An assessment of the potential effect of the Marikana incident on mining companies listed on the JSE

Nicholas Hill

Student Number: 396789

Tel: 083-261-4566

Ethics Number: CACCN/1024

This research report is submitted to the Faculty of Commerce, Law and Management, University of Witwatersrand, in partial fulfilment of the requirements for the Degree of Masters of Commerce in Accounting (50%).

March 2014

ABSTRACT

This report examines the potential effect of the Marikana incident on the companies listed in the mining sector on the Johannesburg Stock Exchange (JSE) for the defined observation period (3rd January 2012 to 23rd August 2012). Event study methodology was used to capture the market reaction to the incident. This entailed the determination of abnormal returns on the event date and cumulative abnormal returns for windows defined as 2 and 5 days post the event date. The entire population of companies listed in the Mining sector on the JSE was used in order to capture the full consequence of the event. The results presented a contained effect, limited exclusively to Lonmin Plc. ('Lonmin'), which exhibited significant abnormal returns on the event date but recovered in the subsequent days.

DECLARATION

I declare this research report to be my own work. It is submitted in partial fulfilment of the requirements for the degree of Master in Commerce in Accounting in the School Of Accounting, University of the Witwatersrand. It has not been submitted for any degree or examination at any other university. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

nickhill Digitally signed by nickhill DN: cn=nickhill Date: 2014.06.30 11:25:29 +02'00'

30/6/2014

Nicholas Rowland Hill | Date

ACKNOWLEDGEMENTS

I would like to extend my gratitude to my supervisor, Warren Maroun, for the support he has provided throughout this research. Without his guidance and thorough input, this report would not have been possible.

Additionally, I would like to acknowledge and thank Ms Lelys Maddock for editing this study.

1 Table of Contents

1. INTRODUCTION

1.1 Purpose of study

The purpose of this research is to examine the relationship between the Marikana incident[1] and the effect on the value of mining stocks listed on the Johannesburg Stock Exchange (JSE), by identifying and measuring abnormal returns over a defined event period. Given the significant attention paid to this event in local and international media, such a case has the potential to negatively affect the value of firms in the JSE's mining sector.

There are similar studies which have examined the effect of unusual events on share prices. Chen and Siems (2004), for example, quantify the impact of terrorist attacks on global stock indexes. Studies by Capelle-Blancard and Laguna (2010) and Hamilton (1995) quantify the impact of stock market reactions to news of companies causing environmental damage. More specifically, White (1996) examines the impact of the Exxon Valdes oil spill on stock prices; Kalra et al (1993) determine the impact of the Chernobyl nuclear disaster on utility share prices; and Hovav and D'Arcy (2003) examine the impact of 'denial of service' (DOS) attack announcements on the affected firms' stock prices.

The above cases bear resemblance in that the market was unable to anticipate the event. The unpredicted nature of the Marikana incident drew significant media attention, both locally and internationally (Nkosi, 2012, Mabuse, 2012). Despite this, there has been no published academic research on the potential economic effect of Marikana. The purpose of this research is to consider the potential effect that the Marikana incident has had on the returns of mining companies listed on the JSE for a specified period, using share prices obtained from the JSE over a defined observation period comprised of an estimation and event window (see Appendix A for the timeline of the observation window).

[1] Refers to the shooting of 34 miners by the South African Police Service on 16 August 2012

1.2 Context and significance of study

The mining sector has traditionally been responsible for driving a significant amount of economic activity in South Africa (Twala, 2012). The sector contributed 8.8% directly, and 10% indirectly, to the country's gross domestic product (GDP); provided employment to approximately one million workers, and supplied approximately R10billion in corporate tax revenue in 2009 (Van der Schyff, 2012: 131). Given the size and importance of the industry, it is understandable that any event that directly impacts the sector (such as Marikana) can trigger a significant effect on the South African economy.

There is currently, however, limited research available on the Marikana incident. Presently, most of the information available on Marikana comes from the popular press and deals with issues such as: the socio-political aspects of the incident, including labour relations (Twala, 2012), the political ramifications (van Graan, 2013) and social aspects focusing on the evolution of protest action (Bond and Mottiar, 2013). Consequently, this paper makes an important contribution by providing an initial quantitative assessment of the potential economic consequence of the Marikana incident.

1.3 Definition of terms

Important terms used in this research report are:

- Marikana incident – This refers to the shooting of 34 miners by the South African Police Service on 16 August 2012.
- Estimation window – The period used to determine the normal level of returns. It is important this window is separate from the event window so as not to be influenced by returns around the event (Appendix A) (MacKinlay, 1997).
- Event date – The specific date when the Marikana incident occurred – 16 August 2012 (Appendix A) (MacKinlay, 1997).

- Normal returns – The expected return over the defined estimation window. The market model developed by MacKinlay (1997) will be used to determine the normal level of expected returns (Appendix A).
- Event study methodology – This is defined as a statistical study performed on securities examining the impact that a catalysing event can have on the value of a firm (MacKinlay, 1997).
- Alpha – Defined as the measure of performance on a risk-adjusted basis. This can be further explained as the excess return of a security, experienced relative to that of a specified benchmark (Harvey and Sticht, 2014).
- Beta –defined as the measure of systematic risk or volatility in relation to the market as a whole. This measure forms an intrinsic part of the measurement of expected returns in the CAPM model (Harvey and Sticht, 2014).
- Abnormal returns: The excess of returns over the expected normal returns (MacKinlay, 1997). It is the term used to describe how the returns generated by a security over a period of time differ from the expected returns (Harvey and Sticht, 2014).

1.4 Limitations and delimitations of this study

This paper excludes:

- Companies not listed on the JSE because of the lack of readily available data.
- Companies listed on foreign stock exchanges. The economic effect of this event will be examined in a South African context, given the locality of the event.
- Companies not listed as part of the Mining Index on the JSE. Since this index will experience the direct impact of the incident, this study will isolate the population to include only mining companies listed on the JSE Mining Index.
- To retain focus on the effect of Marikana on stock prices, the impact of the incident on other variables such as: commodity prices, gross-domestic product (GDP), and tax revenues is not dealt with. Due to difficulties in objectively estimating social and

political costs, this is excluded from the study. Consequently, changes in returns cannot provide a total account of the loss of value.

- The research will not carry out an econometric evaluation designed to separate the movement in share prices into multiple determinants. Consequently, the research does not claim to test for or prove causal relationships between share prices, returns and the Marikana incident. There is also the tacit assumption, due to the use of a relatively short observation period (Kothari and Warner, 2006), that the Marikana incident is the only material determinant of share prices for the period under review. This mimics the assumptions of other similar studies (Chen and Siems, 2004, White, 1996, Capelle-Blancard and Laguna, 2010) which test share price reactions to a single unpredicted event. Since the study will use a short event-window there will be no need for cross sectional variance adjustments as recommended by Corrado (2011) for studies with longer event windows.
- As this study is testing the effect of the Marikana incident (as an unusual event) on normal and abnormal returns only, the effect of preceding strike action, which formed part of normal labour negotiations, is not examined. Given industrial action is a common feature in the mining industry (McClenaghan, 2012), this study will aim to assess the potential effect of the deaths of the mine workers (the unforeseen single event) rather than the strike itself. That these proceeding events may have had an impact on returns which continued after the Marikana incident is possible but not here examined further.
- This study will not apply quadratic or multifactor models to the observation data since the gains from applying such models are limited in comparison to the more direct market model approach (MacKinlay, 1997) (see Section 3.1 for further details).
- This report aims to assess the market's reaction as a whole to the Marikana event and does not attempt to profile specific investors and their reaction.

- This study will not analyse the impact of the other specifications, such as size of the tested corporations, since this report is testing the effect of the event across all firms listed in the specific mining sector.

1.5 Assumptions

The following assumptions have been made in respect of the research process:

- The date of the first media publications will be the most accurate reflection of when the market became acutely aware of the event, in terms of the semi-efficient market hypothesis theory (Malkiel and Fama, 1970).
- The data collected from the JSE is accurate and complete. The market processes information about the event in an efficient and unbiased manner. The JSE operates at a semi-strong form market efficiency level. (Choudhry, 1999, Magnusson and Wydick, 2002, Jefferis et al, 1999, Glass and Smit, 1995).
- The volume of trade on the day of the event and during the corresponding event window will be sufficient to reflect the information content in the share prices as the media reports become accessible to the public (Blume et al, 1994). The use of the rank test (Corrado, 1989) and sign test (Cowan, 1992) help to alleviate the problem of thin trading since, being non-parametric tests, both tests do not depend on the assumption of normal distribution (Cowan and Sergeant, 1996). This study will apply both the sign and rank tests as part of the tests of robustness. Nevertheless, this study will not be able to prove a causal relationship between the event under review and share prices (Section 1.4).
- Share prices reflect all available market information and the volatility is a correct measure of the markets response to the information (Fama et al, McWilliam and Siegal 1997) and, therefore, abnormal returns capture the effect of the Marikana incident (MacKinlay, 1997).

- Share volatility is a measure of the market response and reflects the information contained in the share prices in an efficient and unbiased manner (Fama et al, 1969).
- The data collected from the *BFA McGregor* database regarding the JSE share prices is accurate and complete.
- The Marikana incident can be considered an unforeseen event from a market perspective (Nkosi, 2012, Mabuse, 2012). The abnormal returns will, therefore, reflect this unanticipated market response (Fama, 1965b).

2 LITERATURE REVIEW

2.1 The efficient market hypothesis

2.1.1 Background

The efficient market hypothesis (EMH) is an economic theory developed by Fama et al (1969) asserting that financial markets will process information efficiently. The term 'efficient markets was first conceived by Fama (1965a), who later defined it as:

> 'a market where there are large numbers of rational, profit-maximizers actively competing with each trying to predict the future market values of individual securities, and where important current information is almost freely available to all participants. In an efficient market, competition among the many intelligent participants leads to a situation where, at any point in time, actual prices of individual securities already reflect the effects of information based both on events that have already occurred and on events which, as of now, the market expects to take place in the future' (Fama, 1965b, p.56).

Brown (2009) deconstructs the above definition and simplifies it into three separate assumptions: there must be multiple market participants who analyse and value stocks independently from each other, new information (that could not be predicted) is brought into the market at random, and, lastly, stock prices will react quickly to this new information as profit maximizers discount this information into the stock prices.

Malkiel and Fama (1970) acknowledge that 'a frictionless market' in which all information is freely available and investors agree on its implications is not descriptive of markets in practice but this does suggest that the above conditions 'exist to some extent in real world markets' (Malkiel and Fama, 1970, p. 387-388). The EMH has, therefore, formed a popular basis for multiple finance studies (MacKinlay, 1997).

The EMH requires that each economic agent demonstrate a behavioural response to this information that will maximize returns (Fama, 1965a). In theory, this model is based on the assumption that shareholders have rational expectations about the future and this kind of expectation is identical to the optimal forecast of future events assuming all available information has been taken into account (Muth, 1961).

The EHM theorem dictates that, whenever new information is made available to the users, their assumptions are updated immediately and they will react accordingly (Fama et al, 1969). It is important to note that it is not necessary for an investor to react rationally to this market news - that is to say that either an over-or under-reaction will take place. The EMH only requires that the market's reaction follows a normal distribution pattern so that any one person can be wrong about the market but the overall market will be right (Fama et al, 1969).

The EMH, based on investors' responses, suggests that all relevant information to share-value has been incorporated into the share price (Brown, 2009). Principally, should new information come to light (i.e. from an unforeseen event), it will be immediately taken into account in a firm's share price as investors reassess the respective entity's current and future prospects. The new share price will reflect an investor's assessment of the discounted value of a firm's current and future performance. The strength of the information content of the share price will depend on the overall assessment of many investors and their ability to process and assimilate this information into the market prices of the firms (Schwert, 1981). The scope of the share price to reflect fully all available information will be subject to how efficiently the market can absorb it (Malkiel and Fama, 1970).

2.1.2 Market forms

How efficiently the market responds to this new information will depend on the form of the market (Malkiel and Fama, 1970). The three common market forms derived from the EMH model are weak-form efficiency, semi-strong form efficiency and strong-form efficiency which are differentiated by levels of information reflected in share prices (Brealey et al, 2008).

In weak form efficiency markets, share prices are a reflection of past information only and cannot be used as a forecast basis to predict future prices (Malkiel and Fama, 1970). This implies that future price movements are determined by information that is independent of that already discounted into the share price and thus share price will exhibit no patterns. In other words, any movements in the share price will occur at random. Past information will, therefore, provide no signalling to investors to forecast future returns since they would have already learnt to interpret and take advantage of this information (Bodie et al, 2010).

The semi-strong form efficiency theory is critical to this study as this market model suggests that share prices will immediately react to information as it becomes available to the public (Malkiel and Fama, 1970). Additionally, the market will react in an unbiased fashion and the information will be included in the value of the share thus no additional gains may be made from trading on that information. In order to determine whether a strong-form efficient market exists, it is necessary to examine the impact of news that was previously unknown in terms of magnitude, direction and the speed at which the market assimilates this information. A perfectly semi-strong form efficient market will absorb publically available information instantaneously. For a semi-strong market to remain efficient, well trained analysts who understand economic powers are required, since it is not only necessary to act on financial information but also to comprehend the market impact of processing this information (Clarke et al, 2001).

In strong-form efficient markets, share prices will reflect all public and private information, meaning that it will be impossible to earn additional returns from access to this information (Malkiel and Fama, 1970). A test for strong-form efficient markets would be to observe whether an investor is consistently able to beat the market in the long-term. If this is the case then, the market is not an efficient market since it means that information may not be available to every investor, which would result in arbitrage. This assumption is disputed by Seyhun (1986), (1998) who provides empirical evidence that insider traders' profit from information is not already incorporated into a share price.

Concerns have been expressed regarding some of the assumptions inherent in the EMH theory. There are three main misconceptions borne out of the EMH theory, namely that: investors cannot outperform the market, financial analysis research is ineffective since all information is already available, and investors who evaluate information must be informed and skilled (Clarke et al, 2001). Much research has been conducted regarding the above concerns, notably the report by Basu (1977).

Basu (1977), a sceptic about the EMH, criticised the model, based on the fact that low-price-to earnings stocks tended to outperform other stocks. Simply, he argues, share prices are biased and price-to-earnings ratios are an indicator of this bias since they have reliable forecast power (something that should not exist in an efficient market).

Despite these noted imperfections, the EMH is widely considered to be a reasonable basis for describing changes in share prices (Malkiel, 2003).

2.1.3 South African context

Numerous studies have examined the efficiency of African markets, and, as a sub-category, the JSE. Magnusson and Wydick (2002) find that the JSE does not have the same level of efficiency as the NYSE but fares well when compared to the Asian and South American countries. Jefferis and Smith (2004) examine the changing efficiency of African markets and specifically cite the study by Jefferis et al (1999) as a test of how efficiently the stock markets of South Africa, Botswana, and Zimbabwe respond to new information in terms of speed and price adjustments. The study found that the JSE is semi-strong form efficient (Jefferis and Smith, 2004). Glass and Smit (1995) tested whether the JSE demonstrated factors of a strong-form efficiency market and found that, although there were slight opportunities for exploiting market inefficiencies, the market did not fully conform to strong-form efficiency. Nevertheless, he concluded that the market was at least semi-strong form efficient.

The market's ability to respond efficiently to publically available information (e.g. the Marikana incident) is crucial to the successful implementation of event study methodology (Schwert, 1981).

2.2 The Marikana incident

The Marikana incident is considered a significant event in South African history with parallels drawn between the Marikana shootings and the Sharpeville and Soweto uprisings of 1960 and 1976 respectively (Sorensen, 2012). The event attracted significant attention from local and international media due to the number of casualties, as well as the historical sensitivity associated with the South African Police Service's (SAPS) use of force (Marinovich, 2012). This also evoked a response from the investor community with many implying that this was evidence that the South African mining industry is in decline (Cawadas and Mitchell, 2012).

The Marikana incident was the climax of an unprecedented year of strike action in the South African mining industry which witnessed the highest number of protests per month since the end of Apartheid (McClenaghan, 2012). Unrest in the mining sector was first started by Rock Drill Operators (RDO's) at the Impala Platinum mine in January 2012 (Chinguno, 2013). The mandate from the RDO's was a wage increase of 200% due to a decision made by management to award mine blasters an 18% increase in retention allowance. The RDO's particularly wanted prevent the involvement of their union (the National Union of Mineworkers (NUM)) who believed the workers' demands to be unattainable. As such, they rejected any approach for representation by the NUM, and opted instead to form an independent committee to present their demands to management. This rejection of NUM allowed the Association of Mining and Construction Union (AMCU) to emerge as a competitor in the industrial relations arena (Onslow, 2012). This strike action saw the beginnings of trade union rivalry, a factor crucial in the Marikana incident.

The strike gained notoriety because of the acts of violence and levels of worker activism (Onslow, 2012). Additionally, it saw the demise of the old collective bargaining process

which the workers perceived to be out-dated and unable to meet their aspirations (Cawadas and Mitchell, 2012). Management ultimately conceded to worker demands and offered a 22% increase in gross package which inadvertently validated workers' actions (Bond and Mottiar, 2013). This agreement would catalyse wild-cat[2] strike action and set a precedent for future wage dispute resolution (Chinguno, 2013).

Borne of the success of the independent bargaining wage negotiations at Impala Mines, the workers at Lonmin saw an opportunity for their own wage negotiations due to the growing disillusionment with formal union representation (Cawadas and Mitchell, 2012, McClenaghan, 2012). Workers felt that wages were failing to meet their living costs since stop-order loan repayment systems (micro-credit lending facilities) (Bateman, 2012) were significantly reducing their take-home pay (Bond and Mottiar, 2013). Inspired by the previous strike action by mineworkers at the Impala Mine, workers at Lonmin (in Marikana) embarked on a wildcat strike on 10 August 2012 (Marinovich, 2012).

Workers rejected attempts by NUM to mediate the conflict and followed the model of the Lonmin strikers whereby independent committees were created to champion the workers' cause (Chinguno, 2013). Lonmin management were aware of the failure of Impala management to engage with the workers via the old collective bargaining approach and, instead, elected to respond to the workers outside of the traditional negotiation framework. NUM disagreed with the process, which angered workers who believed this was their pact. Clashes ensued between protesting workers and union officials, the first of which took place on 11 August 2012. Marching strikers were shot at by NUM members causing the death of two workers (Bond and Mottiar, 2013). This act incited workers to retaliate, further instigating violent confrontations and resulting in an increase in police presence in the area. By this stage, the share price shed over 6% of its value by 16 August 2012 as Lonmin announced it

[2] A strike begun by workers spontaneously or without union approval.
(n. Dictionary.com. *Collins English Dictionary - Complete & Unabridged 10th Edition*. HarperCollins Publishers. http://dictionary.reference.com/browse/wildcat-strike (accessed: February 13, 2014).)

had lost 15 000 ounces worth of platinum production due to the strike and the related stoppages (Reuters, 2012c).

As a result, the SAPS were deployed to move the striking miners down from a hill where they had been gathering for a number of days. They positioned barbed wire fencing and fired teargas in an attempt to move the workers. As the workers descended from their position, the SAPS opened fire on the miners, killing 34 and wounding an additional 78 (Nkosi, 2012). The motives of the SAPS officers are unclear but it has been suggested that one of the workers was carrying a pistol and fired the first shots causing the SAPS to retaliate (Bond and Mottiar, 2013).

Days of protest climaxed with the deaths of 34 mine workers by members of the SAPS on 16 August 2012, sparking the reaction of local and international media (Marinovich, 2012). In the aftermath of the incident, the Farlam Commission of Inquiry was established to investigate the incident (Smith, 2013, Evans, 2013). No attempt as yet has been made to discipline any of the police officers accused of the killings (Bond and Mottiar, 2013). The Marikana event has had a profound impact on the labour landscape of South Africa and is suggested as being a major reason for the gaining popularity of wildcat strikes (McClenaghan, 2012).

Despite increased media attention and the convening of a formal commission of enquiry, there has been no published academic research on the potential economic effect of the Marikana incident. Consequently, the purpose of this research is to consider the effect that the Marikana incident has had on the share price returns of mining companies listed on the JSE for a specified period. The detail of the application of the testing process is provided in Section 3.

3 RESEARCH METHODOLOGY

3.1 Background

Event-study methodology is a forward-looking approach which identifies abnormal returns resulting from a single event. Event studies provide an insightful approach in determining the significance of a particular event, measured in terms of the effect on share prices. (Kothari and Warner, 2006).

Two key papers by Ball and Brown (1968) and Fama et al (1969) are considered to be the origin of event study methodology. The study performed by Ball and Brown (1968) evaluated the response of accounting numbers to specific reports being either 'good' or 'bad' news whereas, the study performed by Fama et al (1969) examined the speed of the reaction of a stock price to new information (a stock split announcement). MacKinlay (1997), however, declares the study performed by Dolley (1933) on the reaction of share prices to the announcements of share splits, as the first recorded instance of an event-study.

Interest in capital structure research, spearheaded by Modigliani and Miller (1958) played a pivotal role in bringing capital asset pricing issues to the forefront of finance research and promoting interest in new finance models, such as the event-study methodology (Corrado, 2011). Event study methodology has now become the standard measure for determining share price reaction to announcements or events (Binder, 1998, MacKinlay, 1997). The early success of these studies can be largely attributed to the use of the 'market model' approach to calculating normal returns which was styled on the popularised economic Capital Asset Pricing Model of Sharpe (1964).

Two major advancements in event study methodology have taken place since its inception: firstly, the more prominent use of daily stock returns over monthly returns due to the latter providing a more definite measure of abnormal returns and, secondly, the enhancement of the methods used to estimate abnormal returns and determine the statistical significance of those returns (Kothari and Warner, 2006).

The event-study methodology has a number of very useful applications, notably in insider trading cases such as the one performed by Mitchell and Netter (1994) who use financial economics to prove accused traders guilty. This study defined 't_0' as the date of the merger announcement and proved that the disturbance in the normal movement in the build-up to the event date was attributable to the gains trading of the investors with insider information. Event-study methodology can also play a crucial role in testing the efficiency of a market: more specifically, consistent non zero abnormal returns that continue after an event are an indication that the market is not behaving in an efficient manner (Kothari and Warner, 2006). Fama (1991) goes as far to suggest that event studies are the 'cleanest evidence we have on efficiency' (Fama, 1991. p. 1602). Of importance is the examination of the post-event period in determination of how efficiently the market responds to new information (Kothari and Warner, 2006).

3.1.1 Past event studies

Numerous event methodology studies focus on the effect on stock prices from announcements, namely: earnings announcements (Chambers and Penman, 1984), announcements of new equity issues (Barclay and Litzenberger, 1988), and the impact of bond rating agency announcements on bond prices (Hand et al, 1992). Specific to share price movements, Rosen (2006) identifies how the announcement of a merger (a single event) can trigger a short-term movement in stock price based on investor sentiment.

Other studies focus on events not within the control of the entity, such as the event-study performed by Worrell and Davidson (1987), which specifically examines the impact of CEO succession on the wealth of shareholders following the death of their predecessors. Chen and Siems (2004) used event-study methodology to assess the immediate impact that terrorist attacks (most notably the September 11 attack) had on United States of America's (USA) capital markets. In the South African context Bhana has conducted numerous event-studies in terms of: announcements of management buyouts (Bhana, 2005), examining the event of unbundling transactions on the JSE (Bhana, 2006), and reaction to share

repurchase announcements and their impacts on JSE listed firms (Bhana, 2007). The Marikana incident bears a resemblance to the above and, therefore, endorses the use of event-study methodology for testing the impact[3] of the Marikana incident on mining companies listed on the JSE (Section 1.3).

Past studies have indicated that the JSE has demonstrated a weak to semi-strong market efficiency, as discussed in Section 2.1.3 (Choudhry, 1999, Magnusson and Wydick, 2002, Jefferis et al, 1999, Glass and Smit, 1995) and, therefore, share prices will absorb and react to publicly available information (Malkiel and Fama, 1970). This means that event study methodology is an effective technique for dealing with the proposed research objective.

[3] The term 'testing the impact' is used as the event methodology does not prove causality.

3.1.2 The event-method

The aim of an event study is to examine the return reaction of a sample of firms responding to a specific event (Kothari and Warner, 2006). Principally, the abnormal return will be the difference between the observed return (R_{it}) and the predicted or 'normal' return (K_{it}), composed as in Kothari and Warner (2006):

$$e_{it} = R_{it} - K_{it} \qquad \textit{(Equation 1)}$$

Normal returns should be modelled using an estimation window which is kept separate from the event window in order ensure that the normal return is not influenced by the fluctuations caused by the event (Kothari and Warner, 2006). Modelling this return can be done using either statistical or economic approaches (MacKinlay, 1997). Two economic approaches used to model normal returns are the Capital Asset Pricing Model (CAPM) (Sharpe, 1964, Lintner, 1965) and the Arbitrage Pricing Theory (Ross, 1976). When selecting an event methodology model to apply to test data, no single method is generally accepted as superior (Corrado, 2011). However, economic models are used less frequently in event-study methodology as the benefit of enhanced accuracy of findings seldom justifies the costs of using a more complex model (MacKinlay, 1997).

Therefore, MacKinlay (1997) proposes the use of simpler statistical models. Two focal statistical approaches recommended by MacKinlay (1997) are the Constant Mean Return Model and the Market Model, which were originally designed by Brown and Warner (1980). Brown and Warner (1985) suggest that these models yield results similar to more complex models due to the fact that variance of the abnormal return is not reduced by choosing a more sophisticated model.

The Constant Mean Return Model has been applied in numerous studies, notably Chen and Siems (2004). The abnormal return (AR_{it}) is determined as the difference between the predicted return (K_{it}) and the actual return (R_{it}), demonstrated below (Brown and Warner, 1980):

$$AR_{it} = R_{it} - K_i \qquad \textbf{(Equation 2)}$$

where the expected return (K_i) is determined as the mean return for security (i) under the assumption that the security has constant systematic risk (Brown and Warner, 1980).

The second model provided by Brown and Warner (1980) is the market adjusted returns model which assumes the expected returns will be distributed equally across securities if a market portfolio of shares is a combination of all securities returns. The abnormal return (AR_{it}) for a specific share (i) will be the return on a share of its return (R_{it}) less the return of the market (RM_{it}). The last model discussed by Brown and Warner (1980) is the market and risk adjusted return model or more simply the 'Market Model' which uses elements of the CAPM formula to determine the expected return.

MacKinlay (1997) proposes the use of the Market Model approach over the Constant Mean Return Model since the Market Model removes abnormalities in the return, associated with market variations, as well as incorporating the systematic risk of the share. The model adjusts the event date return of the whole market against the return of a single share, confirmed by the following formula (Corrado, 2011, Fama et al, 1969):

$$R_t = a + b \times RM_t + e_t \qquad \textbf{(Equation 3)}$$

where R_t and RM_t are the returns on a specified share and the return of the overall market at time (t). This method removes the effect of the economy-wide (market) returns on the stock

(i) while dissecting just the return related to firm-specific information. The firm-specific return isolated from that of the market is e_t. The market model parameters of a ('alpha' being the excess of return, relative to a specific benchmark index) and b ('beta' being the measure of correlation in change of a specified share in relation to a designated index) are determined by ordinary least squares regression of firm returns R_t and market RM_t over a defined estimation window (Corrado, 2011) (see Appendix A). It is assumed that these coefficients will remain constant during the event and estimation windows (Binder, 1998).

Ball and Brown (1968) observe that the event itself should not form part of the estimation window since it will distort the measurement of the normal returns. Estimation windows vary depending on the preference of the analyst but windows of 250 days are typically used which corresponds comparatively with the trading calendar year, usually ending 6 days before the event date (Corrado, 2011).

The length of the event-window has a considerable influence on the reliability of the results from event test (Kothari and Warner, 2006). Long-horizon methods (applied for event studies with larger event-windows) are much less dependable due to innate variability in long run abnormal returns (Brown and Warner, 1980). As such, the forecasting of these returns accurately over a longer period is much more difficult which naturally makes the results of short-horizon terms much more reliable (Kothari and Warner, 2006). This study will, therefore, have a short-horizon (6 days CAR) to avoid the problem of forecasting estimated returns over a longer window.

3.1.3 Robustness tests

An event-study aims to establish whether the cross sectional distribution of abnormal returns at the event date will be consistently different from that which was predicted (Kothari and Warner, 2006). In order to determine this statistical significance, it is necessary to apply test statistics to the data.

A common assumption key to formulating the tests of statistical significance is that the abnormal returns will be normally distributed (Corrado, 2011). Principally, this suggests that under the null hypothesis, the abnormal returns on the event date should have an expected value of zero during the event period if they are normally distributed but a return will be evident under a true alternative hypothesis. This is stated as follows:

$$H_0: AR_t = 0 \qquad H_A: AR_t \neq 0$$

It is necessary to compare the distributions of actual abnormal returns to predicted abnormal returns and determining whether these distributions are similar for statistical significance (Kothari and Warner, 2006). This cross sectional mean abnormal return for N securities over period (t) is determined using the following formula (Kothari and Warner, 2006, Fama et al, 1969):

$$AR_t = \frac{1}{N}\sum_{i=1}^{N} e_{it} \qquad \textbf{(Equation 4)}$$

Over a multi-period interval, a cumulative average residual method is used, defined as:

$$CAR_{(t_1,t_2)} = \sum_{t=t_1}^{t_2} AR_t \qquad \textbf{(Equation 5)}$$

The standard null hypothesis t-test statistic is calculated as follows (Kothari and Warner, 2006):

$$\frac{CAR(t_1 t_2)}{\sigma^2[\,(t_1 t_2)]^{1/2}} \qquad \textbf{(Equation 6)}$$

Where: $\sigma^2\,(t1, t2) = L\sigma 2(ARt)$

Once computed, the test statistic is compared to its assumed distribution under the null hypothesis (Kothari and Warner, 2006). The null hypothesis is rejected if the test statistic exceeds a critical value, below a 5% level of significance (Capelle-Blancard and Laguna,

2010, Kothari and Warner, 2006). The t-test recommended by Kothari and Warner (2006) is a parametric t-test and will only function if the data is normally distributed (Corrado, 2011).

A number of studies focus on the test statistic performance, most notably Brown and Warner (1985), who examine the effectiveness of test statistics on daily data. This branch of study questioned the reliance on assumption of normally distributed returns for the robustness tests and suggested alternate methods if the test data is not normally distributed – i.e. may be skewed (kurtosis) (Corrado, 2011). The most successful of these models are the nonparametric sign and rank tests (Corrado, 1989) applied in well-known studies by Chandra et al (1992) and more recently Corrado and Truong (2008). The reason for introducing more precise testing such as the nonparametric sign and rank tests was the concern that assumption of normality from parametric tests may be poorly specified when there is the concern that data is not normally distributed (Corrado, 2011). The use of these non-parametric tests in the context of this study is discussed in more detail in Section 3.5.

In summary, in instances where the data is normally distributed, then standard parametric models are applicable but where there is non-normality in the data, then it is necessary to apply the nonparametric tests. Consequently, this study will first apply parametric t-tests to determine significance and subsequently validate the results with non-parametric t-tests.

A second problem faced with test statistics is the issue of event-induced variance which would require cross sectional variance adjustments to the test data (Corrado, 2011). This is only an issue facing a sample where the observer intends to extrapolate the findings over a much larger population and not in an instance where the sample constitutes the entire population of interest (Corrado, 2011) which is the case in this study.

3.2 Research design

As referred to in Section 1.1, Chen and Siems (2004) use the event-study method to assess the impact of unforeseen terrorist events on global market indices, supporting the

use of the same approach in this research report (see also: White (1996), Capelle-Blancard and Laguna (2010), Kalra et al (1993)).

In this report, the event-study methodology has been applied to determine the abnormality of returns attributable to the Marikana event by using the Market Model approach, popular in financial literature (MacKinlay, 1997). This approach allows for the prediction of what the normal returns would be expected to be should no event-induced volatility have occurred during the event window. The abnormality of the returns would be driven by the difference between what the actual returns were during the event window and what the Market Model predict those returns to be (adapted from Chen and Siems (2004)).

3.2.1 Test period

The test period is divided into two sections: the estimation window and the event window. The complete test period begins on 3 January 2012 (beginning of the 2012 trading year) and runs for 145 days (up until 31 July 2012). The estimation window ends at the end of July so as not to dilute the normal returns with the influence of the strike and Marikana incident that take place during August.

The event window begins on 16 of August (the date of the Marikana incident), defined as t_0 and runs for a period of 5 days post the event (t_{+5}) for a total event window of 6 days (adapted from Chen and Siems (2004)).

This estimation window is used to compute beta and alpha (the slope parameters) used in the market model to determine the expected returns during the event window. The event window is the time frame during which the abnormal returns are calculated. This is done beginning on the date of Marikana and continuing for 5 days after the event (cumulatively 6 days). The 6 day event window applied is consistent with the event window applied in the Chen and Siems (2004) study.

3.2.2 Normal returns

An essential component of the Market Model is the computation of the normal return. The Market Model employs a CAPM-type approach to determine the relationship between a particular share and a given index (in this instance the JSE All Share Index). The formula for determining the expected returns is shown below (Corrado, 2011, Fama et al, 1969) (see Section 3.1.2):

$$R_t = a + b \times RM_t + e_t$$

3.2.3 Abnormal returns

Abnormal returns explain how the actual return deviates from the expected return. An abnormal return can be negative or positive, depending on the reaction of the actual return on the test date. Abnormal returns can arise out of two circumstances: prediction error (per the model used) and the event-specific driver (what is being tested). The prediction error is within the control of the researcher so this can be lowered by selecting an appropriate prediction model (such as the Market Model) (MacKinlay, 1997).

3.2.4 Cumulative Abnormal Returns (CAR's)

The CAR is a measure used to cumulate the effect of an event over the event window. This measure is used in event-study methodology as a device to measure the sustained effect of an event by summing the difference between actual and expected returns over the event window (Harvey and Sticht, 2014). This is applied in the instance where a particular event has the ability to affect the share price for more than a single day.

3.2.5 Volume traded

An element that is intrinsic to the understanding of the efficient market hypothesis (Fama et al, 1969) is that the information delivered by the share price will be accurate and complete. In order for this assumption to hold true, there needs to be sufficient volume of the share traded on the date of the event. This thin trading problem is addressed by the application of the sign and rank test as suggested by financial literature (Cowan and Sergeant, 1996).

3.3 Population and sample

3.3.1 Population and sample

This study aimed to examine the potential effect of the Marikana incident on all companies listed on the JSE mining sector during the period 1 January 2012 to 23 August 2012 (5 days trading post the Marikana incident). Since this study will be examining ***all*** the firms listed on the JSE mining sector during this period, it is not necessary to use any additional sampling instructions to extract firms to test. During this observation period 54 companies were listed in the mining sector so the population is comprised of all of these firms.

Small sample size would make extrapolation of results problematic. As a result of the robustness tests carried out below (Section 4.1), as well as the fact that the entire population of mining companies has been tested, provide a strong degree of comfort over the statistical reliability of the results. It should also be reiterated that the aim of this study is not to generalise results but to provide an initial account of the potential effect of the Marikana incident on share prices of JSE-listed mining companies[4].

3.3.2 Data collection

Share prices and daily volume trades were obtained from the *BFA McGregor* database for the observation period for all companies in question.

3.4 Process of hypothesis testing

As applied in many quantitative finance studies, a null hypothesis should be stated and tested in order to draw conclusions about the findings of the research. Hypothesis testing involves setting a goal (statement) and accepting or rejecting this postulated argument, based on statistical results.

[4] The results (Section 4) suggest that the Marikana incident was not widely correlated with changes in share prices. The isolated nature of the incident also negates the need for testing the entire population of JSE listed companies.

3.4.1 Null and Alternate hypothesis

Under the null hypothesis, an event should have no effect on abnormal returns. Therefore, in mathematical notion, our null and alternative hypotheses are described as follows:

$$(1)\ H_0: AR_t = 0 \qquad H_A: AR_t \neq 0$$

$$(2)\ H_0: CAR_{t+2} = 0 \qquad H_A: CAR_{t+2} \neq 0$$

$$(3)\ H_0: CAR_{t+5} = 0 \qquad H_A: CAR_{t+5} \neq 0$$

For the first equation (1), concerning abnormal returns, a two tailed t-test will be performed and the null hypothesis will be tested at 95% confidence level (5% level of significance) against the corresponding the critical values from the z table of 1.96 and -1.96. The null hypothesis will be rejected for any values not within the range of the critical values.

The second equation (2), tests the hypothesis that there will be no CAR for the 3 day event window. The degrees of freedom will be 2 in this instance $(n-1)$ since the event window has now been expanded to three days. As such, the critical values from the student's t-distribution table for a 95% confidence level are 2.92 and -2.92. Similarly for the third equation (3), the degrees of freedom for the 6 day CAR have increased to 5 so the corresponding critical values for a 95% confidence level from the student's t-distribution table are 2.015 and -2.015 respectively. The use of this confidence level is recommended by financial literature (Capelle-Blancard and Laguna, 2010, Kothari and Warner, 2006).

Should any of the observed t-test scores fall within the assigned range of critical values above for any of the above equations, the null hypothesis will fail to be rejected for that particular test.

It should be noted that a significance level of 5% has been selected for this test $(\alpha = 0.05)$. This is widely accepted in event study methodology literature as an appropriate level of confidence to be able to reject the null hypothesis and minimize the possibility of a Type I error (rejecting a null hypothesis that is actually true) (Capelle-Blancard and Laguna, 2010, Kothari and Warner, 2006).

3.5 Calculation of test statistics

Part of determining the significance of the results is to employ robustness tests to the observations successfully. These t-tests need to be applied to both abnormal returns and cumulative abnormal returns and separate values need to be determined for both. Additionally, as discussed in the Section 3.1.3, we cannot assume that the data will follow the normal distribution assumption; therefore, two separate non-parametric t-tests must be performed in order to determine the validity of the data.

To determine the significance of event date abnormal returns, the t-test used is (Patell, 1976):

$$t_{AR_{j,t}} = \frac{AR_{j,t}}{\hat{\sigma}AR_j} \qquad \textit{(Equation 7)}$$

Whereby the standard deviation:

$$\hat{\sigma}AR_j = \sqrt{\frac{1}{M_i - dF} \sum_{t=EWmin}^{EWmax} {AR_{j,t}}^2}$$

And:

EW – represents the estimation window with $EWmax$ denoting the last day of the event window and $EWmin$ denoting the earliest day in the event window

M_i – refers to the non-missing returns (i.e. matched returns in the regression)

dF - refers to the degrees of freedom applied in the market model (in this instance 144 $(n-1)$)

To determine the significance of cumulative abnormal returns, the t-test applied is (MacKinlay, 1997):

$$t_{CAR_{t_1,t_2}} = \frac{CAR_j}{\sqrt{T\hat{\sigma}_{AR_j}{}^2}} \qquad \textit{(Equation 8)}$$

Where:

$$\hat{\sigma}AR_j = \sqrt{1 + \frac{1}{M_i - dF} \sum_{EWmin}^{EWmax} AR_{j,t}{}^2}$$

Both the t-tests described above are considered to be parametric t-tests, meaning that the principle assumption underlying the t-test is that the data will be normally distributed. Since this assumption will not always hold true, it is important also to apply non-parametric tests to the data in order to validate the results (Corrado, 2011). Two of the most successful non-parametric tests which can be performed in this type of study are the sign (Cowan and Sergeant, 1996) and rank (Corrado, 1989, Kolari and Pynnönen, 2010) tests.

The generalized sign test is specified as follows:

$$z_G = \frac{w - n\hat{p}}{\sqrt{n\hat{p}(1-p)}} \qquad \textit{(Equation 9)}$$

In which:

w - number of stocks in the event window for which the cumulative abnormal return is positive

n - number of firms

p- portion of firms with positive signed returns in estimation window

$\hat{p}$ - binomial distribution of positive signs

The generalized rank test is specified as follows:

$$GRANK = \sqrt{d}\frac{\overline{K_D} - MeanRank}{\sqrt{\sum_{t=1}^{151}(\overline{K_t} - MeanRank)^2 / 151}} \quad \textit{(Equation 10)}$$

In which:

d- length of estimation window

$\overline{K_D}$ – average rank during the event window

$\overline{K_t}$– average rank on each date during event and estimation window

Ultimately, by analysing changes in share prices using both parametric t-tests and the non-parametric sign and rank tests, the research can ensure the validity and reliability of the results.

4 PRESENTATION OF RESULTS

The results for each mining company are presented, first for the general mining sector and then, more specifically, for the platinum sector. Finally, a summarised table is provided for all observed companies experiencing abnormal returns at the 90%, 95% or the 99% confidence level. Results are presented in both tabular and graphical format in order to give a more holistic view of the information communicated.

4.1 Results

4.1.1 Abnormal Returns (AR's) and Cumulative Abnormal Returns (CAR's)

Table 1.1 details all corporations tested, showing separately the AR's and the CAR's for each firm, calculated in accordance with the event-study methodology. The AR's are calculated on the date of the Marikana incident and the CAR's are calculated at both two-day and five-day intervals post the event. The table summarises the observations and,

additionally, provides an indication of the significance of the abnormal returns as confirmed by the T-tests applied, as shown by the asterisks (*) symbol.

Table 1.1: GENERAL MINING SECTOR				
Share code	Company name	AR	CAR's 3 Day	CAR's 6 Day
WEZ	WESIZWE PLATINUM LTD	-2.997%	0.186%	12.166%*
PAN	PAN AFRICAN RESOURCES PLC	2.466%*	-6.460%*	-2.619%
DRN	DELRAND RESOURCES LTD	-0.171%	-0.880%	-1.516%
KEH	KEATON ENERGY HOLDINGS LTD	-1.667%	-5.046%	-12.268%*
RBP	ROYAL BAFOKENG PLATINUM LTD	-2.236%*	-4.239%*	-4.976%*
CZA	COAL OF AFRICA LTD	-1.220%	-4.686%	-10.346%*
FSE	FIRESTONE ENERGY LTD	-0.615%	0.667%	-12.112%
VIL	VILLAGE MAIN REEF LTD	-0.188%	-3.481%	-0.548%
CMO	CHROMETCO LTD	0.302%	-13.187%	-12.321%
EPS	EASTERN PLATINUM LTD	-8.076%	-6.534%	3.981%
MMH	MIRANDA MINERAL HOLDINGS LTD	4.588%	5.305%	-0.011%
BDM	BUILDMAX LTD	-7.772%	-7.575%	-0.939%
CRD	CENTRAL RAND GOLD LTD	20.696%**	29.555%*	12.841%
DMC	DIAMONDCORP PLC	0.852%	1.024%	3.067%
FSEO1	FIRESTONE ENERGY LTD	1.126%	1.039%	3.633%
FMC	FORBES AND MANHATTAN COAL CORP	0.712%	0.830%	2.527%
HWA	HWANGE COLLIERY COMPANY LTD	0.636%	0.438%	1.852%
PZG	PAMDZI GOLD LTD	0.000%	0.000%	0.000%
GBG	GREAT BASIN GOLD LTD	-20.171%***	-19.151%*	-13.007%
JBL	JUBILEE PLATINUM PLC	0.198%	2.336%	-0.190%
IRA	INFRASORS HOLDINGS LTD	-8.261%	-13.245%	-5.383%
RDI	ROCKWELL DIAMONDS INCORPORATED	0.117%	0.516%	0.923%
BIL	BHP BILLITON PLC	0.651%	2.010%	2.155%
EXX	EXXARO RESOURCES LTD	-2.465%	-0.632%	-2.585%
AQP	AQUARIUS PLATINUM LTD	0.973%	6.242%	19.932%*
SAH	SOUTH AFRICAN COAL MINING HOLDINGS	0.909%	3.499%	1.146%
KBO	KIBO MINING PLC	0.740%	1.734%	0.374%
UUU	URANIUM ONE INC	5.151%	6.549%	6.517%
PLL	PLATFIELDS LTD	-29.524%	1.469%	0.456%
GGM	GOLIATH GOLD MINING LTD	-0.204%	0.318%	-2.513%
RNG	RANDGOLD & EXPLORATION COMPANY LTD	-0.260%	-24.230%*	-24.786%*
RSG	RESOURCE GENERATION LTD	0.000%	0.000%	0.000%
BAU	BAUBA PLATINUM LTD	0.166%	-16.279%	1.657%
WSL	WESCOAL HOLDINGS LTD	1.045%	-2.421%	-3.659%
TAW	TAWANA RESOURCES NL	-0.643%	-0.880%	-2.457%
WGR	WITWATERSRAND CONSOLIDATED GOLD RESOURCES	-0.157%	1.011%	1.037%
SEP	SEPHAKU HOLDINGS LTD	0.753%	3.181%	1.476%

Table 1.1: GENERAL MINING SECTOR				
Share code	Company name	AR	CAR's 3 Day	CAR's 6 Day
TSX	TRANS HEX GROUP LTD	-1.452%	2.926%	-3.515%
DRD	DRDGOLD LTD	-1.144%	1.130%	1.061%
GDO	GOLD ONE INTERNATIONAL LTD	-2.507%	0.169%	-0.982%
ANG	ANGLOGOLD ASHANTI LTD	2.436%	2.009%	1.589%
HAR	HARMONY GOLD MINING COMPANY LTD	1.516%	-10.177%*	-4.116%
GFI	GOLD FIELDS LTD	1.379%	0.798%	0.599%
IMP	IMPALA PLATINUM HOLDINGS LTD	-1.642%	1.351%	2.462%
NHM	NORTHAM PLATINUM LTD	-2.480%	-1.703%	6.324%*
AMS	ANGLO AMERICAN PLAT LTD	-1.008%	-1.126%	2.871%
AGL	ANGLO AMERICAN PLC	0.403%	0.876%	2.262%
ARI	AFRICAN RAINBOW MINERALS LTD	1.811%	1.379%	-0.911%
ASR	ASSORE LTD	-0.485%	2.971%	5.035%
MRF	MERAFE RESOURCES LTD	-0.191%	0.406%	0.161%
LON	LONMIN PLC	-8.402%***	-10.86%*	-7.302%*
ATL	ATLATSA RESOURCES CORP	-11.122%	3.128%	7.479%
PET	PETMIN LTD	-0.172%	-4.378%	-8.850%*
SNU	SENTULA MINING LTD	0.082%	0.611%	-2.008%

*Significant at a 90% confidence level

**Significant at a 95% confidence level

***Significant at a 99% confidence level

Table 1.2 details only the results for the platinum corporations tested in this research report. The results are displayed in the same format as those for the entire mining sector with the asterisks (*) used to indicate the level of significance for the abnormal returns tested.

Table 1.2: PLATINUM MINING SECTOR				
Share code	Company name	AR	CAR's 3 Day	CAR's 6 Day
AMS	ANGLO AMERICAN PLAT LTD	-1.008%	-1.126%	2.871%
AQP	AQUARIUS PLATINUM LTD	0.973%	6.242%	19.932%*
ATL	ATLATSA RESOURCES CORP	-11.122%	3.128%	7.479%
BAU	BAUBA PLATINUM LTD	0.166%	-16.279%	1.657%
EPS	EASTERN PLATINUM LTD	-8.076%	-6.534%	3.981%
IMP	IMPALA PLATINUM HOLDINGS LTD	-1.642%	1.351%	2.462%
JBL	JUBILEE PLATINUM PLC	0.198%	2.336%	-0.190%
LON	LONMIN PLC	-8.402%***	-10.856%*	-7.302%*
NHM	NORTHAM PLATINUM LTD	-2.480%	-1.703%	6.324%
PLL	PLATFIELDS LTD	-29.524%	1.469%	0.456%
RBP	ROYAL BAFOKENG PLATINUM LTD	-2.236%*	-4.239%*	-4.976%*
WEZ	WESIZWE PLATINUM LTD	-2.997%	0.186%	12.166%

*Significant at a 90% confidence level

**Significant at a 95% confidence level

***Significant at a 99% confidence level

Presented below, Table 1.3 summarises those corporations which experienced significant abnormal returns either on the event date (AR), for 3-day and 6-day cumulative abnormal returns post the event date ("CAR's 3 Day" and "CAR's 6 Day"). The t-test values used in the performance of the significance tests are shown in brackets below the abnormal return results.

Table 1.3: SUMMARY OF SIGNIFICANT RESULTS				
Company name	Mining sector[5]	AR	CAR's 3 Day	CAR's 6 Day
WESIZWE PLATINUM LTD	Plat	-2.997% (-0.91)	0.186% (0.03)	12.166%* (1.50)

[5] Platinum mining companies are shaded blue whilst gold mining companies are shaded gold.

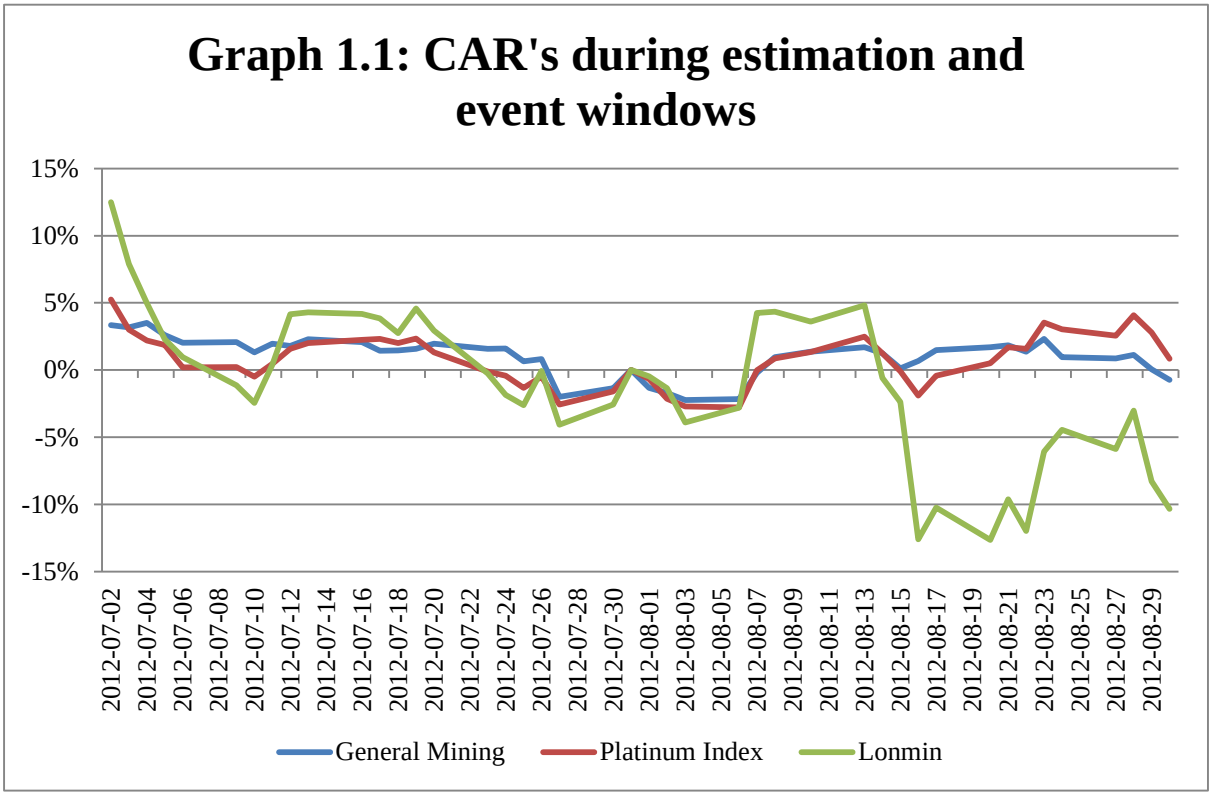
Table 1.3: SUMMARY OF SIGNIFICANT RESULTS				
Company name	Mining sector[5]	**AR**	**CAR's 3 Day**	**CAR's 6 Day**
PAN AFRICAN RESOURCES PLC	Gold	2.466%* (1.82)	-6.460%* (-2.76)	-2.619% (-0.78)
KEATON ENERGY HOLDINGS LTD	Coal	-1.667% (-0.62)	-5.046% (-1.09)	-12.268%* (-1.85)
ROYAL BAFOKENG PLATINUM LTD	Plat	-2.236%* (-1.71)	-4.239%* (-1.87)	-4.976%* (-1.54)
COAL OF AFRICA LTD	Coal	-1.220% (-0.44)	-4.686% (-0.97)	-10.346%* (-1.50)
CENTRAL RAND GOLD LTD	Gold	20.696%** (2.27)	29.555%* (1.87)	12.841% (0.57)
GREAT BASIN GOLD LTD	Gold	-20.171%*** (-4.29)	-19.151%* (-2.35)	-13.007% (-1.12)
AQUARIUS PLATINUM LTD	Plat	0.973% (0.27)	6.242% (1.00)	19.932%* (2.23)
RANDGOLD & EXPLORATION COMPANY LTD	Gold	-0.260% (-0.05)	-24.230%* (-2.67)	-24.786%* (-1.91)
HARMONY GOLD MINING COMPANY LTD	Gold	1.516% (0.86)	-10.177%* (-3.32)	-4.116% (-0.94)
NORTHAM PLATINUM LTD	Plat	-2.480% (-1.64)	-1.703% (-0.65)	6.324%* (1.69)
LONMIN PLC	Plat	-8.402%*** (-5.74)	-10.86%* (-4.28)	-7.302%* (-2.01)
PETMIN LTD	Iron	-0.172% (-0.09)	-4.378% (-1.35)	-8.850%* (-1.92)

*Significant at a 90% confidence level

**Significant at a 95% confidence level

***Significant at a 99% confidence level

As shown in Table 1.3 of the Platinum Mining Companies tested, only Lonmin experienced abnormal returns significant at a 99% confidence level. When graphing the cumulative abnormal returns (Graph 1.1), it is shown that Lonmin experiences a steep share price drop on the date of Marikana when compared to the General and Platinum Mining Indices. It is evident that there is a much stricter correlation of the indexes and share price in the build-up to the event (16 August 2012) at which point Lonmin's share price diverges from the movements of the General Mining and Platinum Index.



As was indicated in Section 3.1.3, it is necessary to conduct non-parametric t-tests in order to validate the results of the parametric t-tests. Table 1.4 below summarises the results of the non-parametric sign and rank tests. An indication of the significance of the test statistic is shown by an asterisk (*). A detailed breakdown of the application of the test statistics is provided in Appendix C (Sign Test) and Appendix D (Rank test).

The sign test statistic below tests the significance of the signs of the population tested in term of the event date (AR) and the event windows for two (CAR 3) and five days post the event (CAR 6). The rank test is applied across the entire population for the duration of the event window (CAR 6); hence the test statistic is one number.

Table 1.4: A summary of the sign and rank test statistics

	AR	CAR 3	CAR 6
Sign	-1.05742	0.658914	-0.48531
Rank	-0.875769667		

The results depicted in Table 1.4 indicate that the results were not significant when applied to the entire population of companies listed on the JSE mining sector.

4.1.2 Volume of shares traded

The volume of daily share trades serves as an indicator for the level of active trading (responsiveness) and can provide insight into the quality of information transferred by share price changes (Blume et al, 1994). Presented below in Table 2.1 is the volume of trades of those shares that experienced significant abnormal returns as depicted in Table 1.3 at the 90% confidence level or above. The table shows an average volume of shares traded per day over the event window (145 days). In the neighbouring column, the volume of shares traded on the date of the Marikana event (16th of August 2012) is provided. The final column shows the event date volume of shares traded as a percentage of the average shares traded during the estimation window.

Table 2.1: Event volumes of shares traded

Company Name	Mining sector	Average shares traded during estimation window (**A**)	Event Date (**B**)	B/A
WESIZWE PLATINUM LTD	Plat	664 173	613 045	**92%**
PAN AFRICAN RESOURCES PLC	Gold	2 311 713	870 972	**38%**
KEATON ENERGY HOLDINGS LTD	Coal	74 095	6 870	**9%**
ROYAL BAFOKENG PLATINUM LTD	Plat	88 155	3 279	**4%**
COAL OF AFRICA LTD	Coal	688 332	67 208	**10%**
CENTRAL RAND GOLD LTD	Gold	350 088	1 000	**0%**
GREAT BASIN GOLD LTD	Gold	68 831	505 476	**734%**
AQUARIUS PLATINUM LTD	Plat	840 481	249 322	**30%**
RANDGOLD & EXPLORATION COMPANY LTD	Gold	9 906	0	**0%**
HARMONY GOLD MINING COMPANY LTD	Gold	1 451 072	634 351	**44%**
NORTHAM PLATINUM LTD	Plat	978 508	867 466	**89%**
LONMIN PLC	Plat	795 811	2 011 243	**253%**
PETMIN LTD	Iron	568 745	314 746	**55%**

5 DISCUSSION OF RESULTS

This report aimed to identify the potential effect that the Marikana incident had on companies listed in the mining sector on the JSE, using the event study methodology. The approach used to obtain the results was the same as that applied in the study performed by Chen and Siems (2004) who measured the impact of terrorist attacks (unforeseen events) on global market indices. The results of this study indicate that the Marikana incident had an isolated effect on companies listed in the general mining index, specifically having a substantial impact on the Lonmin share price. Due to the adverse nature of the event, negative abnormal returns were observed, indicating that the event had a destructive effect on the share price.

5.1 Abnormal returns

The analysis of the abnormal returns observed on the event date serves as a particularly important part of this research report. The Marikana event took place at a specific point in time (16 August 2012). Therefore, the effect of the event on share prices needs to be studied starting on this date.

Abnormal returns on the event date are shown in tables 1.1, 1.2 and 1.3. It is clear that the share price of Lonmin experiences abnormal returns on this date at a 99% confidence level. The level of abnormal return is strongly negative for this particular share with an 8.42% abnormal return observed for Lonmin on the day or Marikana. The actual movement in share price from 15 to 16 August was R90.33 to R83.70 (a 7.34% decline in value) (*BFA McGregor* Database).

Unexpectedly, an additional company - Great Basin Gold Ltd - also experienced abnormal returns significant at the 1% level (Table 1.3). Since this company has no obvious ties to the Marikana incident, it required additional research to determine the source of the abnormality of the returns. As per media publications, it emerged that the company was in emergency talks with lenders in order to avoid insolvency (Reuters, 2012a). The share price fell as the

market absorbed the news and plummeted 42,16% from the previous day's closing price (from R4,15 to R2,40) (*BFA McGregor* Database).

The workings for the rank tests (see Appendix C) suggest that the abnormality of returns experienced on the event date for both Lonmin and Great Basin Gold Ltd are the most significant abnormal returns of all those tested (both attained rankings of '1' - implying the highest abnormality of all observations). This provides supporting evidence for the parametric t-test results of the returns testing significant at a 1% level.

Positive abnormal returns significant at a 95% confidence level were also experienced by Central Rand Gold Ltd. which would not have been predicted given the adverse nature of the Marikana incident (Table 1.3). Further exploration of media publications of the reasons for this steep increase in share price might be attributed to favourable analyst reports published on 15 August 2012, citing better than expected results (Stanley, 2012). Owing to the announcement of this positive information, as well as the fact that the company is not engaged in platinum mining near Marikana, the share price of the Central Rand Gold Ltd unexpectedly rose. Given that the Marikana incident would broadly have a negative influence; it would be unreasonable to assume that this value change had any relationship to the event.

The sign and rank t-tests (Table 1.4) (Appendix C and D) were applied to the entire population of mining companies on the event date to confirm the above findings. Neither the sign nor rank test statistics are significant at the 1%, 5% and 10% level, implying that the mining sector as a whole did not treat this event as significant.

Based on the results of the initial t-tests based on a 99% confidence level (complemented by the non-parametric testing) the effect of the Marikana event appears to be limited solely to Lonmin on the event date. Some other companies experience significant abnormal returns but only at the 90% confidence level which is generally considered in finance literature to be

insufficient evidence to suggest adverse share behaviour (Capelle-Blancard and Laguna, 2010, Kothari and Warner, 2006).

5.2 Cumulative Abnormal Returns

Cumulative Abnormal Returns (CAR's) formed an integral part of this research report due to the fact that they are able to highlight the sustained effect of the event. This study applied two CAR windows being both 3 and 6 days (as applied in the Chen and Siems (2004) study).

The tests of the CAR's for levels of significance only showed that results were significant at the 10% level of significance (Table 1.3). As previously stated, a 10% level of significance is inadequate to claim that results were sufficiently abnormal (Capelle-Blancard and Laguna, 2010, Kothari and Warner, 2006). These parametric t-tests results are confirmed by the observations of the results of the sign and rank tests as depicted in Table 1.5 (see Appendix C and D for workings). The test scores do not show a significant sustained impact on the CAR's at either the 1%, 5% or 10% level of significance.

As such, these results suggest that the event had a sudden and immediate impact, rather than a sustained impact, on the affected companies' share prices. As discussed in Section 5.1, only Lonmin was significantly affected. When considering this lack of persistent effect on the Lonmin share price, it is important to understand the containment measures which the company implemented in order to limit initial losses. In particular, an announcement by Lonmin's management on 20 August 2012 (4 days post the event) of a rights issue would have contributed to a recovery of the share price (Reuters, 2012b). Although the exact amount of the recovery caused by the rights announcement was not determinable from the event method applied, a general recovery of the CAR from the original event date to the 6-day CAR (AR: -8,402%, CAR 3 day: -10.86%, CAR 6 day -7.302%) was noted. Once again, this confirms that the Marikana incident was isolated and influenced only those companies with direct interests in the Marikana event (Lonmin). Additionally, the fact the CAR for both

the 3-day and 6-day post event windows were not significant at the 95% level suggests that the effect of Marikana on Lonmin was immediate but not prolonged.

5.3 Volume of shares traded

The company experiencing the greatest deviation from its average share trades is Great Basin Gold Ltd. where the event date volume traded was 734% of the average volume traded during the estimation window (see Table 2.1). As stated in the previous results section (section 5.2), this particular firm announced a liquidity crisis during the period under review (Reuters, 2012a). As discussed (section 5.2), the source of this volume increase would be driven by the news of this event, rather than triggered by the Marikana incident.

Lonmin experienced the second highest volume trade volatility where the event date volume traded was 253% of the average volume of the trades over the estimation window (see Table 2.1). Perhaps more important is the absolute increase in the volume of trades on the event date (2 011 243 compared to the average of 795 811) (*BFA McGregor* Database).

5.4 Additional discussion on the impact of Lonmin

It is evident that the Marikana incident had an isolated but unmistakably profound effect on the Lonmin share price. The reasons for no escalation effect on the rest of the mining sector are not apparent from the data gathered but analysis can be provided for why the incident could have had such a dramatic effect on the Lonmin share price.

More recently, studies have been conducted examining the impact that corporate social responsibility (CSR) can have on both firm value (Gregory et al, 2013) and stock performance (Flammer, 2013, Chen et al, 2014). The study by Gregory et al (2013) finds that firms with positive social governance practices generally have better longer-term growth prospects, coupled with slightly lower costs of equity. Similarly, the study by Flammer (2013) examines the reaction of firm share prices to environmental announcements and finds that environmentally responsible companies experience a significant share price increase whereas the opposite is true for those reporting negative environmental news. Additionally

Flammer (2013) determines that there has been increased external pressure on firms to behave responsibly towards the environment. The findings suggest that news of poor environmental practices will often correspond to a significant decrease in share price for the affected firm.

This information is especially relevant for a possible explanation of the reaction of the market to the announcement of the Marikana incident. CSR is not a new issue in South African mining and efforts were made by the industry to take a more active role in mining communities (Hamann, 2004) although notable gaps still existed between CSR and accountability and fairness (Hamann and Kapelus, 2004). It can, however, be argued that the poor social responsibility of Lonmin was one of the major factors contributing to the Marikana incident. Investors, seeing that the firm was unable to manage its work force in a perceived ethical manner (i.e. by not satisfying employee demands), penalised the share price on the event date.

A possible explanation of why the Marikana incident did not adversely affect only mining companies is that the South African mining sector had been plagued by industrial unrest during the 2012 year (McClenaghan, 2012). The result is that labour unrest had already been taken into account when pricing equity instruments of the South African mining organisations. It was only the unusually violent nature of this example of worker demonstrations which is being taken into account by the market. This also sheds light on why the CAR's (post the event) are only significant at the 10% level (Table 1.3). The Marikana incident is seen as an unusual event, similar to the attacks on the USA during 2011 (Chen and Siems, 2004) and does not, therefore, have a prolonged effect. By the same token, when Lonmin reacted to the incident to reassure stakeholders, the effect was a partial recovery of the share price.

An alternative, and more optimistic assessment, is that, paradoxically, Marikana is a vote of confidence for the South African Mining Industry. If the South African market is at least semi-

strong form efficient (Choudhry, 1999, Magnusson and Wydick, 2002, Jefferis et al, 1999, Glass and Smit, 1995), had poor labour relations (and social responsibility practices) been widespread, the market would have reacted by discounting the price of all shares in the platinum sector. The same logic applies to other mining companies not directly involved in Marikana. In this way, that Marikana does not appear to have characterised the relationship between the mining houses and labour in the long-term suggests that the efforts at good corporate governance in South Africa's mining industry are having a positive effect.

6 CONCLUSION

This research is among the first to examine the relationship between the Marikana incident and changes in the returns of South African listed mining companies. In doing so, it adds to the current debate on the Marikana incident which, to date, has been confined to the popular press.

This report took the entire population of mining companies listed on the JSE mining index during the observation period and tested the impact of the Marikana incident on those particular companies' share prices. The event study methodology, popular in financial literature, was then applied to determine the extent of abnormal returns observed during the event window. Parametric and non-parametric tests were applied to the abnormal returns and cumulative abnormal returns in order to determine the significance of the abnormality observed. This approached has proven successful in prior studies similar in nature to this research.

The results of the study were informative. Significant abnormal returns were observed only for the Lonmin share price and no escalation effects were apparent. Two companies experienced strongly abnormal returns on the event date, namely Lonmin and Great Basin Gold Ltd. The abnormal returns on the event date for these two firms tested significant at a 1% level. It was unclear what relationship Great Basin Gold Ltd had to the Marikana incident. Therefore, a complementary review of the financial press was carried out to determine the nature of the possible connection. The investigation revealed that news was published on the event date concerning liquidity problems at the firm which were more likely than not the primary driver of the downward movement of the share price.

Great Basin Gold Ltd aside, Lonmin was the only company to experience significant (at the 1% level) abnormal returns on this event date. Suggested reasoning for this contained effect

would provide that the market specifically identified and discounted Lonmin for the poor CSR which contributed to the industrial unrest[6].

What is curious is how rapidly investor confidence was restored in the Lonmin share price after the initial shock. This is observed in the results of the 3-day and 6-day CAR which show less significant abnormality than the event date abnormal return. One of the inherent limitations of the event method is that it does not prove causality between the Marikana incident and changes in share prices. It also lacks the exploratory potential of qualitative methods needed to provide a comprehensive review of this unexpected result. Nevertheless, a reasonable explanation is that industrial unrest is not new to South African mining sector. What the market is reacting to is not the strike itself, but the unusually violent nature of the Marikana incident. In this context, that the effect of this incident on share returns is not widespread and sustained can be interpreted positively suggesting that, on the whole, the South African mining sector continues to be regarded as a socially responsible and economically viable investment choice.

6.1 Recommendations and suggestions for further research

The results of this research provide some valuable insights into the potential effect that such events can have on their related market indices. Shareholders and management can use these results as a potential indicator of share price reaction to apathy towards CSR. Companies which do not have good social responsibility practises can use this research as a base for sensitivity analysis should they wish to forecast the potential negative consequences these events may have on the share prices. The findings should also be of interest to a broader group of stakeholders, including members of the on-going Commission of Enquiry, wanting to understand better the ramifications of unrest at Marikana.

The results also raise possibilities for future research. One of the avenues of research can be to explore the reasons for the recovery of the share price of Lonmin so quickly after the

[6] It must be noted that Lonmin's direct involvement in the killings is not proven. This research does not make any allegations of wrong-doing.

event. Section 5.4 offers some possible explanations but these need to be tested in more detail. For example, how the market has reacted to previous instances of industrial unrest in the platinum sector can be contrasted to the reaction to Marikana in an effort to understand how the country's labour dynamics impact on share prices.

The event study methodology has provided some insights but needs to be refined to provide more rigorous results. The methodology itself is constantly evolving with many aspects that can still be improved. The estimation of the normalized returns, for example, is based on the CAPM model of modelling returns against those of the market. This model is not without limitations (Kürschner, 2008). A key requirement for the successful implementation of event study methodology is the assumption of an efficient market. As the JSE attracts further investment so the efficiency of the market may improve. As the JSE currently operates at a semi-strong level of market efficiency (Choudhry, 1999, Magnusson and Wydick, 2002, Jefferis et al, 1999, Glass and Smit, 1995), any efficiency improvements in the near future may require a re-assessment as to whether this level of efficiency is still considered to be appropriate. Future research could also concentrate on using alternate techniques, such as a modified Ohlson Model, to study the value relevance of the Marikana incident and similar events. In addition, as discussed in Section 1.4, the event method is unable to test for causal relationships and only considers the effect of a single event on share prices. More detailed econometric models, including multiple factors which could have influenced the share price of South African mining companies over the event period, could provide more detailed results. In doing so, alternate perspectives on the isolated impact of Marikana on share prices of the JSE mining sector could emerge.

This study has also focused on the localized effect of the Marikana incident, concentrating only on the impact of the event on those companies listed on the JSE mining sector. The event, however, could have had much broader economic implications for the country, particularly concerning foreign investment. It is very possible that the Marikana incident could have triggered some form of capital flight from South Africa as foreign investors may

have chosen to divest from mining operations as a consequence. Past studies have examined the relationship between political instability in a country and capital flight (Fatehi and Gupta, 1992, Fatehi, 1994, Lensink et al, 2000) with mixed results (Chang et al, 1997, Deppler and Williamson, 1987). Opportunities for further research could, therefore, explore changes in foreign currency movements in the aftermath of Marikana again using econometric-models.

Lastly, this study aimed to assess the effect on share prices only. To enhance the economic literature on the Marikana event it may be informative to explore the relationship between the platinum price and the Marikana incident. Since the platinum price is driven by a multitude of factors, this assessment would require a much more detailed econometric evaluation to determine the extent to which the event may have affected the commodity price.

7 REFERENCES

BALL, R. & BROWN, P. 1968. An empirical evaluation of accounting income numbers. *Journal of accounting research,* 6(2)**,** 159-178.

BARCLAY, M. J. & LITZENBERGER, R. H. 1988. Announcement effects of new equity issues and the use of intraday price data. *Journal of Financial Economics,* 21(1)**,** 71-99.

BASU, S. 1977. Investment performance of common stocks in relation to their price-earnings ratios: A test of the efficient market hypothesis. *The Journal of Finance,* 32(3)**,** 663-682.

BATEMAN, M. 2012. Microcredit and Marikana: How they are linked. Available: http://www.iol.co.za/the-star/microcredit-and-marikana-how-they-are-linked-1.1385126#.UiekoNKnoQg [Accessed 4/9/2013].

BHANA, N. 2005. The share price reaction to management buyout announcements of companies listed on the JSE Securities Exchange. *Investment Analysts Journal,* 62(1)**,** 19-30.

BHANA, N. 2006. The effect of corporate divestments on shareholder wealth: The South African experience. *Investment Analysts Journal,* 63(1)**,** 19-30.

BHANA, N. 2007. The market reaction to open market share repurchases announcements: The South African experience. *Investment Analysts Journal,* 65(1)**,** 25-36.

BINDER, J. 1998. The event study methodology since 1969. *Review of quantitative Finance and Accounting,* 11(2)**,** 111-137.

BLUME, L., EASLEY, D. & O'HARA, M. 1994. Market statistics and technical analysis: The role of volume. *The journal of Finance,* 49(1)**,** 153-181.

BODIE, Z., KANE, A. & MARCUS, A. 2010. *Essentials of Investments (8th ed.)*, New York: McGraw-Hill.

BOND, P. & MOTTIAR, S. 2013. Movements, protests and a massacre in South Africa. *Journal of Contemporary African Studies,* 31(2)**,** 283-302.

BREALEY, R., MYERS, S. & ALLEN, F. 2008. *Principles of Corporate Finance*, McGraw Hill, Boston.

BROWN, K. F. R. 2009. Investment Analysis Portfolio Management (9th Edition). *Thomson South Western,* 152.

BROWN, S. J. & WARNER, J. B. 1980. Measuring security price performance. *Journal of Financial Economics,* 8(3)**,** 205-258.

BROWN, S. J. & WARNER, J. B. 1985. Using daily stock returns: The case of event studies. *Journal of Financial Economics,* 14(1)**,** 3-31.

CAPELLE-BLANCARD, G. & LAGUNA, M.-A. 2010. How does the stock market respond to chemical disasters? *Journal of environmental economics and management,* 59(2)**,** 192-205.

CAWADAS, D. & MITCHELL, A. 2012. Marikana – the causes and wider implications and lessons for the mining industry in Africa. Available: http://www.fasken.com/en/marikana/ [Accessed 4/9/2013].

CHAMBERS, A. E. & PENMAN, S. H. 1984. Timeliness of reporting and the stock price reaction to earnings announcements. *Journal of accounting research,* 22(1)**,** 21-47.

CHANDRA, R., ROHRBACH, K. J. & WILLINGER, G. 1992. Longitudinal rank tests for detecting location shift in the distribution of abnormal returns: An extension*. *Contemporary Accounting Research,* 9(1)**,** 296-305.

CHANG, P., CLAESSENS, S. & CUMBY, R. E. 1997. Conceptual and methodological issues in the measurement of capital flight. *International Journal of Finance & Economics,* 2(2)**,** 101-119.

CHEN, A. H. & SIEMS, T. F. 2004. The effects of terrorism on global capital markets. *European Journal of Political Economy,* 20(2)**,** 349-366.

CHEN, G., WANG, B. & WANG, X. S. 2014. Corporate Social Responsibility and the Informativeness of Stock Prices. Available: http://www.fma.org/Nashville/Papers/CSR_INFO_20140114.pdf [Accessed 15/2/2014].

CHINGUNO, C. 2013. Marikana Massacre and Strike Violence Post-Apartheid. *Global Labour Journal,* 4(2)**,** 160-166.

CHOUDHRY, T. 1999. Re-examining forward market efficiency Evidence from fractional and Harris-Inder cointegration tests. *International Review of Economics & Finance,* 8(4)**,** 433-453.

CLARKE, J., JANDIK, T. & MANDELKER, G. 2001. The efficient markets hypothesis. *Expert Financial Planning: Advice from Industry Leaders,* ed. R. Arffa**,** 126-141.

CORRADO, C. J. 1989. A nonparametric test for abnormal security-price performance in event studies. *Journal of Financial Economics,* 23(2)**,** 385-395.

CORRADO, C. J. 2011. Event studies: a methodology review. *Accounting & Finance,* 51(1)**,** 207-234.

CORRADO, C. J. & TRUONG, C. 2008. Conducting event studies with Asia-Pacific security market data. *Pacific-Basin finance journal,* 16(5)**,** 493-521.

COWAN, A. R. 1992. Nonparametric event study tests. *Review of quantitative Finance and Accounting,* 2(1)**,** 343-358.

COWAN, A. R. & SERGEANT, A. 1996. Trading frequency and event study test specification. *Journal of Banking & Finance,* 20(10)**,** 1731-1757.

DEPPLER, M. & WILLIAMSON, M. 1987. Capital flight: concepts, measurement, and issues. *Staff studies for the world economic outlook,* August**,** 39-58.

DOLLEY, J. C. 1933. Common stock split-ups—Motives and effects. *Harvard Business Review,* 12(1)**,** 70-81.

EVANS, S. 2013. Marikana: Farlam commission's credibility on the rocks. Available: http://mg.co.za/article/2013-08-13-marikana-farlam-commissions-credibility-is-on-the-rocks [Accessed 17/8/2013].

FAMA, E., FISHER, L., JENSEN, M. & ROLL, R. 1969. The adjustment of stock prices to new information. *International economic review,* 10(1)**,** 1-21.

FAMA, E. F. 1965a. The behavior of stock-market prices. *The Journal of Business,* 38(1)**,** 34-105.

FAMA, E. F. 1965b. Random Walks in Stock Market Prices. *Financial Analysts Journal,* 21(5)**,** 55-59.

FAMA, E. F. 1991. Efficient capital markets: II. *The journal of Finance,* 46(5)**,** 1575-1617.

FATEHI, K. 1994. Capital flight from Latin America as a barometer of political instability. *Journal of Business Research,* 30(2)**,** 187-195.

FATEHI, K. & GUPTA, M. 1992. Political instability and capital flight: An application of event study methodology. *The International Executive,* 34(5)**,** 441-461.

FLAMMER, C. 2013. Corporate Social Responsibility and Shareholder Reaction: The Environmental Awareness of Investors. 56(3)**,** 758-781.

GLASS, R. & SMIT, E. 1995. The relationship between changes in the money supply and changes in share prices: the semi-strong form efficiency of the Johannesburg Stock Exchange revisited. *South African Journal of Business Management,* 26(1)**,** 131-140.

GREGORY, A., THARYAN, R. & WHITTAKER, J. 2013. Corporate Social Responsibility and Firm Value: Disaggregating the Effects on Cash Flow, Risk and Growth. *Journal of Business Ethics***,** 1-25.

HAMANN, R. 2004. Corporate social responsibility, partnerships, and institutional change: The case of mining companies in South Africa. *Natural Resources Forum,* 28**,** 278-290.

HAMANN, R. & KAPELUS, P. 2004. Corporate social responsibility in mining in Southern Africa: Fair accountability or just greenwash? *Development,* 47(3)**,** 85-92.

HAMILTON, J. T. 1995. Pollution as news: media and stock market reactions to the toxics release inventory data. *Journal of environmental economics and management,* 28(1)**,** 98-113.

HAND, J. R., HOLTHAUSEN, R. W. & LEFTWICH, R. W. 1992. The effect of bond rating agency announcements on bond and stock prices. *The Journal of Finance,* 47(2)**,** 733-752.

HARVEY, C. & STICHT, P. 2014. *Financial Dictionary* [Online]. Available: http://financial-dictionary.thefreedictionary.com/Alpha [Accessed 15/1/2014].

HOVAV, A. & D'ARCY, J. 2003. The Impact of Denial-of-Service Attack Announcements on the Market Value of Firms. *Risk Management and Insurance Review,* 6(2)**,** 97-121.

JEFFERIS, K., OKEAHALAM, C. & MATOME, T. 1999. International stock market linkages in Southern Africa. *The African Economic Research Consortium 2001.* Botswana Institute for Development Policy Analysis Gaborone.

JEFFERIS, K. & SMITH, G. 2004. CAPITALISATION AND WEAK-FORM EFFICIENCY IN THE JSE SECURITIES EXCHANGE. *South African Journal of Economics,* 72(4)**,** 684-707.

KALRA, R., HENDERSON JR, G. V. & RAINES, G. A. 1993. Effects of the Chernobyl nuclear accident on utility share prices. *Quarterly Journal of Business and Economics,* 32(2)**,** 52-77.

KOLARI, J. W. & PYNNÖNEN, S. 2010. Event study testing with cross-sectional correlation of abnormal returns. *Review of Financial Studies,* 23(11)**,** 3996-4025.

KOTHARI, S. & WARNER, J. 2006. The econometrics of event studies. *Handbook of Empirical Corporate Finance,* 1**,** 4-32.

KÜRSCHNER, M. 2008. *Limitations of the Capital Asset Pricing Model (CAPM)*, GRIN Verlag.

LENSINK, R., HERMES, N. & MURINDE, V. 2000. Capital flight and political risk. *Journal of International Money and Finance,* 19(1)**,** 73-92.

LINTNER, J. 1965. The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *The review of economics and statistics,* 47(1)**,** 13-37.

MABUSE, N. 2012. Rising tensions explode into grisly violence at South African mine. Available: http://edition.cnn.com/2012/08/16/world/africa/south-africa-mine-violence/index.html?iref=allsearch [Accessed 24/2/2014].

MACKINLAY, A. C. 1997. Event studies in economics and finance. *Journal of economic literature,* 35(1)**,** 13-39.

MAGNUSSON, M. & WYDICK, B. 2002. How efficient are Africa's emerging stock markets? *Journal of Development Studies,* 38(4)**,** 141-156.

MALKIEL, B. G. 2003. The efficient market hypothesis and its critics. *Journal of economic perspectives,* 7(1)**,** 59-82.

MALKIEL, B. G. & FAMA, E. F. 1970. Efficient Capital Markets: A Review Of Theory And Empirical Work*. *The Journal of Finance,* 25(2)**,** 383-417.

MARINOVICH, G. 2012. The murder fields of Marikana. The cold murder fields of Marikana. *The Daily Maverick* [Online], 8. [Accessed 25/9/2013].

MCCLENAGHAN, M. 2012. South African massacre was the tip of an iceberg. Available: http://www.thebureauinvestigates.com/2012/10/18/south-african-massacre-was-the-tip-of-an-iceberg/ [Accessed 18/9/2013].

MITCHELL, M. L. & NETTER, J. M. 1994. The Role of financial economics in securities fraud cases: applications at the Securities and Exchange Commission. *The Business Lawyer,* 29(2)**,** 545-590.

MODIGLIANI, F. & MILLER, M. H. 1958. The cost of capital, corporation finance and the theory of investment. *The American economic review,* 48(3)**,** 261-297.

MUTH, J. F. 1961. Rational expectations and the theory of price movements. *Econometrica: Journal of the Econometric Society,* 29(3)**,** 315-335.

NKOSI, M. 2012. South Africa's Lonmin Marikana mine clashes killed 34. Available: http://www.bbc.co.uk/news/world-africa-19292909 [Accessed 4/9/2013].

ONSLOW, S. 2012. Book review: who rules South Africa? *LSE Review of Books* [Online]. Available: http://blogs.lse.ac.uk/lsereviewofbooks/2012/09/17/who-rules-south-africa-martin-plaut-and-paul-holden/ [Accessed 17/9/2013].

PATELL, J. M. 1976. Corporate forecasts of earnings per share and stock price behavior: Empirical test. *Journal of accounting research,* 14(2)**,** 246-276.

REUTERS. 2012a. Great Basin up for sale amid liquidity crunch. Available: http://www.miningreview.com/great-basin-up-for-sale-amid-liquidity-crunch/ [Accessed 9/2/2014].

REUTERS. 2012b. Lonmin considers $1billion rights issue. Available: http://www.miningreview.com/lonmin-considers-1billion-rights-issue/ [Accessed 9/2/2014].

REUTERS. 2012c. Lonmin shares tumble. Available: http://www.iol.co.za/business/companies/lonmin-shares-tumble-1.1364086#.UieWJdKnoQh [Accessed 4/9/2013].

ROSEN, R. J. 2006. Merger Momentum and Investor Sentiment: The Stock Market Reaction to Merger Announcements*. *The Journal of Business,* 79(2)**,** 987-1017.

ROSS, S. A. 1976. The arbitrage theory of capital asset pricing. *Journal of economic theory,* 13(3)**,** 341-360.

SCHWERT, G. W. 1981. The adjustment of stock prices to information about inflation. *The journal of Finance,* 36(1)**,** 15-29.

SEYHUN, H. 1998. Investment intelligence from insider trading. Available: http://deepblue.lib.umich.edu/bitstream/handle/2027.42/63452/1128_bharath.pdf?sequence=1.

SEYHUN, H. N. 1986. Insiders' profits, costs of trading, and market efficiency. *Journal of Financial Economics,* 16(2)**,** 189-212.

SHARPE, W. F. 1964. Capital Asset Prices: A Theory of Market Equilibruim under conditions of risk. *The journal of Finance,* 19(3)**,** 425-442.

SMITH, M. 2013. The Marikana Massacre and Lessons for the Left. *Irish Marxist Review,* 2(5)**,** 53-64.

SORENSEN, P. 2012. The Marikana Tragedy. *International Journal of Environmental Studies,* 69(6)**,** 871-873.

STANLEY, C. 2012. Central Rand Gold. Available: http://www.africanmining.com/sx_1!net474/upload/Analyst%20Report%2015%20August%202012.pdf [Accessed 17/2/2014].

TWALA, C. 2012. The Marikana Massacre: A Historical Overview of the Labour Unrest in the Mining Sector in South Africa. *SOuTHERN AFRICAN,* 1(2)**,** 61.

VAN DER SCHYFF, E. 2012. South African mineral law: a historical overview of the state's regulatory power regarding the exploitation of minerals. *New Contree: A Journal of Historical and Human Sciences for Southern Africa,* 64**,** 131-153.

VAN GRAAN, M. 2013. The Spear and the Marikana Massacre: Mirroring the Decline of South African Democracy. *African Arts,* 46(2)**,** 1-4.

WHITE, M. A. 1996. Investor response to the Exxon Valdez oil spill. *University of Virginia* [Online]. Available: http://www.environmental-expert.com/Files%5C0%5Carticles%5C2611%5CWhite.pdf [Accessed 25/9/2013].

WORRELL, D. L. & DAVIDSON, W. N. 1987. The effect of CEO succession on stockholder wealth in large firms following the death of the predecessor. *Journal of Management,* 13(3)**,** 509-515.

8 APPENDICIES

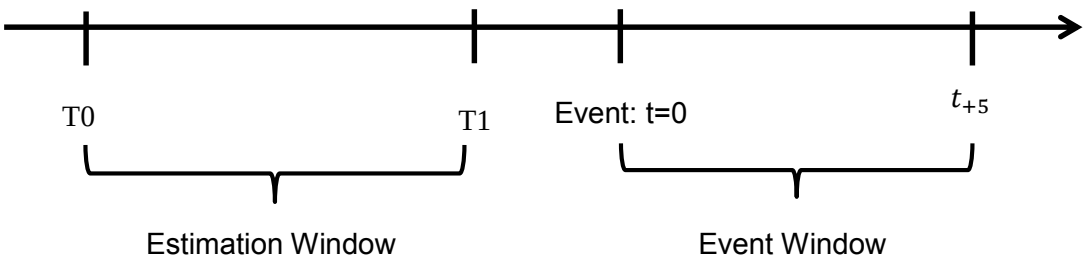
8.1 Appendix A - Timeline of observation period

Observational period time line (MacKinlay, 1997)

[T0;T1] - The estimation period used to determine average normal returns. It is important that the estimation period and the event window do not overlap so that the event window returns will not influence the estimate of the average normal returns. The estimation window begins on 3 January 2012 (T_0) and runs until 31 of July 2012 (T_1), a total of 145 returns. This window only includes days that the shares actually trade.

[t=0] – The event date. The event is indicated at t=0 (16 August 2012), the date on which the Marikana event takes place. This single defined date avoids the problem of 'clustering' whereby the event date differs for the each of the observed firms (MacKinlay, 1997).

[t0; t_{+5}] – A post-event window is included in the estimation of the average normal returns to increase the robustness of the average normal return measure. This event window begins on the date of Marikana (16 August 2012 - t_0) and runs for an additional 5 trading days until 23 August 2012 (t_{+5}) for a total of 6 days.



8.2 Appendix B – List of abbreviations

- AMCU – Association of Mining and Construction Union
- CAPM – Capital Asset Pricing Model
- CAR – Cumulative Abnormal Return
- CSR - Corporate Social Responsibility
- DOS – Denial of Service
- EMH – Efficient Market Hypothesis
- GDP – Gross Domestic Product
- JSE – Johannesburg Stock Exchange
- NUM – National Union of Mineworkers
- RDO's - Rock Drill Operators
- SAPS – South African Police Service

8.3 Appendix C - Sign t-test workings

Company Name	$\hat{p}$	AR	CAR 3	CAR 6
WESIZWE PLATINUM LTD	0.57931	-	+	+
PAN AFRICAN RESOURCES PLC	0.468966	+	-	-
DELRAND RESOURCES LTD	0.055172	-	-	-
KEATON ENERGY HOLDINGS LTD	0.627586	-	-	-
ROYAL BAFOKENG PLATINUM LTD	0.482759	-	-	-
COAL OF AFRICA LTD	0.544828	-	-	-
FIRESTONE ENERGY LTD	0.468966	-	+	-
VILLAGE MAIN REEF LTD	0.510345	-	-	-
CHROMETCO LTD	0.772414	+	-	-
EASTERN PLATINUM LTD	0.482759	-	-	+
MIRANDA MINERAL HOLDINGS LTD	0.510345	+	+	-
BUILDMAX LTD	0.4	-	-	-
CENTRAL RAND GOLD LTD	0.593103	+	+	+
DIAMONDCORP PLC	0.717241	+	+	+
FIRESTONE ENERGY LTD	0.696552	+	+	+
FORBES AND MANHATTAN COAL CORPORATION	0.717241	+	+	+
HWANGE COLLIERY COMPANY LTD	0.641379	+	+	+
GREAT BASIN GOLD LTD	0.496552	-	-	-
JUBILEE PLATINUM PLC	0.517241	+	+	-
INFRASORS HOLDINGS LTD	0.503448	-	-	-
ROCKWELL DIAMONDS INCORPORATED	0.931034	+	+	+
BHP BILLITON PLC	0.475862	+	+	+
EXXARO RESOURCES LTD	0.510345	-	-	-

Company Name	$\hat{p}$	AR	CAR 3	CAR 6
AQUARIUS PLATINUM LTD	0.572414	+	+	+
URANIUM ONE INC	0.475862	+	+	+
PLATFIELDS LTD	0.531034	-	+	+
GOLIATH GOLD MINING LTD	0.475862	-	+	-
RANDGOLD & EXPLORATION COMPANY LTD	0.365517	-	-	-
BAUBA PLATINUM LTD	0.77931	+	-	+
WESCOAL HOLDINGS LTD	0.42069	+	-	-
TAWANA RESOURCES NL	0.262069	-	-	-
WITWATERSRAND CONSOLIDATED GOLD RESOURCES	0.593103	-	+	+
SEPHAKU HOLDINGS LTD	0.455172	+	+	+
TRANS HEX GROUP LTD	0.482759	-	+	-
DRDGOLD LTD	0.524138	-	+	+
GOLD ONE INTERNATIONAL LTD	0.6	-	+	-
ANGLOGOLD ASHANTI LTD	0.489655	+	+	+
HARMONY GOLD MINING COMPANY LTD	0.475862	+	-	-
GOLD FIELDS LTD	0.468966	+	+	+
IMPALA PLATINUM HOLDINGS LTD	0.489655	-	+	+
NORTHAM PLATINUM LTD	0.537931	-	-	+
ANGLO AMERICAN PLAT LTD	0.489655	-	-	+
ANGLO AMERICAN PLC	0.510345	+	+	+
AFRICAN RAINBOW MINERALS LTD	0.489655	+	+	-
ASSORE LTD	0.503448	-	+	+
MERAFE RESOURCES LTD	0.489655	-	+	+
LONMIN PLC	0.489655	-	-	-

Company Name	$\hat{p}$	AR	CAR 3	CAR 6
PETMIN LTD	0.475862	-	-	-
SENTULA MINING LTD	0.544828	+	+	-
w		22	28	24
$\boldsymbol{n\hat{p}}$		0.524419		
Generalized sign test statistic		-1.057419484	0.658914	-0.48531

8.4 Appendix D - Rank t-test workings

	2012/08/16	2012/08/17	2012/08/20	2012/08/21	2012/08/22	2012/08/23
WESIZWE PLATINUM LTD	23	138	40	126	127	149
PAN AFRICAN RESOURCES PLC	145	1	4	129	149	59
DELRAND RESOURCES LTD	108	41	53	134	143	9
KEATON ENERGY HOLDINGS LTD	28	125	9	61	26	6
ROYAL BAFOKENG PLATINUM LTD	11	62	12	17	103	95
COAL OF AFRICA LTD	45	73	15	30	66	19
FIRESTONE ENERGY LTD	60	32	128	45	103	24
VILLAGE MAIN REEF LTD	70	76	14	145	53	32
CHROMETCO LTD	103	57	7	122	54	106
EASTERN PLATINUM LTD	4	121	54	130	27	147
MIRANDA MINERAL HOLDINGS LTD	134	98	87	41	101	15
BUILDMAX LTD	6	145	13	38	150	17
CENTRAL RAND GOLD LTD	148	61	126	109	3	95
DIAMONDCORP PLC	109	41	56	136	39	112
FIRESTONE ENERGY LTD	109	42	56	135	39	111
FORBES AND MANHATTAN COAL CORPORATION	110	41	56	136	38	114
HWANGE COLLIERY COMPANY LTD	108	44	56	132	41	110
GREAT BASIN GOLD LTD	1	17	137	87	138	66
JUBILEE PLATINUM PLC	77	87	113	3	125	112
INFRASORS HOLDINGS LTD	10	25	49	41	147	57
ROCKWELL DIAMONDS INCORPORATED	47	114	99	21	117	44
BHP BILLITON PLC	116	146	68	49	89	102
EXXARO RESOURCES LTD	7	145	51	107	73	5
AQUARIUS PLATINUM LTD	86	148	43	149	61	146

	2012/08/16	2012/08/17	2012/08/20	2012/08/21	2012/08/22	2012/08/23
URANIUM ONE INC	141	129	41	19	139	46
PLATFIELDS LTD	7	94	146	41	95	57
GOLIATH GOLD MINING LTD	55	105	98	34	108	14
RANDGOLD & EXPLORATION COMPANY LTD	55	107	1	39	109	52
BAUBA PLATINUM LTD	55	3	95	148	27	128
WESCOAL HOLDINGS LTD	96	36	56	99	54	58
TAWANA RESOURCES NL	44	110	96	16	113	40
WITWATERSRAND CONSOLIDATED GOLD RESOURCES	53	108	97	28	109	50
SEPHAKU HOLDINGS LTD	94	105	95	37	108	54
TRANS HEX GROUP LTD	47	138	62	79	121	2
DRDGOLD LTD	44	137	55	42	77	109
GOLD ONE INTERNATIONAL LTD	16	142	42	31	110	40
ANGLOGOLD ASHANTI LTD	139	136	14	130	46	39
HARMONY GOLD MINING COMPANY LTD	121	2	1	148	114	107
GOLD FIELDS LTD	126	123	17	38	82	110
IMPALA PLATINUM HOLDINGS LTD	17	138	124	112	96	57
NORTHAM PLATINUM LTD	8	97	90	56	144	151
ANGLO AMERICAN PLAT LTD	30	12	139	127	104	141
ANGLO AMERICAN PLC	101	61	117	130	8	148
AFRICAN RAINBOW MINERALS LTD	142	73	62	47	29	46
ASSORE LTD	53	99	145	27	105	143
MERAFE RESOURCES LTD	66	94	87	26	44	138
LONMIN PLC	1	106	4	133	10	150
PETMIN LTD	70	49	7	36	16	40
SENTULA MINING LTD	87	121	36	12	34	128

	2012/08/16	2012/08/17	2012/08/20	2012/08/21	2012/08/22	2012/08/23
Average rank	68.02	85.81	62.71	76.69	81.91	77.55
Population mean rank	76					
d	151					
Generalized Rank Test statistic	-0.875769667					