canadian Institute of Mining, Metallurgy and Petroleum Valuation of Mineral Properties (CIMVAL) is associated with the NI 43-101 and the Australasian Code for Public Reporting of Technical Assessments and Valuations of Mineral Assets (VALMIN) is associated with the JORC code.

The valuation of mineral assets relies on multiple technical and economic inputs, and takes consideration of the fact their extraction leads to a depletion of their quantity over time. Therefore, valuation codes are linked to the requirements for mineral resource reporting set out in the respective mineral resource reporting codes (SAMVAL, 2016; CIMVAL, 2003; VALMIN, 2015). The mineral asset valuation codes prescribe three valuation approaches for the valuation of mineral assets, which are the Income Approach, Market Approach or Cost Approach (Table 3.1). The Income Approach uses several valuation methods such as the Discounted Cash Flow and Real Options and requires the determination of the present value of future cash flows over the remaining life of the mineral asset. This approach is used mainly for the evaluation of development and production mining properties. The Market Approach uses valuation methods such as Comparable Transactions, by comparing the mineral property being valued to the transaction value offered for other mineral properties with similar characteristics (SAMVAL, 2016; CIMVAL, 2003; VALMIN, 2015).

Table 3.1 Valuation approaches prescribed by the SAMVAL, CIMVAL and VALMIN codes for mineral asset valuation (Canadian Institute of Mining, 2009), extracted from Baurens, 2010.

VALUATION APPROACH	DESCRIPTION	VALUATION METHOD	EXPLORATION PROPERTIES	DEVELOPMENT PROPERTIES	PRODUCTION PROPERTIES
Income or Cash Flow	Relies on the "value-in-use" principle and requires determination of the present value of future cash flows over the useful life of the Mineral Property	**Discounted Cash Flow**	Not generally used	Widely used	Widely used
		Real Options	Less widely used	Quite widely used	Quite widely used
		Monte Carlo Analysis	Less widely used	Less widely used	Less widely used
		Probabilistic Methods	Not widely used	Not widely used	Not widely used
Market	Relies on the principle of substitution. The Mineral Property being valued is compared with the transaction value of similar Mineral Properties, transacted on an open market	**Comparable Transactions**	Widely used	Widely used	Widely used
		Option Agreement Terms	Widely used	Widely used	Quite widely used
		Gross "in Situ" Metal Value	Not acceptable		
		Net Metal Value per unit of metal	Widely used rule of thumb		
Cost	Relies on historical and/or future amounts spent on the Mineral Asset	**Appraised Value**	Quite widely used	Not widely used	Not generally used
		Multiples	Quite widely used	Quite widely used	widely used
		Geoscience Factor	Not widely used	Not widely used	Not generally used

The Cost Approach uses valuation methods such as the Appraised Value or Multiples, and uses the historical cost spent on or estimated future costs to be spent on the mineral asset.

The valuation approaches prescribed by the mineral asset valuation codes are concerned with determining the intrinsic value of the mineral assets, and are therefore used to determine the value investors should expect to pay for a mineral property under consideration for a M&A transaction. Following the examples used in the valuation-driven acquisition theory literature, this research investigates the possibility of relative stock market misvaluation of listed mining companies, and does not seek to determine the intrinsic value of mineral assets. For this reason, the valuation approaches prescribed by the valuation codes are not applied.

3.5 Data

3.5.1 Data Source

Following mainly Ang & Cheng (2006) and Tobler (2007), the following data were sourced from the indicated resources

- 2000-2013 M&A Transaction data from S&P Capital IQ (courtesy of Neal Brewster – Rio Tinto's GM Valuation Improvement, a subscriber)
- 1997-2013 Historical mining securities data listed on the Canadian, Australian, British, South African and US stock exchanges from S&P Capital IQ
- 1997-2013 Mining firm accounting data from S&P Capital IG
- 1997-2013 US Treasury bills historical risk-free rates from S&P Capital IG

3.5.2 M&A Data

M&A data from 2000 to 2013 for only publically listed mining companies was used and all transaction data was used whether the M&A transaction was completed, incomplete, or withdrawn. In order to form part of the analysis, the M&A data had to include information on: the date of announcement; name of targets and bidder; the main commodity mined for the bidder and target; measures of payment (cash and/or stock); form of the offer (merger or tender offer); offer price; target hostility; number of bidders; bid success; date of bid withdrawal or cancellation and date of M&A completion.

3.5.3 Historical Security Data

The research focused on the top 8 stock exchanges on which the majority of bidding/target companies were listed, and which host the largest number of mining stocks. Hence, it was required that both companies involved in an M&A transaction were listed on either the Toronto Stock Exchanges (TSX and TSXV), the Australian Stock Exchange (ASX), the London Stock Exchanges (LSX and AIM), the New York Stock Exchanges (NYSE and AMEX) or the Johannesburg Stock Exchange (JSE). Combined, these stock exchanges host mining companies with a combined market capitalisation of about US$ 3 Trillion (Toronto Stock Exchange). For each transaction in each year, the historical month-end ordinary common stock price and monthly total outstanding shares data for the bidder and target was extracted, starting at least 3 years before the M&A announcement date, and ending 3 years after the M&A completion date. Parallel to this, historical security data for all mining companies were extracted over the same period. In the event that a bidding company was

involved in more than one M&A transaction in the same year, then only data for the earliest announced M&A was used in the analysis.

3.5.4 Accounting Data

The book value and total assets data were extracted from the fiscal year-end financial statements released closest to the M&A announcement. The data were used to calculate the PB ratio for each company involved in M&A as well as for the other companies within the mining industry represented on the selected stock exchanges; and the and the SML, and HML factors of Equation 3.6 for each mining sector analysed. Additionally, the following accounting data was extracted, which informed much of the calculations used in the analysis (Table 3.2)

Table 3.2 List of accounting data downloaded

Total Assets	Total Liabilities
Book value	Deferred taxes
Goodwill	Common equity
Goodwill Impairments	Outstanding shares

4 Results

4.1 Introduction

The ER and PB metrics explained in Section 3 were used as proxies to determine whether mining stocks involved in M&A transactions between 2000 and 2013 were overvalued or undervalued relative to the overall mining industry. Companies that made offers to acquire other companies are referred to as the "Bidders", and those companies that are being considered by acquisitions are referred to as the "Targets". PB and ER metrics were calculated for all companies listed as mining companies on the JSE, ASX, TSX, TSXV, LSE, AIM and NYSE in the mining industry.

The methods for calculating the ER and PB metrics are explained in detail in Appendix A and B respectively. The results were averaged and grouped into Target, Bidder and Industry averages for the purposes of comparison. The results were compared based on univariate statistics (Appendix C), t-test analysis and intrinsic firm characteristics based on accounting information. The purpose of these comparisons was to determine if there are significant differences between the average Target, Bidder and Industry ER and PB metrics. The average Industry valuations were regressed against the annual number of reported M&A transactions so as to test for a correlation between the overall valuations and the number of M&A transaction. These analyses were conducted so as to test the propositions of the valuation-driven acquisition theory explained in Section 3.1.

The transaction values were compared to the reported assets, market capitalisation and book values of the listed companies, so as to compare the proportion by which different Bidders exceed the accounting values of the Targets when making acquisition offers. In this report, this proportion is referred to as the Target overpayment ratio and was calculated for comparative purposes only. The Target overpayment ratio was then compared to annual reported goodwill impairments of companies participating in M&A transactions over the sample period. Bidder companies were grouped based on their level of misvaluation, and these groups were compared based on their calculated Target Overpayment ratios. The purpose of this was to determine whether there is a correlation between Bidder valuation, the propensity for higher overpayment ratios and reported impairments.

This section is arranged as follows: Section 4.2 explains and summarises the sample data; Section 4.3 explains how the valuation metrics were calculated; as mentioned, detailed explanations can be found in Appendix A and B. Sections 4.4 to 4.7 provide the results

obtained from analyzing the Gold, Copper, Diversified Metals and Mining and Combined (i.e., undifferentiated) M&A data to test for the main propositions of valuation-driven acquisition theory (Hypothesis $\mathbf{H_0}$ defined in Section 3.1). Each of these sections start with a summary of the respective M&A trends over the sample period, compares the univariate statistics of Target, Bidder and Industry groups as well as contrasting the valuation metrics of Cash and Stock transactions. The results of t-test analyses for differences between the different groups are summarised, and conclusions for each sector are summarised. The differences in overall firm characteristics between Target, Bidder and Industry groups are provided in Section 4.7 as a further analysis of whether the differences evident from the valuation metrics are visible based on fundamental accounting data. The correlation between merger waves and trends in the valuation metrics is analysed in Section 4.8 as a test for Hypothesis $\mathbf{H_1}$ defined in Section 3.1. This section ends with the analysis of results obtained from correlating valuation metrics of targets and bidders, to reported annual impairments and the relative target overpayment ratio and a concluding summary is provided.

4.2 Sample Data

Between 2 March 2014 and 30 April 2014, several sets of data were extracted from the S&P Capital IG database to support this research: mining M&A transaction data over the period 1990-2013; financial data for mining securities over the period 1996 -2013. Analysis of the M&A data in gold, copper, iron ore and coal sectors (Table 4.1) found that 10 183 M&A transactions were announced between 1990 and 2013, of which only 1 007 or 10% were associated with at least one stock exchange listed Target companies. Of the listed companies, 69% were listed on the ASX, NYSE, AIM, LSE, TSX and JSE.

Table 4.1 Summary of M&A activities from 1990 to 2013 in the Gold, Copper, Iron ore and coal sectors

Mining Sector	Global M&A	Stock Exchanges	Select Exchanges
Gold	4 699	393	292
Copper	2 083	266	203
Iron	823	135	81
Coal	2 578	213	121
Total M&A	10 183	1 007	697
Proportions of Global M&A		10%	7%

Analysis of the trends in M&A data from S&P Capital IG database found that 99% of recorded M&A activities were within the 2000-2013 period (Figure 4.1), which supported limiting the sample period to that period. This brought the initial sample size to 697 M&A transactions. Financial data was available on the S&P Capital IG database for the majority of the stocks listed on the selected stock exchanges but were discontinuous or absent for the stocks listed on other stock exchanges. This further supported the decision to limit the sample data to the selected stock exchanges. However, only 100 transactions involved M&A between mining companies that were both listed on the selected stock exchanges and therefore had sufficient financial data in the S&P Capital IG database.

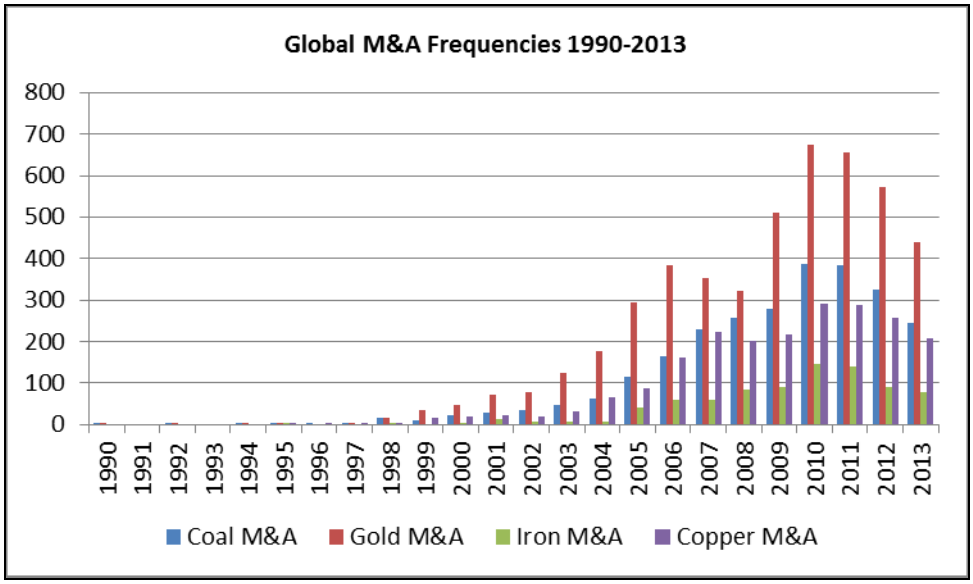


Figure 4.1 Distribution of global M&A activities in the gold, copper, iron ore and coal mining sectors between 1990 and 2013.

Of the 100 transactions, 56% involved a Target company in the diversified metals and mining, 23% were in the coal and consumable fuels and 16% were classified under precious metals and mining (Table 4.2).

Table 4.2 Summary of representation of mining sectors in the sample set. Classifications as defined by S&P Capital database

Sector Classifications	Bidder Sector %	Target Sector %
Coal and Consumable Fuels	17	23
Steel	7	
Diversified Metals and Mining	43	56
Gold	19	3
Precious Metals and Minerals	11	16
Silver	3	2

4.3 Calculation of Valuation Metrics

4.3.1 Risk-adjusted excess returns (ER)

The Risk-adjusted Excess Returns (ER) metric of Tobler (2007) requires full sector stock returns data and financial data for a period of 36 months before at least 30 days prior to the announcement of M&A transactions, for the Targets, Bidders and their markets. The 30 days rule prevents the effect of pre-announcement drift on the stock returns. Monthly share price returns (monthly difference in share prices) were calculated on a monthly basis for all stock exchange list stocks, by mining sectors. Data paucity in some of the participating mining sectors resulted in insufficiently small sample sizes for the calculation of the metric. A decision was then made to construct time series for within-sector transactions, and for the overall mining stocks traded on the selected stock exchanges. The monthly USA risk free rate (Treasury bills) was deducted from the monthly returns to create “risk adjusted returns” for the regressions in Equations 3.6 and 3.7.

The four-factor pricing model (FFPM) factors for each mining sector were constructed, following the Fama French approach. Companies with no market-to-book data or with negative book equity values were excluded as per procedure for constructing the four factors. The risk-adjusted returns covering the earliest 24 months of the 36 month time-series were regressed against the FFPM as per Equation 3.6. The factor loadings for each company resulting from this first regression were then captured and regressed against the risk-adjusted returns of each mining company in the data set covering the last 12 months prior to one month before the M&A transaction was announced, using Equation 3.7. The intercepts calculated from the second regression were then added to the residuals calculated in the first regression of each company. Three ER metrics were estimated considering the average risk-adjusted excess returns for 3, 6 and 12 months stock holding periods, i.e. ER3, ER6 and ER12 respectively. All calculations were conducted on Microsoft Excel.

The construction of the four-factors is summarised below.

SMB (Small vs. Big stocks)

Three sets of data are required to calculate the SMB factor: for the size factor (S), the market capitalization of each stock in the sector was obtained at June of the year; for the Book to Market (B/M) factor or value factor, the book equity value at the end of the stock's financial year and the market capitalization of the stock as at December of the previous year was used. All stock without any of the above data was excluded from calculating the SMB factor.

The size factor was estimated by ranking the stocks by market capitalization and then calculating the median point of the data series. The median market capitalization was then used to divide the data series into two groups: small companies were those with a market capitalization below the median, and big companies were those with a market capitalization above the median. The value factor was estimated by ranking the stocks according to the B/M ratio: the breaking points splitting the data series into low, neutral and high-value stocks were set at 30%, 70% percentile levels. Six portfolios were created as the intersection of size value companies (Table 4.3):

Table 4.3 Construction of 6 SMB portfolios as prescribed by Fama & French

		30%		70%
	SMB Portfolios	Low Value Companies	Neutral Value Companies	High Value Companies
50%	Small Companies	Small/Low (S/L)	Small/Neutral (S/N)	Small/High (S/H)
	Big Companies	Big/Low (B/L)	Big/Neutral (B/N)	Big/High (B/H)

The portfolio rankings were conducted once a year at the financial year end, but the SMB factor was calculated monthly as the equal-weighted average of the value-weighted monthly returns of the small stocks portfolios minus the large stock portfolios, from July of the previous year to June of the year under consideration,

Equation 4.1 SMB = ((S/L-B/L) + (S/N-B/N) + (S/H-B/H))/3

HML (High-value stocks vs. Low-value stocks)

The HML factor was calculated from the same portfolios calculated for the SMB factor, but in this case, the factor was calculated as the equal-weighted average of the returns on the value stock portfolio minus the returns on the growth stock portfolio.

Equation 4.2 HML = ((S/H –S/L) - (B/H-B/L))/2

Momentum factor (MOM)

For the momentum factor, similar portfolio sorts as for the SMB factor was conducted monthly, but the stocks were ranked based on the size (market capitalization) at June of the previous year, and their "prior performance", i.e. returns one year before and up to one month before the month under consideration (11 months). The size breaking point was set at 50% (the median), and the returns performance was divided into 3 categories, with breaking points at 30% and 70%. Six value weighted portfolios were thus created as intersections between size and prior performance (Table 4.4):

Table 4.4 Construction of 6 MOM portfolios as prescribed by Fama & French

		30%		70%
	Momentum Portfolios	Losers	Neutrals	Winners
50%	Small Companies	Small/Losers (S/L)	Small/Neutrals (S/N)	Small/Winners (S/W)
	Big Companies	Big/Losers (B/L)	Big/Neutral (B/N)	Big/Winners (B/W)

The momentum factor was calculated as the equal-weighted average of the returns on the winner stocks less the returns on the loser stocks:

Equation 4.3 MOM = ((S/W-S/L) + (B/W-B/L))/2

Market Factor (MKT)

The market factor is the monthly market capitalization weighted returns of all stocks in the industry sector (Rm), minus the risk-free monthly return (Rt) (US Treasury bills risk-free rate).

Equation 4.4 MKT = Rm – Rt

Portfolio sample sizes

Iron ore and Coal portfolios were limited by the small number of listed stocks relative to the number of listed stocks in the Gold and Copper sectors. There were only 58 listed coal stocks on the selected stock exchanges by 2013, of which 32 were unidentified and had no market data available, and another 4 were identified but had no market capitalization data on the S&P Capital database. This left only 22 coal stocks with the full amount of market data for FFPM portfolio construction. The 1996 data had 23 stocks with valid identifiers but no market capitalization data available, and leaving only 3 listed stocks with the required market data. When the sample data was expanded to global data and removing the selected stock exchange restriction, it was found that 210 stocks were globally listed, of which 106 had "invalid IDs" and therefore had no market capitalization data on the S&P Capital database. Another 100 of the stocks were identified but had no market data available, meaning only four stocks had market data in 1996, and 51 samples in the 2013 dataset. A similar trend was observed for the financial data: only 31 stocks had financial data in the 1996 data set, and 100 stocks with financial data in 2013. However, the more limited market data would reduce the data used for portfolio calculation to 4 in 1996 and 51 in 2013. A decision was then made not to conduct any portfolio construction and FFPM factor calculations specifically for the coal sector.

The market data set for the Iron Ore sector was not as limited as for the coal sector; however, there was no data for the period 1996-1997 which is required to compile a full 3 years data set for transactions that occurred in 2000. There were also some inconsistencies with regards to how companies were categorised on the S&P database. For example, the "Copper" sector was available as a filter for Target sector but was not available in the Bidder sector filter. Some companies listed under the copper sector in the Target filter were showing up as "diversified" or "precious metals" when running mining industry-wide queries. A decision was therefore taken to create FFPM portfolios using the "All Mining Stocks" data range from the S&P Capital IQ database instead of limiting the portfolio construction to within sector only. By doing so, the following analysis on evaluation of M&A participating stocks could be conducted:

- Gold Target vs. Gold Bidder Transactions
- Copper Target vs. Diversified Target Transactions
- All Bidder vs. Diversified Target Transactions
- Combined Transactions

4.3.2 Price to Book misvaluation metric (PB)

The PB metric was calculated using Equation 3.2, using available accounting and stock data and calculated for Targets, Bidders and the overall mining market for each transaction. The PB metric was calculated from ordinary common stocks for every firm that was involved in an M&A transaction, and for the related mining sector, and was based on the most recent book equity data at most one year before the transaction was announced and market equity one month before the deal announcement (Dong *et al,* 2006, Ang & Chen, 2006). Both completed and withdrawn M&A offers were considered in the calculation, and at least 5 stocks were required to calculate the industry median price-to-book ratio.

4.3.3 Summary of valuation-driven acquisition theory tested

The following main premises of the valuation-driven acquisition theory were tested for the above-mentioned transactions, so as to determine whether valuation plays a role in determining which companies participate in M&A:

- Targets and Bidders are overvalued in relation to their markets
- That Bidders are more overvalued than Targets
- Targets acquired with cash are valuated lower than Targets purchased with stock
- More overvalued Bidders tend to use stock for acquisitions
- Periods of high M&A activity correspond to periods of high stock valuation

Further to the above, acquisitions were analysed to determine whether there is a correlation between Bidder and Target overvaluation and the likelihood of post-acquisition goodwill impairment.

4.4 Testing the valuation-driven acquisition theory: Gold M&A

4.4.1 Global Gold M&A trends

Between 2000 and 2013, 69 M&A transactions worth US$15.7 Billion involved the acquisitions of Gold Target companies on the selected stock exchanges (Table 4.5). In 76.8% of the transactions, the bidding companies were identified as operating within the "Gold" sector, with a combined deal value of about US$15.3 Billion. For the rest of the transactions, the Bidders' sectors were identified as being either "Diversified Metals & Mining" or "Coal & Consumable Fuels". Companies registered on the TSX, TSXV and ASX exchanges made up 81.1% of Target companies, and 72.5% of Bidder companies involved in Gold M&A transactions.

Table 4.5 M&A Frequency by Bidder sector (a) and Stock exchange (b)

(a)

Gold Bidder Sector	No. of M&A	Deal Value
Gold	53	15 276
Diversified Metals and Mining	10	328
Coal and Consumable Fuels	6	67

(b)

Exchange	Target	Bidder
JSE	3	5
TSX	19	23
ASX	14	13
NYSE	2	3
TSXV	23	14
AIM	3	1
LSE	1	4
Other	4	7

The frequency of Gold M&A transactions for companies registered on the selected stock exchanges followed a similar trend as the global mining M&A activities: steadily increasing transactions between 2000 and 2006, declines in 2007 and 2008 related to the global financial crisis, and a steady increase towards exceeding pre-global financial crisis levels after 2010 and 2011. M&A activities in 2013 were at triple the levels of 2006. On average, about 56.5% of all transactions between 2000 and 2013 offered Bidder stock for more than 50% of the total deal value (Figure 4.2).

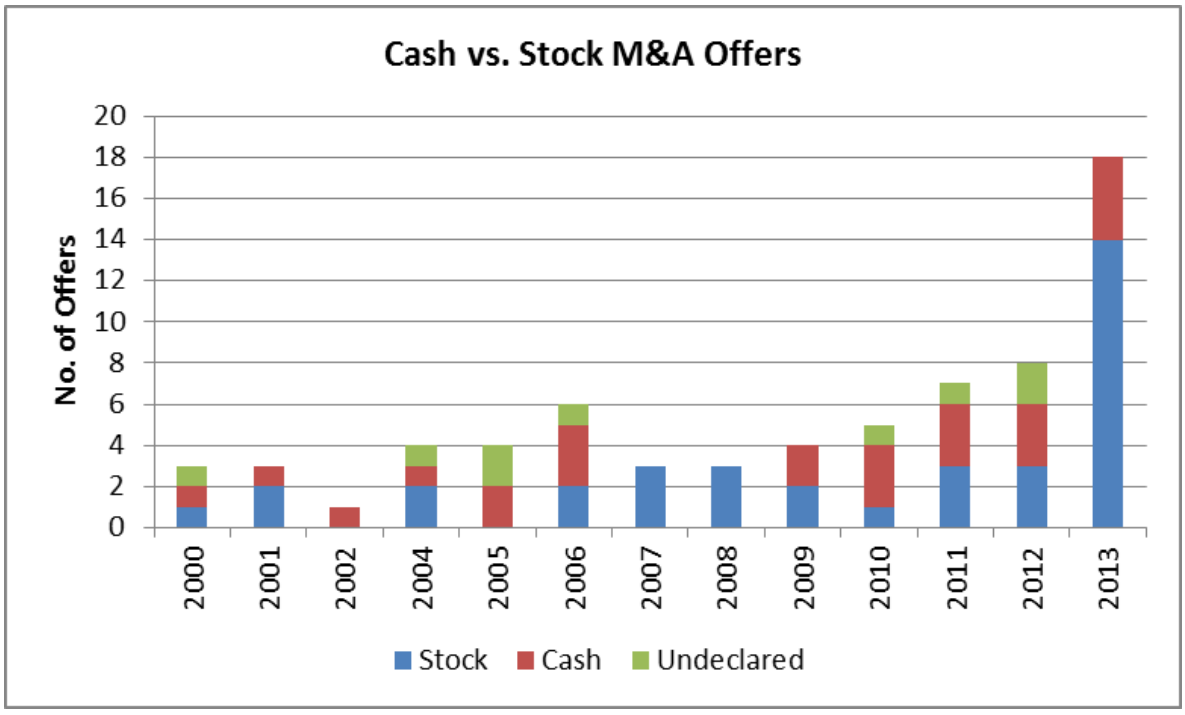


Figure 4.2 Gold M&A Deal Frequency by year and methods of payment (cash vs. stock)

4.4.2 Results for the Gold transactions analysis

Of the 53 Gold-Gold sector transactions, 47 transactions had either Target or Bidder return data meeting the 36 months pre-M&A announcement requirement, however only 23 transactions had both Target and Bidder returns data meeting that criteria. These 23 transactions were used to test whether at least some of the premises of the valuation driven acquisition theory.

Testing the Valuation-based M&A theory hypothesis

Univariate analysis of Bidder, Target and Industry valuations

As described above, valuation metrics were calculated for Target and Bidder companies, as well as for the mining industry. The excess-returns metric (ER) were calculated for 3, 6 and 12 month stock holding periods (ER3, ER6 and ER12, respectively), and were compared to the Price-to-Book misvaluation metric (PB). The resultant univariate statistics of the metrics are summarised in Figure 4.3.

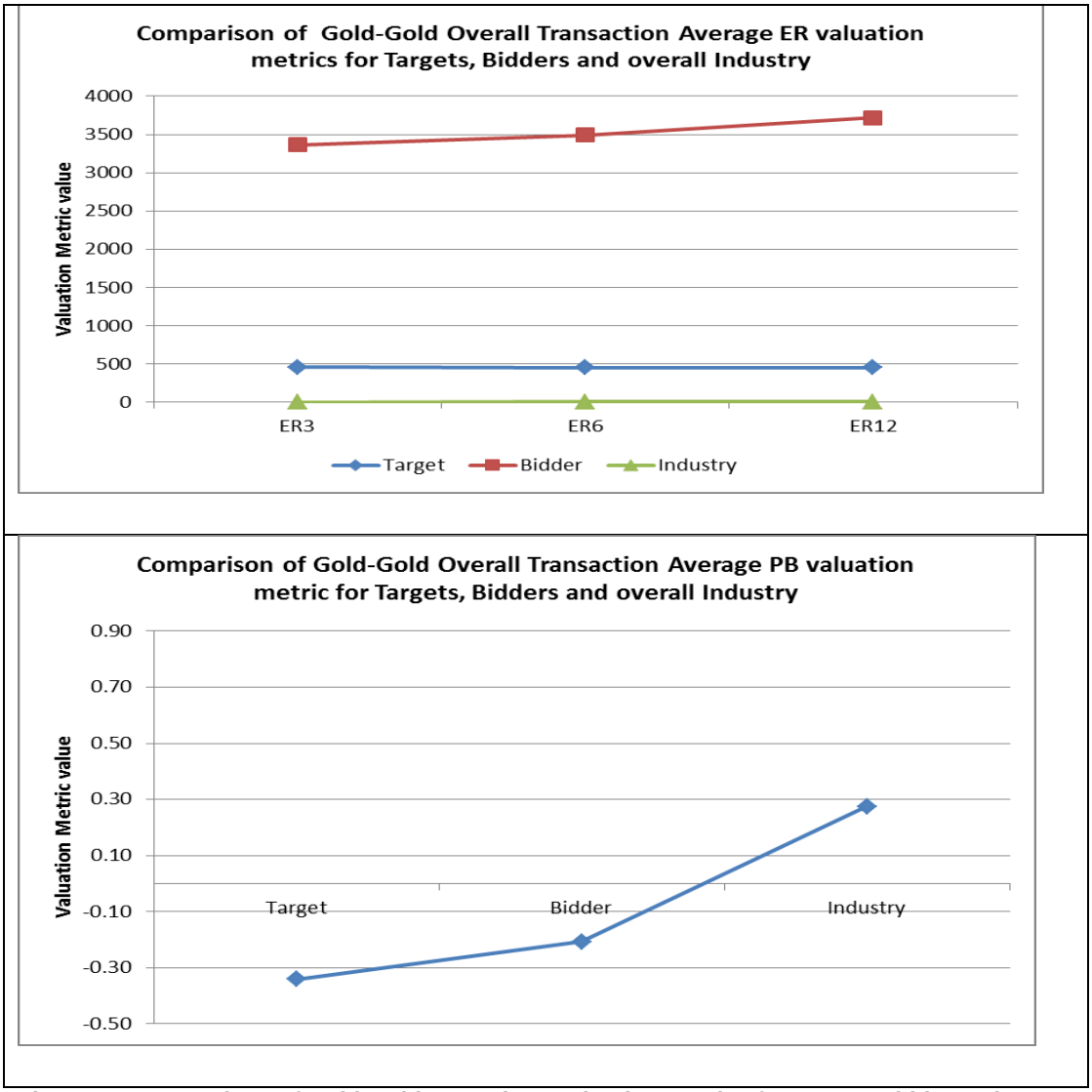


Figure 4.3 Comparison of Gold-Gold ER and OB valuation metrics for Target, Bidder and Industry Gold M&A Deal Frequency by year and methods of payment (cash vs. stock)

Valuation metrics vary widely for Target and bidding companies, although bidding companies have the highest valuations with maximum ER of 26 563, and a maximum PB of 0.96.

Both the ER metrics and the PB metric suggest that there are differences between M&A participating companies, and between these companies and the mining industry. According to the ER3, ER6 and ER12 metrics for the different stock holding periods, Bidder company valuation mean and medians were found to be 86% to 89% higher than Target company valuations. Bidder company mean ER valuations were between 868 and 2983 times higher than industry mean valuations, while their median valuations were between 48 and 154 times higher than industry median valuations. Target company mean ER valuations were between

105 and 405 times higher than industry mean valuations, and their median valuations were between 5 and 21 times higher than industry median valuations.

The mean PB metric for both bidding and Target companies were negative, suggestive of undervaluation relative to the overall industry. Bidding companies mean PB was found to be 65% higher than the mean PB metric for Target companies, while the median PB metric was 129% higher than the Target median PB metric. Industry mean PB metrics was 224% higher than Target mean PB, and 175% higher than Bidder mean PB. The industry median PB was 143% higher than Target PB but 52% lower than the Bidder PB.

Univariate analysis of Bidder, Target and Industry valuations arranged by cash vs. stock

Cash Targets' mean ERs were about 55% lower than stock Targets' mean ERs, while the medians were 36% lower than the median stock Targets' ERs. Stock Bidders' mean ERs were about 822% lower than cash Bidders' mean ERs, and their median ERs were about 2815% lower than the cash Bidders' median ERs. The mean and median PB metrics also showed that cash Targets had lower valuations than stock Targets. Cash Bidders' mean PB was 350% lower that stock Bidders' mean PB, but the cash Bidders' median PB was 167% higher than stock Bidders' median PB.

A comparison of the univariate statistics of cash purchases found that Bidders using mainly cash for acquisitions had mean ERs between 96% and 97% higher than their Targets' mean ER metrics. Median ERs of the same Bidders were between 99% and 100% higher than the Targets' median ERs. Mean Target ERs were between 37 and 236 times higher than industry mean ERs, while the median Target ERs were 3 and 15 times higher than industry median ERs. Bidder mean ERs were between 1367 and 5945 times higher than industry mean ERs, and the median ERs were between 568 and 3028 times higher than industry median ERs.

The mean PB for cash Bidders were 72% higher than the mean PB for cash Targets, while the median PB was 35% higher. Cash Target mean PB was determined to be 17% higher than the industry mean, and the median PB was 50% higher than the industry median PB. Cash Bidder mean PB was 312% higher than the industry mean PB, and the Bidder mean was 131% higher than the industry median PB (Figure 4.4).

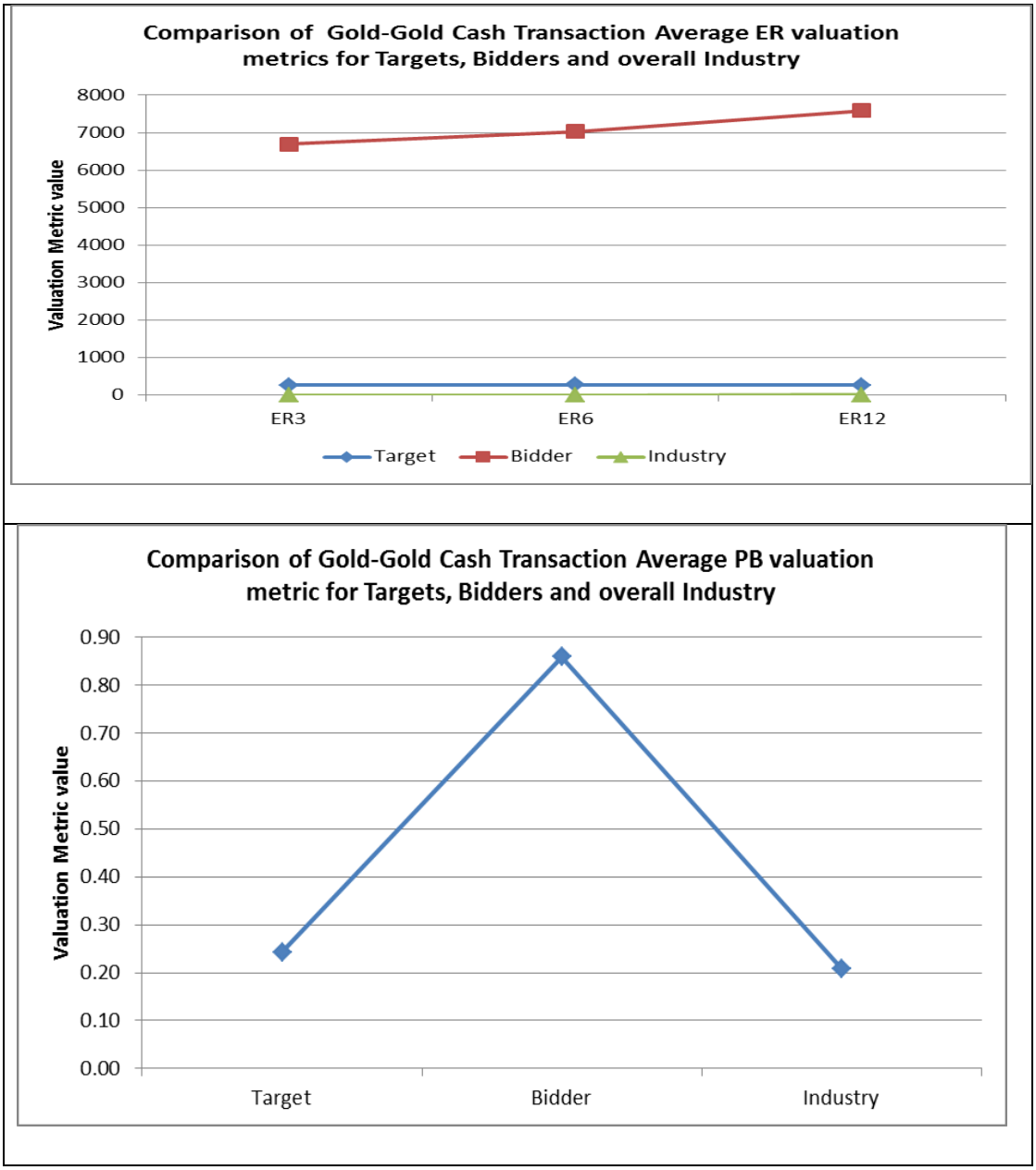


Figure 4.4 Comparison of Gold-Gold Cash transaction ER and OB valuation metrics for Target, Bidder and Industry

The mean ERs for Bidders that purchased Targets mainly with their stock were between 20% and 24% higher than Target mean ERs, but the Bidder median ERs were between 77% and 78% higher than median Target ERs. Stock purchased Targets' mean ERs were between 148 and 535 times higher than mean industry ERs, while their medians were between 8 and 35 times higher than industry mean ERs. Mean ERs for Bidders were 186 to 707 higher than

mean industry ERs, while their median ERs were 35 to 156 times higher than median industry ERs.

Overall, stock Bidders' mean PB was 60% higher than stock Target mean PB, while the median Bidder PB was 222% higher than stock median PB. Target mean PB was 268% lower than industry mean PB, and Target mean PB was 163% lower than industry median PB. Stock Bidder mean PB was 205% lower than industry mean PB, while the median PB was 48% lower than industry median PB (Figure 4.5).

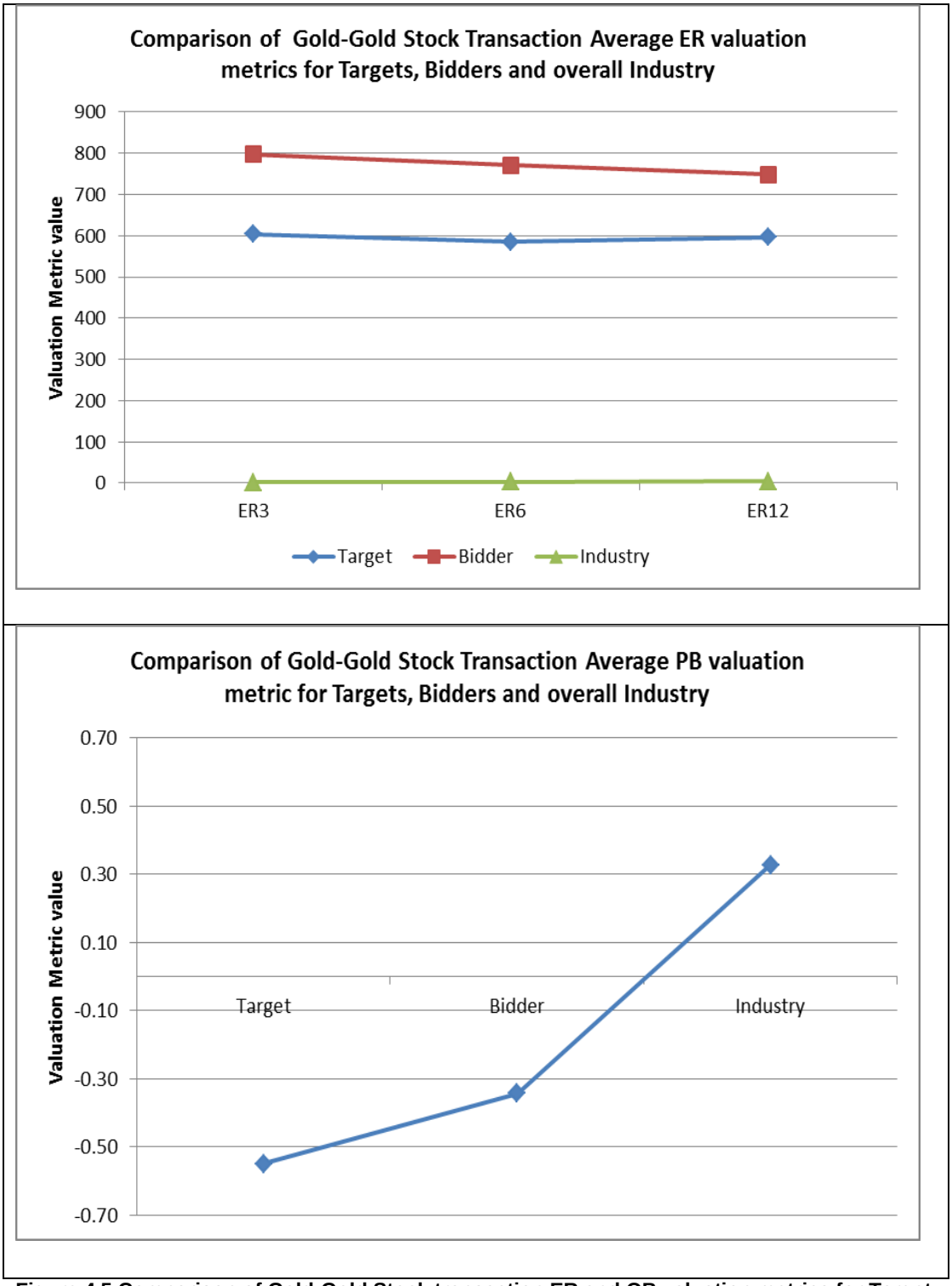


Figure 4.5 Comparison of Gold-Gold Stock transaction ER and OB valuation metrics for Target, Bidder and Industry.

T-test Analysis on Valuation metrics

T-tests were conducted to test whether there were significant differences in the valuations of Target companies, Bidder companies and the mining industry. Further to that, valuations of M&A majority cash offers were compared to majority stock offers. All t-tests were conducted at the 5% significant level.

The t-test results (Table 4.6) based on the three ER valuation metrics differ from the PB metric: According to the ER3 metrics t-tests for Gold Target and Gold Bidder transactions, Targets and Bidder companies were valuated differently by the market, however the t-tests for the ER6 and ER12 metrics suggest that there was no difference in the valuations of Target and Bidder companies. The t-test for all three ER metrics did not find any differences in the valuation of Target companies and the mining industry valuations, but found that Bidder companies were valuated differently from the overall mining industry.

Table 4.6 Summary of t-test analysis for Gold-Gold transactions

Valuation Metric	t-test:	Target vs. Bidder	Target vs. Equal-weighted Industry	Bidder vs. Equal-weighted Industry	Target vs. value-weighted Industry	Bidder vs. value-weighted Industry
ER3	Overall t-stat	-2.10	1.77	2.47	1.79	2.47
	t Critical two-tail	2.06	2.07	2.07	2.07	2.07
ER6	Overall t-stat	-2.06	1.79	2.39	1.83	2.39
	t Critical two-tail	2.07	2.07	2.07	2.07	2.07
ER12	Overall t-stat	-2.03	1.64	2.32	1.72	2.33
	t Critical two-tail	2.07	2.07	2.07	2.07	2.07
PB	Overall t-stat	-0.41	0.66	0.66	-3.08	-1.86
	t Critical two-tail	2.01	2.01	2.01	2.06	2.06

In contrast, the t-tests on the PB metric found no difference between Target and Bidder companies' valuations, and found that Bidder company valuations were similar to the overall mining industry. The t-tests on the PB metric found that Target companies' valuations differed from the overall mining industry.

T-tests comparing the ER3, ER6 and ER12 metrics for cash and stock transactions found no differences in the valuations of cash offer Target companies and stock offer Target companies, cash offer Bidder companies and stock offer Bidder companies, and stock offer Target companies and stock offer Bidder companies (Table 4.7). Only the t-test of the ER3 metrics found a difference between cash offer Target companies and cash offer Bidder companies.

Table 4.7 Summary of t-test analysis of cash vs. stock Gold-Gold transactions

Valuation metric	t test:	Cash vs Stock Targets	Cash vs. Stock Bidders	Cash Target vs. Bidder	Stock Target vs. Bidder
ER3	Overall t-stat	-0.73	2.08	-2.29	-0.31
	t Critical two-tail	2.14	2.26	2.26	2.06
ER6	Overall t-stat	-0.71	2.05	-2.23	-0.32
	t Critical two-tail	2.14	2.26	2.26	2.06
ER12	Overall t-stat	-0.71	2.04	-2.20	-0.25
	t Critical two-tail	2.14	2.26	2.26	2.07
PB	Overall t-stat	1.32	0.64	0.05	0.47
	t Critical two-tail	2.07	2.07	2.10	2.05

The t-tests on the PB metrics found no difference in the valuations of cash offer Target companies in relation to stock offer Target companies or between cash offer Bidder companies in relation to stock offer Bidder companies. Further to that, no difference was found between Targets and Bidders involved in cash offer transactions, and between Targets and Bidders involved in stock offer transactions.

Summary of Results

The results of the Gold-Gold M&A analysis only partially supports the valuation-driven acquisition theory, and can be summarised as follows:

Univariate analysis

- The findings differed based on whether the PB or ER metric were used
- Different conclusions were drawn if the median industry PB was used instead of the mean.
- According to the ER metrics, both Target and Bidder companies on average had higher valuations than the overall mining market, suggestive overvaluation relative to the overall mining industry. This was found to be the case for both stock and cash M&A transactions. These findings are in support of the valuation-driven theory which predicts Target and Bidder overvaluation relative to their markets.
- The PB metric suggests that both Target and Bidder companies were undervalued relative to the mining industry. When Target and Bidder PB metrics were compared to the industry median PB, it was found that Bidders were overvalued and Target companies undervalued in relation to the overall mining industry. The findings based on the industry mean PB contradicts the valuation-driven theory which predicts Target and Bidder overvaluation relative to their markets.

- Both the PB and ER metrics found that on average, Target companies had lower valuations than the Bidder companies. This finding is in support of the valuation-driven acquisition theory.
- According to the PB metrics, Targets offered mainly cash as a means of payment had higher valuations than Targets offered mainly stock, and Bidder companies offering mainly cash for the purchase had higher valuations than Bidder companies offering mainly stock for a purchase. These findings are in contrast to the valuation-driven acquisition theory, which predicts that cash Targets would be undervalued when compared to stock Targets, and that Bidder companies would be aware of this and therefore use cash to purchase undervalued stock. Additionally, these findings also refute the prediction that stock Bidders would have higher valuations and therefore would use their overvalued stock to purchase overvalued Targets.
- According to the ER metrics, Targets offered mainly cash had lower valuations than Targets offered mainly stock. This finding is supportive of the valuation-driven acquisition theory, which predicts that cash Targets would be undervalued when compared to stock Targets.
- Both cash Target and Bidder companies had higher valuations than the industry valuations according to the PB metrics. The valuation-driven acquisition theory predicts that cash Targets would be undervalued relative to their market, which is contradicted by this finding.
- Stock Bidders and Targets had lower valuations than mean industry PB. The valuation-driven acquisition theory predicts that stock Targets and Bidders would be overvalued relative to their market, which is contradicted by this finding.

t-test analysis

- Similar to the univariate statistical analysis, the results from the t-test analysis differ depending on which valuation metric was used
- T-tests on the ER metrics found that Targets and Bidder companies had different valuations, Target companies have similar valuations as the overall mining industry, but Bidder valuations differed from the industry valuations. This finding partially supports the valuation-driven acquisition theory with regards to different valuations of Targets and Bidders, however, the finding that Target companies' valuations are not significantly different from the overall industry contrast the valuation-driven acquisition theory.

- T-tests on the PB metrics found that Bidder companies' valuations did not differ significantly from the overall mining industry; however, Target companies' valuations differed from the overall mining industry. This finding partially supports the valuation-driven acquisition theory with regards to different valuations of Targets and the overall industry, however the finding that Bidder companies' valuations are not significantly different from the overall industry contrast the predictions of the valuation-driven acquisition theory.
- A t-test comparing cash and stock transactions found no difference between cash and stock Target companies, cash and stock Bidder companies, or the mining industry. The valuation-driven acquisition theory predicts that cash Targets would be undervalued and stock Targets overvalued relative to their market, which is contradicted by this finding.

4.5 Testing the valuation-driven acquisition theory: Copper M&A

4.5.1 Global Copper M&A trends

There were 47 M&A announcements involving copper Targets between 2000 and 2013 between mining and metals companies registered on the TSX, TSXV, ASX, JSE, LSE, AIM and NYSE, with a total deal value of US$11.6 Billion. More than 75% of the Targets and 88% of the Bidders were trading on the TSX, TSXV and ASX (Table 4.8).

Table 4.8 Copper M&A Frequency by Stock exchange (a) and Bidder sector (b)

(a)

Exchange	Target	Bidder
AIM	1	2
ASX	16	16
JSE	1	2
LSE	6	2
NYSE	1	
Other	2	
TSX	13	11
TSXV	8	15

(b)

Copper M&A Bidder Sector	No. of M&A	Deal Value (US$ Million)
Aluminium	1	-2
Coal and Consumable Fuels	3	61
Diversified Metals and Metals	26	2 652
Gold	5	7 230
Precious Metals and Minerals	2	1 600
Non-Mining	10	14

The leading bidding sector was the Diversified Metals & Mining sector with 26 deals announced, which accounted for 23% of announced deal values. Deals involving bidding companies identified as “Gold” companies accounted for 63% of overall deal values, from a total of 5 transactions. Two transactions involving “Precious Metals & Minerals” bidding companies accounted for 14% of overall deal values involving Copper Targets.

The trend in M&A announcements for this dataset does not exactly match the trends in the overall mining M&A trends (Figures 2.2 & 4.6), most likely due to restricting the data to transactions where both the Target and Bidder companies were registered on the specified stock exchanges. Between 2000 and 2007, the sample set had an average of two M&A transactions involving a Copper Target and Diversified Metals & Mining Bidders annually, and 60% were cash transactions. M&A transactions increased by more than 100% in the 2008 to 2013 period, despite a reduction in M&A announcements in 2010 and 2011. Cash transactions reduced to 30% during the latter period, whereas stock transactions increased to 38% of transactions. Deal values were withheld for about 30% of announced transactions throughout the sample period.

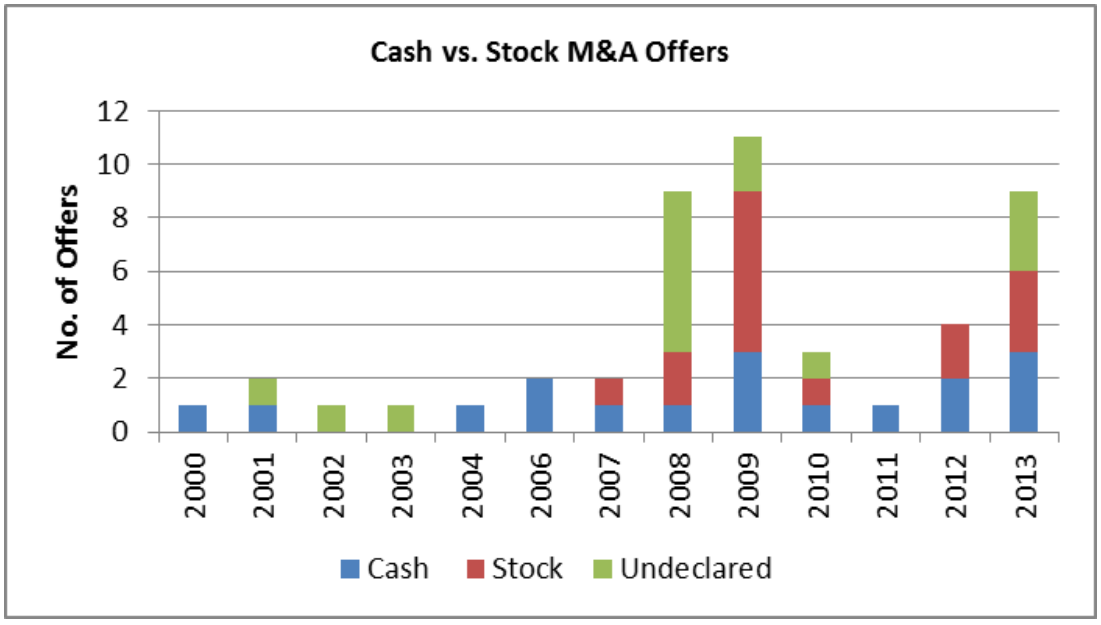


Figure 4.6 Copper M&A Deal Frequency b year and method of payment (cash vs. stock)

The rest of the analysis focused on M&A transactions involving copper Targets and diversified metals & mining Bidders, which made up about 55% of the copper transactions.

4.5.2 Results for Copper Transactions

Of the 26 Copper-Diversified Metals & Mining sector transactions, 23 transactions had both Target or Bidder return data meeting the 36 months pre-M&A announcement requirement, however only 17 transactions had both Target and Bidder returns data meeting that criteria per transaction. These 17 transactions were used to test whether at least some of the premises of the valuation driven acquisition theory could be observed.

Testing the Valuation-based M&A theory hypothesis

Univariate analysis of Bidder, Target and Industry valuations

Univariate statistics were compiled based on the ERs (ER3, ER6, ER12) and PB valuation metrics of Targets, Bidders and mining industry, in order to determine whether there were differences in the valuation of these three groups (Figure 4.7). The ERs are suggestive of Target and Bidder overvaluation relative to the mining industry, and Bidder overvaluation relative to Targets. The mean ERs for bidding companies were between 78% and 81% higher than the mean ERs of the Target companies, while the median ERs of bidding companies were in excess of the median ERs of Target companies by 75% to 78%. Target mean ERs were between 349 and 1255 times higher than the industry weighted mean ERs, while the median Target ERs were 5 to 23 times higher than the industry median ERs. The difference between Bidder and industry ERs were even more significant: Bidder mean ERs were 1618 to 6448 times higher than industry weighted mean ERs, while Bidder median ERs were 22 to 96 times higher than industry median ERs.

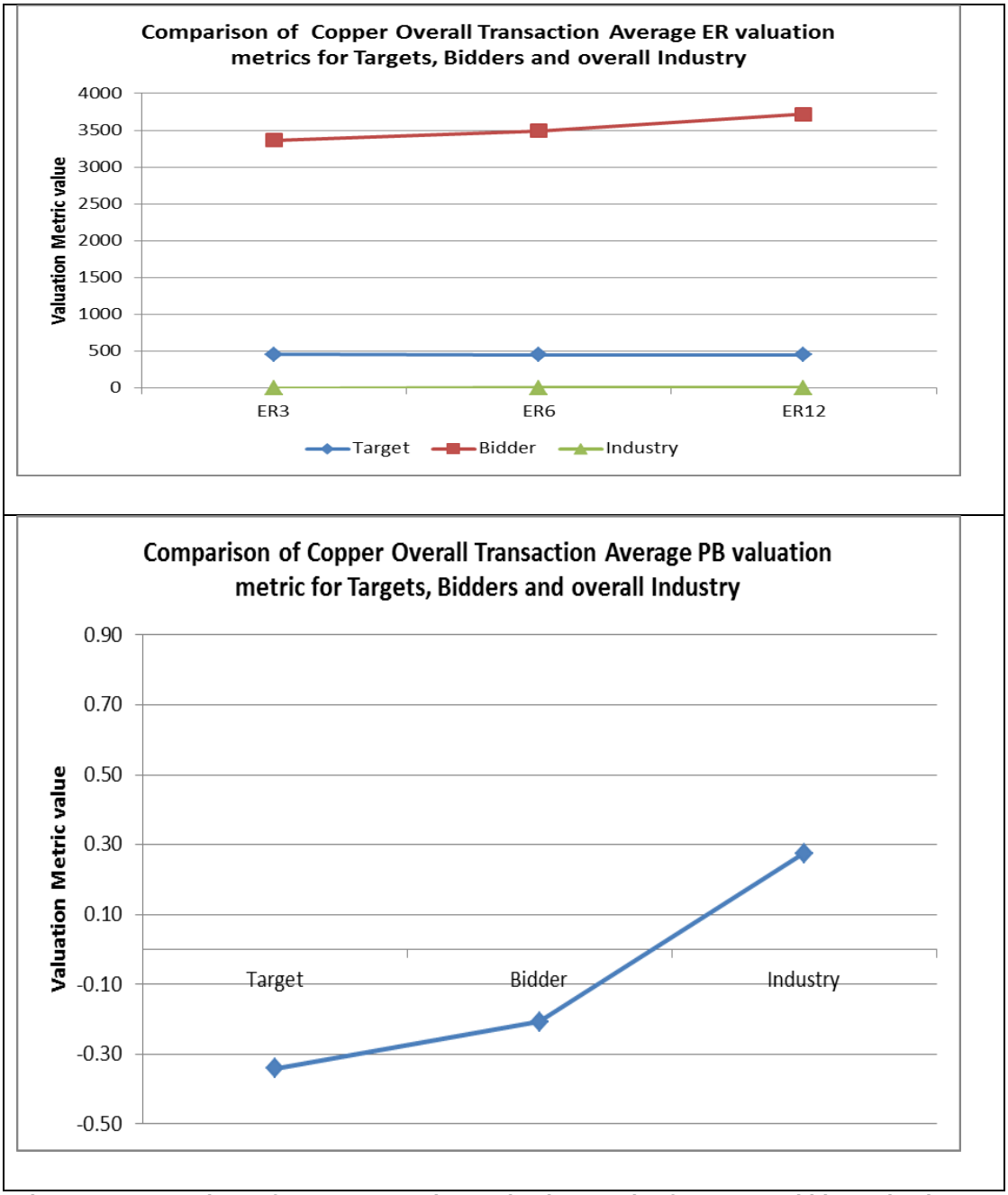


Figure 4.7 Comparison of Copper ER and OB valuation metrics for Target, Bidder and Industry

The PBs calculated for the three groups suggest different valuations of Targets and Bidders in comparison to the ERs: both Target and Bidder companies have negative average PBs, suggestive of undervaluation relative to the industry, and a higher undervaluation for Target companies. The mean Bidder PB was 250% higher than mean Target PB, while the median Bidder PB was 862% higher than the median Target PB. Target mean PB was almost 450% lower than the industry weighted mean PB, while the Target median PB was 218% lower

than the industry median PB. The mean Bidder PB was almost 200% lower than the industry weighted mean PB, and the median Bidder PB was 85% lower than the industry median PB.

Univariate analysis of Bidder, Target and Industry valuations arranged by cash vs. stock

The Targets in M&A transactions where more than 50% of the purchase offer was in cash had mean ER metrics that were between 699% and 2007% higher than Targets purchased with more than 50% Bidder stock. The median ERs for cash Targets was 1062% higher than the median ERs for stock Targets. Cash Bidder mean ERs were 5805% to 11154% higher than stock Bidder mean ERs, while the median ERs for cash Bidders were 1311% higher than stock Bidder median ERs. The cash Targets' mean PB was 48% higher than the mean stock PB, while the cash Bidders' mean PB was 72% higher than the mean PB of stock Bidders (Figures 4.8 and 4.9).

For cash M&A transaction mean Bidder ERs were between 80% and 83% higher than mean Target ERs, while Bidder median ERs were 36% to 74% higher than median Target ERs. Cash Target mean ERs were 536 to 1803 times higher than industry weighted mean ERs, while the cash Target median ERs were 17 to 129 times higher than industry median ERs. Cash Bidder mean ERs were 2679 to 10344 times higher than industry weighted mean ERs, and cash Bidder median ERs were 65 to 202 times higher than industry median ERs.

The mean PB for cash Targets was 442% lower than the mean PB for cash Bidders, while the median PB for cash Targets was 508% lower than the median PB for cash Bidders. Industry weighted mean PB was 328% higher than the cash Targets' mean PB, while the industry median PB was 297% higher than the cash Targets' median PB. The mean PB for cash Bidders was 142% lower than the industry weighted mean PB, and the median cash Bidder PB was 132% lower than the industry median PB.

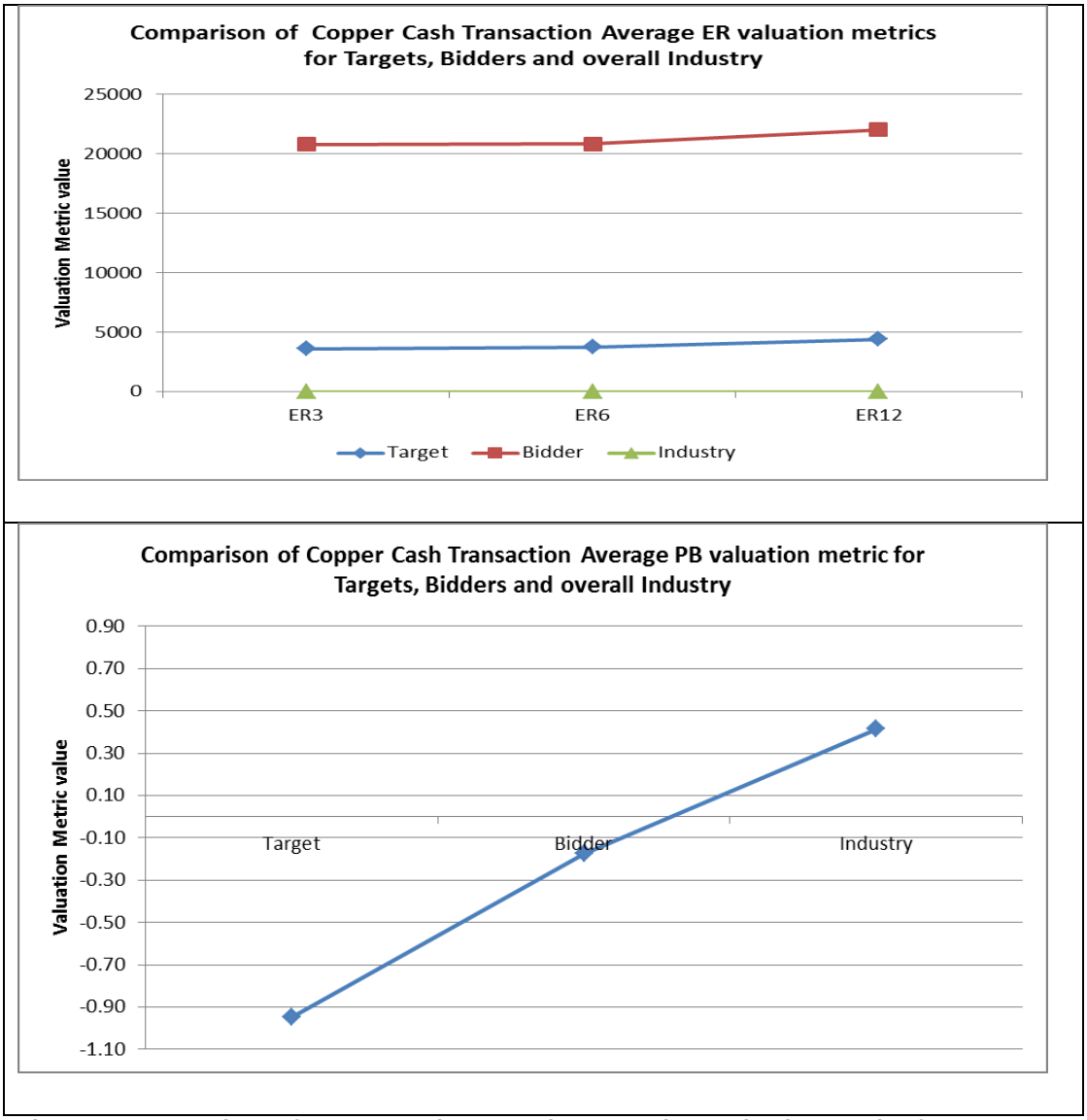


Figure 4.8 Comparison of Copper Cash transaction ER and OB valuation metrics for Target, Bidder and Industry.

The trends in valuation metrics for stock Targets and Bidders differ from the cash Target and Bidder analysis: Targets purchased with more than 50% Bidder stock had mean ERs that were 7% to 29% higher than mean Bidder ERs. Stock Targets' median ERs were between 31% and 67% higher than the stock Bidders' median ERs. The mean ERs for stock Targets were between 49 and 464 times higher than the industry weighted mean ERs, while the stock Targets' median ERs were 1.2 to 16.9 times higher than the industry median ERs. Mean ERs for stock Bidders were between 46 and 360 times higher than the industry weighted mean

ERs, and the stock Bidders' median ERs were 4 to 24 times higher than industry median ERs.

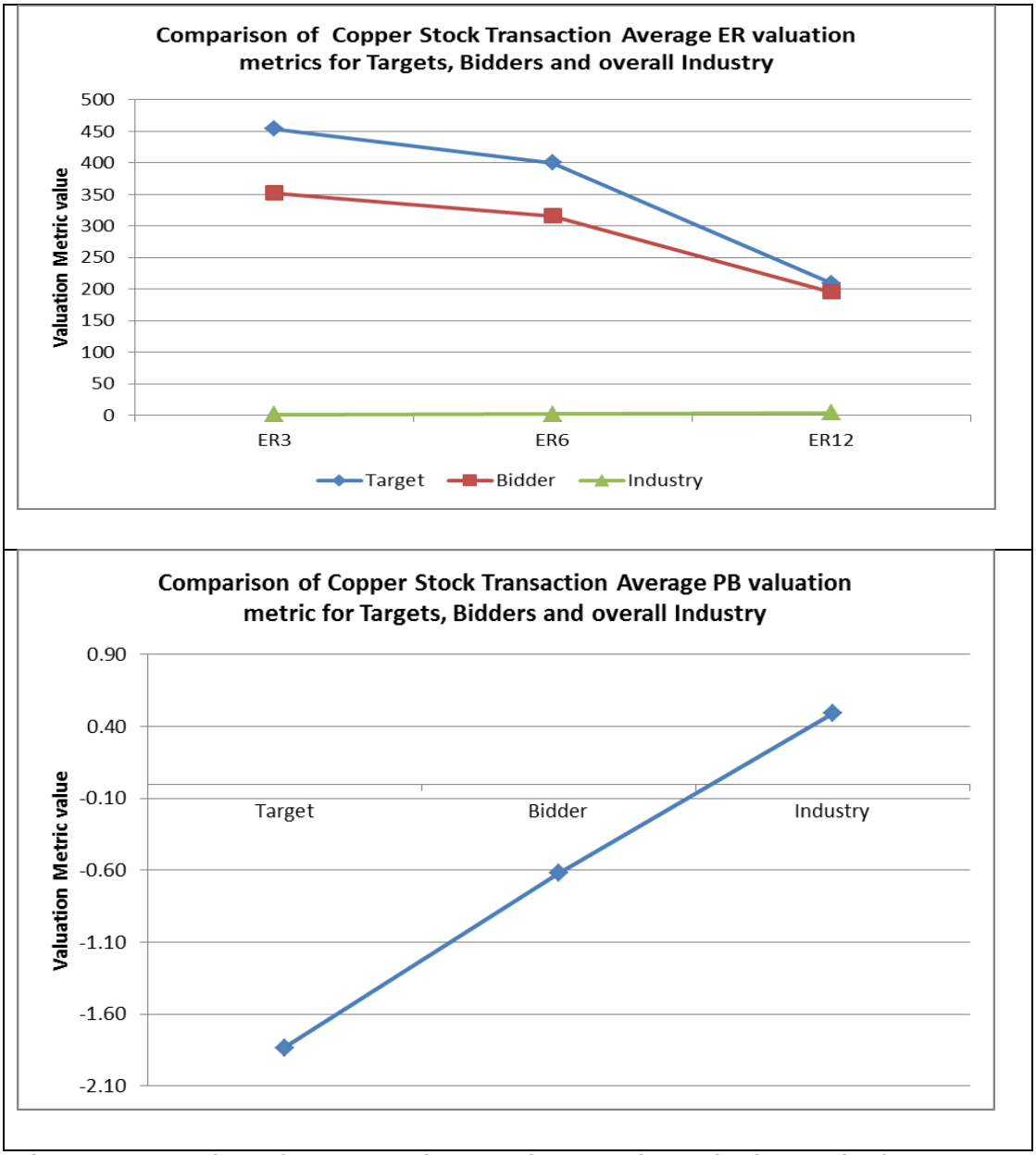


Figure 4.9 Comparison of Copper Stock transaction ER and OB valuation metrics for Target, Bidder and Industry.

Unlike the ER metrics, the PB metrics for stock Targets suggest a similar relationship between stock and cash Targets and Bidders. The mean stock Bidder PB was 197% higher than the mean stock Target PB, while the median stock Bidder PB was 267% higher than the median stock Target PB. The stock Target mean PB was 474% lower than the industry weighted mean PB, and the stock Target median PB was 144% higher than the industry median PB. Stock Bidders' mean PB was 226% lower than the industry weighted mean PB, and the stock Bidders' median PB was 73% lower than the industry median PB.

T-tests Analysis on Valuation metrics

According to the t-tests on the ER3, ER6, ER12 and PB metrics for Copper Target and Diversified Bidder transactions, there was no difference in the valuations of Targets and Bidder companies, between Target companies and the overall mining industry and between Bidder companies and the overall mining industry (Table 4.9)

Table 4.9 T-test statistics of Copper M&A Bidders and Targets vs. Mining industry

Valuation Metric	t-test:	Target vs. Bidder	Target vs. value-weighted Industry	Bidder vs. value-weighted Industry
ER3	Overall t-stat	-1.57	2.12	1.98
	t Critical two-tail	2.11	2.12	2.12
ER6	Overall t-stat	-1.55	2.08	1.97
	t Critical two-tail	2.11	2.12	2.12
ER12	Overall t-stat	-1.46	2.01	1.90
	t Critical two-tail	2.11	2.12	2.12
PB	Overall t-stat	-0.89	-1.96	-1.98
	t Critical two-tail	2.07	2.12	2.12

Similarly, the t-tests on the ER3, ER6, ER12 and PB metrics found no difference between the valuations of cash offer Target companies and stock offer Target companies, cash offer Bidder companies and stock offer Bidder companies. Further, no difference in the valuations of Target companies and Bidder companies involved in cash offer transactions or stock transactions (Table 4.10)

Table 4.10 T-test statistics of Copper M&A cash vs stock transactions

Valuation metric	t test:	Cash vs Stock Targets	Cash vs. Stock Bidders	Cash Target vs. Bidder	Stock Target vs. Bidder
ER3	Overall t-stat	1.58	1.91	1.58	-0.19
	t Critical two-tail	2.31	2.36	2.36	2.26
ER6	Overall t-stat	1.62	1.92	1.57	-0.17
	t Critical two-tail	2.31	2.36	2.31	2.26
ER12	Overall t-stat	1.78	1.89	1.50	10.00
	t Critical two-tail	2.36	2.36	2.31	0.96
PB	Overall t-stat	0.88	-0.63	0.63	0.74
	t Critical two-tail	2.23	2.23	2.23	2.18

Summary of results

The results of the Copper-Diversified Metals & Mining M&A analysis can be summarised as follows:

Univariate analysis

- The findings differed based on whether the PB or ER metric were used
- According to the ER metrics, both Target and Bidder companies on average had g higher valuations than the overall mining market, suggestive of overvaluation relative to the overall mining industry. This was found to be the case for both stock and cash M&A transactions. These findings are in support of the valuation-driven theory which predicts Target and Bidder overvaluation relative to their markets.
- The PB metric suggests that both Target and Bidder companies were undervalued relative to the mining industry, irrespective of whether the mean PB or median PB was used. These findings contradict the valuation-driven theory which predicts Target and Bidder overvaluation relative to their markets.
- Both the PB and ER metrics found that on average, Target companies had lower valuations than the Bidder companies. This finding is in support of the valuation-driven acquisition theory.
- According to the ER metrics, Targets offered mainly cash had higher valuations than Targets offered mainly stock. This finding contradicts the valuation-driven acquisition theory, which predicts that cash Targets would be undervalued when compared to stock Targets.
- According to the analysis of the PB metrics, Targets offered mainly cash as a means of payment had higher valuations than Targets offered mainly stock, and Bidder companies offering mainly cash for the purchase had higher valuations than Bidder companies offering mainly stock for a purchase. These findings are in contrast to the valuation-driven acquisition theory, which predict that cash Targets would be

undervalued when compared to stock Targets, and that Bidder companies would be aware of this and therefore use cash to purchase undervalued stock. Additionally, these findings also refute the prediction that stock Bidders would have higher valuations and therefore would use their overvalued stock to purchase overvalued Targets.

- Both cash Target and Bidder companies had lower valuations than the industry valuations according to the PB metrics. The valuation-driven acquisition theory predicts that cash Targets would be undervalued relative to their market, which is supported by this finding, however, Bidder undervaluation contradicts the valuation-driven acquisition theory
- Stock Bidders and Targets had lower valuations than mean industry PB. The valuation-driven acquisition theory predicts that stock Targets and Bidders would be overvalued relative to their market, which is contradicted by this finding.

t-test analysis

- Similar to the univariate statistical analysis, the results from the t-test analysis differed depending on which valuation metric was used
- T-tests on the ER and PB metrics found no difference between the valuations of Targets and Bidder companies, and that both Target and Bidder companies had similar valuations as the overall mining industry. These findings contradict the valuation-driven acquisition theory with regards to different valuations of Targets and Bidders and the prediction that both Targets and Bidders would have different valuations relative to their
- A t-test comparing cash and stock transactions found no difference between cash and stock Target companies, cash and stock Bidder companies, or the mining industry. The valuation-driven acquisition theory predicts that cash Targets would be undervalued and stock Targets overvalued relative to their market, which is contradicted by this finding.

4.6 Testing the valuation-driven acquisition theory: Diversified Metals M&A

4.6.1 Global Diversified Metals M&A trends

Between 2000 and 2013, 54 M&A transactions involved the acquisition of mining companies classified as “Diversified Metals & Mining”, on the TSX, TSXV, ASX, AIM, LSE, JSE and NYSE exchanges. Total deal value amounted to US$5.2 Billion, of which 65% involved

Bidders also classified as “Diversified Metals & Mining” companies, and 19% of the deal value was due to “Gold Bidders”. More than 80% of the Targets and Bidders involved in M&A over the said period were registered on the TSXV, TSX and ASX (Table 4.11).

Table 4.11 M&A Frequency by Bidder sector (a) and stock exchange (b)

(a)

Diversified M&A Bidder Sector	No. of M&A	Deal Value (US$ Million)
Coal and Consumable Fuels	3	151
Diversified Metals and Metals	35	3 725
Gold	10	1 284
Steel	3	4
Precious Metals and Minerals	3	20

(b)

Exchange	Target	Bidder
TSXV	17	12
TSX	12	14
AIM	4	4
ASX	18	18
JSE	2	5
LSE	1	1

Between 2000 and 2007, up to 2 M&A transactions involved the acquisition of a company classified as “Diversified Metals & Mining” annually in the specified stock exchanges. During this period, 56% of purchase offers involved mainly Bidder stock, 11% of the offers were mainly cash-based, while the rest of the transactions did not report deal values. Much like the Copper transactions, an increase in M&A transactions occurred from 2008 to 2013, at an average rate of 181% inclusive of the 33% decline in 2010. The proportion of cash M&A offers increased to 31%, while the stock offers were slightly less at 53% during the latter period (Figure 4.10). Average deal values decreased from about US$309.8 Million per transaction before 2008, to US$53.3 Million after 2008.

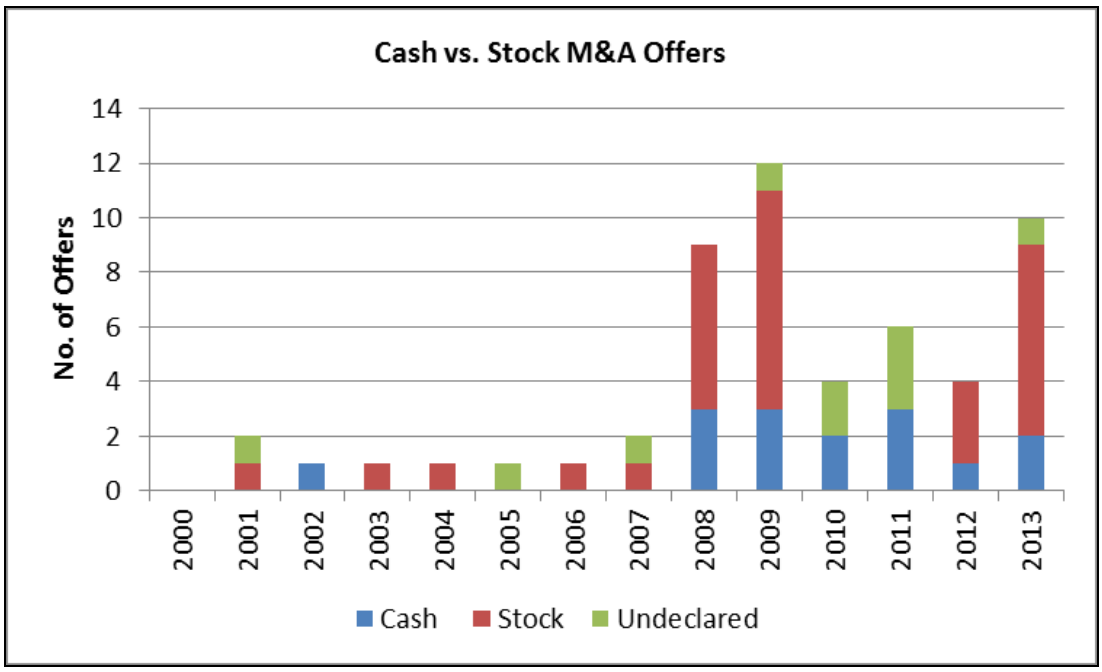


Figure 4.10 Diversified metals & mining M&A deal frequency by year and method of payment (cash vs. stock)

4.6.2 Results for Diversified Metals & Mining transactions

Valuation metrics were calculated for the 54 transactions involving Diversified Metals & Mining Targets, however, only 23 transactions had valuation metrics for both the Target and Bidder companies. These 23 transactions were used to test whether at least some of the premises of the valuation driven acquisition theory could be observed.

Testing the Valuation-based M&A theory hypothesis

Univariate analysis of Bidder, Target and Industry valuations

Univariate analysis of ER metrics of diversified metals & mining Targets and their Bidders shows that these M&A participating companies were overvalued relative to the market or industry ERs (Figure 4.11). The PB metric suggests Target and Bidder undervaluation relative to the mining market, although Targets were more undervalued than Bidders.

Mean Target ERs were 77% to 81% lower than mean Bidder ERs, while the median Target ERs were 51% to 71% lower than median Bidder ERs. The mean ERs for Target companies were 1258 to 3732 times higher than the mean ERs for the mining industry, while the median

ERs for Target companies were 8 to 91 times higher than the industry median ERs. Mean Bidder ERs were 5452 to 19150 times higher than mean industry ERs, while Bidder median ERs were 28 to 249 times higher than median industry ERs.

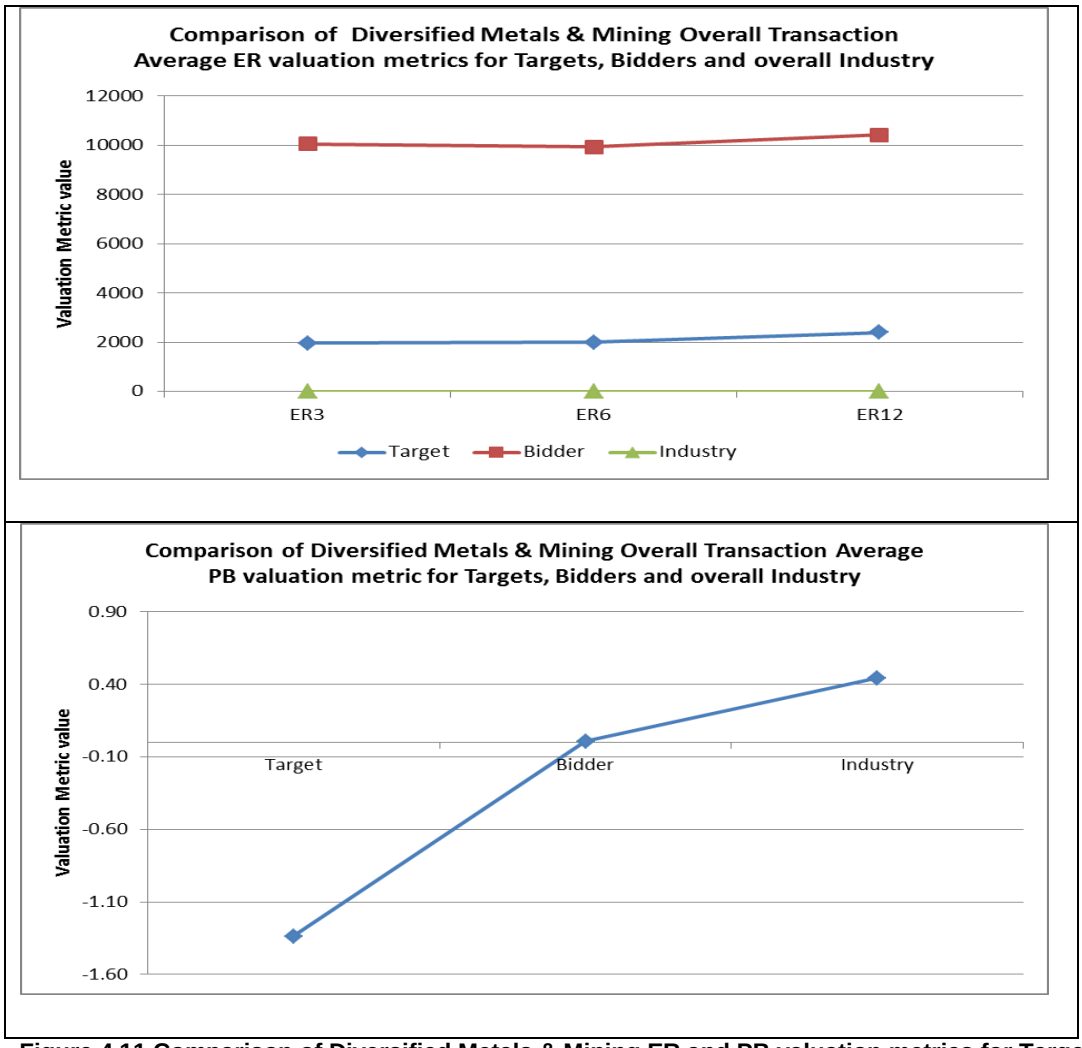


Figure 4.11 Comparison of Diversified Metals & Mining ER and PB valuation metrics for Target, Bidder and Industry.

The mean PB of Target companies was 19000% lower than the mean Bidder mean PB, while the median PB of Target companies was 370% lower than Bidder median PB. Industry weighted average PB was 400% higher than mean Target PB and the median industry weighted average PB was 149% higher than median Target PB. Mean industry weighted PB was 98% higher than mean Bidder PB, while the industry median PB was 82% higher than the median Bidder PB.

Univariate analysis of Bidder, Target and Industry valuations arranged by cash vs. stock

The average ERs for M&A transactions where more than 50% of the deal offer was in cash, were higher than the transactions in which more than 50% of the deal offers was Bidder stock, suggesting higher valuations of companies involved in cash transactions. Cash Targets' mean ERs were between 887% and 450% higher than stock Targets' mean ERs. Cash Bidders' mean ERs were between 796% and 1187% higher than stock Bidders' mean ERs. The industry mean ERs for cash transactions were 66% to 125% higher than industry mean ERs for stock transactions. For cash transactions, the mean Target PB was 59% higher than stock transactions, and the mean Bidder PB was 209% higher than stock transactions. The mean industry PB for cash transactions was 13% lower than stock transactions (Tables 4.12 and 4.13)

Cash Targets' mean ERs were 77% to 82% lower than cash Bidders' mean ERs, and more than 4700 times higher than industry weighted mean ERs. Cash Bidder mean ERs were almost 26000 times higher than industry weighted mean ERs. Cash Targets' median ERs varied -14% to 44% relative to the Bidder median ERs, and up to 64 times higher than industry median ERs. Cash Bidder median ERs were up to 115 times higher than industry weighted mean ERs.

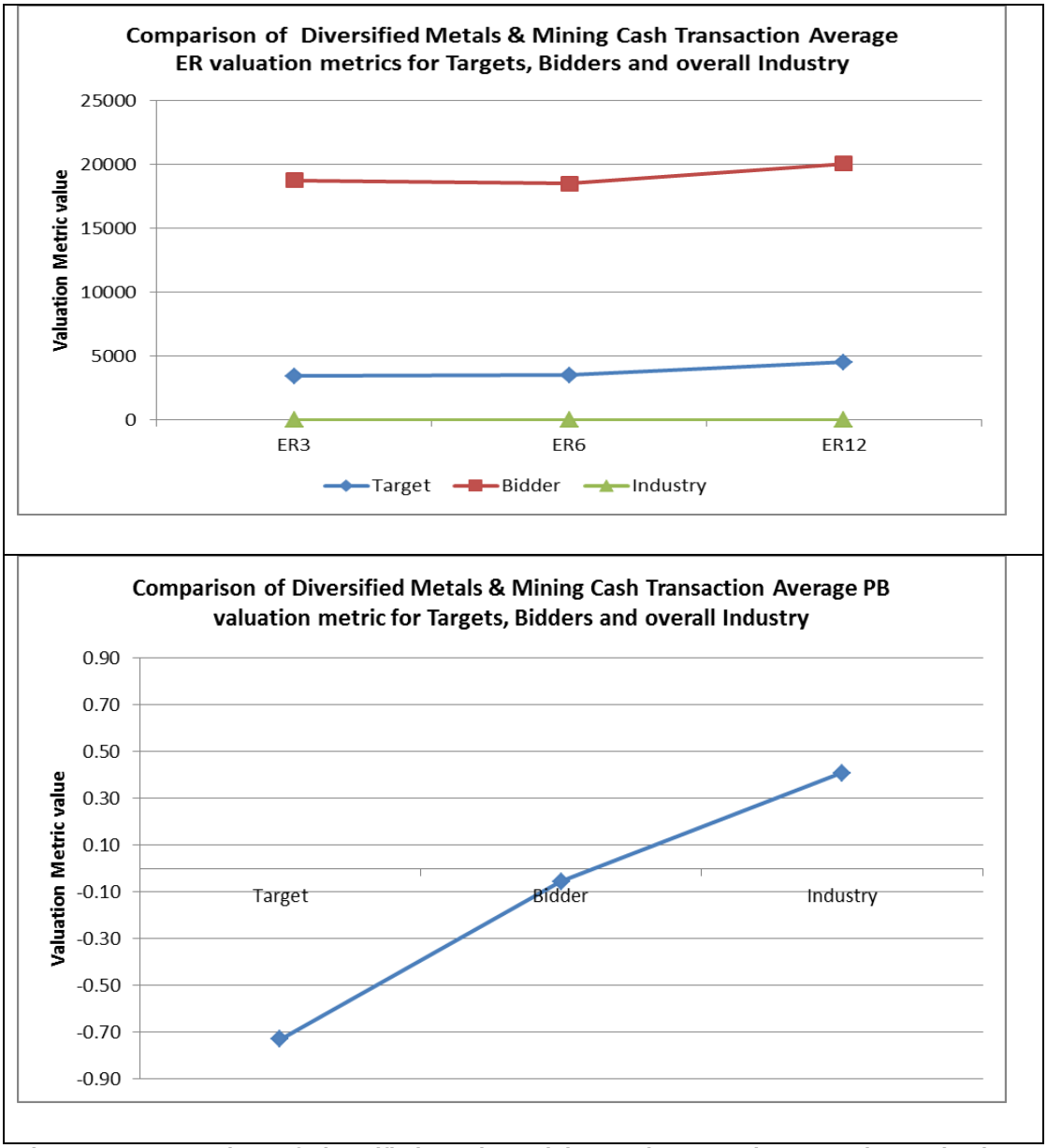


Figure 4.12 Comparison of Diversified Metals & Mining Cash transaction ER and OB valuation metrics for Target, Bidder and Industry

As with the previous sectors, the PB metric valuations differ from the ER valuations: the mean PB for cash Targets was 1245% lower than the mean PB for cash Bidders, while the median PB for cash Targets was 711% lower than the median PB for cash Bidders. Industry weighted mean PB was 278% higher than the cash Targets' mean PB, while the industry median PB was 205% higher than the cash Targets' median PB. The mean PB for cash

Bidders was 113% lower than the industry weighted mean PB, and the median cash Bidder PB was 83% lower than the industry median PB.

Stock Targets' mean ERs were 70% lower than stock Bidders' mean ERs, and more than 1800 times higher than industry weighted mean ERs. Stock Bidder mean ERs were up to 6000 times higher than industry weighted mean ERs. Stock Targets' median ERs were 78% to 82% lower than Bidder median ERs, and up to 51 times higher than industry median ERs. Stock Bidder median ERs were up to 276 times higher than industry weighted mean ERs.

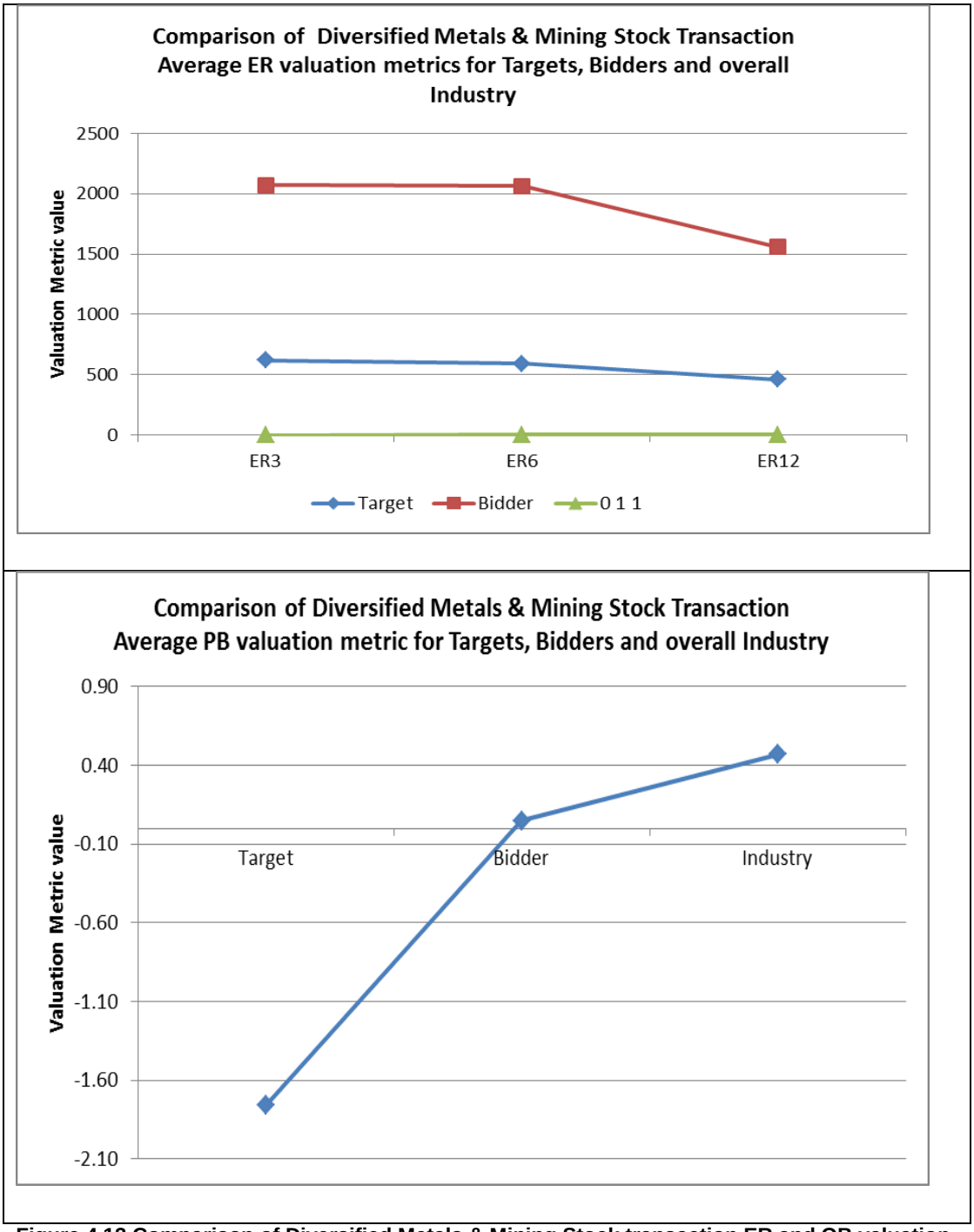


Figure 4.13 Comparison of Diversified Metals & Mining Stock transaction ER and OB valuation metrics for Target, Bidder and Industry.

The mean PB for stock Targets was 3642% lower than the mean PB for cash Bidders, while the median PB for stock Targets was 185% lower than the median PB for stock Bidders. Industry weighted mean PB was 473% higher than the cash Targets' mean PB, while the industry median PB was 130% higher than the cash Targets' median PB. The mean PB for cash Bidders was 89% lower than the industry weighted mean PB, and the median cash Bidder PB was 65% lower than the industry median PB.

T-tests Analysis on Valuation metrics

According to the t-tests on the ER3, ER6, ER12 metrics for Diversified Target and diverse Bidder transactions, there was no difference in the valuations of Targets and Bidder companies, however, there were differences between Target companies and the overall mining industry and between Bidder companies and the overall mining industry. The t-tests on the PB metrics found differences in the valuations of Target companies and Bidder companies, and between Targets, Bidders and the mining industry (Table 4.12)

Table 4.12 T-test statistics of Diversified Metals & Mining M&A Bidders and Targets vs. Mining Industry

Valuation Metric	t-test:	Target vs. Bidder	Target vs. value-weighted Industry	Bidder vs. value-weighted Industry
ER3	Overall t-stat	-1.76	2.31	2.22
	t Critical two-tail	2.06	2.07	2.07
ER6	Overall t-stat	-1.75	2.32	2.24
	t Critical two-tail	2.06	2.07	2.07
ER12	Overall t-stat	-1.65	0.02	0.02
	t Critical two-tail	2.02	0.00	0.00
PB	Overall t-stat	-2.41	-3.30	-3.04
	t Critical two-tail	2.02	2.02	2.02

T-tests on the ER3, ER6, ER12 and PB metrics for cash and stock transactions found no difference between the valuations of cash offer Target companies and stock offer Target companies, cash offer Bidder companies and stock offer Bidder companies. Further, no difference in the valuations of Target companies and Bidder companies involved in cash offer transactions or stock transactions were found (Table 4.13).

Table 4.13 T-test statistics of Diversified Metals & Mining M&A cash vs. stock transactions

Valuation metric	t test:	Cash vs Stock Targets	Cash vs. Stock Bidders	Cash Target vs. Bidder	Stock Target vs. Bidder
ER3	Overall t-stat	1.65	1.88	-1.73	-0.78
	t Critical two-tail	2.02	2.20	2.20	2.18
ER6	Overall t-stat	1.71	1.89	1.71	1.89
	t Critical two-tail	2.20	2.20	2.20	2.20
ER12	Overall t-stat	1.88	2.01	1.88	2.01
	t Critical two-tail	2.23	2.23	2.23	2.23
PB	Overall t-stat	1.08	-0.36	-1.51	-2.03
	t Critical two-tail	2.02	2.03	2.07	2.06

Summary of results

The results of the Diversified Metals & Mining M&A analysis can be summarised as follows:

Univariate analysis

- The findings differed based on whether the PB or ER metric were used
- According to the ER metrics, both Target and Bidder companies on average had higher valuations than the overall mining market, suggestive overvaluation relative to the overall mining industry. This was found to be the case for both stock and cash M&A transactions. These findings are in support of the valuation-driven theory which predicts Target and Bidder overvaluation relative to their markets.
- The PB metric suggests that both Target and Bidder companies were undervalued relative to the mining industry whether the comparison was based on the mean or median industry PB. The findings based on the industry mean PB contradicts the valuation-driven theory which predicts Target and Bidder overvaluation relative to their markets.
- Both the PB and ER metrics found that on average, Target companies had lower valuations than the Bidder companies. This finding is in support of the valuation-driven acquisition theory.
- According to the PB metrics, Targets offered mainly cash as a means of payment had higher valuations than Targets offered mainly stock, and Bidder companies offering mainly cash for the purchase had higher valuations than Bidder companies offering mainly stock for a purchase. These findings are in contrast to the valuation-driven acquisition theory, which predicts that cash Targets would be undervalued when compared to stock Targets, and that Bidder companies would be aware of this and therefore use cash to purchase undervalued stock. Additionally, these findings also refute the prediction that stock Bidders would have higher valuations and therefore would use their overvalued stock to purchase overvalued Targets.

- According to the ER metrics, Targets offered mainly cash had higher valuations than Targets offered mainly stock. This finding contradicts the valuation-driven acquisition theory, which predicts that cash Targets would be undervalued when compared to stock Targets.
- Both cash Target and Bidder companies had lower valuations than the industry valuations according to the PB metrics. The valuation-driven acquisition theory predicts that cash Targets would be undervalued relative to their market, which is supported by this finding.
- Stock Bidders and Targets had lower valuations than mean industry PB. The valuation-driven acquisition theory predicts that stock Targets and Bidders would be overvalued relative to their market, which is contradicted by this finding.

t-test analysis

- Similar to the univariate statistical analysis, the results from the t-test analysis differed depending on which valuation metric was used
- T-tests on the ER metrics found that Targets and Bidder companies had similar valuations, but both Target and Bidder valuations differed from the industry valuations. This finding contradicts the valuation-driven acquisition theory with regards to different valuations of Targets and Bidders, however, the finding that Target and Bidder companies' valuations were different from the overall industry support the valuation-driven acquisition theory.
- T-tests on the PB metrics found that Bidder companies' valuations differed from Target valuations, and both Target and Bidder metrics differed significantly from the overall mining industry. These findings support the valuation-driven acquisition theory with regards to different valuations of Targets relative to Bidders, as well as both Targets and Bidders relative to the overall industry.
- A t-test comparing cash and stock transactions found no difference between cash and stock Target companies, cash and stock Bidder companies. Additionally, no difference was found between Bidders offering mainly cash or stock and their respective Targets. The valuation-driven acquisition theory predicts that cash Targets would be undervalued and stock Targets overvalued relative to their market, which is contradicted by this finding.

4.7 Testing the valuation-driven acquisition theory: Combined Target vs. Bidder vs. Industry Valuations

A combined analysis of all industries discussed above was conducted so as to increase the sample size for analysis and determine whether the predictions made by the valuation-driven acquisition theory would be more discernable especially with the widely used PB metric. This resulted in a sample size of 60 M&A transactions with ER valuations, and 65 transactions with PB valuations. Further to that, an analysis of firm characteristics was done to assess whether there are fundamental differences between M&A participating companies and the general mining industry.

4.7.1 Results for Combined transactions

Testing the Valuation-based M&A theory hypothesis vs. Valuations

Univariate analysis of Bidder, Target and Industry valuations

Similar trends were observed in this combined sample as the analyses conducted for specific sectors above, with the ER metrics suggesting Target and Bidder overvaluation relative to the mining industry, and Bidder companies being more overvalued than Target companies. The PB metric suggests Target and Bidder company undervaluation relative to the mining industry, but also finds that Bidder companies are valued higher that Target companies (Figure 4.14).

Mean Bidder companies ER metrics were between 51% and 53% higher than mean Target ERs, while median Bidder ERs where 80% to 89% higher than median Target ERs. Mean Target ERs were 15 to 731 times higher than mean industry value-weighted ERs, while the median Target ERs were 3 to 25 times higher than median value-weighted ERs of the industry. Mean Bidder ERs were 313 to 1515 times higher than mean industry value-weighted ERs, while the median Bidder ERs were 29 to 124 times higher than median value-weighted ERs of the industry.

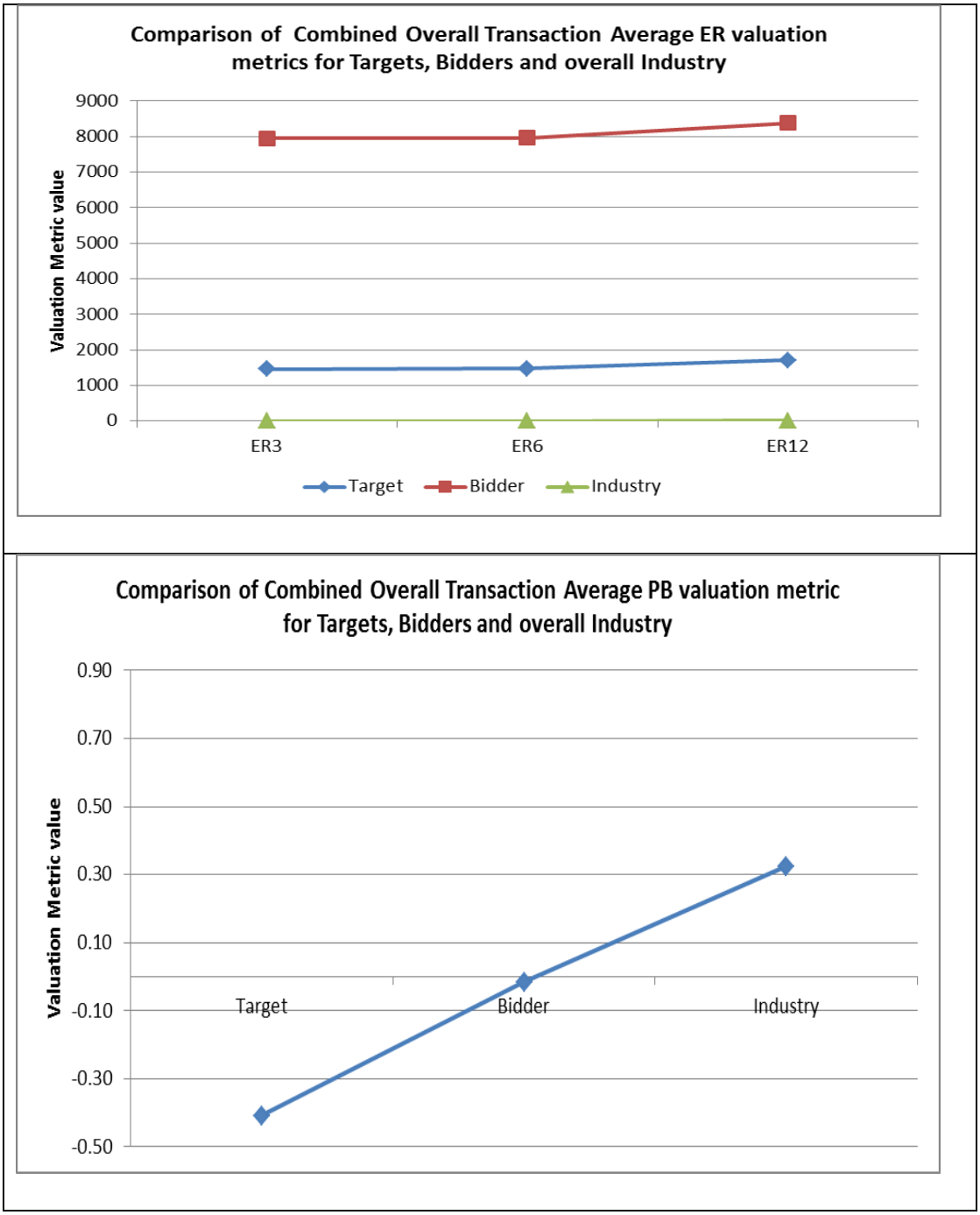


Figure 4.14 Comparison of Diversified Metals & Mining ER and PB valuation metrics for Target, Bidder and Industry

The PB metric also shows a similar trend for the combined sample as for the discrete sector analysis described above. Target and Bidder PBs were lower than the value-weighted mean industry PB. Mean Bidder PB was 231% higher than the mean Target PB, while the median Bidder PB was 263% higher than mean Target PB. Mean value-weighted industry PB was 378% higher than the mean Target PB, while the median value weighted industry PB was 138% higher than the median Target PB. Mean value-weighted industry PB was 184% higher than the mean Bidder PB, while the median value-weighted industry PB was 77% higher than the median Bidder PB.

Univariate analysis of Bidder, Target and Industry valuations arranged by cash vs. stock

The average ERs for M&A transactions where more than 50% of the deal offer was in cash, were higher than the transactions in which more than 50% of the deal offers was Bidder stock, suggesting higher valuations of companies involved in cash transactions. Cash Targets' mean ERs were between 311% and 546% higher than stock Targets' mean ERs. Cash Bidders' mean ERs were between 1158% and 1167% higher than stock Bidders' mean ERs. The industry mean ERs for cash transactions were 53% to 56% higher than industry mean ERs for stock transactions. For cash transactions, the mean Target PB was 57% higher than stock transactions, and the mean Bidder PB was 93% higher than stock transactions. The mean industry PB for cash transactions was 22% lower than stock transactions (Figures 4.15 and 4.16).

Cash Targets' mean ERs were 81% to 84% lower than cash Bidders' mean ERs, and up to 1962 times higher than industry weighted mean ERs. Cash Bidder mean ERs were up to 12450 times higher than industry weighted mean ERs. Cash Targets' median ERs were 88% to 93% lower than Bidder median ERs, and up to 34 times higher than industry median ERs. Cash Bidder median ERs were up to 274 times higher than industry weighted mean ERs.

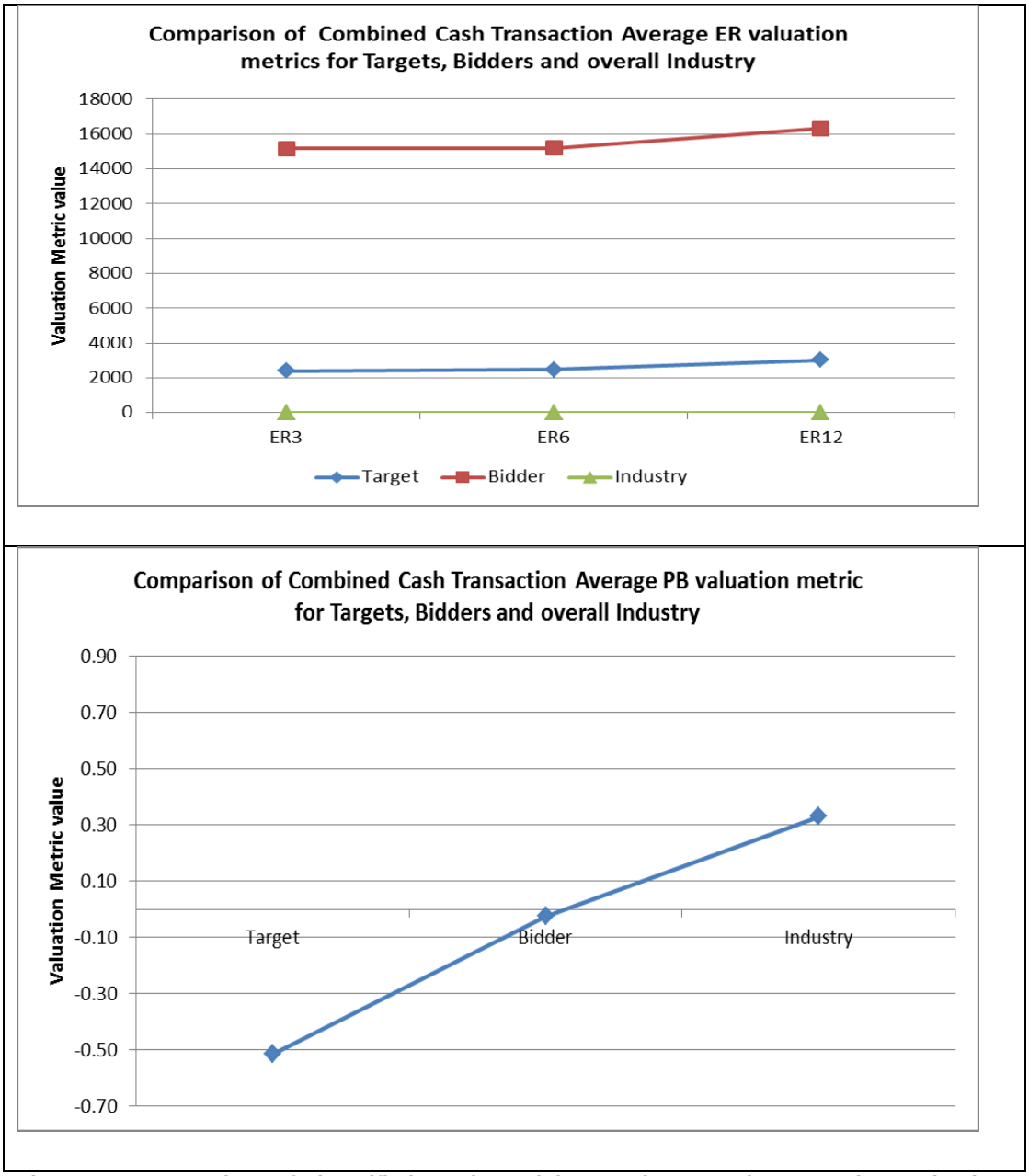


Figure 4.15 Comparison of Diversified Metals & Mining Stock transaction ER and OB valuation metrics for Target, Bidder and Industry

As with the previous sectors, the PB metric valuations differ from the ER valuations relative to the overall mining industry: the mean PB for cash Targets was 2043% lower than the mean PB for cash Bidders, while the median PB for cash Targets was 58% lower than the median PB for cash Bidders. Industry weighted mean PB was 255% higher than the cash Targets'

mean PB, while the industry median PB was 271% higher than the cash Targets' median PB. The mean PB for cash Bidders was 107% lower than the industry weighted mean PB, and the median cash Bidder PB was 31% lower than the industry median PB.

Stock Targets' mean ERs were about 50% lower than stock Bidders' mean ERs, and up to 731 times higher than industry weighted mean ERs. Stock Bidder mean ERs were up to 1515 times higher than industry weighted mean ERs. Stock Targets' median ERs were 80% to 89% lower than Bidder median ERs, and up to 25 times higher than industry median ERs. Stock Bidder median ERs were up to 124 times higher than industry weighted mean ERs.

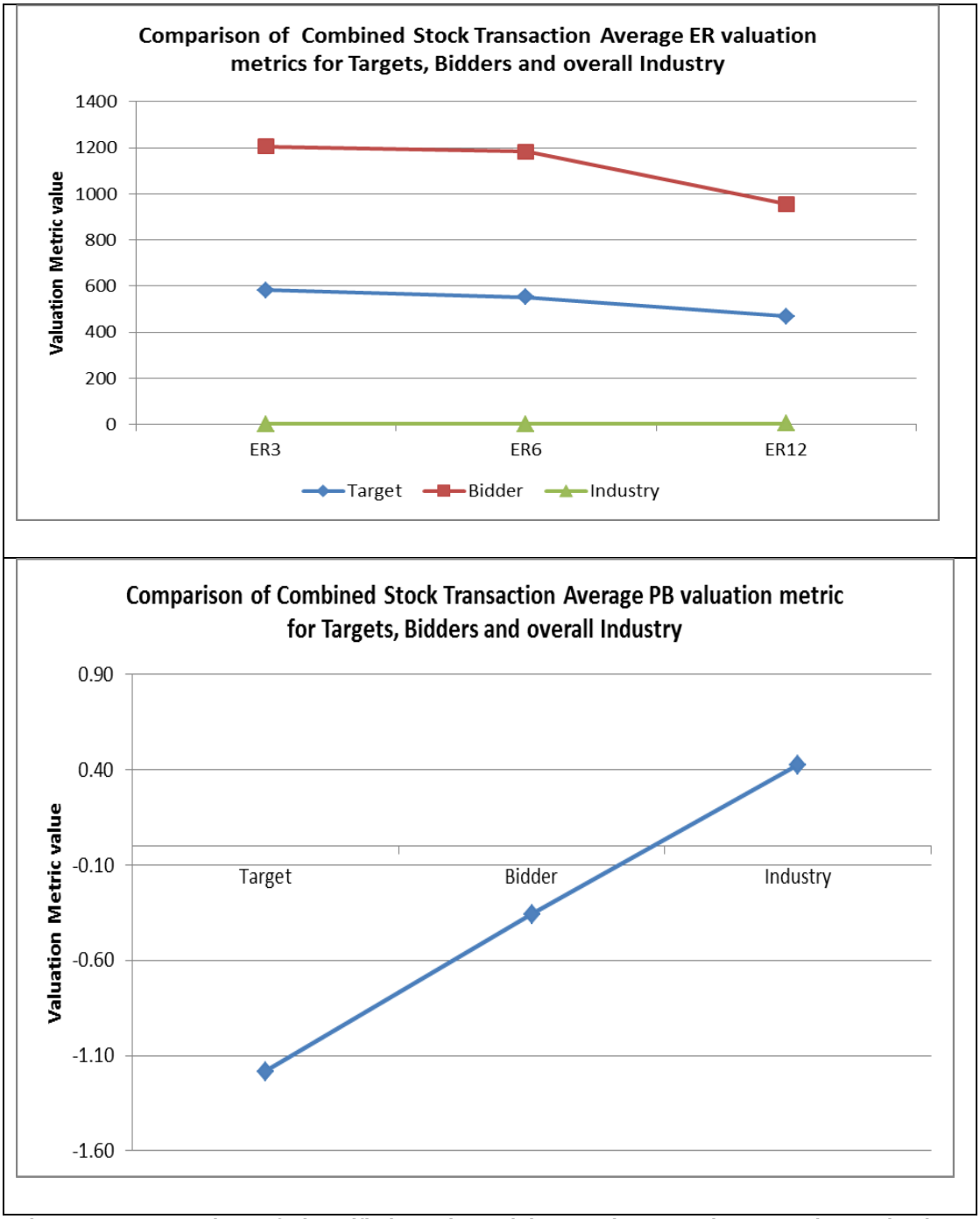


Figure 4.16 Comparison of Diversified Metals & Mining Stock transaction ER and OB valuation metrics for Target, Bidder and Industry.

The mean PB for stock Targets was 231% lower than the mean PB for cash Bidders, while the median PB for stock Targets was 263% lower than the median PB for stock Bidders. Industry weighted mean PB was 378% higher than the cash Targets' mean PB, while the industry median PB was 138% higher than the cash Targets' median PB. The mean PB for cash Bidders was 184% lower than the industry weighted mean PB, and the median cash Bidder PB was 77% lower than the industry median PB.

T-test analysis of valuation metrics

T-tests conducted on the ER3, ER6 and ER12 metrics for the combined sample of gold, copper and diversified M&A transactions found differences between the Target company and Bidder company valuations and differences in the valuation of Target and Bidder companies in relation to the mining industry. The t-tests on the PB metrics also found no differences between the valuations of Target companies and Bidder companies. The t-tests on the PB metric that Target companies and Bidder companies were valuated differently to the mining industry (Table 4.14).

Table 4.14 T-test analysis of valuation metrics of Combined M&A transactions

Valuation Metric	t-test:	Target vs. Bidder	Target vs. Equal-weighted Industry	Bidder vs. Equal-weighted Industry	Target vs. value-weighted Industry	Bidder vs. value-weighted Industry
ER3	Overall t-stat	-2.69	3.27	3.34	3.29	3.35
	t Critical two-tail	2.00	2.00	2.00	2.00	2.00
ER6	Overall t-stat	-2.70	3.22	3.36	3.27	3.37
	t Critical two-tail	2.00	2.00	2.00	2.00	2.00
ER12	Overall t-stat	-2.58	3.00	3.30	3.08	3.32
	t Critical two-tail	2.00	2.00	2.00	2.00	2.00
PB	Overall t-stat	-1.82	-4.32	-3.80	-3.89	-3.35
	t Critical two-tail	2.00	1.99	1.98	2.01	2.00

T-tests on the ER3, ER6, and ER12 metrics for cash and stock transactions found differences in the valuations of cash offer Target companies and stock offer Target companies, cash offer Bidder companies and stock offer Bidder companies, as well as cash offer Target companies and cash offer Bidder companies. No difference in the valuations of stock offer Target companies and stock offer Bidder companies were found based on the three ER metrics. T-tests on the PB metrics found no difference between the valuations of cash offer Target companies and stock offer companies, cash offer Bidder companies and stock offer Bidder companies, cash offer Target companies and cash offer Bidder companies, and stock offer Target companies and stock offer Bidder companies (Table 4.15).

Table 4.15 T-test analysis of valuation metrics of cash vs. stock offer Combined M&A transactions

Valuation metric	t test:	Cash vs Stock Targets	Cash vs. Stock Bidders	Cash Target vs. Bidder	Stock Target vs. Bidder
ER3	Overall t-stat	2.05	3.05	2.78	0.82
	t Critical two-tail	2.03	2.05	2.04	2.03
ER6	Overall t-stat	2.13	3.09	2.79	0.83
	t Critical two-tail	2.04	2.05	2.04	2.03
ER12	Overall t-stat	2.33	3.17	2.70	0.80
	t Critical two-tail	2.04	2.05	2.04	2.02
PB	Overall t-stat	1.14	0.99	1.44	1.41
	t Critical two-tail	2.00	2.00	2.01	2.00

Summary of results: Testing the Valuation-based M&A theory hypothesis vs. Valuations

The results of the Combined M&A analysis can be summarised as follows:

Univariate analysis

- The findings differed based on whether the PB or ER metric were used
- According to the ER metrics, both Target and Bidder companies on average had higher valuations than the overall mining market, suggestive overvaluation relative to the overall mining industry. This was found to be the case for both stock and cash M&A transactions. These findings are in support of the valuation-driven theory which predicts Target and Bidder overvaluation relative to their markets.
- The PB metric suggests that both Target and Bidder companies were undervalued relative to the mining industry whether the comparison was based on the mean or median industry PB. The findings based on the industry mean PB contradicts the valuation-driven theory which predicts Target and Bidder overvaluation relative to their markets.
- Both the PB and ER metrics found that on average, Target companies had lower valuations than the Bidder companies. This finding is in support of the valuation-driven acquisition theory.
- According to the PB metrics, Targets offered mainly cash as a means of payment had higher valuations than Targets offered mainly stock, and Bidder companies offering mainly cash for the purchase had higher valuations than Bidder companies offering mainly stock for a purchase. These findings are in contrast to the valuation-

driven acquisition theory, which predicts that cash Targets would be undervalued when compared to stock Targets, and that Bidder companies would be aware of this and therefore use cash to purchase undervalued stock. Additionally, these findings also refute the prediction that stock Bidders would have higher valuations and therefore would use their overvalued stock to purchase overvalued Targets.

- According to the ER metrics, Targets offered mainly cash had higher valuations than Targets offered mainly stock. This finding contradicts the valuation-driven acquisition theory, which predicts that cash Targets would be undervalued when compared to stock Targets.
- Both cash Target and Bidder companies had lower valuations than the industry valuations according to the PB metrics. The valuation-driven acquisition theory predicts that cash Targets would be undervalued relative to their market, which is supported by this finding.
- Stock Bidders and Targets had lower valuations than mean industry PB. The valuation-driven acquisition theory predicts that stock Targets and Bidders would be overvalued relative to their market, which is contradicted by this finding.

t-test analysis

- Similar to the univariate statistical analysis, the results from the t-test analysis differed depending on which valuation metric was used
- T-tests on the ER metrics found that Targets and Bidder companies had different valuations, and both Target and Bidder valuations differed from the industry valuations. These findings support the valuation-driven acquisition theory with regards to different valuations of Targets and Bidders, and the finding that Target and Bidder companies' valuations were different from the overall industry support the valuation-driven acquisition theory.
- T-tests on the PB metrics found that Bidder companies' valuations did not differ from Target valuations, and both Target and Bidder metrics differed significantly from the overall mining industry. These findings contradict the valuation-driven acquisition theory with regards to different valuations of Targets relative to Bidders but support the valuation-driven theory regarding both Targets and Bidders having different valuations relative to the overall industry.
- A t-test comparing ER metrics of cash and stock transactions found no difference between cash and stock Target companies, which contradicts the valuation-driven

acquisition theory. Cash Bidder companies had different valuations in relation to their Targets, while no difference was observed in the metrics of stock Bidders relative to their Target, which contradict the valuation-driven acquisition theory.

Firm Characteristics

All companies involved in M&A transactions were compared on the following firm accounting characteristics at the time of the announcement of the transactions: total assets, market capitalisation, debt: equity ratio, goodwill, goodwill: assets ratio. Valuation-based acquisition theory postulates that Target and Bidder companies are valuated differently by their markets, which is why these companies tend to be involved in M&A. The purpose of conducting comparisons based on firm characteristics was, therefore, to determine whether the valuation differences are visible at fundamental firm characteristic level. In this analysis, Target companies were compared to Bidder companies, and companies involved in M&A transactions were compared to the rest of the mining industry.

Univariate Statistics for Firm Characteristics

The mean industry total assets, market capitalisation and debt: equity ratio were higher than the Target and Bidder company mean, however, the mean industry goodwill was lower than Target and Bidder companies. The median industry values for the accounting characteristics were lower than Target and Bidder companies. Industry means were skewed by one stock, therefore comparison relative to the median statistics are included in this analysis. For example, the maximum market capitalisation in the mining industry was found to be US$ 199 533 Million, in comparison to the 75th percentile market capitalisation of US$ 42.6 Million.

On average, Bidder companies' mean total assets were 66% higher than Target companies' total assets. The value-weighted mean total assets for the mining industry were 90% higher than Bidder companies and 96% higher than Target companies. The median value-weighted industry total assets were 688% lower than median Bidder total assets and 128% lower than median Target total assets. The mean Bidder market capitalisation was 72% higher than the mean Target market capitalisation. Mean industry market capitalisation was 90% higher than Bidder companies' market capitalisation and 96% higher than the mean Target company market capitalisation. Median industry market capitalisation was 978% lower than median Bidder market capitalisation and 84% lower than mean Target market capitalisation (Table 4.16).

Table 4.16 Univariate statistics of Targets and Bidders firm characteristics

Firm Characteristics	Mean			Median		
	Target	Bidder	Industry	Target	Bidder	Industry
Assets	1589.93	4634.42	45112.61	18.17	62.71	7.96
Market Cap	1668.02	5965.49	45631.40	16.61	97.20	9.02
Debt: Equity	323.80	305.52	7061.07	21.95	37.22	3.08
Goodwill	2728.82	3174.38	1587.35	74.44	267.98	40.14
Goodwill:Assets	0.11	0.06	0.04	0.14	0.08	8.48

On average, mean Bidder debt: equity ratio was 6% lower than the mean Target debt: equity ratio. Industry mean debt: equity ratio was 96% higher than Bidder debt: equity ratios, and 95% higher than mean Target debt: equity ratios. Median Bidder debt: equity ratios were 41% higher than Target median debt: equity ratios, while 1108% higher than industry median debt: equity ratios.

Bidder companies' mean goodwill was 14% higher than Target companies and 100% higher than industry mean goodwill. Target companies mean goodwill was 72% higher than industry goodwill. Median goodwill for Bidder companies was 72% higher than Target companies and 568% higher than median industry goodwill. Median Target goodwill was 85% higher than industry goodwill. The median goodwill to assets ratio of Bidder companies was 74% lower than Target companies, while industry goodwill to assets ratios was 98% higher than Target companies and 99% higher than Bidder companies.

Target vs Bidder Firm Characteristics quartile deportment

Industry quartiles were calculated for the firm characteristics with the purpose of assessing which quartiles Target and Bidder companies mainly deported to (Table 4.17). Industry averages for firm characteristics have a strong negatively skewed distribution, with high 75th percentile companies having total assets and market capitalisation about 5000 times lower than the maximum value. The debt: equity ratio of the 75th percentile companies was 250 times lower than the maximum debt: equity ratio, while the goodwill of the 75th companies was 53 times lower than the maximum.

Table 4.17 Firm characteristics quartiles for the Mining industry

Quartiles	Mean			
	25th	50th	75th	100th
Assets	1.98	7.96	35.63	174237.01
Market Cap	3.15	9.02	34.57	179327.02
Debt: Equity	0.24	3.08	26.47	6651.62
Goodwill	4.58	40.14	302.08	16165.48
Goodwill:Assets	0.02	0.05	0.12	0.75

For most of the firm characteristics assessed, more than 50% of Bidder companies reported in the fourth quartile, except for the goodwill to total assets ratio. Bidder companies' market capitalisation and total assets were more than 62% within the fourth quartile. More than 80% of Bidder companies report to the third and fourth quartiles of the mining industry for all firm characteristic accept the goodwill to assets ratio where 50% deportment was observed (Table 4.18).

Table 4.18 Deportment of Target and Bidder companies in firm characteristics quartiles

Quartile Deportment	25th		50th		75th		100th		Total Observations vs. Transactions	
	Target	Bidder	Target	Bidder	Target	Bidder	Target	Bidder	Target	Bidder
Assets	12%	4%	22%	15%	26%	20%	39%	62%	63%	63%
Market Cap	17%	3%	19%	14%	24%	12%	40%	71%	54%	54%
Debt: Equity	15%	4%	15%	15%	19%	31%	50%	50%	15%	15%
Goodwill	38%	15%	0%	0%	25%	31%	38%	54%	5%	8%
Goodwill:Assets	25%	29%	13%	21%	13%	36%	50%	14%	5%	8%

More than 38% of Target companies deported to the fourth quartile for all firm characteristics, and between 63% and 69% of Target companies deported to the third and fourth quartiles of the mining industry firm characteristics.

T-test for differences in Target vs. Bidder vs. industry firm characteristics

T-tests conducted to compare total assets found no difference between the total assets, debt:equity ratio and goodwill of Target companies and Bidder companies. Significant differences were found between the total assets and goodwill of Target and Bidder companies in relation to the mining industry. T-tests for Target and Bidder company market capitalisation were different. No difference was observed between the Target company

market capitalisation and the overall mining industry; however, the Bidder company market capitalisation differed from the overall mining industry (Table 4.19).

Table 4.19 T-test analysis on firm characteristics

Valuation Metric	t-test:	Target vs. Bidder	Target vs. value-weighted Industry	Bidder vs. value-weighted Industry
Total Assets	Overall t-stat	-1.63	-24.08	-18.44
	t Critical two-tail	1.97	1.97	1.97
Market Capitalisation	Overall t-stat	-2.47	1.32	3.55
	t Critical two-tail	1.98	1.99	1.99
Debt: Equity	Overall t-stat	-1.94	-21.12	0.43
	t Critical two-tail	2.06	2.06	2.06
Goodwill	Overall t-stat	-0.64	-7.37	-6.40
	t Critical two-tail	1.97	1.97	1.98
Goodwill: Asset	Overall t-stat	0.22	-6.90	-9.72
	t Critical two-tail	1.97	1.98	1.97

Summary of results: Testing the Valuation-based M&A theory hypothesis vs. Firm Characteristics

Target and Bidder companies' firm characteristics differed from median industry firm characteristics as summarised below. The fundamental values of Target and Bidder companies are mostly aligned with the propositions of the valuation-driven acquisition theory.

Univariate analysis

Target and Bidder companies' firm characteristics differed from median industry firm characteristics as summarised below:

- Median Bidder total assets, market, debt: equity ratios, and goodwill were higher than equivalent Target firm characteristics, suggesting that the largest companies in the mining industry tend to be bidding companies.
- Median Target and Bidder total assets, market, debt: equity ratios, and goodwill were higher than median industry firm characteristics, suggesting the largest companies in the mining industry participate actively in M&A activities
- Target and Bidder companies had lower goodwill: total assets ratios relative to the overall industry

- Target and Bidder companies occur mainly within the third and fourth quartile of mining industry firm characteristics, further suggesting the largest companies in the mining industry participate actively in M&A activities

T-test analysis

- The t-test analysis found no difference between Target and Bidder total assets, debt: equity ratio, goodwill and goodwill: assets ratios.
- Bidder market capitalisation was different from Target and industry market capitalisation.
- Target market capitalisation was similar to the industry market capitalisation
- Both Bidders and Target companies' total assets, debt: equity ratio, goodwill and goodwill: assets differed from equivalent industry firm characteristics

4.8 Testing the valuation-driven acquisition theory: Merger waves and valuation trends

According to the valuation-driven acquisition theory, merger waves can be explained by changes in market valuations: periods of high M&A activities corresponds to periods of a high number of undervalued stock. To test this hypothesis, the annual weighted average market valuation metrics for mining companies registered on the selected stock exchanges were regressed against the annual M&A volumes and overall M&A deal values. Periods of depressed overall market valuation metrics were interpreted as periods with a relatively higher number of undervalued stocks in comparison to periods of higher overall market valuations (Figure 4.17). M&A activity in the 2000-2004 period was subdued in comparison to the 2005-2013 period: the annual M&A deals announced were less than 200 in the former period but increased to above 300 annually in the latter period.

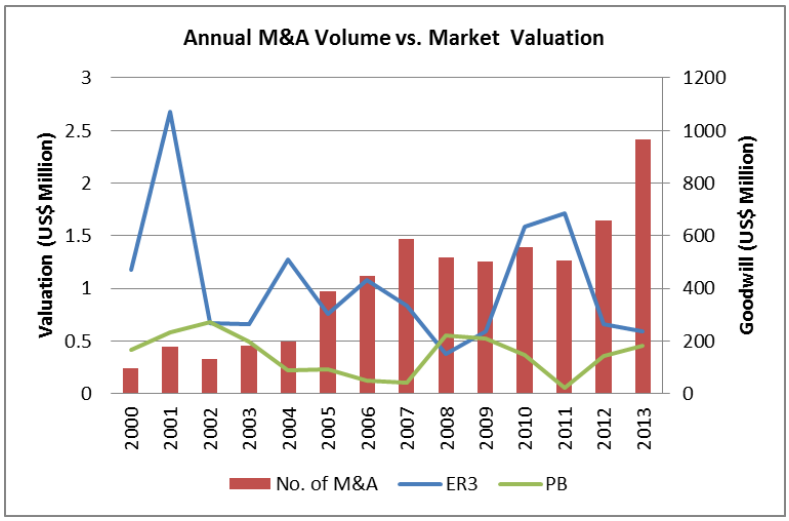


Figure 4.17 Annual M&A activity in selected stock exchanges vs. average aggregate annual ER and PB valuations

The average market valuation metrics for the 2000-2004 period was estimated to be 1.3 (ER3) and 0.5 (PB), which were higher than the average market valuations for the latter period, estimated at 0.9 (ER3) and 0.3 (PB). This finding suggests that periods of higher M&A activities do correspond to lower market valuations, as predicted by the valuation-driven acquisition theory, but was further tested using regression analysis. Annual M&A deal volume and M&A deal values were regressed against the ER3 and PB valuation metrics. The results as summarised in Table 4.20 show that there is a difference in correlation coefficients of the 2000-2004 relative to the 2005-2013 period: in the 2000-2004 period, a weak positive correlation coefficient of 0.26 is estimated between the M&A deal volume and the ER3 metric, while it is 0.10 between the M&A deal value and the ER3 metric. For the 2005-2013 period, the correlation coefficients are similar in magnitude but are negative. Using the PB metric in a correlation coefficient of -0.30 is estimated when regressed against the M&A volume for the 2000-2004 and 0.33 for the 2005-2013 period. The correlation coefficients estimated for the regression of M&A value with PB finds a more significant relationship: -0.81 over the 2000-2004 period, and 0.41 over the 2005-2013 period.

Table 4.20 Correlation between M&A deal volumes and valuations vs. valuation metrics

Correlation Coefficients	Valuation Metrics	
	ER3	PB
M&A volume vs. Valuation		
2000-2004	0.26	-0.30
2005-2013	-0.25	0.33
Overall	-0.32	-0.25
Overall p-value	0.26	0.39
M&A deal value vs. Valuation		
2000-2004	0.10	-0.81
2005-2013	-0.12	-0.41
Overall	-0.22	-0.58
Overall p-value	0.46	0.03

The overall correlation coefficients were tested at the 5% level of significance over the 2000-2013 period. The p-values for the regression of M&A deal volume against both the ER3 and PB metrics were all significantly above 5% suggesting that changes in the annual M&A deal volumes over the period analysed are not explained by changes in overall market valuations. Similarly, there seemed to be no relationship between the annual M&A deal value and the overall ER3 metric as the p-value of the regression was above 5%. In contrast, the p-value for the regression between the M&A deal value against the PB metric was below 5% which suggests that changes in annual M&A deal values are to an extent explained by changes in the PB metric. The coefficient of determination (R^2) of 0.33 suggests that only about 33% of the changes in the M&A deal values were explained by changes in the PB metric.

Summary of results

There seems to be no relationship between overall ER and PB market valuation and trends M&A deal volumes, suggesting that M&A are not triggered by trends in market valuation. The strong positive correlation between M&A deal values and the PB metric is significant, but not matched by the ER metric.

4.9 Testing the Valuation vs. Post-acquisition value write-downs hypothesis

As stated in section 2.6.1, when the amount paid for an acquisition exceeds the fair value of the tangible assets (corrected for the value of liabilities), the excess amount is captured on balance sheets as an intangible asset referred to as “goodwill” (FASB, 1999). In this section, the results of the analyses for correlation between M&A volumes, goodwill, impairments and valuations are presented. The study is restricted to all M&A reported on the stock exchanges as defined above, however, the absence of financial and market data for many transactions reduced the sample size considerably.

4.9.1 Overall Goodwill vs. M&A activity

Total goodwill carried on the balance sheets of mining companies listed on the selected exchanges was compared to M&A transactions volumes over the 2000 to 2013 period (Figure 4.18). From 2000 to 2006, average reported annual goodwill was about US$34 Billion and increased to an average of about US$151 Billion between 2007 and 2013.

The increase in the amount of M&A transactions has a strong positive correlation with total goodwill in the year of the deal announcement, with a correlation coefficient of 0.75. The correlation coefficient increases to 86% one year after the deal was announced, which is by the time M&A-related goodwill would be expected to appear in financial statements.

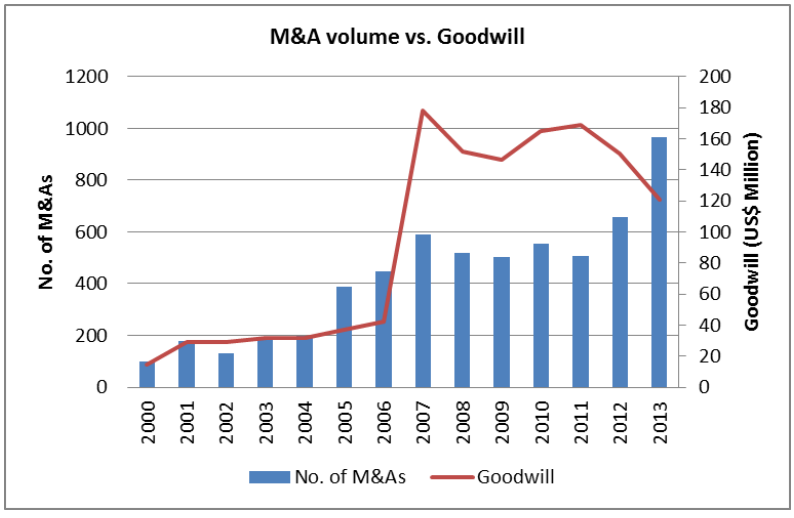


Figure 4.18 Annual M&A activity in selected stock exchanges vs. annual overall Goodwill

Reported goodwill was regressed against the commodity price index (CRB) and the mining index (Index Mundi, 2016) (Figure 4.19) and positive correlation coefficients of 0.69 and 0.90 were observed respectively. The p-value was significantly below 5% and suggests that changes in mining goodwill were related to industry-wide changes in mining and the global economy.

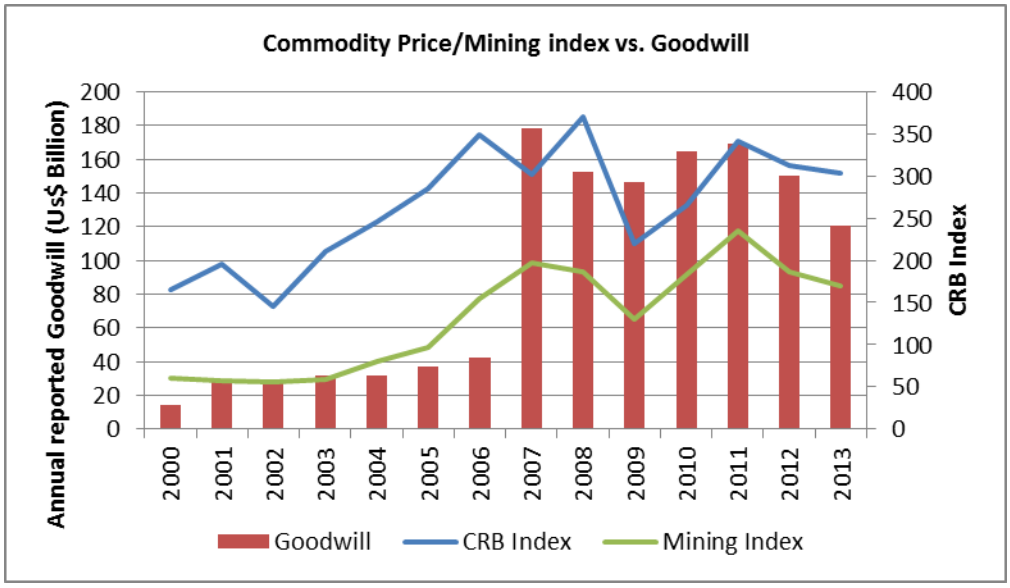


Figure 4.19 Annual M&A activity in selected stock exchanges vs. annual CRB and Mining indexes

4.9.2 Goodwill impairments vs. M&A activity

Total goodwill impairments carried on the balance sheets of mining companies listed on the selected exchanges was compared to M&A transactions volumes over the 2000 to 2013 period (Figure 4.20). Reported impairments follow a similar trend as the goodwill: from 2000 to 2006, the average annual goodwill impairments reported was US$0.25 Billion, indicative of positive impairment values as opposed to actual negative goodwill impairments. During this period, the absolute value of goodwill impairments varied from 0% to 2.7% of reported goodwill. Average annual goodwill impairments from 2007 to 2013 was US$ -6.95 Billion, and coincided with increased M&A transactions and reported goodwill. Absolute goodwill impairments reported in the latter period ranged from 0% to 6.6% of overall goodwill.

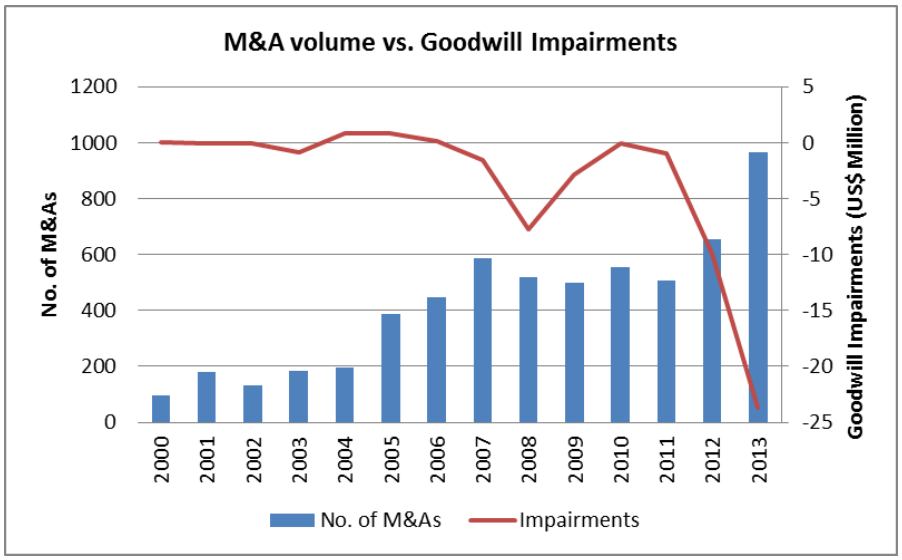


Figure 4.20 Annual M&A activity in selected stock exchanges vs. annual goodwill impairments

The correlation coefficient between goodwill impairments and M&A volume suggest a strong negative correlation of -0.77 when measured in the same year as reported M&A transactions, and decreased to -0.62 when cross-correlated a year after the M&A transaction. Goodwill impairments have a strong negative correlation with reported goodwill: -0.55 one year after the reported goodwill and strengthened to -0.79 five years after the reported goodwill. Reported goodwill impairment was regressed against the commodity price index (CRB) (Investing) and the mining index (Index Mundi, 2016) (Figure 4.21), and weak correlation coefficients of -0.35 and -0.37 were observed. When the mining index was regressed against goodwill impairments two years after M&A transactions occurred, then the correlation coefficient is strong at 0.72, with a p-value significantly below 5%. This suggests that changes in the goodwill impairments may partially be associated with changes in the mining index two years prior to reporting of the impairments.

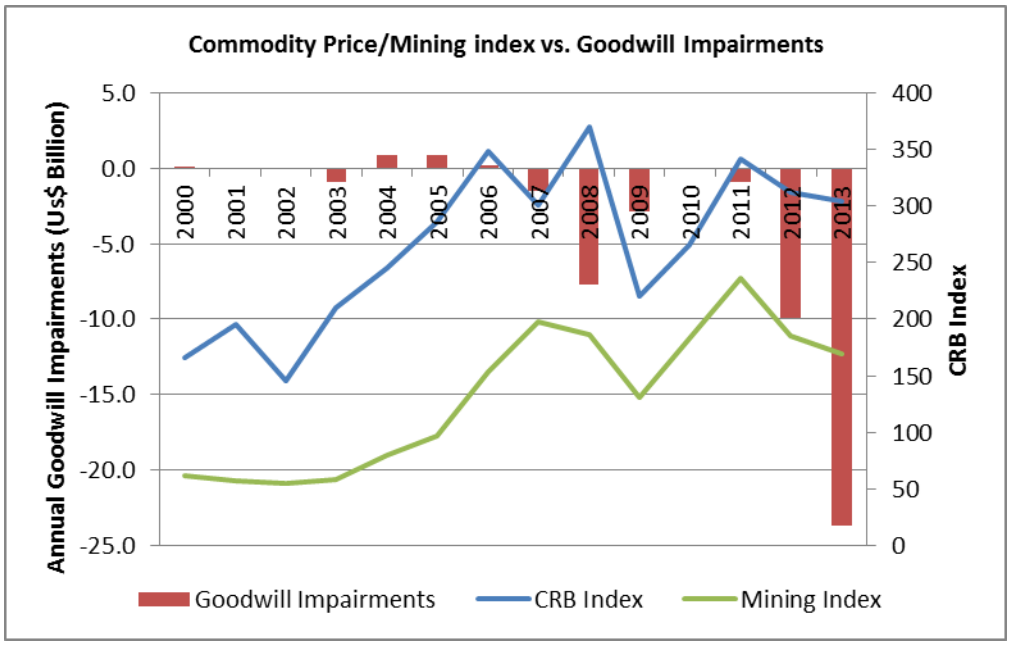


Figure 4.21 Annual goodwill impairments in selected stock exchanges vs. CRB and Mining indexes

4.9.3 Overall annual Impairments vs. Market Valuation

Annual impairments were correlated to the overall mining market ER and PB valuation metrics estimated annually. In general, the PB and ER metrics for the overall market have negative correlation coefficients relative to goodwill impairments, suggesting an opposite relationship. The market ER metrics had a positive correlation with annual impairments in the year of the valuation, at an average of 0.43.

When the market ERs were correlated with impairments several years after the ER metrics were calculated it was found that the correlation coefficient ranges from -0.38 to -0.72 two years after the ER metric was calculated. Analysis of the correlation between the market PB metric and impairments found a similar but opposite relationship: the correlation between the impairments and the market PB in the same year was negative with a correlation coefficient of -0.20. The correlation coefficient becomes positive at 0.62 two years after the market PB was estimated (Table 5.10).

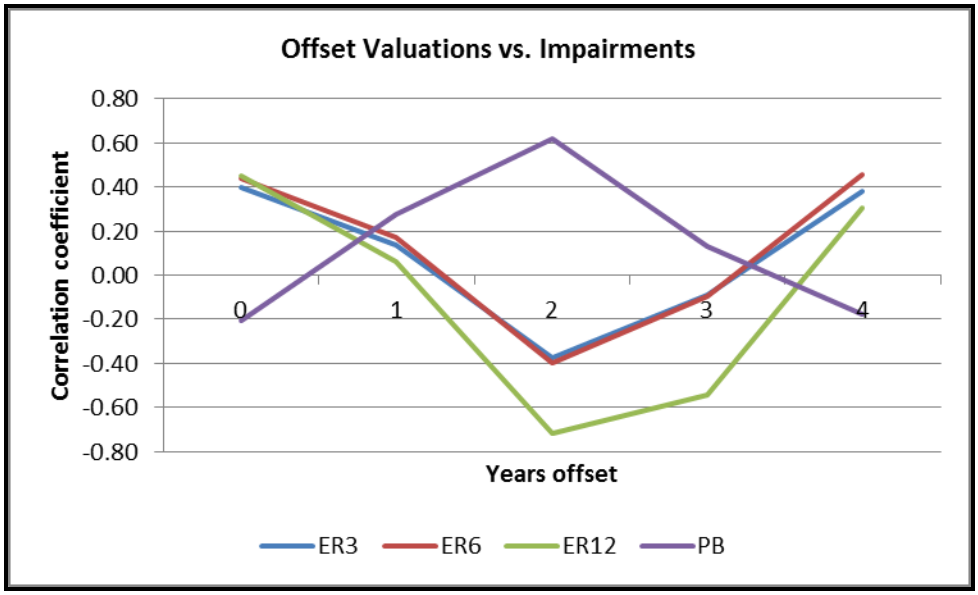


Figure 4.22 Change in correlation coefficients when impairments and valuations metrics are offset by up to 4 years after M&A valuation metrics were constructed

The differences between the ER and PB correlations with impairments are related to the fact that the ER predicts overvaluation of Targets and Bidders participating in M&A, while the PB predicts undervaluation, relative to the mining market. A strengthening of the correlation coefficient two years after the measurement of overall market valuation as estimated from both metrics suggest some relationship between market valuation and eventual goodwill impairments.

4.9.4 Goodwill and Impairments vs. M&A transactions

Of the 2631 mining companies registered on the selected exchanges, a maximum proportion of 3% reported annual goodwill impairments over the period 2000 to 2013. Up to 2% reported annual negative goodwill impairments. Of the Bidder companies in the M&A data set, only 32 reported goodwill impairments, of which 50% reported negative overall goodwill impairments. Fifteen Target companies reported goodwill impairments, of which over 60% were positive goodwill impairments. Target companies in the sample set reported positive goodwill impairments of about US$1.094 Billion, between 2000 and 2013 at an average of US$6.4 Million per company. Bidder companies in the sample set reported negative goodwill impairments of US$-9.034 Billion, over the same period, at an average of US$ -52.8 Million per company. This points to goodwill impairments being related to bidding company activities

or M&A activities as Target companies are generally absorbed into the Bidder companies post-M&As.

Due to the unavailability of both goodwill and goodwill impairment data for all companies involved in the M&A transactions analysed, an estimate of Target overpayment was used as a predictor for goodwill. Target overpayment was estimated as the ratios between the deal values and the Target market capitalisation, book equity or total assets as reported in the financial year prior to the transaction was announced, all of which were corrected for the percentage ownership sought per acquisition. The analysis below includes these overpayment ratios.

Bidder companies impairments vs. Valuation

Goodwill impairments reported over the full sample period (2000-2013) for all companies involved in M&A were aggregated so as to conduct an analysis of trends amongst Bidder companies. Bidder companies were sorted into two groups, one group "Negative" being companies that reported goodwill impairments below the weighted average for the overall market, and those with reported goodwill impairments above the weighted average for the overall market "Positive" during the year in which impairments were reported (Table 4.21).

Table 4.21 Comparison of companies with negative vs. positive goodwill impairments

Bidder Category	Overpayment Ratios			Target Valuation Metrics		Bidder Valuation Metrics	
	Market Capitalisation	Book Equity	Total Assets	PB	ER3	PB	ER3
Negative	1.29	187	27	-0.301	3939	-0.32	15808
Positive	0.35	128	16	-3.938	5381	-0.28	25345
Average	0.76	90	8	-1.451	1570	-0.01	7165

This analysis found that Bidder companies falling within the "Negative" category had higher overpayment ratios than Bidder companies falling within the "Positive" category, using all three Target overpayment ratios. Both the PB and ER3 valuation metrics found that Bidder companies in the "Negative" category were valuated lower than Bidder companies falling within the "Positive" category. The analysis based on both the ER3 and PB metrics suggests that Bidder companies with higher valuations reported more positive goodwill impairments

than Bidder companies with lower valuations and the overall market. This same group of companies had lower overpayment ratios in comparison to the companies with more negative impairments and lower valuations. Targets purchased by the Bidder companies in the "Negative" category had similar PB ratios to the Bidder companies and higher PBs than Targets purchased by the "Positive" Bidders. The ER3 metrics were lower than Targets purchased by Bidder companies in the "Positive" category. The average PB for Targets purchased by "Positive" Bidder companies was significantly smaller than the Bidder companies' PB and the PB of Target companies in the "Negative" category.

Bidder valuation vs. Target Overpayment vs. Goodwill Impairments

Of the M&A transactions analysed, only 33 had both valuation data and financial data for estimation of the overpayment as described above. Of these, only four companies had available goodwill impairments data over the sample period. At the same time, not all Bidder companies reporting impairments had all the required financial data for calculating valuation metrics. A decision was therefore taken to analyse for trends in Target overpayment and Bidder valuation using the 33 samples that had a full set of data, and to compare the averages of all the Bidder data against this analysis (Figures 5.11 and 5.12). All Bidder companies reporting impairments were grouped based on whether they reported more positive goodwill impairments "Positive" or more negative goodwill impairments "Negative", as explained above. The overall average valuation metrics and average overpayment ratios for these two groups were calculated regardless of whether many did not have all the data, and then compared against the analysis based on the valuation of the 33 companies (Figure 4.23 and 4.24). The purpose of this was to assess the relationship between Bidder valuation, Target overpayment and goodwill impairments, based on the comparison between the "Positive" and "Negative" impairment Bidder groups.

For transactions where both the deal values and market capitalisation values were available, average deal values amounted to about 130% of Target market capitalisation values (overpayment ratio: 1.3) at the end of the financial year prior to the deal announcement. Of these transactions, only about 35% of deal values exceeded the market capitalisation values of Targets, in contrast to expected industry premiums ranging from 30% to 60% above market capitalisation (Besler, 2013). On average, deal values amounted to about 313% (overpayment ratio: 3.13) of Target total asset values, suggestive of significant overpayment relative to tangible assets.

Using both overpayment ratios and Bidder PB valuations for the 33 companies, transactions were grouped into four categories: undervalued – underpaid (11), overvalued – underpaid (21), undervalued – overpaid (12) and overvalued-overpaid (22), as depicted in Figure 4.22.

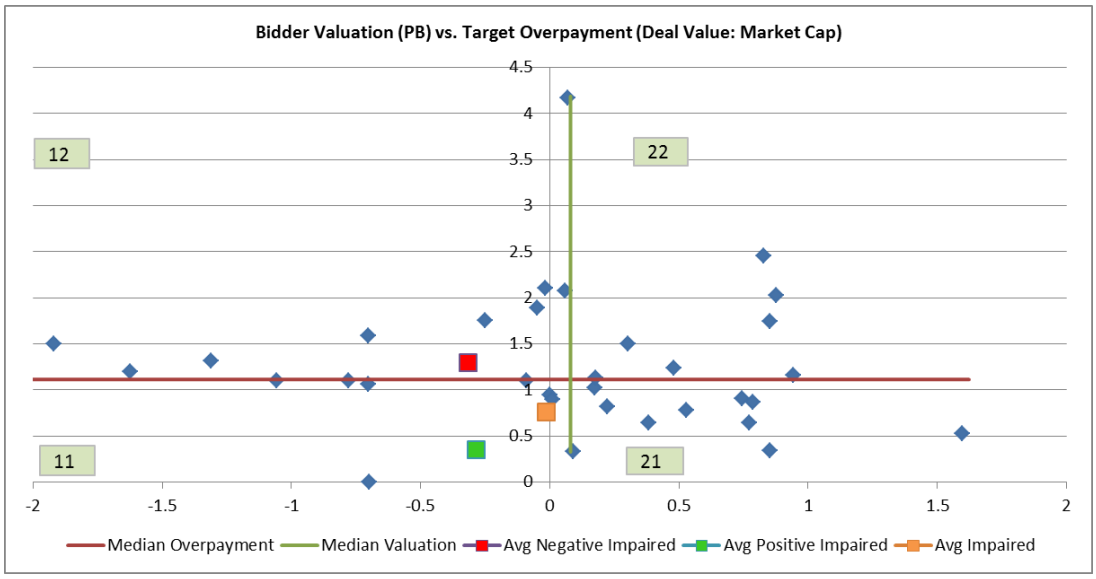


Figure 4.23 Bidder valuation vs. Target overpayment ratios estimated from market capitalisation

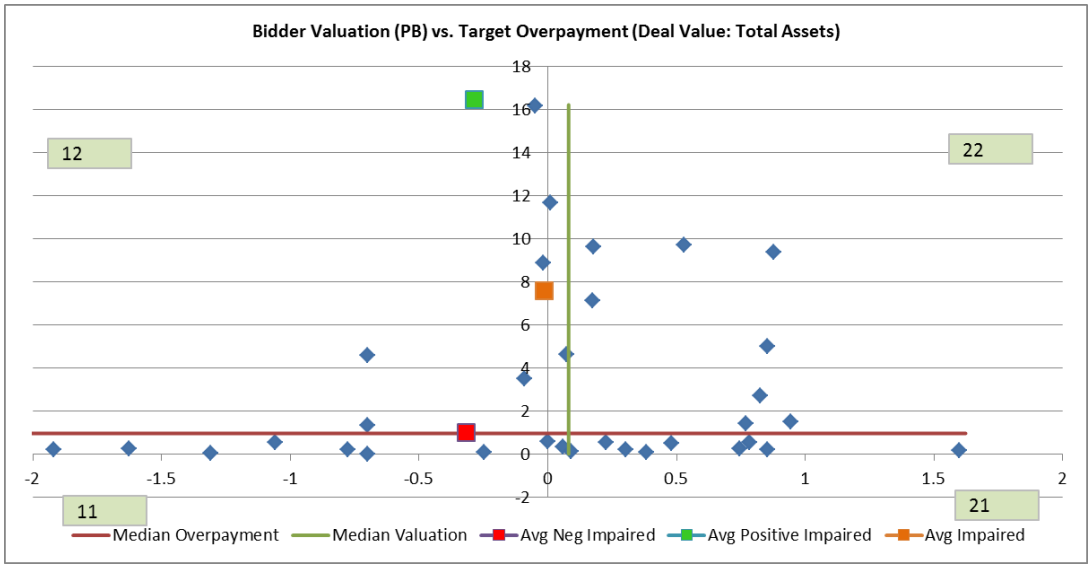


Figure 4.24 Bidder valuations vs. Target overvaluation ratio based on total assets

Bidders falling within categories 12 and 21 had significantly higher average total asset values, and market capitalisations, while Targets within category 21 had the highest average total assets and market capitalisations (Table 4.22). Using the Target overpayment ratios based on book equities and total assets, it was observed that companies reporting positive and negative goodwill impairments had overpayment ratios above the overall averages for all transactions. The average overpayment ratios for companies with negative impairments were higher than companies reporting positive impairments: the difference was 73% using the market capitalisation, 32% using the book equity and 38% using total assets for estimating Target overpayment. This suggests a positive relationship between overpayment above market capitalisation and negative goodwill impairments.

Table 4.22 Bidder valuation classes vs. Bidder and Target assets and market capitalisation

Category	Bidder Average Assets	Target Average Assets	Bidder Average Market Cap	Target Average Market Cap
11	251	546	118	83
12	24355	12	20073	78
21	3406	1585	3927	628
22	394	2	846	4

Comparisons based on the PB metrics found that Bidder companies with positive goodwill impairments had 10% higher valuations than Bidder companies with negative goodwill impairments. The ER3 metric also found that companies with negative goodwill impairments had relatively lower valuations than Bidder companies with positive goodwill impairments, with a more significant difference of 60%.

Using the market capitalisation overpayment ratio relative to the PB metric, this analysis showed that companies that recorded more negative goodwill impairments fell within the lower part of the “12” quadrant (overpay; valuation metric below industry median). Companies that recorded more positive goodwill impairments fell within the “11” quadrant (below median overpayment ratio, and below market median valuation). Relative to the overpayment ratio based on total assets, all Bidder companies fell within the “12” quadrant irrespective of whether more positive or negative impairments were reported. The position of companies below the market median valuation was a function of the PB metric which found that Bidder and Target companies were both undervalued relative to the mining market. The

ER metric found that all Bidder companies were overvalued relative to the market, and occurred within the same Target overpayment area.

4.9.5 Summary of Results of valuation vs. goodwill impairments analysis

This analysis found that only about 3% of companies reported goodwill impairments, with Bidder company goodwill impairments being significantly more negative than Target companies. Reported goodwill impairments were well correlated to changes in M&A deal volumes, and changes in goodwill impairments had the strongest correlations with M&A activity and valuations after an offset of two years post-M&A.

On average Bidders reporting Negative goodwill impairments were associated with higher overpayment ratios and had lower valuation metrics than Bidders with Positive goodwill impairments. Targets chosen by these Bidders had similar PB valuations as the Bidders. Conversely, Bidders reporting Positive goodwill impairments were associated with lower overpayment ratios and higher Bidder valuations. Additionally, the Target companies selected by these Bidders had lower PB valuations that Target companies selected by the "Negative" impairment bidding companies. It is therefore concluded that negative impairments are correlated with Target overpayment, and potentially reflect poor Target selection strategies by the Bidders.

5 Discussion of observations vs. Hypotheses

This research sought to determine whether at least some of the premises of the valuation-based acquisition theory apply to mergers and acquisitions within the mining industry and whether there was a correlation between valuation and likelihood of post-M&A goodwill write-downs. The results described in Chapter 5 are discussed below based on the hypotheses that were defined in Chapter 3:

5.1 The Null hypothesis: M&A activities in select mining sectors do not show evidence of market-driven/valuation-based acquisition theory

Some of the central tenets of the valuation-driven acquisition theory were tested using two different valuation metrics, namely the excess-returns (ER) metrics and the Price-to-book misvaluation (PB) metric. The conclusions that could be drawn from each set of analyses were not identical, indicating differences in the ability of each metrics to predict stock over- or under-valuation.

5.1.1 Target companies are undervalued and Bidder companies are overvalued in relation to their markets

The t-test analysis for overvaluation based on the ER3, ER6 and ER12 metrics for the gold, copper, diversified and combined sectors analysed suggest that both Target and Bidder companies were overvalued in comparison to the overall mining industry and the overvaluations were statistically significant at the 5% level. Univariate statistics of the three ER metrics also found that on average, Target and Bidder companies had higher ER metrics than the weighted average equivalent metrics for the overall mining industry. Bidder overvaluation is predicted by multiple industry based research from the research by Tobler (2007) who developed the excess returns valuation metrics. Target overvaluation is in contrast to the findings of the same study. The results from the t-test analysis based on the PB metric for the gold, copper, diversified and combined sectors showed that both Target and bidding companies were undervalued relative to the overall mining industry. Target undervaluation is predicted by multiple industry based research by the main proponents of the valuation-based acquisition theory(Shleifer & Vishny, 2003; Rhodes-Kropf, *et al.*, 2005; Dong *et al.*, 2006; Ang & Cheng, 2006), however, Bidder undervaluation is in contrast to the

findings of the same research. The results show that the two sets of valuation metrics used only partially supports the valuation-based acquisition theory in the data sets analysed.

Analysis of the ER metrics contrasting majority cash and majority stock transactions find that both Bidders and Targets in either type of payments are overvalued relative to the overall mining industry. The results of the PB metric find that Bidder and Targets are undervalued relative to the overall mining industry irrespective of the method of payment.

Analysis of firm characteristics for the combined sector further showed significant differences between M&A participating companies relative to the overall mining industry and was similar to Tobler (2007). Comparison of median asset and market capitalisation values found that Bidder companies were larger than Target companies and that both Target and Bidder companies were bigger than the mining industry medians. More than 60% of Target and Bidder companies fall within the third and fourth quartiles of the overall mining industry in terms of their size.

5.1.2 Bidder companies have higher valuations than Target companies

The t-test analysis for overvaluation based on the ER3, ER6 ER12 and PB metrics for the gold, copper, diversified and combined sectors analysed suggest Bidder companies had higher valuations than Target companies. This finding is in line with the valuation-driven acquisition theory which posits that owners of bidding companies are aware of market misvaluation of stock, and consciously Target undervalued or less overvalued stocks as a capital allocation strategy (Schleifer & Vishny, 2003; Rhodes-Kropf, *et al.*, 2005; Dong *et al.*, 2006; Ang & Cheng, 2006). Univariate analysis of firm characteristics as a basis for comparison between Target and Bidder companies found that on average, Target companies were smaller than Bidder companies. The comparison was based on total assets and market capitalisation, and suggests there are fundamental differences between Bidder companies and those that tend to be acquired during M&A transactions. These findings were partially also supported by the t-test analysis, which found that the market capitalisation of Target and Bidder companies were significantly different relative to each other. However, the t-test found no differences between Target and Bidder overall assets, which is in contrast to the univariate statistical analysis.

When contrasting the ER metrics for Bidder and Target companies in M&A transactions based on method of payment, this study finds that in cash transactions, Bidder companies have higher valuations than Target companies in all mining sectors analysed. For majority stock transactions, Bidder valuations exceed Target valuations for all mining sectors

analysed except the copper samples. The PB metric suggests that in stock transactions Bidder companies have higher valuations than Target companies in all the mining sectors analysed. Apart from the two exceptions mentioned in the copper data set, these findings using both metrics are consistent with predictions made by the valuation-driven acquisition theory. This theory hypothesises that Bidder companies are aware of their overvaluation by the market and therefore seek to support their overvalued stock with real assets from less overvalued Target stock (e.g. Dong *et al.*, 2006). Also, when Bidder companies are aware of their overvaluation they are better able to raise capital for cash-based acquisitions, and can, therefore, maximise profits by Targeting undervalued companies for M&A (e.g. Dong *et al.*, 2006).

5.1.3 Target companies acquired with cash are valuated lower than Target companies purchased with stock

In the valuation-driven acquisition theory, proponents suggest there is a significant difference between Target companies acquired mainly with cash relative to Target companies acquired mainly with Bidder stock, which is also related to the degree of Bidder overvaluation. Both valuation metrics used in this study find that in the copper, diversified and combined sectors analyses, Target companies acquired mainly with cash are valued higher than Target companies acquired mainly with Bidder stock. This is in contrast to the prediction that stock acquired Targets would be overvalued relative to cash stock (Schleifer & Vishny, 2003; Rhodes-Kropf, *et al.*, 2005; Dong *et al.*, 2006; Ang & Cheng, 2006; Tobler, 2007), however analysis of valuations in the gold sector sample validate this prediction.

5.1.4 More overvalued Bidders tend to use stock for acquisitions

Analysis based on both the ER and PB metrics found that Bidders using predominantly cash were valuated higher than Bidders using predominantly stock for M&A transactions in all sectors examined except for the gold transactions analysed. This finding is in contrast to what the valuation-driven acquisition theorists concluded from their studies, where it is posited that more overvalued Bidders would rather use their overvalued stock as a means of payment (Rau & Vermaelen, 1998; Shleifer & Vishny, 2003; Dong *et al*, 2006 and Tobler, 2007).

5.2 H1: periods of high M&A deal volumes correspond to periods of lower average market valuations

Studies by Rhodes-Kropf & Viswanathan (2004) and Rhodes-Kropf, *et al.* (2005) found evidence that merger waves are correlated to aggregated market valuations. The analysis in this report (Section 5.5.) compared overall trends in annual market valuations and interpreted periods of low market valuations as indicative of an increased number of lower valuated stocks. The results are not fully supportive of this hypothesis when the valuation metrics are regressed against annual M&A deal volume, however, the correlation coefficient for the M&A deal value against the PB metric was found to be significant. It appears that market misvaluations do not explain the changes in the annual number of M&A deals and that other factors are more important in determining so-called merger waves within the mining sector. This gives support to the neoclassical theory of merger waves which argues for a significant correlation between merger waves and "industry shocks" such as changes in regulation, increased capital liquidity, technology changes, changes in supply and demand conditions, and changes in economic factors (Gort, 1969; Mitchell & Mulherin, 1996; Harford, 2005, Gregoriou & Renneboog, 2007). The strong positive correlation between M&A volumes and the CRB index and Mining index appear to support the neoclassical theory of merger waves, as trends in commodity prices are impacted by macroeconomic factors (Labys, *et al*, 1999).

The next few paragraphs summarise the main motives for mining M&A waves over the 2000-2012 period, as was reported in annual reports on mining M&A of mainly PricewaterhouseCooper and Ernst & Young, and indicate that mining M&A activities were driven mainly by macroeconomic factors and changes in the minerals market.

Mining M&A in the Early 2000s

The main drivers of M&A during this period were:

- End of Apartheid sanctions in South Africa, one of the most mineral resource-rich nations in the world. The new SA government caused uncertainties about economic and fiscal policies, including the introduction of the Black Economic Empowerment policies aimed at increasing black participation in the economy;
- Global low stock valuations and low foreign exchange rates
- Low gold prices
- Cost reduction synergies
- Capital liquidity

Following the end of anti-Apartheid sanctions in the mid-1990s, companies such as AngloGold were divesting high-cost South African mines and were expanding their production capacities by acquiring low-cost assets outside South Africa, and were in so doing extending their geographical spread (Erricsson, 2002). At the same time, BEE companies such as Africa Rainbow Minerals were entering the mining landscape by acquiring the divested low-cost or marginal mines, and turning profits by having reduced overhead expenditure in comparison to the previous owners. Metal companies like Rio Tinto Targeted profitable and low operating cost companies as a growth strategy (Erricsson, 2002) by taking advantage of prevailing low equity prices and low exchange rates (Bogden, 2002). Renewed investor interest in gold shares and availability of capital influenced the level of M&A in the Gold sector during this period (Bogden, 2002). Specifically, the gold mining sector engaged in M&A for consolidation so as to create bigger companies that had a better chance of surviving the low gold price conditions. In the copper sector, the most dominant reasons for merging were to gain financial strength, reduce overhead costs and research& development costs inclusive of exploration expenditure (Ericsson, 2002). As in the late-1990s, the iron ore sector continued the trend of consolidations towards becoming more concentrated and therefore gaining more influence on price negotiations (Bogden, 2002).

Mining M&A in the mid- to late 2000s

The main drivers of M&A during this period were:

- High commodity prices during the mid-2000s
- Positive outlook for the industry growth potential and profitability; High market capitalisation
- Sustained demand for minerals from Asia;
- Large cash reserves on mining companies' balance sheets;
- Emerging economies securing raw minerals supply for industrial growth;
- Global financial crisis and rapidly declining commodity prices from 2008

In the early 2000s, cost-cutting on the back of low commodity prices drove down exploration expenditure and hence a sluggish development of mineral resource deposits. The recovery in commodity prices and positive market outlook in the mid-2000s re-ignited M&A activity and companies engaged M&A for global scale expansion, consolidation to increase company sizes, resource acquisition, resource portfolio diversification and the vertical integration of power and steel producers. Countries such as Russia, China and India were entering the

mining M&A landscape in a bid to secure raw materials supply. The increasing M&A activities towards the end of the 2000s were curtailed by crashing commodity prices and the intensifying financial crisis in the last quarter of 2008.

Mining M&A in 2010

The main drivers of M&A during this period were:

- Improvement in commodity prices and global demand;
- Low-interest rates, low foreign exchange rates and low inflation due to post-GFC austerity measures;
- Demand for gold by global Central Banks;

According to a PWC report (2011), 2010 M&A in the Gold mining sector was driven mainly by reserve growth and geographical diversification. Mining corporations saw the need to replace declining gold reserves in their own mines, due to expectations of further gold price increases, prevailing low-interest rates, reduction in both the US$ exchange rate and inflation. These macroeconomic factors also lead to an increased demand for gold from Central Banks. Coal acquisitions were driven by vertical integration strategies of steel manufacturers and power utilities in their attempt to build production capacity to meet growing global demand. Copper Targets were mainly exploration or development phase projects, and the Bidders aimed at accessing reserves to curtail the growing copper supply deficit, meet growing demand for copper in Asia and to benefit from expected copper price increases. In the iron ore mining sector, there were also expectations of demand increases from China, hence the need to replenish reserves was also a major driver for M&A. Vertical integration of supply chains was an M&A motive for steel manufacturers, which wanted secure supplies of iron ore.

Mining M&A in 2011

The main drivers of M&A during this period were:

- Strong balance sheets and improved leverage;
- High commodity prices;
- Availability of free cash flow;
- Need for reducing operating and capital costs;

- Need to expand production output

Ernst & Young (2012) reported that for 2011, very few M&A was loan-financed, so strong balance sheets and improved leverage drove M&A. As in 2010, commodity prices were good and provided abundant free cash flow for M&As. In terms of M&A motives, there was a strategic objective to reduce operating costs while focusing on growth via economies of scale and therefore lower risk Targets were favoured. Consequently, a large proportion of the M&A for 2011 were national-scale consolidations where major companies acquired a majority shareholding in partly-owned Targets. Another strategy in 2011 was the acquisition of scarce low-cost, but long life-of-mine deposits, such as Rio Tinto's acquisition of Riversdale in Mozambique. Major corporations also acquired junior exploration companies so as to enter the project pipeline early. In terms of value, the dominant M&A commodity was coal, although gold dominated in terms of volume. Coal producers wanted to expand their output, while power and steel manufactured wanted a security of raw material supply by vertically integrating with coal producers. Gold acquisitions were dominated by the consolidation of mid-tier companies and junior exploration companies.

Mining M&A in 2012

The main drivers of M&A during this period were:

- Weaker commodity prices;
- Demand uncertainties;
- Reduction in Capital projects;
- Low market capitalisation;
- Non-traditional M&A financing options

M&A in 2012 was subdued as mining corporations adopted more cautious approaches because of the uncertainties in demand and volatility of mining production costs (PWC, 2013). E&Y (2013) reported that mining shareholders demanded a reduction in capital projects due to weaker commodity prices, higher operating expenditure and high cost of capital. M&A activities were driven by the increased availability of non-traditional financing such as State-owned Enterprises (SOEs), and Sovereign Wealth Funds. Low stock prices resulted in the divergence in expected Target prices and Bidder offered prices, which slowed down the pace of M&A deal finalisation. Major corporations like Vale, Rio Tinto and BHP Billiton divested some non-core assets, and their M&A was mainly driven by consolidation,

e.g. Anglo American's acquisition of the remaining shareholding of diamond producer De Beers.

5.3 H2: There is a positive relationship between the degree of over/undervaluation, and the likelihood of post-M&A value write-downs

Several studies into goodwill impairments found positive correlations between stock misvaluation, transaction characteristics and the likelihood of post-M&A value write-downs (e.g. Gu & Lev, 2011; Li *et al.,* 2011 and Olante, 2013). This study sought to test whether similar evidence exists within mining M&A using the estimated valuation metrics and reported overall goodwill impairments. The results of the analysis in this report show that goodwill recorded on financial statements have a significant relationship with M&A activity, and that increased goodwill impairments follow about two years after strong market valuations. On average, the analysis found that relatively lower valuated bidding companies tended to overpay for Targets and tend to report more negative goodwill impairments. Conversely, bidding companies with higher valuations did not significantly overpay for Target companies and reported more positive goodwill impairments. Bidding companies reporting more positive goodwill impairments appeared to be attracted to Target companies with more significantly lower PB valuations than Targets sought by bidding companies with more negative goodwill impairments, however the opposite is true when using the ER3 metric. It appears that goodwill impairments were likely more related to Target overpayment as opposed to Target valuation, and that bidding companies with higher valuations had better Target selection strategies. Shleifer & Vishny (2003) proposed that even if the Target company valuation is high, an acquirer should never pay more for an acquisition than its own price or the value of the expected synergies from the mergers as doing so would result in long-term losses to investors. This essentially provides the maximum value that should be spent for acquisitions; hence even if a Bidder is purchasing an "overvalued" Target, impairment of goodwill should not necessarily occur (Gu & Lev, 2011). It is therefore concluded that impairments of goodwill after M&A are at least partially the result of overestimation of expected synergies which results in significant Target overpayment. This is supportive of the findings of Olante (2013) that found strong correlations between the likelihood of post-M&A goodwill impairments with high bidding premiums, and with the amount of goodwill in the total purchase price (Olante, 2013). However, the results are in contrast to the study of Gu & Lev (2011) which found that overvalued Bidders are likely to overpay for acquisitions and hence incur goodwill impairment losses.

Commodity prices are a critical component of establishing the value of Target companies in M&A transactions, and deal values are positively correlated to favourable medium to long term commodity price forecasts at the time of the deal negotiation (Samograd, J. KPMG, 2016. This study found a strong positive relationship between M&A activities and the mining price index, as well as between the mining price index and reported goodwill, suggestive that M&A activities are at least partially driven by mining price cycles. Correlation with goodwill impairments were strongest two years after peaks in both mining price index increases and valuation metrics. Actual commodity price performance after the acquisition might be significantly below the forecasted values at the time of the acquisition. The IFRS requires that mining companies assess mining assets for impairments should significant and long-lasting declines in commodity price trends be forecasted. This is because commodity prices affect forecasted business growth rates, projected production rates, sales forecasts, cost of capital, cost structure and forecast cash flow (CPA, 2014).

As already explained in Section 2.8.2, Rio Tinto wrote down about US$14 Billion in the 2012 financial year, some of it related to the group's acquisitions of Alcan Aluminium in the US and the Riversdale Mining's coal projects in Mozambique (Campbell, 2013; Garvey, 2016). At the time of acquiring Alcan in 2007, Rio Tinto expected that smelter and refinery capacities would be expanded in response to market demand. However, these projects had to be deferred given deteriorating economic conditions and commodity prices, strong currencies in some regions, high energy costs and high raw material costs Goodwill impairment was recorded for Riversdale in response to unexpected infrastructure constraints and downward revisions of recoverable coking coal reserves (Rio Tinto). Barrick Gold's write-down of about US$5.5 Billion on its acquisition of Pascua Lama was mainly necessitated by declining gold prices, which forced a delay in the development of the mining project. Negative investor sentiment further led to declining market capitalisation while escalating mining costs further put pressure on the group to record write-downs (Jamasmie, 2013). Barrick also wrote down US$4.2 Billion on its Zambian Lumwana Copper Mine, in response to working capital costs and operating costs that were above expectations determined at the time of the acquisition (Jamasmie, 2013). Kinross Gold acquired the Mauritanian Tassiast mine in 2010 for US$7.99 Billion, however in 2011 it posted a US$2.49 Billion write down, and another US$3.09 Billion write-down in the 2012 financial year on this acquisition. These write-downs were necessitated due to a revision in the project development plan following depressed gold prices and increased operating costs (Hill, 2013).

Glencore acquired Xstrata for US$44.6 Billion in 2012, but by the end of the 2012 financial year, US$7.7 Billion was written off as goodwill impairment on this acquisition, in response to low commodity prices (Ausick, 2013).

As explained in Sections 2.5.1 and 3.4, mineral resources are the assets which underpin the value of mineral properties. The valuation of mining acquisitions for the purposes of economic transactions like M&As is based on the mineral assets using the Income, Market or Cost Approaches. The definition of mineral reserves and the valuation approaches rely on assumptions about expected revenue (metal prices), expected capital outlay, production costs and assumptions about existing supporting infrastructure. When the above mentioned post-M&A impairments are studied, it can be seen that the impairments were caused by post-acquisition changes in the conditions upon which the acquisitions were valued. As mentioned, declining metal prices, above plan capital and operating costs and unplanned infrastructure requirements resulted in the reported write downs. The valuation metrics used in this research are not capable of taking such information in consideration as they rely strictly on market and accounting data, and therefore any correlation between the impairments and these valuation metrics will need to be verified using the prescribed valuation approaches.

6 Conclusions

6.1 Introduction

The aim of this research project was to determine whether M&A activities in the mining industry show signs of the valuation-driven acquisition theory as defined by numerous scholars (e.g. Shleifer & Vishny, 2003; Rhodes-Kropf, *et al.*, 2005; Dong *et al.*, 2006; Ang & Cheng, 2006) based on their research into multiple-industry M&A activities. The key proposition of the valuation-driven acquisition theory is that security markets are inefficient and therefore some stocks would be undervalued while others would be overvalued relative to the overall industry valuations. Managers of the misvalued companies would be aware of the relative under- or overvaluation of their stocks, and would attempt to take advantage of this misvaluation through M&A activities. Companies that are overvalued would tend to be M&A Bidders and would make takeover offers to companies with lower valuations, and use their own stock for the acquisitions if the Target companies are overvalued, but would use cash if the Target companies are undervalued. In this way Bidders attempt to displace their inflated stock with the tangible assets of another stock through acquisitions before the inefficient market corrects itself toward the "true" market values. Given the theory that Targets would be selected based on their valuation in relation to the overall market and the Bidders, this research sought to determine whether there are signs of sub-optimal Target selection which eventually result in M&A related goodwill impairments in the mining M&A. Some proponents of the valuation-driven theory further assert that trends in M&A waves are strongly correlated with trends in stock valuations. The results of hypothesis testing conducted in this research only partially supports the valuation-driven acquisition theory, and suggests that goodwill impairments are potentially influenced by Target overpayment and selection of relatively higher valued Target companies. The conclusions are summarised below.

6.2 Hypothesis testing

6.2.1 Conclusions for the Null Hypothesis (H0): M&A activities in select mining sectors do not show evidence of market-driven/valuation-based acquisition theory

The null hypothesis is partially rejected. According to the dataset used in this research there was evidence that companies participating in M&A within the mining industry were valuated differently to the mining market. Whether they were overvalued or undervalued depended on

the valuation method used. The ER metric found that Targets and Bidders were overvalued relative to the mining market, whereas the PB metric found that Target and Bidder companies had lower valuations than the market. On average, Bidder companies were valuated higher than Target companies irrespective of the method of payment or valuation method employed. Furthermore, cash acquired Targets had higher valuations than stock acquired Targets, which is contrary to the valuation-driven acquisition theory. This is a Target-selection strategy that mining companies should consider as studies have showed that overvalued Bidders using their stock to purchase higher valued Targets have higher post-merger success rates

The smaller sample size of this research relative to the wider market-based studies upon which the valuation-driven acquisition theory was based likely contributes to the contrary findings. That similar findings regarding relative valuations of Target and Bidder companies across different mining sectors analysed suggest that some aspects of the valuation-driven acquisition theory do play a role in mining M&A, although the extent of this would need to be tested using a database with significantly more equity and financial data.

6.2.2 Conclusion for the H1 hypothesis: periods of high M&A deal volumes correspond to periods of lower average market valuations

This hypothesis is rejected. The analysis conducted in this research found no correlation between the valuation metrics and the number of M&A deals across the sample period 2000-2013. Strong correlations were observed between M&A deal volumes and both the Thomson Reuters/Core commodity price index (CRP) and the Mining index (www., suggesting that mining M&A are significantly driven by macroeconomic factors. The synthesis of M&A activities based on industry experts' analysis suggest that M&A over the sample period were mainly driven by supply-demand dynamics mainly influenced by the emerging markets, commodity price fluctuations, input cost pressures, all of which could affect market valuations. While the neoclassical theory on M&A probably provides a better explanation for the advent of M&A waves at industry level, the valuation-driven theory helps to explain which companies are involved in M&A, which companies are the likely Bidders and which companies are the likely Targets (Rhodes-Kropf *et al.*(2005). The results of this study suggest that Targets and Bidder companies have different valuations than the mining market, and that higher valued companies tend to be Bidder companies, which allude to Target selection being at least partially driven by valuation.

6.2.3 Conclusion for the H2 hypothesis: There is a positive relationship between the degree of over/undervaluation, and the likelihood of post-M&A value write-downs

This hypothesis is partially accepted. The results of this research found strong positive correlation between goodwill and M&A activity, which result from high M&A premiums paid for Targets. Goodwill impairments follow about two years after strong market valuations and deal volumes. On average, the analysis found that relatively lower valuated bidding companies tended to overpay for Targets and tend to report more negative goodwill impairments. Bidders reporting more negative goodwill impairments appeared to Target companies with relatively higher valuations, which likely explain their higher overpayment ratios. While impairments related to commodity price depressions might not be completely unavoidable, it is proposed that Target overpayment and suboptimal Target selection strategies exacerbate the extent of goodwill impairments. Shleifer & Vishny (2003) proposed that Bidder companies should limit the values of bid premiums to the maximum synergies or expected benefits that could be realised from the M&A. However commodity price fluctuations do significantly erode expected M&A benefits, which inevitably trigger goodwill impairments.

6.3 Conclusions about the Valuation Metrics

The valuation metrics used in this research were chosen so as to allow for a like-for-like comparison against the valuation-driven acquisition theory literature. The results were however not in agreement on all the valuation-driven acquisition theory propositions tested. That the ER metrics estimated Target and Bidder overvaluation, while the PB metric suggested undervaluation possibly suggests that neither metrics were suitable for the analyses conducted here, and should at best be used for relative comparisons only. The results of the metrics did allow for relative comparisons between Targets, Bidders and the mining market, which concluded that Targets and Bidders valuations differed from industry valuations. These differences were supported by the analysis of the Target and Bidder firm characteristics relative to each other and to the overall mining market.

The results of this research do not show strong evidence of the “valuation-driven acquisition theory” therefore it cannot be concluded that decisions by Mining Managers to participate in

M&A activities and their Target selection strategies are driven by stock misvaluations. The main reason for this lies in the fact that the valuation methods used mimicked the methods prescribed in the financial economics literature which rely purely on stock market and accounting data for valuating industrial assets; however, the assets acquired during mining M&A activities are mineral resources which form the basis for the valuation of mining companies. The attractiveness of a mineral asset for selection as a potential M&A Target is based on factors such commodity prices, mineral resource characteristics, geographical location, development costs and/or operating costs. Quantification and reporting of mineral resources is regulated by stock exchange mandated codes for reporting of mineral resources such as the SAMREC code of South Africa, the JORC code of Australia and NI 43-101 of Canada, to ensure consistency in the methods in which the mineral resources are quantified and classified. Additionally, there are codes for the reporting of mineral asset valuations such as the SAMVAL code of South Africa, the VALMIN code of Australia and CIMVAL code of Canada which build upon the requirements of their respective mineral resource reporting codes. The mineral asset valuation reporting codes set the minimum standards and guidelines for the public reporting of mineral assets listed on their respective stock exchanges. Only three valuation approaches are recognised, namely the income approach, cost approach and the market approach, and each of these are based on the underlying mineral resource. The valuation methods used on this research are therefore not applicable to determine the "misvaluation" of mining assets, and attempts to link the trends in the valuation metrics to impairments are, by extension, futile.

6.4 Conclusions about the data set

The biggest disadvantage of using either metric was the requirement for accounting data for both the Target and Bidders, whereas 90% of the M&A involved unlisted Target companies which had limited or no accounting data available on the S&P Capital database. The decision to limit the data set to the TSX, TSXV, ASX, LSE, AIM, NYSE, AMEX and JSE securities markets was therefore sensible, however inconsistencies in mining sector definitions prevalent in the S&P Capital dataset were problematic. Limiting the hypothesis testing to only transactions where both Target and Bidder companies had valuations further reduced the sample size; however it was believed this would allow for a more realistic comparison of valuation trends.

6.5 Recommendations

This research could be improved by conducting an analysis of mining acquisitions using mineral asset attractiveness factors to rate all mining acquisitions, study the history and details around each M&A transaction, and do a comparative analysis of impaired and non-impaired acquisitions to identify trends that cut across all impaired acquisitions. The results of such an analysis would be meaningful to the minerals industry, as the method would be directly related to factors that are actually relevant to the industry

The sparse data set used in this research potentially makes drawing general conclusions about the overall mining industry based on the selected valuation metrics superfluous, even where some results correspond with the valuation-driven acquisition theory. Further research into the influence of misvaluation in mining M&A Target selection strategies and goodwill impairments should employ mining specific valuation methods.

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APPENDIX

APPENDIX A

Calculation of risk-adjusted excess returns (ER) metrics

For each transaction, obtain monthly risk-adjusted stock returns that cover a period of 36 months, and excludes the month before the transaction was announced.

The following equations were used to calculate the ER metrics:

Stage 1 regression: For the first 24 months of the data series (Stage 1 regression)

Equation 3.6 $R_t - R_f = \alpha_i + \delta_1 MKT + \delta_2 SML + \delta_3 HML + \delta_4 MOM + \varepsilon i$

R_t = monthly stock returns

R_f = risk-free rate (US treasury bill rate)

α_i = intercepts per company

δ_i = historical risk premia per factor for each company

MKT = market factor

SML = size factor

HML = book-to-market factor

MOM = momentum factor

εi = residuals per company

Stage 2 Regression: using the last 12 months of the risk-adjusted monthly stock returns: data series

Equation 3.7 $R_t - R_f = \alpha_j + \gamma_1\delta_1 + \gamma_2\delta_2 + \gamma_3\delta_3 + \gamma_4\delta_4 + \varepsilon j$

R_t = monthly stock returns

R_f = risk-free rate (US treasury bill rate)

α_j = cross-sectional intercepts

δ_i = historical risk premia per company

γ_i = sectional risk premia pre-M&A

εj = cross-sectional risk premia

The ER metric is calculated for each company by adding the α_i for the industry from Equation 3.7, to the εj (residuals per company) obtained from Equation 3.6).

Procedure

1. First stage of the regression: calculate residuals (εi) of the risk adjusted four-factor pricing model (FFPM):

Equation 3.6 $R_t - R_f = \alpha_i + \delta_1 MKT + \delta_2 SML + \delta_3 HML + \delta_4 MOM + \varepsilon i$

1.1. Calculation of the risk adjusted returns

a) For each stock on the selected stock exchanges, the closing share price on the last day of each was downloaded for S&P Capital IQ's database

B2615 =ciqfunctions.udf.CIQ($A2615,"IQ_LASTSALEPRICE",B$1,,USD)

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Stock ID	1/31/1997	2/28/1997	3/31/1997	4/30/1997	5/30/1997	6/30/1997	7/31/1997	8/29/1997	9/30/1997	10/31/1997	11/28/1997	12/31/1997
2615	TSX:AEM	18	19.55	15.7	14	14.7	13.25	11.65	12.15	14	9.95	6.75	7.65
2616	NYSE:AEM	13.375	14.25	11.25	10	10.625	9.625	8.562	8.812	10.062	7.125	4.75	5.375
2617	AMEX:FRD	4.78197	4.42204	4.73055	4.48117	5.29102	5.07506	6.80274	8.04451	7.39663	6.26284	5.83092	5.18304
2618	TSX:PDL	4.5	6.2	5.3	5.25	6.45	5.25	4.5	4.6	3.75	3	2.4	1.8
2619	TSX:TCK.A	16	16	13.75	13.5	14.75	13.25	13.5	13.4	13.625	11.875	10.25	11.25
2620	TSX:TCK.B	15.15	16.7	15.125	13.825	15.30001	13.975	13.875	13	14.25	12.25	10.2	10.775
2621	TSXV:AB.H	4.55	5	5.5	4.55	21.5	21.5	18	22.60001	19	19	26	25.39999
2622	NYSE:MTRN	18.125	17.625	18.125	19	21.25	20.9375	22.8125	25	25.6875	24.0625	23.75	24.5
2623	NYSE:AA	17.25	17.8125	17	17.46875	18.40625	18.84375	22.125	20.5625	20.5	18.25	16.8125	17.59375
2624	NYSE:CAS	20.5	20.875	17.375	17.25	21.75	22.125	22.5625	25.75	26	24.0625	23.375	22.875
2625	NYSE:CLF	5.4375	5.375	5.28125	5.29688	5.28125	5.09375	5.4375	5.21094	5.45313	5.42969	5.39063	5.72657
2626	NYSE:CMC	3.64063	3.625	3.57813	3.46875	3.70313	4	3.96875	3.84375	3.99219	4.03125	4.11719	3.94532
2627	NYSE:CRS	18	18.25	19.125	20.3125	21.625	22.875	23.75	22.40625	24.75	24.1875	23.5625	24.03125
2628	NYSE:GNI	58.75	56	56.875	55.75	56	58.375	62	66.5	63.5625	67.25	65.25	65.1875
2629	NYSE:HL	5.625	7.125	5.875	5.375	5.75	5.4375	5.125	5.4375	6.0625	5.125	4.9375	4.9375
2630	NYSE:MSB	4.625	4.625	4.625	4.25	4.5	4.375	4	3.9375	4	3.8125	3.875	3.75
2631	NYSE:NEM	39.875	47.5	38.75	34.625	39.125	39	41.25	42.3125	44.9375	35	30	29.375
2632	NYSE:NUE	13	12.03125	11.4375	12.46875	14.75	14.125	15.51563	14.17188	13.17188	13.0625	12.5	12.07813

b) The raw monthly stock returns "R_t" were calculated for each stock as the rate of change in the monthly share price relative to the previous month.

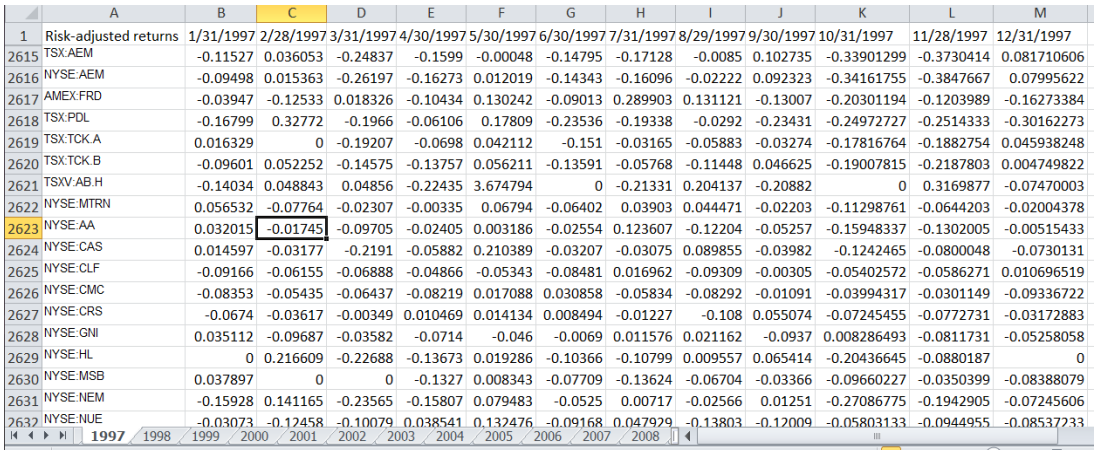
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Raw Returns	1/31/1997	2/28/1997	3/31/1997	4/30/1997	5/30/1997	6/30/1997	7/31/1997	8/29/1997	9/30/1997	10/31/1997	11/28/1997	12/31/1997
2615	TSX:AEM	-0.064935	0.086111	-0.196931	-0.10828	0.05	-0.098639	-0.120755	0.042918	0.152263	-0.289286	-0.321608	0.133333
2616	NYSE:AEM	-0.044643	0.065421	-0.210526	-0.111111	0.0625	-0.094118	-0.110442	0.029199	0.141852	-0.29189	-0.333333	0.131579
2617	AMEX:FRD	0.01087	-0.075268	0.069766	-0.052717	0.180723	-0.040816	0.340426	0.18254	-0.080537	-0.153285	-0.068966	-0.111111
2618	TSX:PDL	-0.117647	0.377778	-0.145161	-0.009434	0.228571	-0.186047	-0.142857	0.022222	-0.184783	-0.2	-0.2	-0.25
2619	TSX:TCK.A	0.066667	0	-0.140625	-0.018182	0.092593	-0.101695	0.018868	-0.007407	0.016791	-0.12844	-0.136842	0.097561
2620	TSX:TCK.B	-0.045669	0.10231	-0.094311	-0.08595	0.106692	-0.086602	-0.007156	-0.063063	0.096154	-0.140351	-0.167347	0.056373
2621	TSXV:AB.H	-0.09	0.098901	0.1	-0.172727	3.725275	0	-0.162791	0.255556	-0.159292	0	0.368421	-0.023077
2622	NYSE:MTRN	0.10687	-0.027586	0.028369	0.048276	0.118421	-0.014706	0.089552	0.09589	0.0275	-0.06326	-0.012987	0.031579
2623	NYSE:AA	0.082353	0.032609	-0.045614	0.027574	0.053667	0.023769	0.174129	-0.070621	-0.00304	-0.109756	-0.078767	0.046468
2624	NYSE:CAS	0.064935	0.018293	-0.167665	-0.007194	0.26087	0.017241	0.019774	0.141274	0.009709	-0.074519	-0.028571	-0.02139
2625	NYSE:CLF	-0.041323	-0.011494	-0.017442	0.00296	-0.002951	-0.035503	0.067485	-0.041666	0.046477	-0.004298	-0.007194	0.062319
2626	NYSE:CMC	-0.033195	-0.004293	-0.01293	-0.030569	0.067569	0.080167	-0.007813	-0.031496	0.038619	0.009784	0.021318	-0.041744
2627	NYSE:CRS	-0.017065	0.013889	0.047945	0.062092	0.064615	0.057803	0.038251	-0.056579	0.104603	-0.022727	-0.02584	0.019894
2628	NYSE:GNI	0.08545	-0.046809	0.015625	-0.01978	0.004484	0.042411	0.062099	0.072581	-0.044173	0.058014	-0.02974	-0.000958
2629	NYSE:HL	0	0.266667	-0.175439	-0.085106	0.069767	-0.054348	-0.057471	0.060976	0.114943	-0.154639	-0.036585	0
2630	NYSE:MSB	0.088235	0	0	-0.081081	0.058824	-0.027778	-0.085714	-0.015625	0.015873	-0.046875	0.016393	-0.032258
2631	NYSE:NEM	-0.108939	0.191223	-0.184211	-0.106452	0.129964	-0.003195	0.057692	0.025758	0.062038	-0.22114	-0.142857	-0.020833

c) The US Treasury bill monthly return rate, the "risk-free rate" (R_f) was downloaded from S&P Capital IQ's database

	A	B	C	D	E	F	G	H	I	J	K	L	M
	Month Year	January	February	March	April	May	June	July	August	September	October	November	December
	1996	0.04997	0.04827	0.04962	0.04952	0.05015	0.05094	0.05150	0.05047	0.05092	0.04986	0.05028	0.04911
	1997	0.05034	0.05006	0.05144	0.05162	0.05048	0.04931	0.05052	0.05142	0.04953	0.04973	0.05143	0.05162
	1998	0.05037	0.05086	0.05032	0.04950	0.04999	0.04975	0.04964	0.04902	0.04606	0.03961	0.04415	0.04391
	1999	0.04335	0.04438	0.04441	0.04290	0.04499	0.04567	0.04551	0.04721	0.04676	0.04861	0.05071	0.05196
	2000	0.05319	0.05548	0.05695	0.05658	0.05791	0.05686	0.05955	0.06094	0.05998	0.06107	0.06172	0.05769
	2001	0.05146	0.04882	0.04425	0.03873	0.03620	0.03485	0.03513	0.03362	0.02636	0.02157	0.01871	0.01690
	2002	0.01655	0.01727	0.01793	0.01715	0.01730	0.01702	0.01684	0.01617	0.01629	0.01580	0.01235	0.01191
	2003	0.01169	0.01165	0.01131	0.01132	0.01068	0.00917	0.00900	0.00949	0.00937	0.00922	0.00932	0.00896
	2004	0.00883	0.00926	0.00938	0.00944	0.01024	0.01267	0.01333	0.01479	0.01653	0.01760	0.02069	0.02187
	2005	0.02334	0.02539	0.02739	0.02781	0.02841	0.02973	0.03216	0.03441	0.03420	0.03706	0.03884	0.03886
	2006	0.04236	0.04433	0.04512	0.04604	0.04715	0.04791	0.04947	0.04960	0.04806	0.04917	0.04943	0.04848
	2007	0.04975	0.05027	0.04939	0.04869	0.04733	0.04611	0.04821	0.04202	0.03892	0.03900	0.03273	0.02996
	2008	0.02753	0.02125	0.01263	0.01294	0.01734	0.01856	0.01626	0.01722	0.01134	0.00675	0.00191	0.00035
	2009	0.00130	0.00296	0.00214	0.00158	0.00176	0.00177	0.00184	0.00171	0.00123	0.00074	0.00051	0.00055
	2010	0.00062	0.00109	0.00150	0.00162	0.00160	0.00124	0.00158	0.00155	0.00152	0.00135	0.00143	0.00141
	2011	0.00152	0.00132	0.00100	0.00059	0.00041	0.00037	0.00038	0.00024	0.00014	0.00019	0.00014	0.00011
	2012	0.00035	0.00092	0.00084	0.00084	0.00090	0.00091	0.00097	0.00103	0.00105	0.00105	0.00094	0.00070
	2013	0.00074	0.00099	0.00087	0.00060	0.00044	0.00051	0.00035	0.00044	0.00016	0.00047	0.00068	0.00067

Attributions | Monthly Average TBills | Chart 1 with Data (2) | **Monhtly TBill rate** | Chart

d) The risk adjusted returns ($R_t - R_f$) were calculated by deducting the US Treasury bill monthly return rate from the monthly stock returns



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Risk-adjusted returns	1/31/1997	2/28/1997	3/31/1997	4/30/1997	5/30/1997	6/30/1997	7/31/1997	8/29/1997	9/30/1997	10/31/1997	11/28/1997	12/31/1997
2615	TSX:AEM	-0.11527	0.036053	-0.24837	-0.1599	-0.00048	-0.14795	-0.17128	-0.0085	0.102735	-0.33901299	-0.3730414	0.081710606
2616	NYSE:AEM	-0.09498	0.015363	-0.26197	-0.16273	0.012019	-0.14343	-0.16096	-0.02222	0.092323	-0.34161755	-0.3847667	0.07995622
2617	AMEX:FRD	-0.03947	-0.12533	0.018326	-0.10434	0.130242	-0.09013	0.289903	0.131121	-0.13007	-0.20301194	-0.1203989	-0.16273384
2618	TSX:PDL	-0.16799	0.32772	-0.1966	-0.06106	0.17809	-0.23536	-0.19338	-0.0292	-0.23431	-0.24972727	-0.2514333	-0.30162273
2619	TSX:TCK.A	0.016329	0	-0.19207	-0.0698	0.042112	-0.151	-0.03165	-0.05883	-0.03274	-0.17816764	-0.1882754	0.045938248
2620	TSX:TCK.B	-0.09601	0.052252	-0.14575	-0.13757	0.056211	-0.13591	-0.05768	-0.11448	0.046625	-0.19007815	-0.2187803	0.004749822
2621	TSXV:AB.H	-0.14034	0.048843	0.04856	-0.22435	3.674794	0	-0.21331	0.204137	-0.20882	0	0.3169877	-0.07470003
2622	NYSE:MTRN	0.056532	-0.07764	-0.02307	-0.00335	0.06794	-0.06402	0.03903	0.044471	-0.02203	-0.11298761	-0.0644203	-0.02004378
2623	NYSE:AA	0.032015	-0.01745	-0.09705	-0.02405	0.003186	-0.02554	0.123607	-0.12204	-0.05257	-0.15948337	-0.1302005	-0.00515433
2624	NYSE:CAS	0.014597	-0.03177	-0.2191	-0.05882	0.210389	-0.03207	-0.03075	0.089855	-0.03982	-0.1242465	-0.0800048	-0.0730131
2625	NYSE:CLF	-0.09166	-0.06155	-0.06888	-0.04866	-0.05343	-0.08481	0.016962	-0.09309	-0.00305	-0.05402572	-0.0586271	0.010696519
2626	NYSE:CMC	-0.08353	-0.05435	-0.06437	-0.08219	0.017088	0.030858	-0.05834	-0.08292	-0.01091	-0.03994317	-0.0301149	-0.09336722
2627	NYSE:CRS	-0.0674	-0.03617	-0.00349	0.010469	0.014134	0.008494	-0.01227	-0.108	0.055074	-0.07245455	-0.0772731	-0.03172883
2628	NYSE:GNI	0.035112	-0.09687	-0.03582	-0.0714	-0.046	-0.0069	0.011576	0.021162	-0.0937	0.008286493	-0.0811731	-0.05258058
2629	NYSE:HL	0	0.216609	-0.22688	-0.13673	0.019286	-0.10366	-0.10799	0.009557	0.065414	-0.20436645	-0.0880187	0
2630	NYSE:MSB	0.037897	0	0	-0.1327	0.008343	-0.07709	-0.13624	-0.06704	-0.03366	-0.09660227	-0.0350399	-0.08388079
2631	NYSE:NEM	-0.15928	0.141165	-0.23565	-0.15807	0.079483	-0.0525	0.00717	-0.02566	0.01251	-0.27086775	-0.1942905	-0.07245606
2632	NYSE:NUE	-0.03073	-0.12458	-0.10079	0.038541	0.132476	-0.09168	0.047929	-0.13803	-0.12009	-0.05803133	-0.0944955	-0.08537233

1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008

1.2. Calculate the FFPM factors (MKT, SML, HML and MOM)

1.2.1. SML (Size factor) is calculated for each year and uses the market capitalisation and book-to-market (B/M) factors

a) The size factor is the market capitalisation of each stock at June of each year under consideration (column B below).

	A	B	C	D	E	F	G
1	Gold Stocks	6/30/1997	12/31/1996	6/28/1996			
2615	TSX:AEM	0	0	191.188			
2616	NYSE:AEM	400.37807	521.45236	191.188			
2617	AMEX:FRD	37.91139	35.22447	20.46672			
2618	TSX:PDL	61.95556	59.19758	20.694			
2619	TSX:TCK.A	0	0	1288.267			
2620	TSX:TCK.B	2698.4864	3054.43254	1288.267			
2621	TSXV:AB.H	60.9955	14.185	-9.926			
2622	NYSE:MTRN	341.11375	266.30663	200.302			
2623	NYSE:AA	13087.362	11054.44176	5962.1			
2624	NYSE:CAS	310.1925	269.67325	103.291			
2625	NYSE:CLF	463.1645	515.823	342.6			
2626	NYSE:CMC	489.376	486.00663	302.64			
2627	NYSE:CRS	889.33462	608.7075	238.434			
2628	NYSE:GNI	87.5625	81.1875	14.04291			
2629	NYSE:HL	299.53561	287.64567	163.541			
2630	NYSE:MSB	57.4	55.76	0.5414			
2631	NYSE:NEM	3881.3883	4453.46567	812.035			
2632	NYSE:NUE	4963.638	4473.618	1587.77082			

1996 1997 1998 1999 2000 2001 2002 2003 2004 2005

b) For the B/M factor, the book equity value at the end of each stock's previous financial year (column D), and the market capitalisation at December of the previous year (column C above) were obtained.

c) The book equity value was calculated as follows:

The following accounting data was downloaded for each stock from S&P Capital IQ database:

- Total assets download

B1343 =ciqfunctions.udf.CIQ($A1343,"IQ_TOTAL_ASSETS",IQ_FY,B$1,,USD)

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Total Assets	1/31/2013	2/28/2013	3/28/2013	4/30/2013	5/31/2013	6/28/2013	7/31/2013	8/30/2013	9/30/2013	10/31/2013	11/29/2013	12/31/2013
2	AIM:KOD	0.03144	0.03144	0.03144	0.3801	0.3801	0.3801	0.3801	0.3801	0.3801	0.3801	0.3801	0.3801
3	ASX:BRBCA	7.34669	7.34669	7.34669	7.34669	7.34669	7.34669	2.68983	2.68983	2.68983	2.68983	2.68983	2.68983
1343	TSXV:TTQ	21.67283	21.67283	21.67283	21.67283	21.67283	21.67283	20.9651	20.9651	20.9651	20.9651	20.9651	20.9651
1344	TSXV:NOW	23.41899	23.41899	23.41899	23.41899	23.41899	23.41899	23.41899	23.41899	23.41899	23.41899	23.41899	23.41899
1345	TSXV:CN	6.86745	4.03756	4.03756	4.03756	4.03756	4.03756	4.03756	4.03756	4.03756	4.03756	4.03756	4.03756
1346	TSXV:CMT	1.91961	1.91961	1.91961	1.91961	1.91961	1.91961	1.91961	1.91961	1.91961	1.91961	1.91961	1.91961
1347	TSXV:PEM	3.74093	3.74093	3.74093	3.74093	3.74093	3.74093	3.74093	3.74093	3.74093	3.74093	3.74093	3.74093
1348	TSXV:GVR	0.66984	0.66984	0.66984	0.66984	0.66984	0.66984	0.66984	0.66984	0.66984	0.66984	0.66984	0.66984
1349	TSXV:LRA	10.36299	10.36299	10.36299	10.36299	10.36299	10.36299	10.36299	10.36299	10.36299	10.36299	10.36299	10.36299
1350	ASX:RHI	12.34523	12.34523	12.34523	12.34523	12.34523	12.34523	13.17347	13.17347	13.17347	13.17347	13.17347	13.17347
1351	LSE:0OIQ	4215.634	4215.634	4215.634	4215.634	4215.634	4215.634	4215.634	4215.634	4215.634	4215.634	4215.634	3990.97
1352	AIM:SOLG	41.56088	41.56088	41.56088	41.56088	41.56088	41.56088	19.25787	19.25787	19.25787	19.25787	19.25787	19.25787
1353	TSX:WDO	108.85	108.85	108.85	108.85	108.85	108.85	108.85	108.85	108.85	108.85	108.85	103.049
1354	TSX:AXR	212.3	212.3	212.3	212.3	212.3	212.3	212.3	212.3	212.3	212.3	212.3	212.3
1355	TSX:MGT	15.50754	15.50754	15.50754	15.50754	15.50754	15.50754	15.50754	15.50754	15.50754	15.50754	15.50754	15.50754

- Total Liabilities download

C1959 =ciqfunctions.udf.CIQ($A1959,"IQ_TOTAL_LIAB",IQ_FY,C$1,,USD)

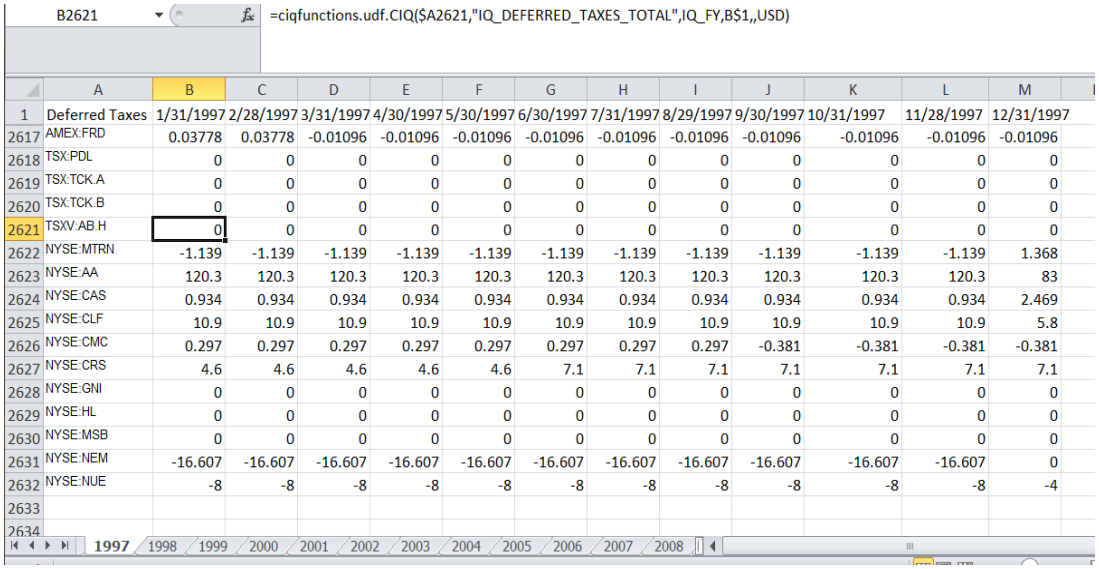
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Total Liabilities	1/31/1997	2/28/1997	3/31/1997	4/30/1997	5/30/1997	6/30/1997	7/31/1997	8/29/1997	9/30/1997	10/31/1997	11/28/1997	12/31/1997
1956	NYSE:SCCO	242.439	242.439	242.439	242.439	242.439	242.439	242.439	242.439	242.439	242.439	242.439	444.307
1957	TSXV:TWR	0.16409	0.16409	0.16409	0.16409	0.16409	0.16409	0.16409	0.16409	0.16409	0.10801	0.10801	0.10801
1958	TSXV:AVM	0.29789	0.29789	0.29789	0.29789	0.29789	0.29789	0.1088	0.1088	0.1088	0.1088	0.1088	0.1088
1959	AIM:MIO	0	0	0	0	0	0	0	0	0	0	0	0
1960	AMEX:LON	1.57017	1.57017	1.57017	1.57017	1.57017	1.04942	1.04942	1.04942	1.04942	1.04942	1.04942	1.09518
1961	TSXV:AUA	0.07291	0.07291	0.07291	0.24689	0.24689	0.24689	0.24689	0.24689	0.24689	0.24689	0.24689	0.24689
1962	AMEX:GPL	0.27709	0.27709	0.27709	0.27709	0.27709	0.27709	0.27709	0.27709	0.27709	0.27709	0.27709	0.09202
1963	TSX:ANX	0	0	0	0	0	0	0	0	0	0	0	0
1964	TSXV:GPM	0.05923	0.05923	0.05923	0.05923	0.05923	0.05923	0.05923	0.05923	0.05923	0.05923	0.05923	0.01244
1965	TSXV:MOK	0.04598	0.04598	0.04598	0.04598	0.04598	0.04598	0.04598	0.04598	0.04598	0.04598	0.04598	0.04595
1966	ASX:VII	14.247	14.247	14.247	14.247	14.247	14.247	14.247	14.247	14.247	14.247	14.247	12.64369
1967	TSX:FPX	0	0	0	0	0	0	0	0	0	0	0	0
1968	ASX:LEG	0	0	0	0	0	0	0	0	0	0	0	0
1969	TSXV:IGC	0.07679	0.07679	0.07679	0.07679	0.07679	0.07679	0.23456	0.23456	0.23456	0.23456	0.23456	0.23456
1970	TSXV:AGM	0.00756	0.00756	0.00756	0.00756	0.00756	0.00756	0.00756	0.00756	0.00756	0.00756	0.00756	0.01318
1971	TSXV:AHR	0.04131	0.04131	0.19549	0.19549	0.19549	0.19549	0.19549	0.19549	0.19549	0.19549	0.19549	0.19549
1972	TSXV:HLM	0	0	0.23499	0.23499	0.23499	0.23499	0.23499	0.23499	0.23499	0.23499	0.23499	0.23499
1973	NYSE:WLT	2814.683	2814.683	2814.683	2814.683	2814.683	2707.973	2707.973	2707.973	2707.973	2707.973	2707.973	2707.973

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- Deferred Taxes download

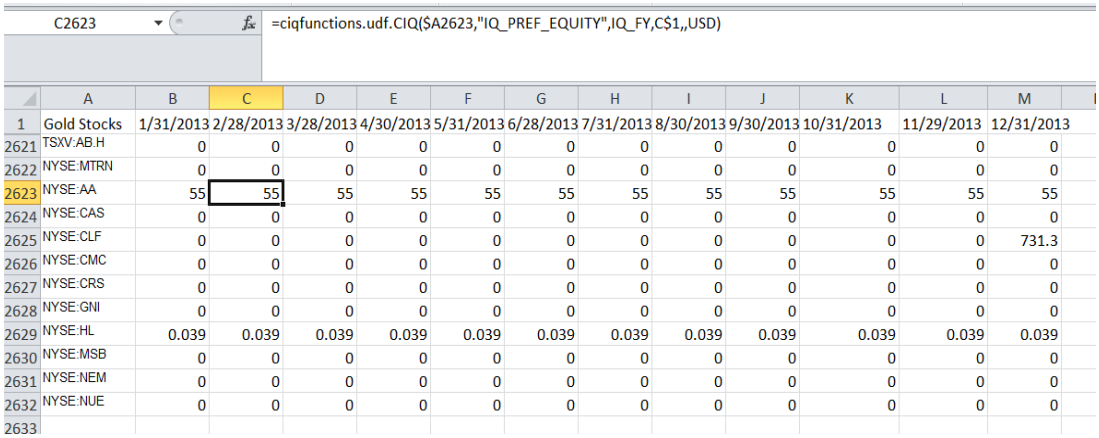


B2621 =ciqfunctions.udf.CIQ($A2621,"IQ_DEFERRED_TAXES_TOTAL",IQ_FY,B$1,,USD)

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Deferred Taxes	1/31/1997	2/28/1997	3/31/1997	4/30/1997	5/30/1997	6/30/1997	7/31/1997	8/29/1997	9/30/1997	10/31/1997	11/28/1997	12/31/1997
2617	AMEX:FRD	0.03778	0.03778	-0.01096	-0.01096	-0.01096	-0.01096	-0.01096	-0.01096	-0.01096	-0.01096	-0.01096	-0.01096
2618	TSX:PDL	0	0	0	0	0	0	0	0	0	0	0	0
2619	TSX:TCK.A	0	0	0	0	0	0	0	0	0	0	0	0
2620	TSX:TCK.B	0	0	0	0	0	0	0	0	0	0	0	0
2621	TSXV:AB.H	0	0	0	0	0	0	0	0	0	0	0	0
2622	NYSE:MTRN	-1.139	-1.139	-1.139	-1.139	-1.139	-1.139	-1.139	-1.139	-1.139	-1.139	-1.139	1.368
2623	NYSE:AA	120.3	120.3	120.3	120.3	120.3	120.3	120.3	120.3	120.3	120.3	120.3	83
2624	NYSE:CAS	0.934	0.934	0.934	0.934	0.934	0.934	0.934	0.934	0.934	0.934	0.934	2.469
2625	NYSE:CLF	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	5.8
2626	NYSE:CMC	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	-0.381	-0.381	-0.381	-0.381
2627	NYSE:CRS	4.6	4.6	4.6	4.6	4.6	7.1	7.1	7.1	7.1	7.1	7.1	7.1
2628	NYSE:GNI	0	0	0	0	0	0	0	0	0	0	0	0
2629	NYSE:HL	0	0	0	0	0	0	0	0	0	0	0	0
2630	NYSE:MSB	0	0	0	0	0	0	0	0	0	0	0	0
2631	NYSE:NEM	-16.607	-16.607	-16.607	-16.607	-16.607	-16.607	-16.607	-16.607	-16.607	-16.607	-16.607	0
2632	NYSE:NUE	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-4
2633													
2634													

1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008

- Preferred Equity download



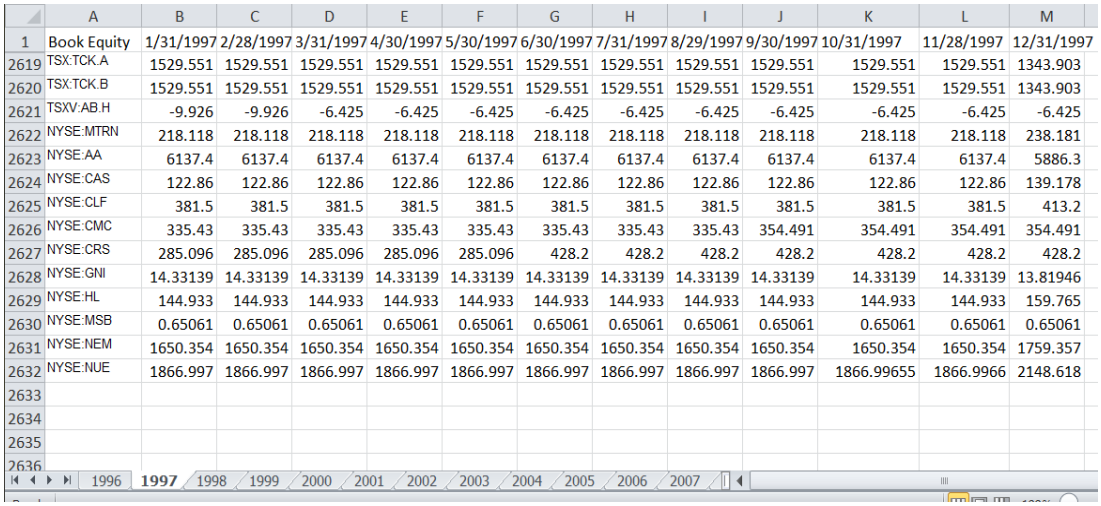
C2623 =ciqfunctions.udf.CIQ($A2623,"IQ_PREF_EQUITY",IQ_FY,C$1,,USD)

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Gold Stocks	1/31/2013	2/28/2013	3/28/2013	4/30/2013	5/31/2013	6/28/2013	7/31/2013	8/30/2013	9/30/2013	10/31/2013	11/29/2013	12/31/2013
2621	TSXV:AB.H	0	0	0	0	0	0	0	0	0	0	0	0
2622	NYSE:MTRN	0	0	0	0	0	0	0	0	0	0	0	0
2623	NYSE:AA	55	55	55	55	55	55	55	55	55	55	55	55
2624	NYSE:CAS	0	0	0	0	0	0	0	0	0	0	0	0
2625	NYSE:CLF	0	0	0	0	0	0	0	0	0	0	0	731.3
2626	NYSE:CMC	0	0	0	0	0	0	0	0	0	0	0	0
2627	NYSE:CRS	0	0	0	0	0	0	0	0	0	0	0	0
2628	NYSE:GNI	0	0	0	0	0	0	0	0	0	0	0	0
2629	NYSE:HL	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
2630	NYSE:MSB	0	0	0	0	0	0	0	0	0	0	0	0
2631	NYSE:NEM	0	0	0	0	0	0	0	0	0	0	0	0
2632	NYSE:NUE	0	0	0	0	0	0	0	0	0	0	0	0
2633													

- Calculation: Shareholders Equity = Total Assets – Total Liabilities

	A	B	C	D	E	F	G	H	I	J	K	L	M
	Shareholders Equity	1/31/1997	2/28/1997	3/31/1997	4/30/1997	5/30/1997	6/30/1997	7/31/1997	8/29/1997	9/30/1997	10/31/1997	11/28/1997	12/31/1997
	TSX:TCK.B	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1343.903
	TSXV:AB.H	-9.926	-9.926	-6.425	-6.425	-6.425	-6.425	-6.425	-6.425	-6.425	-6.425	-6.425	-6.425
	NYSE:MTRN	219.257	219.257	219.257	219.257	219.257	219.257	219.257	219.257	219.257	219.257	219.257	236.813
	NYSE:AA	6072.9	6072.9	6072.9	6072.9	6072.9	6072.9	6072.9	6072.9	6072.9	6072.9	6072.9	5859.1
	NYSE:CAS	121.926	121.926	121.926	121.926	121.926	121.926	121.926	121.926	121.926	121.926	121.926	136.709
	NYSE:CLF	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	407.4
	NYSE:CMC	335.133	335.133	335.133	335.133	335.133	335.133	335.133	335.133	354.872	354.872	354.872	354.872
	NYSE:CRS	309.077	309.077	309.077	309.077	309.077	449.3	449.3	449.3	449.3	449.3	449.3	449.3
	NYSE:GNI	14.33139	14.33139	14.33139	14.33139	14.33139	14.33139	14.33139	14.33139	14.33139	14.33139	14.33139	13.81946
	NYSE:HL	145.508	145.508	145.508	145.508	145.508	145.508	145.508	145.508	145.508	145.508	145.508	160.34
	NYSE:MSB	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061
	NYSE:NEM	1666.961	1666.961	1666.961	1666.961	1666.961	1666.961	1666.961	1666.961	1666.961	1666.961	1666.961	1759.357
	NYSE:NUE	1874.997	1874.997	1874.997	1874.997	1874.997	1874.997	1874.997	1874.997	1874.997	1874.99655	1874.9966	2152.618

- Calculation: Book Equity = (Shareholders Equity + Deferred Taxes) - Preferred Equity

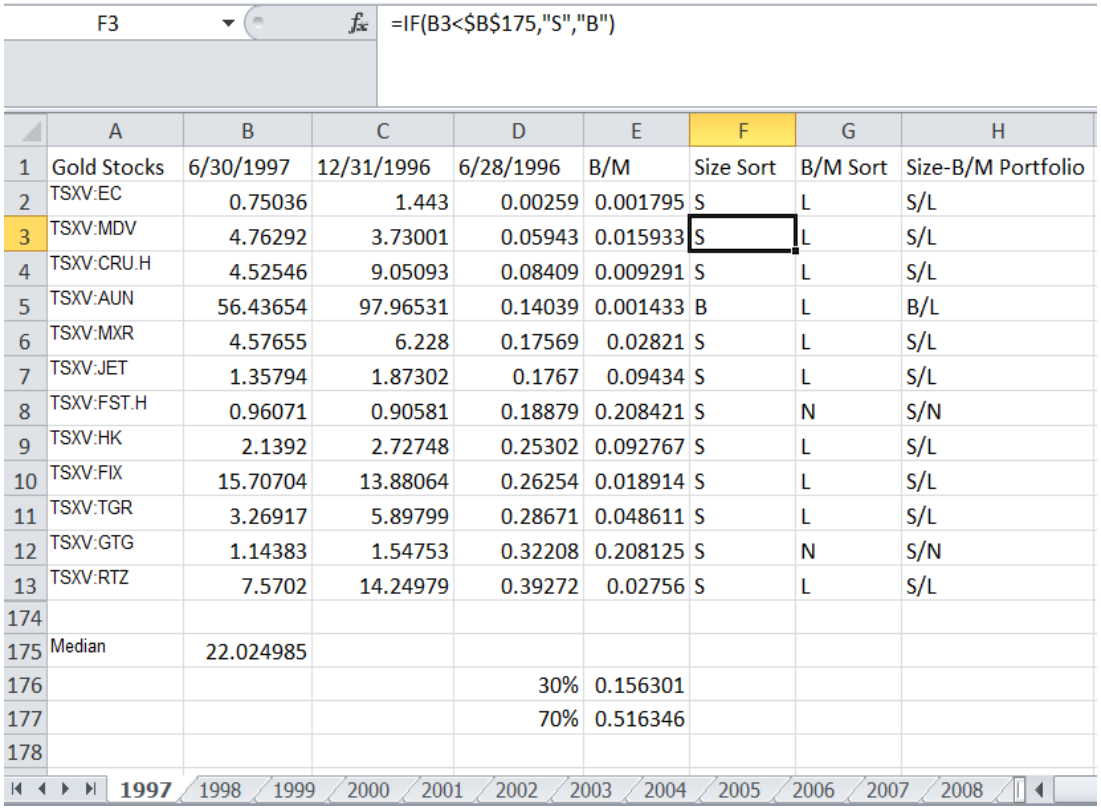


	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Book Equity	1/31/1997	2/28/1997	3/31/1997	4/30/1997	5/30/1997	6/30/1997	7/31/1997	8/29/1997	9/30/1997	10/31/1997	11/28/1997	12/31/1997
2619	TSX:TCK.A	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1343.903
2620	TSX:TCK.B	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1529.551	1343.903
2621	TSXV:AB.H	-9.926	-9.926	-6.425	-6.425	-6.425	-6.425	-6.425	-6.425	-6.425	-6.425	-6.425	-6.425
2622	NYSE:MTRN	218.118	218.118	218.118	218.118	218.118	218.118	218.118	218.118	218.118	218.118	218.118	238.181
2623	NYSE:AA	6137.4	6137.4	6137.4	6137.4	6137.4	6137.4	6137.4	6137.4	6137.4	6137.4	6137.4	5886.3
2624	NYSE:CAS	122.86	122.86	122.86	122.86	122.86	122.86	122.86	122.86	122.86	122.86	122.86	139.178
2625	NYSE:CLF	381.5	381.5	381.5	381.5	381.5	381.5	381.5	381.5	381.5	381.5	381.5	413.2
2626	NYSE:CMC	335.43	335.43	335.43	335.43	335.43	335.43	335.43	335.43	354.491	354.491	354.491	354.491
2627	NYSE:CRS	285.096	285.096	285.096	285.096	285.096	428.2	428.2	428.2	428.2	428.2	428.2	428.2
2628	NYSE:GNI	14.33139	14.33139	14.33139	14.33139	14.33139	14.33139	14.33139	14.33139	14.33139	14.33139	14.33139	13.81946
2629	NYSE:HL	144.933	144.933	144.933	144.933	144.933	144.933	144.933	144.933	144.933	144.933	144.933	159.765
2630	NYSE:MSB	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061	0.65061
2631	NYSE:NEM	1650.354	1650.354	1650.354	1650.354	1650.354	1650.354	1650.354	1650.354	1650.354	1650.354	1650.354	1759.357
2632	NYSE:NUE	1866.997	1866.997	1866.997	1866.997	1866.997	1866.997	1866.997	1866.997	1866.997	1866.99655	1866.9966	2148.618
2633													
2634													
2635													
2636													

1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007

d) Construction of SML portfolios:

- Size factor: For each year, each stock is assigned as having small (S) or big (B) Size factors depending on whether their market capitalisation is lower (S) of higher (B) than median market capitalisation of the industry (column F below).



F3 | =IF(B3<B175,"S","B")

	A	B	C	D	E	F	G	H
1	Gold Stocks	6/30/1997	12/31/1996	6/28/1996	B/M	Size Sort	B/M Sort	Size-B/M Portfolio
2	TSXV:EC	0.75036	1.443	0.00259	0.001795	S	L	S/L
3	TSXV:MDV	4.76292	3.73001	0.05943	0.015933	S	L	S/L
4	TSXV:CRU.H	4.52546	9.05093	0.08409	0.009291	S	L	S/L
5	TSXV:AUN	56.43654	97.96531	0.14039	0.001433	B	L	B/L
6	TSXV:MXR	4.57655	6.228	0.17569	0.02821	S	L	S/L
7	TSXV:JET	1.35794	1.87302	0.1767	0.09434	S	L	S/L
8	TSXV:FST.H	0.96071	0.90581	0.18879	0.208421	S	N	S/N
9	TSXV:HK	2.1392	2.72748	0.25302	0.092767	S	L	S/L
10	TSXV:FIX	15.70704	13.88064	0.26254	0.018914	S	L	S/L
11	TSXV:TGR	3.26917	5.89799	0.28671	0.048611	S	L	S/L
12	TSXV:GTG	1.14383	1.54753	0.32208	0.208125	S	N	S/N
13	TSXV:RTZ	7.5702	14.24979	0.39272	0.02756	S	L	S/L
174								
175	Median	22.024985						
176				30%	0.156301			
177				70%	0.516346			
178								

1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008

- B/M factor: The B/M (column above and below) is calculated as the factor of the book equity value for each stock and the market capitalisation of each stock, calculated using the book equity of the previous financial year and market capitalisation reported in December prior to the year under consideration. The market 30th and 70th B/M percentiles are calculated (cells E176, E177 below). For each year, each stock is assigned as being low value companies (L) if their B/M is below the 30th percentile, neutral value companies (N) if their B/M is between the 30th and 70th percentile, or high value companies (H) if their B/M is above the 70th percentile values of the industry (column G).

G2 =IF(E2<E176,"L",IF(E2>E177,"H","N"))

	A	B	C	D	E	F	G	H
1	Gold Stocks	6/30/1997	12/31/1996	6/28/1996	B/M	Size Sort	B/M Sort	Size-B/M Portfolio
2	TSXV:EC	0.75036	1.443	0.00259	0.001795	S	L	S/L
3	TSXV:MDV	4.76292	3.73001	0.05943	0.015933	S	L	S/L
4	TSXV:CRU.H	4.52546	9.05093	0.08409	0.009291	S	L	S/L
5	TSXV:AUN	56.43654	97.96531	0.14039	0.001433	B	L	B/L
6	TSXV:MXR	4.57655	6.228	0.17569	0.02821	S	L	S/L
7	TSXV:JET	1.35794	1.87302	0.1767	0.09434	S	L	S/L
8	TSXV:FST.H	0.96071	0.90581	0.18879	0.208421	S	N	S/N
9	TSXV:HK	2.1392	2.72748	0.25302	0.092767	S	L	S/L
10	TSXV:FIX	15.70704	13.88064	0.26254	0.018914	S	L	S/L
11	TSXV:TGR	3.26917	5.89799	0.28671	0.048611	S	L	S/L
12	TSXV:GTG	1.14383	1.54753	0.32208	0.208125	S	N	S/N
13	TSXV:RTZ	7.5702	14.24979	0.39272	0.02756	S	L	S/L
174								
175	Median	22.024985						
176				30%	0.156301			
177				70%	0.516346			

- A combination of the Size and B/M factors (column H) for each stock results in the following six SMB portfolios overall:

		30%	70%
	SMB Portfolios	Low Value Companies	Neutral Value Companies	High Value Companies
50%	Small Companies	Small/Low (S/L)	Small/Neutral (S/N)	Small/High (S/H)
	Big Companies	Big/Low (B/L)	Big/Neutral (B/N)	Big/High (B/H)

- The SMB factors for each year are then calculated using Equation 4.1, based on the monthly stock returns of different portfolios.

Equation 4.1 SMB = ((S/L-B/L) + (S/N-B/N) + (S/H-B/H))/3

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Stock ID	Size-B/M Portfolio	7/31/1998	8/31/1998	9/30/1998	10/30/1998	11/30/1998	12/31/1998	1/29/1999	2/26/1999	3/31/1999	4/30/1999	5/31/1999	6/30/1999
379	JSE:HAR	B/H	64.43	-167.39	379.44	24.96	12.37	-69.69	4.92	24.97	66.76	324.44	-165.98	-129.48
380	TSX:S	B/H	-49.19	-81.15	37.35	-36.30	22.18	-0.72	3.65	-6.96	-31.30	77.83	12.86	-3.54
381	TSX:TCK.B	B/N	-174.66	-305.37	630.08	-97.81	-177.20	88.95	-104.04	67.17	40.19	197.45	-167.72	222.99
382	JSE:EHS	B/H	489.28	-164.66	181.24	196.96	-23.95	-103.85	-77.97	-130.32	77.36	713.30	-244.59	24.72
389	TSX:ABX	B/N	-1094.04	-1347.27	5869.72	843.45	-804.65	-257.48	-346.25	-765.84	-330.64	1570.40	-1472.47	1494.29
390	JSE:AMS	B/L	5277.59	-719.49	1383.93	-212.07	1625.63	-2131.59	2098.80	3008.64	-786.69	3166.50	1123.69	6473.46
391	ASX:AWC	B/N	92.44	-641.71	1058.81	427.91	-430.90	-110.33	-33.90	127.86	22.96	2245.44	-991.75	1335.46
392	NYSE:AA	B/N	597.41	-1494.30	2418.03	1687.89	-859.95	57.60	1851.57	-455.97	256.49	11764.47	-2367.28	2858.34
393	JSE:ACL	B/H	919.59	-322.92	133.08	275.49	-123.53	-614.23	162.35	-145.42	2087.34	912.31	-778.50	1178.16
394	ASX:RIO	B/L	-1551.29	-1397.44	5835.30	-553.36	692.88	-1514.27	483.17	630.10	2852.75	5398.52	-4757.11	5530.50
395	LSE:RIO	B/N	185.60	-1236.56	1977.02	340.20	-205.76	-151.69	484.07	1183.55	742.57	3909.27	-1968.43	2363.99
396	ASX:BHP	B/N	-562.86	-2280.57	39.05	3337.21	-1723.21	-1169.19	-640.61	825.53	2950.59	9001.64	-2839.11	4460.82
397	LSE:AAL	B/H	423.85	-1207.34	733.74	645.12	18.97	-494.15	131.64	523.91	447.92	3659.13	-584.87	328.65
398														
399														
400	Value-weighted Returns													
401		B/H	0.15	-0.20	0.15	0.08	0.01	-0.13	0.07	0.05	0.20	0.33	-0.12	0.08
402		B/L	0.02	-0.10	0.23	-0.02	0.04	-0.08	0.04	0.06	0.02	0.14	-0.07	0.16
403		B/N	-0.02	-0.16	0.30	0.02	-0.03	-0.03	0.06	0.01	0.05	0.30	-0.10	0.14
404		S/H	0.02	-0.14	0.18	-0.01	0.15	-0.08	0.27	0.13	0.11	0.60	-0.03	-0.01
405		S/L	-0.12	-0.11	0.14	0.36	0.12	0.05	0.26	0.12	0.18	0.45	0.13	0.06
406		S/N	0.03	-0.11	0.22	0.17	0.13	0.18	0.46	0.06	0.12	0.13	0.06	-0.06
407														
408														
409	Factors	SMB	-0.07	0.04	-0.05	0.15	0.13	0.13	0.27	0.06	0.05	0.14	0.15	-0.13
410														
411		HML	0.14	-0.07	-0.02	-0.14	0.00	-0.09	0.02	0.00	0.05	0.17	-0.10	-0.07
412														

The average value-weighted returns for each of the six portfolios is calculated, which is then used in Equation 4.1 to calculate the monthly SMB factor (row 409 above)

1.2.2. HML factor: uses the same portfolios calculated for the SMB factor, but calculated using only the high value and low value stocks (row 411 above):

Equation 4.2 HML = ((S/H –S/L) - (B/H-B/L))/2

1.2.3. MOM factor: the momentum factor is calculated by constructing portfolios for twelve months from July to June of the next year (column C to N below). The market capitalisation of June the previous year is used as the size factor (column B below).

a) For each stock, monthly raw returns are calculated for twelve months running from July to June of the next year (column C to N below).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Gold Stocks	6/30/1997	7/31/1997	8/29/1997	9/30/1997	10/31/1997	11/28/1997	12/31/1997	1/30/1998	2/27/1998	3/31/1998	4/30/1998	5/29/1998	6/30/1998
2	TSX:MDW	11.815	5.181818	5.399465	5.679658	5.623055	5.473055	5.496584	5.427619	5.230088	5.399319	5.425634	4.912814	-0.400583
3	TSXV:GSP	3.85803	-0.650615	0.571607	0.404941	0.244941	0.316369	0.205258	0.205258	0.705258	0.688592	0.569948	0.609985	1.093997
4	TSXV:TGM	1.3125	-0.013158	-0.066491	-0.066491	-0.038322	-0.052021	-0.038132	-0.010735	0.002599	-0.050033	-0.036144	-0.063541	-0.092637
5	ASX:AGD	128.3472	-0.025421	0.109195	-0.077246	0.110254	-0.126588	-0.011645	-0.186903	-0.499403	-0.590312	-0.410312	-0.412688	-0.598143
6	TSXV:SLI	0.47304	-0.218435	-0.181398	-0.092112	-0.141292	-0.279223	-0.779223	-0.739223	-0.739223	-0.816146	-0.784284	-0.768411	-0.769813
400	NYSE:CRS	889.3346	0.33331	0.356524	0.262908	0.435367	0.324517	0.266987	0.303946	0.193828	0.235092	0.314348	0.324964	0.17997
401	NYSE:GNI	87.5625	0.242245	0.266505	0.307836	0.245986	0.299037	0.200162	0.113754	0.156727	0.12859	0.068448	-0.003833	-0.062153
402	NYSE:HL	299.5356	-0.065603	-0.223074	-0.143917	0.119174	-0.057204	-0.051236	-0.051236	-0.381194	0.091542	0.280815	0.173311	0.011973
403	NYSE:MSB	57.4	0.115142	-0.001822	0.073462	-0.043998	-0.149697	-0.077748	-0.198241	-0.148241	-0.132368	0.042463	-0.059218	-0.001589
404	NYSE:NEM	3881.388	-0.168409	-0.181603	-0.049462	0.03374	-0.222535	-0.300118	-0.212013	-0.433023	-0.231269	-0.070938	-0.147732	-0.36978
405	NYSE:NUE	4963.638	0.228567	0.329685	0.157518	0.153458	-0.002603	0.016403	-0.036954	0.023334	0.15405	0.120925	0.039001	-0.059398
406														
407														
408	Median	8.309575												
409	30%		-0.343391	-0.501162	-0.461755	-0.387573	-0.503756	-0.701853	-0.801922	-0.83832	-0.690587	-0.627808	-0.591928	-0.537667
410	70%		0.193729	0.081008	0.074419	0.137447	0.050324	-0.08021	-0.190681	-0.204388	-0.049731	-0.015817	0.023296	0.027543
411														
412														
413														
414														
415														

1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007

b) The 30th and 70th percentile of the monthly raw returns are calculated for the purpose of assigning each stock either to the “Losers” L stock category for companies with monthly returns below the 30th percentile, to the “Neutrals” N sock category for companies with monthly returns between the 30th and 70th percentile and the “Winners” W stock category for companies with monthly returns above the 70th percentile (column Q to AB below).

	A	B	C	D	O	P	Q	Z	AB	AC	AD	AM	AO
1	Gold Stocks	6/30/1997	7/31/1997	8/29/1997		Size Sort	7/31/1997	4/30/1998	6/30/1998		7/31/1997	4/30/1998	6/30/1998
2	TSX:MDW	11.82	5.18	5.40		B	W	W	N		B/W	B/W	B/N
3	TSXV:GSP	3.86	-0.65	0.57		S	L	W	W		S/L	S/W	S/W
400	NYSE:CRS	889.33	0.33	0.36		B	W	W	W		B/W	B/W	B/W
401	NYSE:GNI	87.56	0.24	0.27		B	W	W	N		B/W	B/W	B/N
402	NYSE:HL	299.54	-0.07	-0.22		B	N	W	N		B/N	B/W	B/N
403	NYSE:MSB	57.40	0.12	0.00		B	N	W	N		B/N	B/W	B/N
404	NYSE:NEM	3881.39	-0.17	-0.18		B	N	N	N		B/N	B/N	B/N
405	NYSE:NUE	4963.64	0.23	0.33		B	W	W	N		B/W	B/W	B/N
406													
407													
408	Median	8.31											
409	30%		-0.34	-0.50									
410	70%		0.19	0.08									

c) The Median market capitalisation is calculated; all the stock with a market capitalisation below the median is assigned to the “Small companies” group “S”, and those with a market capitalisation above the median is assigned to the “Big companies” group “B” (column P above).

d) A combination of the Size and Losser/Neutral/Winner results in six monthly momentum portfolios (below), to which each stock is assigned

		30%	70%
Momentum Portfolios	Losers	Neutrals	Winners
Small Companies	Small/Losers (S/L)	Small/Neutrals (S/N)	Small/Winners (S/W)
50% Big Companies	Big/Losers (B/L)	Big/Neutral (B/N)	Big/Winners (B/W)

e) Each stock is assigned to one of the 6 momentum portfolios based on the calculations explained above:

	A	B	C	D	E	F	G	R	S	T	U	V	W	X	Y
1	Gold Stocks	7/31/1997	7/31/1997	8/29/1997	8/29/1997	9/30/1997	9/30/1997	3/31/1998	3/31/1998	4/30/1998	4/30/1998	5/29/1998	5/29/1998	6/30/1998	6/30/1998
2	TSX:MDW	B/W	3.13118	B/W	5.160459	B/W	-0.983491	B/W	0.3566447	B/W	-3.385897	B/W	-0.75444	B/N	-0.938039
3	TSXV:GSP	S/L	10.4786	S/W	-1.19075	S/W	-0.960221	S/W	-0.881559	S/W	-1.063431	S/W	0.299072	S/W	-1.028808
4	TSXV:TGM	S/N	-0.0663	S/N	0	S/N	0.057577	S/W	0.0283889	S/N	-0.054466	S/N	-0.08045	S/N	0
5	ASX:AGD	B/N	19.6033	B/W	-22.0884	B/N	26.37906	B/N	13.106227	B/N	-4.601759	B/N	-8.43681	B/L	-1.20785
6	TSXV:SLI	S/N	0.01817	S/N	0.047711	S/N	-0.06207	S/L	-0.034414	S/L	0	S/L	-0.09498	S/L	0
395	NYSE:AA	B/W	2675.72	B/W	-1010.27	B/W	-43.34958	B/W	-719.415	B/W	1647.5999	B/W	-1224.75	B/N	-550.1689
396	NYSE:OAS	B/W	6.25504	B/N	51.00212	B/W	3.539029	B/W	-13.45611	B/W	9.0140878	B/W	-16.6299	B/W	-6.865467
397	NYSE:CLF	B/N	33.3658	B/W	-19.7649	B/N	23.0717	B/W	28.231723	B/W	26.634642	B/W	-32.8698	B/W	7.907477
398	NYSE:CMC	B/N	-3.6418	B/N	-14.2196	B/N	18.10849	B/W	48.647813	B/W	-23.09088	B/W	-36.8244	B/N	0.932973
399	NYSE:CRS	B/W	35.3195	B/W	-49.2865	B/W	100.9883	B/W	173.14155	B/W	99.086613	B/W	-105.537	B/W	-59.54578
400	NYSE:GNI	B/W	5.77516	B/W	7.239919	B/W	-4.211613	B/W	-7.073099	B/W	-5.59322	B/N	-1.29162	B/N	4.437969
401	NYSE:HL	B/N	-16.225	B/N	18.26702	B/N	38.39236	B/W	38.021295	B/W	-13.25399	B/W	-59.4183	B/N	18.29393
402	NYSE:MSB	B/N	-4.4983	B/N	-0.80719	B/N	0.833016	B/N	5.38125	B/W	-2.354571	B/N	1.688955	B/N	0
403	NYSE:NEM	B/N	236.845	B/N	170.3376	B/N	435.7189	B/N	257.66041	B/N	267.7864	B/N	-879.128	B/N	-194.6106
404	NYSE:NUE	B/W	536.79	B/W	-431.353	B/W	-326.6452	B/W	273.38302	B/W	533.16637	B/W	-638.37	B/N	-432.576
405															
406															
407		B/L	0.02691		0.068593		0.038922		0.0319532		0.3179763		-0.10712		-0.094371
408		B/N	-0.034		-0.03496		0.040209		0.0737201		0.0754645		-0.10849		-0.042534
409		B/W	0.04427		-0.03051		-0.014587		0.0364098		0.0575905		-0.1288		-0.069494
410		S/L	4.14396		0.074775		0.393401		0.3103473		0.1074126		-0.06013		-0.046778
411		S/N	-0.0684		0.156007		0.069448		0.0777764		0.0235378		0.029304		-0.122443
412		S/W	0.02273		0.148287		5.190931		4.2519659		-0.039173		0.008859		-0.144074
413															
414															
415	WML		-2.052		-0.013		2.372		1.973		-0.203		0.024		-0.036
416															
417															
418															
419															
420															
421															
422															

1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008

f) The weighted average monthly raw returns are calculated for each portfolio (row 407 to 412 above, from which the monthly momentum factor is calculated using the formula:

Equation 4.3 MOM = ((S/W-S/L) + (B/W-B/L))/2

The result is stored in row 425 in the above figure.

1.2.4. MKT factor: the market factor is calculated as the weighted average of the monthly returns of all stocks (Rm), minus the risk-free monthly rate of the US Treasury bills (Rt):

Equation 4.4 MKT = Rm – Rt

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Gold Stocks	7/31/1997	8/29/1997	9/30/1997	10/31/1997	11/28/1997	12/31/1997	1/30/1998	2/27/1998	3/31/1998	4/30/1998	5/29/1998	6/30/1998
2	TSXV:TSD	2.48812	-1.937118	3.201625	-4.631667	-2.472991	-1.948031	0.6272571	-1.155168	0.6286629	2.5140375	-1.3752	0.6294533
3	TSX:LIF	20.359322	-7.378247	-1.49505	-17.28477	-36.72931	10.779468	-7.361111	23.773585	-5.914286	-22.6087	7.6442308	-29.00377
4	TSXV:GRX.H	-0.141905	0.51405	-0.142522	-0.650182	0	-0.363188	-0.138277	0.56175	0	-0.36432	0	-0.300438
178	NYSE:CAS	6.2550388	51.002119	3.5390291	-25.13953	-9.363357	-6.868861	1.7643388	16.565221	-13.45611	9.0140878	-16.62987	-6.865467
179	NYSE:CLF	33.365834	-19.76488	23.071704	-2.124618	-3.530438	32.48992	35.57143	31.481499	28.231723	26.634642	-32.86985	7.907477
180	NYSE:CMC	-3.641824	-14.21957	18.108489	4.6327192	10.309361	-19.53416	-18.65075	27.446479	48.647813	-23.09088	-36.82445	0.9329726
181	NYSE:CRS	35.319509	-49.28652	100.98828	-21.44332	-23.77074	18.665022	-81.59667	82.852017	173.14155	99.086613	-105.5366	-59.54578
182	NYSE:GNI	5.7751606	7.2399194	-4.211613	5.8521386	-2.910781	-0.09366	-0.373562	-1.203501	-7.073099	-5.59322	-1.291619	4.4379691
183	NYSE:HL	-16.22534	18.267019	38.392355	-43.66421	-9.952376	0	-16.12749	98.277582	38.021295	-13.25399	-59.41834	18.293929
184	NYSE:MSB	-4.498286	-0.807188	0.8330159	-2.344688	0.8334426	-1.587097	2.583	0.8330159	5.38125	-2.354571	1.6889552	0
185	NYSE:NEM	236.84507	170.33761	435.71891	-1209.687	-670.5923	-95.75732	-132.8343	79.608327	257.66041	267.7864	-879.1279	-194.6106
186	NYSE:NUE	536.78955	-431.3527	-326.6452	-38.12173	-189.2756	-143.3364	-59.57843	368.3599	273.38302	533.16637	-638.3698	-432.576
187													
188	Market Raw Returns	0.0123931	-0.033703	0.0332486	-0.117298	-0.103433	0.0258689	0.0337017	0.0021121	0.0710688	0.0673355	-0.124283	-0.051185
189													
190	MKT	-0.03813	-0.085122	-0.01628	-0.167025	-0.154867	-0.025754	-0.016668	-0.048746	0.0207506	0.0178403	-0.174268	-0.10094
191													

1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008

1.3. For each transaction, use multiple-regression to regress the risk-adjusted returns (R_t – R_f), e.g. columns CVY to CWF below, against the monthly SMB, HML, MOM and MKT factors (columns CWG to CWJ below).

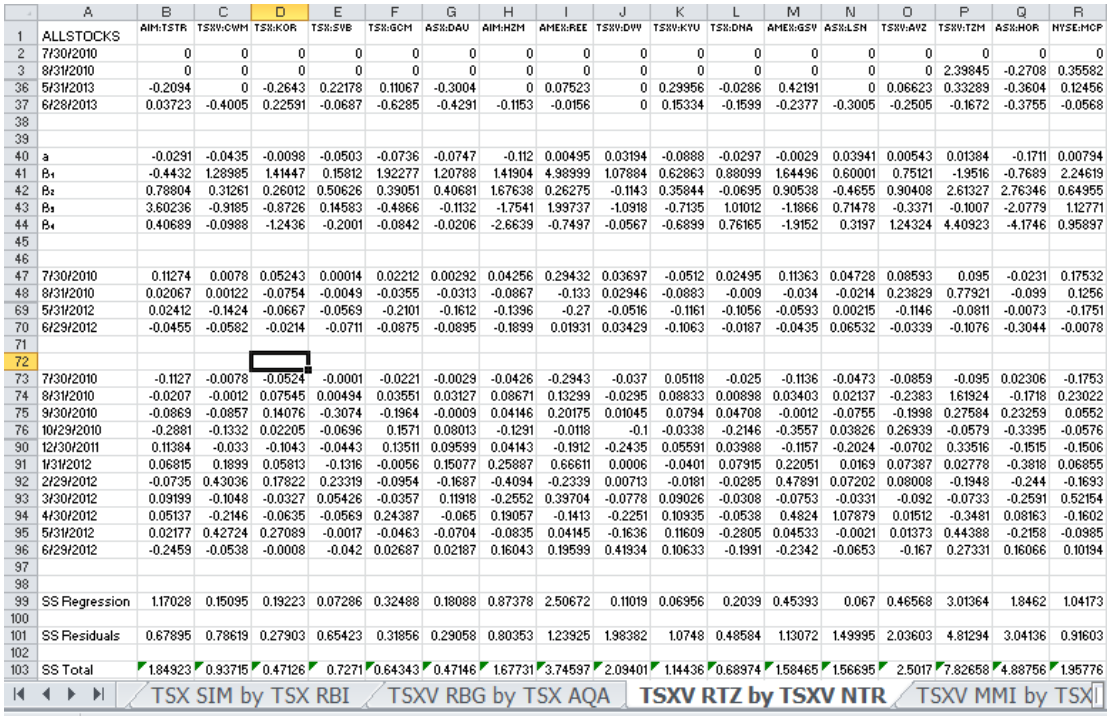
The risk-adjusted monthly returns data in use for each transaction cover the first 24 months of the 36 month data series prior to the month before the transaction was announced (column A, row 1 to 37).

	A	CVY	CVZ	CWA	CWB	CWC	CWD	CWE	CWF	CWG	CWH	CWI	CWJ
1	ALLSTOCKS	NYSE:CLF	NYSE:CMC	NYSE:CRS	NYSE:GNI	NYSE:HL	NYSE:MSB	NYSE:NEM	NYSE:NUE	MKT	SMB	HML	MOM
2	2/27/1998	0.003	0.007	0.0384	-0.063	0.2464	-0.035	-0.033	0.0305	-0.049	0.0967	-0.012	-0.002
3	3/31/1998	-0.004	0.0434	0.091	-0.13	0.0538	0.0434	0.0036	0.0067	0.0208	0.0244	-0.033	1.973
4	4/30/1998	-0.008	-0.096	0.0257	-0.117	-0.087	-0.092	0.0037	0.0515	0.0178	-0.012	0.0017	-0.203
5	5/29/1998	-0.105	-0.131	-0.137	-0.066	-0.266	-0.02	-0.275	-0.191	-0.174	0.0923	0.0333	0.0237
6	6/30/1998	-0.037	-0.048	-0.102	0.0022	0.0127	0	-0.102	-0.157	-0.101	-0.044	0.0086	-0.036
7	7/31/1998	-0.149	-0.143	-0.188	-0.092	-0.144	-0.122	-0.251	-0.104	-0.04	-0.075	0.1394	-0.073
8	8/31/1998	-0.294	-0.175	-0.214	-0.022	-0.322	-0.127	-0.324	-0.223	-0.193	0.0351	-0.067	0.0616
9	9/30/1998	0.0224	-0.102	-0.036	-0.015	0.4004	0.0048	0.7256	0.0844	0.2209	-0.05	-0.019	-0.421
10	10/30/1998	-0.022	0.118	-0.081	-0.096	-0.151	-0.072	-0.163	0.0758	-0.03	0.1456	-0.136	-0.131
11	11/30/1998	-0.085	-0.093	-0.037	-0.017	-0.114	-0.111	-0.109	-0.113	-0.046	0.1254	0.0027	-0.2
12	12/31/1998	0.0152	0.0524	-0.083	-0.053	-0.178	-0.169	-0.126	-0.019	-0.094	0.1292	-0.09	-0.125
25	1/31/2000	-0.156	-0.116	-0.178	-0.086	-0.173	-0.094	-0.222	-0.146	-0.115	0.6458	0.0332	0.097
26	2/29/2000	-0.163	-0.187	-0.128	-0.05	-0.01	-0.098	0.0304	-0.057	-0.118	1.5694	-1.297	-0.631
27	3/31/2000	-0.11	0	-0.122	-0.071	-0.1	-0.035	-0.043	-0.051	-0.032	0.3504	-0.056	0.0289
28	4/28/2000	-0.017	0.0068	-0.093	-0.063	-0.147	-0.078	-0.012	-0.197	-0.089	-0.121	-0.087	-0.197
29	5/31/2000	-0.022	-0.162	-0.027	-0.098	-0.208	0.1643	-0.074	-0.148	-0.03	-0.059	-0.068	-0.103
30	6/30/2000	-0.042	-0.012	-0.036	-0.047	0.002	-0.184	-0.119	-0.209	-0.02	-0.036	0.0501	-0.006
31	7/31/2000	-0.098	0.0086	0.3902	-0.072	-0.282	0.0446	-0.239	0.0779	-0.067	0.0818	0.0222	-0.059
32	8/31/2000	-0.048	-0.11	0.0003	-0.046	0	0.0523	-0.015	-0.087	0.0536	0.0391	-0.06	0.0639
33	9/29/2000	-0.15	-0.147	-0.164	-0.09	-0.203	-0.145	-0.144	-0.24	-0.108	0.0407	0.087	-0.016
34	10/31/2000	-0.159	0.0076	0.0033	0.0053	-0.311	0	-0.263	0.0904	-0.044	-0.04	0.0377	0.0387
35	11/30/2000	-0.101	-0.163	0.0088	-0.026	0.0494	-0.191	0.0904	-0.06	-0.039	-0.04	-0.004	-0.07
36	12/29/2000	0.0306	-0.15	-0.003	-0.067	-0.258	0.0912	0.0343	0.0844	0.042	-0.041	0.0501	-0.043
37	1/31/2001	-0.296	-0.018	-0.264	0.0115	0.6885	-0.174	-0.146	-0.008	-0.02	0.0807	-0.016	-0.177
38													
39													
40	β_4	0.0165	0.0414	0.069	-0.041	0.0316	0.035	-0.029	0.0121				
41	β_3	0.0416	0.0524	0.0459	0.0187	0.0826	0.0403	0.0757	0.0543				
42	β_2	0.15	0.1399	0.2341	0.2325	0.2827	0.1989	0.6031	0.2356				
43	β_1	0.8382	0.7728	1.4518	1.4391	1.8722	1.1792	7.2176	1.4641				
44	a	0.0248	0.0363	0.0522	0.0086	0.2182	0.0327	0.706	0.0737				
45													

JSE ARI by LSE AAL | ASX KSO by ASX SHD | **LSE BLT by ASX BHP**

The y-intercept "α_i" and factor loadings (δ in Equation 3.6, but ß in the spreadsheet above) were derived from the multiple regressions for each company in the industry.

1.4. Calculation of the residuals using the y-intercept "α_i" and factor loadings from Equation 3.6.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	ALLSTOCKS	AIM:TSTR	TSXV:CWM	TSX:KOR	TSX:SVB	TSX:GCM	ASX:DAU	AIM:HZM	AMEX:REE	TSXV:DW	TSXV:KYU	TSX:DNA	AMEX:GSV	ASX:LSN	TSXV:AVZ	TSXV:TZM	ASX:HOR	NYSE:MCP
2	7/30/2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	8/31/2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.39845	-0.2708	0.35582
36	5/31/2013	-0.2094	0	-0.2643	0.22178	0.11067	-0.3004	0	0.07523	0	0.29956	-0.0286	0.42191	0	0.06623	0.33289	-0.3604	0.12456
37	6/28/2013	0.03723	-0.4005	0.22591	-0.0687	-0.6285	-0.4291	-0.1153	-0.0156	0	0.15334	-0.1599	-0.2377	-0.3005	-0.2505	-0.1672	-0.3755	-0.0568
38																		
39																		
40	a	-0.0291	-0.0435	-0.0098	-0.0503	-0.0736	-0.0747	-0.112	0.00495	0.03194	-0.0888	-0.0297	-0.0029	0.03941	0.00543	0.01384	-0.1711	0.00794
41	β_1	-0.4432	1.28985	1.41447	0.15812	1.92277	1.20788	1.41904	4.98999	1.07884	0.62863	0.88099	1.64496	0.60001	0.75121	-1.9516	-0.7689	2.24619
42	β_2	0.78804	0.31261	0.26012	0.50626	0.39051	0.40681	1.67638	0.26275	-0.1143	0.35844	-0.0695	0.90538	-0.4655	0.90408	2.61327	2.76346	0.64955
43	β_3	3.60236	-0.9185	-0.8726	0.14583	-0.4866	-0.1132	-1.7541	1.99737	-1.0918	-0.7135	1.01012	-1.1866	0.71478	-0.3371	-0.1007	-2.0779	1.12771
44	β_4	0.40689	-0.0988	-1.2436	-0.2001	-0.0842	-0.0206	-2.6639	-0.7497	-0.0567	-0.6899	0.76165	-1.9152	0.3197	1.24324	4.40923	-4.1746	0.95897
45																		
46																		
47	7/30/2010	0.11274	0.0078	0.05243	0.00014	0.02212	0.00292	0.04256	0.29432	0.03697	-0.0512	0.02495	0.11363	0.04728	0.08593	0.095	-0.0231	0.17532
48	8/31/2010	0.02067	0.00122	-0.0754	-0.0049	-0.0355	-0.0313	-0.0867	-0.133	0.02946	-0.0883	-0.009	-0.034	-0.0214	0.23829	0.77921	-0.099	0.1256
69	5/31/2012	0.02412	-0.1424	-0.0667	-0.0569	-0.2101	-0.1612	-0.1396	-0.27	-0.0516	-0.1161	-0.1056	-0.0593	0.00215	-0.1146	-0.0811	-0.0073	-0.1751
70	6/29/2012	-0.0455	-0.0582	-0.0214	-0.0711	-0.0875	-0.0895	-0.1899	0.01931	0.03429	-0.1063	-0.0187	-0.0435	0.06532	-0.0339	-0.1076	-0.3044	-0.0078
71																		
72																		
73	7/30/2010	-0.1127	-0.0078	-0.0524	-0.0001	-0.0221	-0.0029	-0.0426	-0.2943	-0.037	0.05118	-0.025	-0.1136	-0.0473	-0.0859	-0.095	0.02306	-0.1753
74	8/31/2010	-0.0207	-0.0012	0.07545	0.00494	0.03551	0.03127	0.08671	0.13299	-0.0295	0.08833	0.00898	0.03403	0.02137	-0.2383	1.61924	-0.1718	0.23022
75	9/30/2010	-0.0869	-0.0857	0.14076	-0.3074	-0.1964	-0.0009	0.04146	0.20175	0.01045	0.0794	0.04708	-0.0012	-0.0755	-0.1998	0.27584	0.23259	0.0552
76	10/29/2010	-0.2881	-0.1332	0.02205	-0.0696	0.1571	0.08013	-0.1291	-0.0118	-0.1	-0.0338	-0.2146	-0.3557	0.03826	0.26939	-0.0579	-0.3395	-0.0576
90	12/30/2011	0.11384	-0.033	-0.1043	-0.0443	0.13511	0.09599	0.04143	-0.1912	-0.2435	0.05591	0.03988	-0.1157	-0.2024	-0.0702	0.33516	-0.1515	-0.1506
91	1/31/2012	0.06815	0.1899	0.05813	-0.1316	-0.0056	0.15077	0.25887	0.66611	0.0006	-0.0401	0.07915	0.22051	0.0169	0.07387	0.02778	-0.3818	0.06855
92	2/29/2012	-0.0735	0.43036	0.17822	0.23319	-0.0954	-0.1687	-0.4094	-0.2339	0.00713	-0.0181	-0.0285	0.47891	0.07202	0.08008	-0.1948	-0.244	-0.1693
93	3/30/2012	0.09199	-0.1048	-0.0327	0.05426	-0.0357	0.11918	-0.2552	0.39704	-0.0778	0.09026	-0.0308	-0.0753	-0.0331	-0.092	-0.0733	-0.2591	0.52154
94	4/30/2012	0.05137	-0.2146	-0.0635	-0.0569	0.24387	-0.065	0.19057	-0.1413	-0.2251	0.10935	-0.0538	0.4824	1.07879	0.01512	-0.3481	0.08163	-0.1602
95	5/31/2012	0.02177	0.42724	0.27089	-0.0017	-0.0463	-0.0704	-0.0835	0.04145	-0.1636	0.11609	-0.2805	0.04533	-0.0021	0.01373	0.44388	-0.2158	-0.0985
96	6/29/2012	-0.2459	-0.0538	-0.0008	-0.042	0.02687	0.02187	0.16043	0.19599	0.41934	0.10633	-0.1991	-0.2342	-0.0653	-0.167	0.27331	0.16066	0.10194
97																		
98																		
99	SS Regression	1.17028	0.15095	0.19223	0.07286	0.32488	0.18088	0.87378	2.50672	0.11019	0.06956	0.2039	0.45393	0.067	0.46568	3.01364	1.8462	1.04173
100																		
101	SS Residuals	0.67895	0.78619	0.27903	0.65423	0.31856	0.29058	0.80353	1.23925	1.98382	1.0748	0.48584	1.13072	1.49995	2.03603	4.81294	3.04136	0.91603
102																		
103	SS Total	1.84923	0.93715	0.47126	0.7271	0.64343	0.47146	1.67731	3.74597	2.09401	1.14436	0.68974	1.58465	1.56695	2.5017	7.82658	4.88756	1.95776

TSX SIM by TSX RBI | TSXV RBG by TSX AQA | **TSXV RTZ by TSXV NTR** | TSXV MMI by TSX

Process for calculating the residuals:

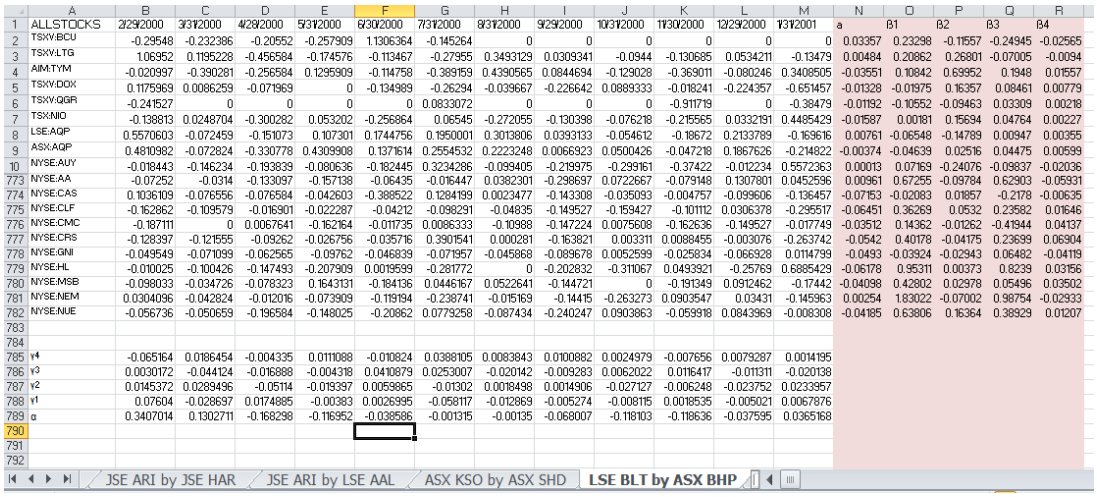
a) Solve Equation 3.6 for the monthly residuals εj over the 24 months as follows:

$(R_t - R_f) - (\alpha_i + \delta_1 MKT + \delta_2 SML + \delta_3 HML + \delta_4 MOM) = \varepsilon i$ (Row 73 to 96) above

b) Finally calculate the Sum of Squares deviation for the εj obtained for the 24 months above (row 101). This is the εj for each stock under consideration.

2. <u>Second stage of the regression:</u> For each transaction, use Equation 3.7 to cross-sectionally regress the monthly risk-adjusted returns (column B to M below) against the factor loadings for each stock derived from Equation 3.6 (column O to R below). The risk-adjusted returns used in this regression cover the last 12 months of the 36 month data series.

Equation 3.7 $R_t - R_f = \alpha_j + \gamma_1\delta_1 + \gamma_2\delta_2 + \gamma_3\delta_3 + \gamma_4\delta_4 + \varepsilon j$



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	ALLSTOCKS	2/29/2000	3/31/2000	4/28/2000	5/31/2000	6/30/2000	7/31/2000	8/31/2000	9/29/2000	10/31/2000	11/30/2000	12/29/2000	1/31/2001	α	β1	β2	β3	β4
2	TSXV:BCU	-0.29548	-0.232386	-0.20552	-0.257909	1.1306364	-0.145264	0	0	0	0	0	0	0.03357	0.23298	-0.11557	-0.24945	-0.02565
3	TSXV:LTG	1.06952	0.1195228	-0.456584	-0.174576	-0.113467	-0.27955	0.3493129	0.0309341	-0.0944	-0.130685	0.0534211	-0.13479	0.00484	0.20862	0.26801	-0.07005	-0.0094
4	AIM:TYM	-0.020997	-0.390281	-0.256584	0.1295909	-0.114758	-0.389159	0.4390565	0.0844694	-0.129028	-0.369011	-0.080246	0.3408505	-0.03551	0.10842	0.69952	0.1948	0.01557
5	TSXV:DOX	0.1175969	0.0086259	-0.071969	0	-0.134989	-0.26294	-0.039667	-0.226642	0.0889333	-0.018241	-0.224357	-0.651457	-0.01328	-0.01975	0.16357	0.08461	0.00779
6	TSXV:QGR	-0.241527	0	0	0	0	0.0833072	0	0	0	-0.911719	0	-0.38479	-0.01192	-0.10552	-0.09463	0.03309	0.00218
7	TSX:NIO	-0.138813	0.0248704	-0.300282	0.053202	-0.256864	0.06545	-0.272055	-0.130398	-0.076218	-0.215565	0.0332191	0.4485429	-0.01587	0.00181	0.15694	0.04764	0.00227
8	LSE:AQP	0.5570603	-0.072459	-0.151073	0.107301	0.1744756	0.1950001	0.3013806	0.0393133	-0.054612	-0.18672	0.2133789	-0.169616	0.00761	-0.06548	-0.14789	0.00947	0.00355
9	ASX:AQP	0.4810982	-0.072824	-0.330778	0.4309908	0.1371614	0.2554532	0.2223248	0.0066923	0.0500426	-0.047218	0.1867626	-0.214822	-0.00374	-0.04639	0.02516	0.04475	0.00599
10	NYSE:AUY	-0.018443	-0.146234	-0.193839	-0.080636	-0.182445	0.3234286	-0.099405	-0.219975	-0.299161	-0.37422	-0.012234	0.5572363	0.00013	0.07169	-0.24076	-0.09837	-0.02036
773	NYSE:AA	-0.07252	-0.0314	-0.133097	-0.157138	-0.06435	-0.016447	0.0382301	-0.298697	0.0722667	-0.079148	0.1307801	0.0452596	0.00961	0.67255	-0.09784	0.62903	-0.05931
774	NYSE:CAS	0.1036109	-0.076556	-0.076584	-0.042603	-0.388522	0.1284199	0.0023477	-0.143308	-0.035093	-0.004757	-0.099606	-0.136457	-0.07153	-0.02083	0.01857	-0.2178	-0.00635
775	NYSE:CLF	-0.162862	-0.109579	-0.016901	-0.022287	-0.04212	-0.098291	-0.04835	-0.149527	-0.159427	-0.101112	0.0306378	-0.295517	-0.06451	0.36269	0.0532	0.23582	0.01646
776	NYSE:CMC	-0.187111	0	0.0067641	-0.162164	-0.011735	0.0086333	-0.10988	-0.147224	0.0075608	-0.162636	-0.149527	-0.017749	-0.03512	0.14362	-0.01262	-0.41944	0.04137
777	NYSE:CRS	-0.128397	-0.121555	-0.09262	-0.026756	-0.035716	0.3901541	0.000281	-0.163821	0.003311	0.0088455	-0.003076	-0.263742	-0.0542	0.40178	-0.04175	0.23699	0.06904
778	NYSE:GNI	-0.049549	-0.071099	-0.062565	-0.09762	-0.046839	-0.071957	-0.045868	-0.089678	0.0052599	-0.025834	-0.066928	0.0114799	-0.0493	-0.03924	-0.02943	0.06482	-0.04119
779	NYSE:HL	-0.010025	-0.100426	-0.147493	-0.207909	0.0019599	-0.281772	0	-0.202832	-0.311067	0.0493921	-0.25769	0.6885429	-0.06178	0.95311	0.00373	0.8239	0.03156
780	NYSE:MSB	-0.098033	-0.034726	-0.078323	0.1643131	-0.184136	0.0446167	0.0522641	-0.144721	0	-0.191349	0.0912462	-0.17442	-0.04098	0.42802	0.02978	0.05496	0.03502
781	NYSE:NEM	0.0304096	-0.042824	-0.012016	-0.073909	-0.119194	-0.238741	-0.015169	-0.14415	-0.263273	0.0903547	0.03431	-0.145963	0.00254	1.83022	-0.07002	0.98754	-0.02933
782	NYSE:NUE	-0.056736	-0.050659	-0.196584	-0.148025	-0.20862	0.0779258	-0.087434	-0.240247	0.0903863	-0.059918	0.0843969	-0.008308	-0.04185	0.63806	0.16364	0.38929	0.01207
783																		
784																		
785	γ4	-0.065164	0.0186454	-0.004335	0.0111088	-0.010824	0.0388105	0.0083843	0.0100882	0.0024979	-0.007656	0.0079287	0.0014195					
786	γ3	0.0030172	-0.044124	-0.016888	-0.004318	0.0410879	0.0253007	-0.020142	-0.009283	0.0062022	0.0116417	-0.011311	-0.020138					
787	γ2	0.0145372	0.0289496	-0.05114	-0.019397	0.0059865	-0.01302	0.0018498	0.0014906	-0.027127	-0.006248	-0.023752	0.0233957					
788	γ1	0.07604	-0.028697	0.0174885	-0.00383	0.0026995	-0.058117	-0.012869	-0.005274	-0.008115	0.0018535	-0.005021	0.0067876					
789	α	0.3407014	0.1302711	-0.168298	-0.116952	-0.038586	-0.001315	-0.00135	-0.068007	-0.118103	-0.118636	-0.037595	0.0365168					
790																		
791																		
792																		

JSE ARI by JSE HAR | JSE ARI by LSE AAL | ASX KSO by ASX SHD | **LSE BLT by ASX BHP**

The y-intercept α (row 789 above) and the factor loadings γ (row 785 to 788) are calculated at monthly intervals for the last 12 months of the 36 month data set.

3. Calculation of the risk-adjusted excess return (ER) metric

For each transaction, the ER metric for each stock was calculated by adding the residuals for each stock calculated from Equation 3.6 to the cross-sectional α obtained from Equation 3.7 for the respective month (row 106 to 117 below) in the last 12 months of the 36 month data series.

	A	B	C	D	E	F	CWH
1	ALLSTOCKS	ASX:OMH	TSXV:VQA	ASX:NSL	TSXV:MAC	TSXV:EST	INDUSTRY VALUE WEIGHTING
101	SS Residuals	0.265047	1.881791	0.326362	0.664416	1.380028	
102							
105	Risk-Adj. ER	ASX:OMH	TSXV:VQA	ASX:NSL	TSXV:MAC	TSXV:EST	
106	2/29/2000	0.605749	2.222492	0.667064	1.005118	1.720729	
116	12/29/2000	0.227452	1.844196	0.288767	0.626821	1.342432	
117	1/31/2001	0.301564	1.918308	0.362879	0.700933	1.416544	
118							
119	3-Month Holding	ASX:OMH	TSXV:VQA	ASX:NSL	TSXV:MAC	TSXV:EST	
120	4/28/2000	1.097816	5.948047	1.281761	2.295923	4.442757	
128	12/29/2000	0.520808	5.371038	0.704752	1.718915	3.865749	
129	1/31/2001	0.675428	5.525658	0.859372	1.873535	4.020369	
130							
131	6-Month Holding	ASX:OMH	TSXV:VQA	ASX:NSL	TSXV:MAC	TSXV:EST	
132	7/31/2000	1.736104	11.43657	2.103993	4.132319	8.425986	
137	12/29/2000	1.245277	10.94574	1.613166	3.641492	7.935159	
138	1/31/2001	1.283109	10.98357	1.650998	3.679323	7.972991	
139							
140	12-Month Holding	ASX:OMH	TSXV:VQA	ASX:NSL	TSXV:MAC	TSXV:EST	
141	1/31/2001	3.019213	22.42014	3.754991	7.811642	16.39898	
142							
143	Market Capitalisation						
144	2/29/2000	14.256	4.9845	6.94369	1.01596	0.37552	0.656257745
145	3/31/2000	14.256	4.9845	8.22956	0.71117	0.87622	0.453623536
154	12/29/2000	2.8512	0.67968	3.85761	0.1016	0.21616	0.237455676
155	1/31/2001	3.8016	0.8496	4.62913	0.1016	0.1441	0.318258102
156							
190	Valuation (Average)						
191	3 Months	6.74784	1.889796	6.622223	0.335267	0.261128	0.956207138
192							
194	6-Month Holding	4.887771	1.603119	5.474126	0.246734	0.221043	1.720856038
195							
197	12-Month Holding	3.8016	0.8496	4.62913	0.1016	0.1441	3.219541377
198							
199							

JSE ARI by LSE AAL | ASX KSO by ASX SHD | **LSE BLT by ASX BHP**

The ER metric was compounded to 3 month, 6 month and 12 month stock holding periods (row 119 to 141), after which the market capitalisation was used (row 141 to 155) to calculate the weighted average ER3, ER6 adnd ER12 for each stock, respective to each holding period (row 190 to 197).

The weighted average ER3, ER6 and ER12 metrics for all the stocks were calculated as an estimated of the overall mining industry.

4. ER data summary for statistical analysis:

B	C	D	E	F	G	H	I	J
					ER 3-Months			
Bidder Industry	Cash vs. Stock	Target:Bidder	Target Exchange:Ticker	Bidder Exchange:Ticker	Target	Bidder	Industry Equal Weighted	Industry Value Weighted
Diversified Metals and Mining	Cash	TSXV:RTZ-TSXV:	TSXV:RTZ	TSXV:NTR	2.13	4.60	3.99	0.26
Diversified Metals and Mining	Cash	AIM:AFE-AIM:CG(	AIM:AFE	AIM:CGG	14.49	0.30	4.04	0.29
Steel	Cash	ASX:RVR-ASX:IRI	ASX:RVR	ASX:IRM	1.23	4.92	3.99	0.28
Gold	Stock	TSX:RR-TSX:NGI	TSX:RR	TSX:NGD	396.78	4807.99	3.88	0.59
Gold	Stock	TSXV:CHU-ASX:V	TSXV:CHU	ASX:WAF	6.42	49.52	3.90	0.59
Diversified Metals	Stock	ASX:GES-ASX:CL	ASX:GES	ASX:CLY	2.95	8.48	49.95	1.39
Diversified Metals	Stock	ASX:PMQ-ASX:M	ASX:PMQ	ASX:MLM	11.95	35.97	7.68	0.91
Diversified Metals	Stock	ASX:HNR-ASX:FX	ASX:HNR	ASX:FXR	16.27	82.02	8.02	0.72
Diversified Metals	Stock	TSXV:CUU-TSXV	TSXV:CUU	TSXV:LGM	30.14	10.05	12.49	0.95
Diversified Metals	Stock	ASX:PMQ-ASX:OI	ASX:PMQ	ASX:OUM	15.66	5.79	12.49	0.95
Diversified Metals	Stock	TSX:LUN-TSX:HE	TSX:LUN	TSX:HBM	2648.03	1972.48	13.07	0.94
				Overall Average	1455.55	7952.95	11.88	1.00
				Median	22.27	101.22	5.86	0.76
				Min	0.89	0.30	2.63	0.19
				Max	16124.10	75997.30	67.81	4.44
	Cash		29	Avg	2389.89	15166.06	15.19	1.22
				Median	32.64	262.38	5.97	0.96
	Stock		31	Avg	581.49	1205.19	8.79	0.80
				Median	16.27	82.02	5.55	0.66
	Cash Min				0.92	0.30	2.63	0.19
	Cash Max				16124.10	75997.30	67.81	4.44
	Stock Min				0.89	5.46	2.79	0.19
	Stock Max				5826.31	22067.52	49.95	2.77
	Standard Dev				3420.473519	18394.19375	13.31358619	0.841938033

Appendix B

Calculation of Price-to-Book (PB) valuation metric

The following equations were used to calculate the PB valuation metric:

Equation 3.1 P/B = Market Value of Equity/Book Value of Equity.

This is referred to as the "Price-to-Book" ratio

Equation 3.2 $(PB)_{it}$ Misvaluation = $[(P/B)_{it} - (P/B)_{it}]/(P/B)_{it}$

$(P/B)_{it}$ = Price to book ratio of the company under consideration

$(P/B)_{it}$ = Median Price to book ratio of the overall industry

P = "Price", the market capitalisation

B= "Book value", calculated as explained in Section 1.2.1 (b) above.

Procedure

1. For each transaction, the market capitalisation and book equity of each stock in the market is obtained for the month prior to the transaction was announced. To P/B ratio is calculated for each stock ($(P/B)_{it}$ as per Equation 3.1 (column B) below.

2. The industry median is calculated by excluding all stock with no market capitalisation or book equity data at the time (column C).

	A	B	C	D	E	F	G
1	ALLSTOCKS	8/31/2006	Exclude Zeros	MisValuation	Market Capitalisation		
2625	NYSE:CLF	2.1134743	2.113474	-0.48814	1519.37667		
2626	NYSE:CMC	2.0194671	2.019467	-0.55742	2587.21606		
2627	NYSE:CRS	2.6638343	2.663834	-0.18068	2445.93264		
2628	NYSE:GNI	11.145215	11.14521	0.717803	165		
2629	NYSE:HL	4.8221893	4.822189	0.347776	777.77574		
2630	NYSE:MSB	51.058469	51.05847	0.938401	254.528		
2631	NYSE:NEM	2.484186	2.484186	-0.26607	23045.7935		
2632	NYSE:NUE	3.387299	3.387299	0.071488	15067.5495		
2633							
2634	Industry Median		3.14514918				
2637							
2638							
2639							
2640							
2641							
2642							

TSXV KRR by TSX PGD | ASX ITT by ASX HGO2 | ASX FXR by ASX WSA | JSE ARI by

The PB metric for each stock is calculated using Equation 3.2 (column D).

3. PB data summary for statistical analysis

	A	B	C	D	E	F	G	H	I
1								PB	
2	Target Industry	Bidder Industry	Cash vs. Stock	Target Exchange:Ticker	Bidder Exchange:Ticker	**Target**	**Bidder**	**Industry Median PB**	**Industry Value Weighted PB**
3	Diversified Metals and Mining	Diversified Metals and Mining	Cash	AIM:AFE	AIM:CGG	0.73	0.83	0.76	0.47
4	Gold	Gold	Cash	AIM:HGM	TSX:ABX	-1.66	0.61	3.02	0.15
5	Diversified Metals and Mining	Precious Metals and Minerals	Cash	AIM:RLD	AIM:GEM	-2.24	-1.92	1.37	0.58
6	Diversified Metals and Mining	Diversified Metals and Mining	Cash	AIM:THR	ASX:WDR	-0.76	0.88	2.26	0.47
7	Diversified Metals and Mining	Diversified Metals and Mining	Cash	ASX:CVV	ASX:HGO	0.66	-0.02	1.11	0.55
63	Diversified Metals and Mining	Diversified Metals and Mining	Stock	TSXV:MMI	TSX:CZN	-0.15	0.85	0.64	0.50
64	Gold	Gold	Stock	TSXV:NGG	TSXV:PGK	-1.67	0.58	1.69	0.13
65	Diversified Metals and Mining	Diversified Metals and Mining	Stock	TSXV:RBG	TSX:AQA	0.48	-1.06	0.64	0.50
66	Diversified Metals and Mining	Gold	Stock	TSXV:RCR	TSXV:TAW	-3.06	-0.70	0.64	0.50
67	Diversified Metals and Mining	Gold	Stock	TSXV:TRA	TSXV:PRZ.H	1.02	-2.60	1.88	0.55
68					Overall Average	-0.41	-0.02	1.87	0.32
69					Median	0.09	0.18	2.05	0.31
70					Min	-4.27	-3.33	0.64	-0.08
71					Max	0.82	1.01	3.60	0.68
72									
74			Cash	25		-0.51	-0.02	1.82	0.33
75			Median			0.09	0.21	2.05	0.30
76			Stock	40		-1.18	-0.36	1.42	0.43
77			Median			-0.19	0.12	1.16	0.50
78									
79			Cash Min			-4.27	-3.33	0.64	-0.08
80			Cash Max			0.82	1.01	3.60	0.68
81			Stock Min			-17.37	-8.24	0.59	-0.06
82			Stock Max			1.60	1.60	3.15	0.70
83									
84			Standard Dev			2.716601074	1.473656482	0.789015949	0.197171038
85									

Appendix C

Gold Transactions – Univariate statistical analysis of all transactions

Valuation Metric	Target vs. Bidder vs. Industry	Mean	Median	Minimum	Maximum	Range
ER3	Target	457	22	2	5826	5824
	Bidder	3361	166	4	24607	24602
	Industry Equal-weighted Average	6	4	3	24	22
	Industry Value-weighted Average	1	1	1	3	2
ER6	Target	449	21	2	5560	5558
	Bidder	3491	154	4	26177	26173
	Industry Equal-weighted Average	12	8	5	49	44
	Industry Value-weighted Average	2	2	1	6	5
ER12	Target	451	20	2	5972	5971
	Bidder	3720	188	5	26563	26559
	Industry Equal-weighted Average	24	17	10	97	87
	Industry Value-weighted Average	4	4	2	8	5
PB	Target	-0.34	-0.12	-2.38	0.89	3.27
	Bidder	-0.21	0.43	-3.39	0.96	4.35
	Industry Equal-weighted Average	1.99	2.14	0.64	3.60	2.97
	Industry Value-weighted Average	0.28	0.28	-0.08	0.63	0.71

Gold transactions – univariate statistical analysis of Cash transactions

Valuation Metric	Target vs. Bidder vs. Industry	Mean	Median	Minimum	Maximum	Range
ER3	Target	266	16	2	940	938
	Bidder	6694	3281	4	24607	24602
	Industry Equal-weighted Average	6	5	3	23	20
	Industry Value-weighted Average	1	1	1	3	2
ER6	Target	272	15	2	1026	1024
	Bidder	7027	3169	4	26177	26173
	Industry Equal-weighted Average	13	10	5	46	41
	Industry Value-weighted Average	2	2	1	6	5
ER12	Target	263	15	2	1124	1122
	Bidder	7584	2827	5	26563	26559
	Industry Equal-weighted Average	26	21	10	92	82
	Industry Value-weighted Average	5	5	3	7	4
PB	Target	0.24	0.30	-1.66	0.82	2.47
	Bidder	0.86	0.46	-3.33	0.86	4.19
	Industry Equal-weighted Average	2.15	2.32	1.22	3.60	2.38
	Industry Value-weighted Average	0.21	0.20	-0.08	0.43	0.51

Gold transactions – univariate statistical analysis of Stock transactions

Valuation Metric	Target vs. Bidder vs. Industry	Mean	Median	Minimum	Maximum	Range
ER3	Target	604	23	6	5826	5821
	Bidder	797	108	5	4808	4803
	Industry Equal-weighted Average	6	4	3	24	21
	Industry Value-weighted Average	1	1	1	2	1
ER6	Target	585	25	5	5560	5555
	Bidder	771	109	5	4657	4652
	Industry Equal-weighted Average	11	8	6	49	43
	Industry Value-weighted Average	2	1	1	4	3
ER12	Target	597	23	2	5972	5971
	Bidder	748	101	5	3957	3952
	Industry Equal-weighted Average	23	16	12	97	85
	Industry Value-weighted Average	4	3	2	8	5
PB	Target	-0.55	-0.21	-2.38	0.89	3.27
	Bidder	-0.34	0.17	-3.39	0.96	4.35
	Industry Equal-weighted Average	1.71	1.67	0.64	3.10	2.46
	Industry Value-weighted Average	0.33	0.33	-0.06	0.63	0.69

Copper Transactions – Univariate statistical analysis of all transactions

Valuation Metric	Target vs. Bidder vs. Industry	Mean	Median	Minimum	Maximum	Range
ER3	Target	2107	22	1	14836	14835
	Bidder	10827	91	5	67208	67203
	Industry Equal-weighted Average	21	12	5	68	63
	Industry Value-weighted Average	2	1	1	4	4
ER6	Target	2141	22	1	15143	15142
	Bidder	10756	88	3	66974	66971
	Industry Equal-weighted Average	43	25	10	136	126
	Industry Value-weighted Average	3	2	1	9	8
ER12	Target	2403	23	0	16250	16250
	Bidder	11141	101	2	79181	79179
	Industry Equal-weighted Average	85	50	20	271	251
	Industry Value-weighted Average	7	5	3	21	18
PB	Target	-1.60	-0.61	-17.32	1.60	18.92
	Bidder	-0.46	0.08	-8.24	1.01	9.25
	Industry Equal-weighted Average	1.30	1.11	0.59	3.34	2.75
	Industry Value-weighted Average	0.46	0.52	0.14	0.70	0.56

Copper Transactions – Univariate statistical analysis of Cash transactions

Valuation Metric	Target vs. Bidder vs. Industry	Mean	Median	Minimum	Maximum	Range
ER3	Target	3631	159	1	14836	14835
	Bidder	20815	248	5	67208	67203
	Industry Equal-weighted Average	24	13	5	68	63
	Industry Value-weighted Average	2	1	1	4	4
ER6	Target	3746	130	1	15143	15142
	Bidder	20836	248	3	66974	66971
	Industry Equal-weighted Average	49	27	10	136	126
	Industry Value-weighted Average	4	3	1	9	8
ER12	Target	4409	78	0	16250	16250
	Bidder	22039	300	2	79181	79179
	Industry Equal-weighted Average	97	53	20	271	251
	Industry Value-weighted Average	8	5	3	21	18
PB	Target	-0.95	-0.91	-4.26	0.92	5.18
	Bidder	-0.18	-0.15	-1.73	1.01	2.74
	Industry Equal-weighted Average	1.45	1.37	0.64	2.24	1.60
	Industry Value-weighted Average	0.42	0.46	0.15	0.68	0.53

Copper Transactions – Univariate statistical analysis of Stock transactions

Valuation Metric	Target vs. Bidder vs. Industry	Mean	Median	Minimum	Maximum	Range
ER3	Target	454	16	3	2648	2645
	Bidder	352	23	6	1972	1967
	Industry Equal-weighted Average	17	12	8	50	42
	Industry Value-weighted Average	1	1	1	1	1
ER6	Target	400	13	3	2341	2339
	Bidder	316	20	8	1788	1780
	Industry Equal-weighted Average	35	25	15	100	85
	Industry Value-weighted Average	2	2	1	3	1
ER12	Target	209	5	1	1234	1232
	Bidder	196	16	7	1106	1099
	Industry Equal-weighted Average	69	50	31	200	169
	Industry Value-weighted Average	4	4	3	6	2
PB	Target	-1.83	-0.25	-17.32	1.60	18.92
	Bidder	-0.62	0.15	-8.24	0.85	9.09
	Industry Equal-weighted Average	1.20	0.88	0.59	3.34	2.75
	Industry Value-weighted Average	0.49	0.56	0.14	0.70	0.56

Diversified Metals & Mining Transactions – Univariate statistical analysis of all transactions

Valuation Metric	Target vs. Bidder vs. Industry	Mean	Median	Minimum	Maximum	Range
ER3	Target	1959	30	1	16124	16123
	Bidder	10054	82	0	75997	75997
	Industry Equal-weighted Average	12	8	4	31	27
	Industry Value-weighted Average	1	0	0	1	1
ER6	Target	1991	25	1	15665	15665
	Bidder	9929	50	0	72198	72197
	Industry Equal-weighted Average	24	16	8	63	55
	Industry Value-weighted Average	1	1	0	3	3
ER12	Target	2405	11	0	16923	16922
	Bidder	10419	38	0	79181	79181
	Industry Equal-weighted Average	45	29	16	126	110
	Industry Value-weighted Average	2	1	1	5	4
PB	Target	-1.34	-0.24	-17.37	1.21	18.58
	Bidder	0.01	0.09	-2.60	1.60	4.20
	Industry Equal-weighted Average	1.36	1.14	0.59	3.15	2.55
	Industry Value-weighted Average	0.45	0.50	0.07	0.70	0.64

Diversified Metals & Mining Transactions – Univariate statistical analysis of Cash transactions

Valuation Metric	Target vs. Bidder vs. Industry	Mean	Median	Minimum	Maximum	Range
ER3	Target	3419	49	1	16124	16123
	Bidder	18760	88	0	75997	75997
	Industry Equal-weighted Average	16	10	4	31	27
	Industry Value-weighted Average	1	1	0	1	1
ER6	Target	3519	51	1	15665	15664
	Bidder	18507	45	0	72198	72197
	Industry Equal-weighted Average	33	19	8	63	55
	Industry Value-weighted Average	1	1	0	3	2
ER12	Target	4528	26	1	16923	16922
	Bidder	20083	38	0	79181	79181
	Industry Equal-weighted Average	55	36	16	126	110
	Industry Value-weighted Average	2	3	1	5	4
PB	Target	-0.73	-0.49	-4.27	0.92	5.19
	Bidder	-0.05	0.08	-1.92	1.01	2.93
	Industry Equal-weighted Average	1.48	1.26	0.64	2.49	1.85
	Industry Value-weighted Average	0.41	0.47	0.07	0.68	0.61

Diversified Metals & Mining Transactions – Univariate statistical analysis of Stock transactions

Valuation Metric	Target vs. Bidder vs. Industry	Mean	Median	Minimum	Maximum	Range
ER3	Target	621	15	1	4256	4255
	Bidder	2073	79	10	22068	22058
	Industry Equal-weighted Average	8	6	4	24	20
	Industry Value-weighted Average	0	0	0	1	0
ER6	Target	591	14	1	4277	4276
	Bidder	2065	64	9	22209	22200
	Industry Equal-weighted Average	16	12	8	47	39
	Industry Value-weighted Average	1	1	0	1	1
ER12	Target	459	9	0	3984	3984
	Bidder	1560	49	6	16934	16928
	Industry Equal-weighted Average	31	25	16	95	79
	Industry Value-weighted Average	1	1	1	3	2
PB	Target	-1.76	-0.15	-17.37	1.21	18.58
	Bidder	0.05	0.18	-2.60	1.60	4.20
	Industry Equal-weighted Average	1.28	1.13	0.59	3.15	2.55
	Industry Value-weighted Average	0.47	0.50	0.15	0.70	0.55

Combined Transactions – Univariate statistical analysis of all transactions

Valuation Metric	Target vs. Bidder vs. Industry	Mean	Median	Minimum	Maximum	Range
ER3	Target	1456	22	1	16124	16123
	Bidder	7953	101	0	75997	75997
	Industry Equal-weighted Average	12	6	3	68	65
	Industry Value-weighted Average	1	1	0	4	4
ER6	Target	1475	22	1	15665	15665
	Bidder	7954	99	0	72198	72197
	Industry Equal-weighted Average	24	12	5	136	130
	Industry Value-weighted Average	2	1	0	9	9
ER12	Target	1704	18	0	16923	16922
	Bidder	8378	104	0	79181	79181
	Industry Equal-weighted Average	46	23	10	271	261
	Industry Value-weighted Average	4	3	1	21	20
PB	Target	-0.41	0.09	-4.27	0.82	5.09
	Bidder	-0.02	0.18	-3.33	1.01	4.33
	Industry Equal-weighted Average	1.87	2.05	0.64	3.60	2.97
	Industry Value-weighted Average	0.32	0.31	-0.08	0.68	0.76

Combined Transactions – Univariate statistical analysis of Cash transactions

Valuation Metric	Target vs. Bidder vs. Industry	Mean	Median	Minimum	Maximum	Range
ER3	Target	2390	33	1	16124	16123
	Bidder	15166	262	0	75997	75997
	Industry Equal-weighted Average	15	6	3	68	65
	Industry Value-weighted Average	1	1	0	4	4
ER6	Target	2462	32	1	15665	15665
	Bidder	15191	277	0	72198	72197
	Industry Equal-weighted Average	30	12	5	136	130
	Industry Value-weighted Average	2	2	0	9	9
ER12	Target	3024	26	0	16923	16922
	Bidder	16313	402	0	79181	79181
	Industry Equal-weighted Average	57	23	10	271	261
	Industry Value-weighted Average	5	3	1	21	20
PB	Target	-0.51	0.09	-4.27	0.82	5.09
	Bidder	-0.02	0.21	-3.33	1.01	4.33
	Industry Equal-weighted Average	1.82	2.05	0.64	3.60	2.97
	Industry Value-weighted Average	0.33	0.30	-0.08	0.68	0.76

Combined Transactions – Univariate statistical analysis of Cash transactions

Valuation Metric	Target vs. Bidder vs. Industry	Mean	Median	Minimum	Maximum	Range
ER3	Target	581	16	1	5826	5825
	Bidder	1205	82	5	22068	22062
	Industry Equal-weighted Average	9	6	3	50	47
	Industry Value-weighted Average	1	1	0	3	3
ER6	Target	551	14	1	5560	5560
	Bidder	1184	78	5	22209	22204
	Industry Equal-weighted Average	18	11	6	100	94
	Industry Value-weighted Average	2	1	0	6	6
ER12	Target	468	8	0	5972	5972
	Bidder	956	75	5	16934	16929
	Industry Equal-weighted Average	35	22	11	200	189
	Industry Value-weighted Average	3	3	1	8	7
PB	Target	-1.18	-0.19	-17.37	1.60	18.97
	Bidder	-0.36	0.12	-8.24	1.60	9.84
	Industry Equal-weighted Average	1.42	1.16	0.59	3.15	2.55
	Industry Value-weighted Average	0.43	0.50	-0.06	0.70	0.77

Appendix D

Several spreadsheets containing about 10 GB of data will be provided separately on a memory stick containing the following supporting information:

- Raw data exports from S&P Capital IQ
  - M&A transactions
  - Equity data
  - Financial Data
  - US treasury rate
- Calculation of Valuation Metrics
  - Risk-adjusted excess returns (ER)
    - FFPM portfolio construction
    - Monthly excess returns
    - First stage regression
    - Second stage regression
    - Valuation metric calculation
  - PB metric calculation
- Hypothesis testing
  - ER metrics
  - PB metric
- Firm characteristics analysis