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Abnormal volumes traded as an indication of insider trading in JSE listed companies

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Abstract

Insider trading is one of the most unscrupulous financial crimes, as it results in people placed in positions of trust effectively stealing from those that they were supposed to protect. This research examined the volumes traded in shares listed on the JSE All Share index, to determine if it could be used as an indicator of insider trading, and whether it increases significantly in the days immediately preceding SENS announcements.

The top five abnormal returns per share were generated using control portfolios. These were analysed manually to identify the most appropriate SENS announcement. From the 735 abnormal returns, 142 announcements qualified for the volume analysis, after the removal of confounding events. These announcements were classified into seven categories: BEE and governance; financial structure; investment/disinvestment; key personnel; mergers and acquisitions; trading update; and other. The average daily cumulative abnormal volume turnover (ACAVT) was examined using a 21-day event window period preannouncement. The preceding 63 days were used to calculate the benchmark.

Three techniques were used to calculate ACAVTs – equations, t-tests and bootstrapping - which proved successful in determining ACAVT. The tests showed that overall the ACAVT was statistically insignificant. Two categories exhibited significant ACAVT – BEE and governance, and key personnel.

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University.

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1. Introduction to Research Problem

1.1. Research title

Abnormal volumes traded as an indication of insider trading in JSE listed companies.

1.2. Research problem definition

In today's volatile economic environment, listed companies make significant announcements that could have material impact on their share prices and the financial wellbeing of their shareholders. Examples of these announcements include mergers and acquisitions; changes in dividend policy; share issues and buyback; change of directors; trading updates and analyst reports. In South Africa, the announcement of a Black Economic Empowerment (BEE) deal could also have a significant impact.

Insiders could use this information for the purposes of personal gain and self-enrichment, or to minimise losses; as they ensure that they purchase and sell shares at the most appropriate time (before the market has access to the information). The result is a biased market, as information is factored into pricing before it becomes public knowledge. The market probably becomes more efficient, but inequitable in favour of the insiders. These insiders could also be the source of leaks and tip-offs to others in the market.

In an email communication, Bill Urmson – the previous Director: Surveillance at the Johannesburg Stock Exchange (JSE) and the present Head of Risk and

Internal Audit at the same organisation articulated why insider trading is a huge crime that needs to be addressed (Urmson, 2009, p. 1).

> To my mind, Insider Trading is one of the worst forms of theft as it is normally perpetrated by persons who are in a position of trust in relation to those from whom they extract value. Whether it be persons that are employed in one category or another within the company concerned or suppliers of services to that company, they are abusing their positions for personal gain, with a corresponding loss to the shareholders who are the counterparties to their trades.
>
> Investors today have the opportunity to participate in markets around the world with substantially equal ease but, most reasonably, they have an aversion to falling victim to the activities of Insider Traders and will tend to avoid markets which are not effectively regulated. As a consequence, companies that trade on such markets will tend to incur a higher cost of capital than could otherwise have been achieved.
>
> Fortunately, I believe that since effective Insider Trading legislation was introduced in the late 1990s, the joint regulatory efforts of the JSE and FSB have materially improved the perceptions of South Africa's financial markets in the eyes of local and international investors, to the benefit of us all.

Insider trading is an illegal activity, and needs to be rooted out. The efficiency and reputation of the JSE largely depends on the ability to discourage, detect, and prosecute any insider trading activities.

1.3. Research motivation

Bhattacharya and Daouk (2002) stated that it was relatively easy to establish insider trading laws. However, it was much more difficult to enforce these laws. They further stated that there has only been prosecution in only 38 of the 87 countries that have insider trading laws. Differences between the developed and emerging markets were stark. There have been prosecutions in 82 percent of developed countries, while this figure dropped to 25 percent for emerging markets (Bhattacharya and Daouk, 2002). Detection and enforcement in emerging markets must be improved in order to ensure that these markets obtain credibility, so that they may attract investment.

The Securities Services Act 36 of 2004 (RSA, 2004) legislates and controls against insider trading (which is listed as a criminal offence). The Act further stipulates that the Financial Services Board (FSB), amongst other things, is responsible for the investigation and civil prosecution of insider trading activities (RSA 2004). However, the possibility of prosecution does not deter some insiders from practising insider trading. The rewards of self-enrichment and personal gain seem to outweigh the risks of being caught.

In South Africa, there have been a few examples of insider trading. Some of these were reported on the FSB's website or in the media, as discussed below.

Richard Jonah reduced his stake Sentula Mining from 14.6 percent to 6.1 percent just before the results were due to be restated. Jonah also decided not to make himself available for re-election as a non-executive director, and is currently under investigation by FSB for insider trading offences (Brown, 2008). On 26 November 2008, the Directorate for Market Abuse at the FSB reopened insider trading investigations against York Timber and Moribo Leisure (Jacks, 2008).

On 25 November 2008, the FSB's Directorate of Market Abuse (DMA) reported on 14 cases of insider trading, nine of which were being investigated, and five were closed (FSB, 2008d). The next report on 03 March 2009 contained 13 cases, 11 of which were being investigated (five were new cases) and two were closed (FSB, 2009g). The FSB was pursuing enforcement on one case, against Moribo Leisure Limited. In FSB (2009d), the FSB reported that up to September 2008 it investigated 95 cases of insider trading, of which 69 were concluded. One case was referred to the Attorney General for consideration, and ten resulted in the intent to proceed with civil action. Nine of these were settled out of court and the remaining one was proceeding as a civil action (FSB, 2009d).

Some of the recent settlements reached on insider trading activities include the following.

- George Douglas de Jager as a director of Remgro Limited was ordered to pay an administrative penalty R587,511.00 for profiting from insider trading

activities (FSB, 2009a). It was concerning that he was not removed as a director, in spite of this transgression.

- Michael Berman and Neil Stacey participated on 31 March 2005 in the use of manipulative, false, or deceptive practices of trading on the JSE in the shares of two listed companies Ifour Properties and SA Retail Properties Limited (FSB, 2007). They were involved in insider trading activities and manipulation of share prices, and were ordered to pay an administrative penalty R2 million each (FSB, 2007). Berman appealed against his administrative penalty, which was reduced to R1 million (FSB, 2009e).

The fact that only two examples were cited is indicative of the difficulty of proceeding with insider trading cases. During this time, there were at least five successful market manipulation cases prosecuted (FSB, 2007; FSB, 2009c; FSB, 2009b; FSB, 2008a; FSB, 2008b; and FSB, 2008c). These market manipulation cases were probably easier to detect and prosecute because the evidence was probably more clear-cut. It therefore stands to reason that many insider trading cases go undetected, and the potential profits are high. Participating in insider trading activities would be like betting on a race where one already knows the outcome.

The JSE provided the following overview on insider trading (JSE, 2006, p. 4):

> Insider trading has always been the stuff of controversy and scandal, making headlines and destroying reputations. It is at the very root of discrimination, as it gives a small, usually already relatively privileged

minority, an unfair advantage over the broad majority who do not enjoy the same equality of information or opportunity.

The use of privileged information for the purposes of gain (or to avoid a loss) at the expense of others is morally and legally reprehensible. The eradication of this practice is essential to the efficient working and reputation of any market, and the society in which it operates. This is nowhere more critical than in South Africa, which is striving to remove the historical, social and economic inequities that created such huge divides between the "haves" and the "have-nots". It is also a non-negotiable requirement for all markets to remove any suspicion of impropriety in order to attract and retain investment flows.

The DMA together with the JSE's Surveillance Department police insider trading and institute actions against offending insiders (JSE, 2006). However, even the efforts of the JSE and the DMA are not enough to eradicate this practice. Therefore, the more that could be done to characterise, identify, analyse, and statistically prove insider trading, the more effective the policing would become.

The evidence of insider trading activities prior to significant announcements could be detected by abnormal returns in the share price or an increase in volume traded or an increase in both (Meulbroek, 1992). There have been various international studies that researched either one of both of the above phenomena. Locally, the research of van der Plas (2007) investigated the whether the share price in target companies on the JSE increased significantly

during the days immediately preceding a takeover, delisting, or share buy-back announcement.

The research of van der Plas and most international studies on insider trading focused on abnormal returns. Limited international researched was found linking insider trading activities to abnormal volumes traded. This research addressed this important issue and focused on the relationship between possible insider trading and abnormal volume traded in JSE listed shares. No published research on this topic focusing on the JSE could be found.

1.4. Research aim and purpose

The aim of this research was to investigate whether abnormal trading volumes preceded significant announcements on JSE listed companies. These abnormal trading volumes prior to significant announcements could point to insider trading activities. It is hoped that this research project would help the relevant authorities to better detect and prosecute insider traders by considering the abnormal volumes traded (in addition to abnormal returns) preceding significant announcements. If detection and prosecution of insider trading activities improved, it might deter more people from engaging in this illegal activity. This should contribute to improving the efficiency and reputation of the JSE – and hence improve investor confidence.

1.5. Research project scope

This research built on the study conducted by van der Plas, and considered in part whether the volume traded (instead of abnormal returns) in target

companies on the JSE increased significantly in the days preceding a takeover, delisting, or share buy-back announcement. Further, this study was expanded to investigate whether volume traded increased significantly prior to other important announcements such as a change in expected earnings; a change in the financing structure; a change in directors; or the announcement of a BEE deal or reaction to a governance issue.

The research was conducted in three phases. The first phase used abnormal returns to identify significant announcements. These significant announcements were then divided into samples according to the type announcement. In phases two and three, these samples were investigated using the event study methodology to determine if there was any preannouncement insider trading activity based on the volumes traded – phase two analysed the original data sample, while phase three analysed a bootstrap data sample. Finally, the paper determined if the magnitude of insider trading differed per announcement type.

The research report is set out as follows. The theory base is reviewed and relevant literature is described in Chapter 2. Chapter 3 presents the research hypotheses. The proposed research methodology, research design, population and sampling are discussed in Chapter 4. Chapter 5 presents the results of the research, while these results are discussed in Chapter 6. Finally, Chapter 7 presents the conclusion of the research report and recommends further research.

2. Literature review

The literature addresses the definition and regulation of insider trading. It discusses the relevant theory on insider trading. The theory was built up by analysing past research, focusing on the impact of insider trading on volumes traded, the identification of significant announcements, describing the different types of significant announcements, and measuring abnormal volumes traded – describing the analysis of original as well as bootstrapped data samples.

2.1. The definition of insider trading

Paragraph 73 of the Securities Services Act 36 of 2004 states that insider trading is an offence that is committed by an insider under the following circumstances (RSA, 2004, p. 80):

> (1) (a) An insider who knows that he or she has inside information and who deals directly or indirectly or through an agent for his or her own accouht (account) in the securities listed on a regulated market to which the inside information relates or which are likely to be affected by it commits an offence.
>
> (2) (a) An insider who knows that he or she has inside information and who deals, directly or indirectly, for any other person in the securities listed on a regulated market to which the inside information relates or which are likely to be affected by it commits an offence.
>
> (3) (a) An insider who knows that he or she has inside information and who discloses the inside information to another person commits an offence.

(4) An insider who knows that he or she has inside information and who encourages or causes another person to deal or discourages or stops another person from dealing in the securities listed on a regulated market to which the inside information relates or which are likely to be affected by it commits an offence.

The law is therefore clear that the inappropriate use of "inside information" is considered an offence. Further, the Securities Services Act 36 of 2004 in paragraph 72 defines inside information as (RSA, 2004, p. 78):

specific or precise information, which has not been made public and which-

(a) is obtained or learned as an insider; and

(b) if it were made public would be likely to have a material effect on the price or value of any security listed on a regulated market.

The definition of inside information is broad. Circumstances and context determines whether something is inside information or not. Therefore, the determination of whether information is inside or not would have to be done on a case-by-case basis, and is very difficult to prove.

An insider is described in the Security Services Act (RSA, 2004, p. 78) as

a person who has inside information

(a) through-

(i) being a director, employee or shareholder of an issuer of securities listed on a regulated market to which the inside information relates; or

(ii) having access to such information by virtue of employment, office or profession; or

(b) where such person knows that the direct or indirect source of the information was a person contemplated in paragraph (a).

An insider is therefore clearly defined by the act. The combination of the above provisions in the Securities Services Act provides the legal framework for the JSE and DMA to perform their policing function on insider trading.

2.2. The regulation of insider trading in South Africa

The Securities Services Act 36 of 2004 was gazetted on 24 January 2004, and incorporated the old Insider Trading Act 135 of 1998 (RSA, 2004). In addition to the Securities Services Act 36 of 2004, the following documents also refer directly or indirectly to insider trading or issues around disclosure (FSB, 2009f):

- The Companies Act, No 63 of 1973;
- The Financial Markets Control Act, No 55 of 1989;
- The Johannesburg Stock Exchange Listings Requirements;
- The King Report;
- The Securities Regulation Panel Rules and its Code on Takeovers and Mergers;
- The Financial Services Board paper on Personal Account Trading;
- The Rules of the Bond Exchange of South Africa;
- The Rules of the South African Futures Exchange; and
- The Code of Conduct of the South African Institute of Chartered Accountants.

The Securities Services Act 36 of 2004 allows for the prosecution of insider trading offences to be easier from both a civil and criminal perspective (RSA, 2004). The FSB can take civil action against the offenders, while the courts decide on the criminal action. The FSB can impose a penalty of up to three times of the profit gained or loss avoided. The FSB has to prove the case on the balance of probability, and not beyond reasonable doubt. The Securities Services Act 36 of 2004 also makes provision for maximum criminal penalties of a R50 million, ten years imprisonment, or both (RSA, 2004). This figure has increased substantially from the R2 million that was allowable under the old Insider Trading Act, and should act as more of a deterrent.

2.3. The impact of insider trading on volume traded

Although there have been various international studies which investigated the impact of insider trading on volume traded, the amount of research conducted in this area was much less than that conducted on abnormal returns (Ajinkya and Jain, 1989). Even in the recent past, there was much more research conducted on abnormal returns when compared with abnormal volumes traded. Sometimes when researchers considered abnormal volumes traded, they considered it in conjunction abnormal returns (Meulbroek, 1992; Ryan and Taffler, 2004; Jarrell and Poulsen, 1989; and Ascioglu, McInish and Wood, 2002). In fact, Meulbroek (1992) considered abnormal volume traded as a step to calculating abnormal returns.

Most of the researchers concluded that there were abnormally high volumes traded prior to positive and negative significant announcements. Meulbroek

(1992) found that the total volume traded on insider days was higher than expected. She further found that insiders were responsible for most of the unusual trading volume. Keown and Pinkerton (1981) found that the volumes traded increased significantly in the period leading up to a merger announcement. They stated that this increase in volume prior to the merger announcement could be explained if information leaked out.

Jarrell and Poulsen (1989) found that in successful bids (mergers or acquisitions), there were significant stock-price run-up and surges in volume before the bids. Ascioglu, McInish and Wood (2002) found that significant increases in volumes traded occurred from about four days prior to a merger announcement. However, the study by Sanders and Zdanowicz (1992) found that while there was evidence of stock-price run-up before the announcement, they did not find any evidence of abnormal trading volume. They also found no evidence to link the information leaked to insider trading.

Arnold, Erwin, Nail and Nixon (2006) also found that there was significant abnormal stock volumes preceding the announcement. They also concluded that where options were traded, the options displayed abnormal volume trades earlier than normal stocks. This finding was also confirmed by Jayaraman, Frye and Sabherwal (2001). Cao, Chen and Griffin (2005) confirmed that abnormal volume trades prior to significant announcements were more pronounced in options, rather than the actual stock.

Chae (2005) investigated the impact on trading volume prior to scheduled and unscheduled announcements, and concluded that trading volume actually decreased significantly before scheduled announcements and increased significantly before unscheduled announcements. The finding on the impact of scheduled announcements on trading volume contrasted with that of Morse (1981, p. 382), who concluded that there was "a definite lack of activity in the stock market in anticipation of the earnings announcement".

In summary, there was international research evidence indicating that there was abnormal volume traded (increase in volume traded) before significant unscheduled announcements. In contrast, the evidence suggested that scheduled announcements had little impact on volumes traded, or may have even decreased the volume traded. However, the amount of research addressing abnormal volumes traded was a fraction of that addressing abnormal returns, and in some cases was seen as an add-on to the study on abnormal returns.

2.4. Abnormal returns and announcements

In order to analyse the occurrence of abnormal volumes traded on the prior to significant announcements, significant announcements must be identified. This could be done by searching through the JSE Security Exchange News Service (SENS) database and other news sources (like websites, newspapers and television). However, there were vast quantities of items in the database and in the media, many of which did not have any significance. Therefore, due to

time constraints of this study, it was decided to review literature to see if there was a simpler approach to identifying these significant announcements.

Fama, Fischer, Jensen and Roll (1969) when studying the effects of stock splits concluded that markets were efficient and stock prices adjusted rapidly to new information. Keown and Pinkerton (1981, p. 8661) conducted research into merger announcements and insider trading found that their "results do support the semistrong form efficient market hypothesis since the market reaction to the new public information is complete by the day after the announcement". In addition, a number of researchers assumed an efficient market to conduct their studies (Chakravarty, Gulen and Mayhew, 2004; Fidrmuc, Goergen and Renneboog, 2006; Brown and Warner, 1980; McWilliams and Siegel, 1997; and Mushidzhi and Ward, 2004).

Any information from announcements was quickly processed by the market and reflected in the share price. This phenomenon was confirmed by numerous empirical studies. In the study conducted by van der Plas (2007), the abnormal or above average returns on the day of the public announcement was at least 6.4 times greater than the abnormal returns on other days, while this figure was at least 2.7 greater in the research performed by Mushidzhi and Ward (2004). Keown and Pinkerton (1981) showed that the abnormal returns on announcement days were at least 4.7 times that on other days.

Therefore, the largest abnormal returns occurred on the public announcement days. If the day with the highest abnormal return could be identified, then the

date of the applicable announcement would also be identified. This was to be expected, as this was the time when the public had insight into key information, and thus would use this information to trade in securities.

2.5. Event study methodology and significant announcements

The literature reviewed indicated that the event study methodology was the most appropriate method of indentifying abnormal returns around an event (or announcement). The event study methodology was introduced by Fama *et al.* (1969), where they identified "residuals" or unusual stock price returns – which were above average returns. Since then, the event study methodology has been used extensively to identify and measure above average returns. Binder (1998, p. 111) in his review of the event study methodology stated: "The event study methodology has, in fact, become the standard method of measuring security price reaction to some announcement or event".

In their research into the event study framework, McWilliams and Siegel (1997) stated that the framework would facilitate the identification of abnormal returns if the following assumptions were valid:

- Market efficiency: share prices incorporate all available information quickly;
- Unanticipated events: the market only becomes aware of the event upon announcement; and
- Confounding effects: the event under consideration must be isolated from the effects of other events that could have a material impact.

It must be noted that McWilliams and McWilliams (2000) had not disagreed with the above assumptions in their critique of McWilliams and Siegel's research paper (McWilliams and Siegel, 1997).

Binder (1998) further stated that event studies could be used in cases where abnormal returns were measured as residuals from some benchmark of normal returns. Therefore, in order to make statistical inferences from an event study, the empirical (actual) return in the period of interest must be determined; a model that would provide a benchmark for normal (expected) returns must be constructed; and then the two must be compared to see if there were significant differences. The magnitude of this difference would indicate the size of the residual or abnormal return. The period in which the largest abnormal return occurred would probably be the period in which the significant announcement was made public.

The empirical (actual) return in the period of interest was generally calculated by comparing the actual share price at end of the period of interest (including any dividends paid during this period) with the share price at the end of the previous period (Ryan and Taffler, 2004; and Mushidzhi and Ward, 2004). Researchers had two main methods of calculating actual return. Mordant and Muller (2003) used the actual values to calculate the return, while van der Plas (2007), Ryan and Taffler (2004), Keown and Pinkerton (1981), Fama *et al.* (1969), Mushidzhi and Ward (2004), and Strong (1992) used logarithmic values in their calculation. The logarithmic returns approach was superior, as the

returns were more likely to be normally distributed and conform to assumptions of standard statistical techniques (Strong, 1992).

The issue of calculating the benchmark normal (expected) returns was a lot more complex. There were a number of models that were used by different researchers, each of which have advantages and disadvantages. The four popular models available were summarised by Mushidzhi and Ward (2004, p. 20-21) as follows:

- Mean Adjusted Model: a firm is expected to generate the same returns that it averaged during the estimation period.
- Market Model: calculations of a firm's expected returns incorporate the risk of the firm with respect to the market.
- Market Adjusted Model: a firm is expected to generate the same returns as the rest of the market during the event window.
- Control Portfolio Model: a firm is grouped with a portfolio of firms, which are the same depending on the criteria used for the grouping. The expected return of the company will be the same as the observed return of the control portfolio during the event window.

These models have their roots in residual analysis, pioneered by Fama *et al.* (1969). The analysis of the above models by different researchers are discussed below.

Brown and Warner (1980) conducted a performance comparison between three of the models namely mean adjusted returns, market adjusted returns, and market and risk adjusted returns (market model). They also looked briefly at control portfolios. They found that the mean adjusted returns performed at least well as the other models. The control portfolio performed the worst, leading them to conclude that "there is no evidence that more complicated methodologies convey any benefit" (Brown and Warner, 1980, p. 249).

This study was updated to consider event studies with daily returns (Brown and Warner, 1985). They considered the same three models (except that the market and risk adjusted returns was now called OLS [ordinary least squares] market model. They concluded that OLS market model was well specified under a variety of conditions. The OLS market model and market adjusted return also were well specified to non-normal daily returns, and were more powerful than monthly return models. They outperformed the simpler mean adjusted returns. However, the potential negative impact of variance increases, cross-sectional dependence, and autocorrelation would have to be considered.

Bowman (1983) indentified three categories of models: mean adjusted returns, the risk adjusted returns (combination of market and market adjusted models), and the risk controlled portfolio returns. He supported Brown and Warner's assertion in Brown and Warner (1980) that the first two were useful, while there was little merit in pursuing the third.

The methodology used by Mushidzhi and Ward (2004) indicated how to calculate the expected daily return using the market model. The notations and equations indicated below were those used by Mushidzhi and Ward (2004).

$$\widehat{\boldsymbol{R}}_{\boldsymbol{it}} = \boldsymbol{\alpha}_{\boldsymbol{i}} + \boldsymbol{\beta}_{\boldsymbol{i}} \ \boldsymbol{R}_{\boldsymbol{mt}} \qquad \text{(Equation 1)}$$

Where

$\hat{R}_{it} = the\ predicted\ daily\ return\ of\ security\ i\ on\ day\ t;$

$R_{mt} = the\ daily\ return\ of\ the\ market\ on\ day\ t;$

$\alpha_i = the\ constant\ return\ of\ security\ i\ in\ the\ period\ that\ is\ not\ explained\ by\ the\ market;$

$\beta_i = the\ sensitivity\ of\ security\ i\ to\ the\ market\ i.e.\ a\ measure\ of\ the\ systematic\ risk\ i.$

Therefore, the equation utilised to calculate expected returns is based on the capital asset pricing model (CAPM).

$$\boldsymbol{R}_{\boldsymbol{mt}} = \boldsymbol{log}\left(\frac{\boldsymbol{ALSI}_{\boldsymbol{t}}}{\boldsymbol{ALSI}_{\boldsymbol{t-1}}}\right) \qquad \text{(Equation 2)}$$

Where

$ALSI_t = JSE\ All\ Share\ Index\ on\ day\ t;$

$ALSI_{t-1} = JSE\ All\ Share\ Index\ on\ day\ t-1;$

As can be seen from equation 2, Mushidzhi and Ward (2004) used the All Share Index (ALSI) to calculate the benchmark market return. Since this ALSI is the broadest based index on the JSE, it would provide the best approximation of the market return. Mushidzhi and Ward (2004) used a normal logarithmic

base ten (log) transformation in order to approximate a normal distribution, although a natural logarithmic (ln) may have produced a better approximation of normality. They also used published data for α and β. If the published values were not accurate enough, then using the techniques of Scholes and Williams (1977) could be considered to calculate daily α and β values.

Early work in control portfolios was conducted by Fama and French (1995). They found that there was a size-related risk factor in returns. They also found that a high book equity (BE) to market equity (ME) [BE/ME] ratio led to lower earnings. However, they found no evidence to show that this correlated to higher returns. In a later study, Fama and French (1996) found that many of the anomalies of share price returns were not explained by the capital asset pricing model (CAPM) model. They therefore proposed that the expected return in excess of the risk-free rate could be explained by a three-factor model. Fama and French (1998), in contrast to their 1995 study, now found that value stocks (high BE/ME) tended to have higher returns than growth stocks (low BE/ME). They also introduced the concept of the multifactor minimum variance (MMV) portfolio, which is considered as the forerunner of the control portfolio.

In the South African context, Gilbertson and Goldberg (1981) identified the existence to two distinct types of sectors in the JSE, namely the mining and industrial sectors. They further stated that the JSE was different from other stock markets in that large portions of shares in the JSE were influenced by commodity prices. They concluded that any asset pricing model should take

into account this dual nature of JSE listed stock. Investment styles in terms of size and value vs. growth was investigated by Mutooni and Muller (2007). These developments illustrated the usefulness of control portfolios when analysing the returns on the JSE. The model developed by Mordant and Muller (2003) consisted of eight control portfolios based on the resources effect, the price-to-book value ratio and the company size. The price-to-book value ratio and company size were identified by many researchers, including Fama and French (1998). The resources effect theory on the JSE was supported by Mordant and Muller (2003), who included it in their model.

Mordant and Muller (2003) formed their control portfolios by placing each market effect into one of two states: a share's size was either small or large; a share was either a value or growth; finally, a stock was classified as either resource or a non-resource counter. These market effects were used to form the eight control portfolios, as displayed in table 1 below.

Table 1: Factor-mimicking control portfolios (Source: Mordant and Muller, 2003)

	LARGE		SMALL	
	VALUE	**GROWTH**	**VALUE**	**GROWTH**
RESOURCES	LVR	LGR	SVR	SGR
NON-RESOURCES	LVN	LGN	SVN	SGN
Key:	LVR	Large, Value, Resources		
	LVN	Large, Value, Non-resources		
	LGR	Large, Growth, Resources		

	LARGE		SMALL	
	VALUE	**GROWTH**	**VALUE**	**GROWTH**
RESOURCES	LVR	LGR	SVR	SGR
NON-RESOURCES	LVN	LGN	SVN	SGN
	LGN	Large, Value, Non-resources		
	SVR	Small, Value, Resources		
	SVN	Small, Value, Non-resources		
	SGR	Small, Growth, Resources		
	SGN	Small, Growth, Non-resources		

These factors were used to calculate an expected return for shares on the JSE. The equation below represents Mordant and Muller's (2003) eight-factor model.

$$E(R_{i,t}) = \alpha_{i,t} + \beta_{i,1} SVN_t + \beta_{i,2} SVR_t + \beta_{i,3} SGN_t + \beta_{i,4} SGR_t + \beta_{i,5} LVN_t + \beta_{i,6} LVR_t + \beta_{i,7} LGN_t + \beta_{i,8} LGR_t + \varepsilon_{i,t} \quad \text{(Equation 3)}$$

Where

$E(R_{i,t})$ $= expected\ return\ of\ stock_i\ in\ period_t$

$\alpha_{i,t}$ $= alpha\ intercept\ term\ of\ stock_i\ in\ period_t$

$\beta_{i,1} \dots \beta_{i,8}$ $= beta\ coefficients\ or\ factor\ loadings\ on\ each\ control\ portfolio\ return$

$\varepsilon_{i,t}$ $= the\ error\ term$

$SVN_t \cdots LGR_t$ $= returns\ on\ each\ of\ the\ eight\ control\ porfolios\ as\ as\ described\ in\ Table\ 1\ above$

Both the market and control portfolio models would be useful in determining the benchmark of normal returns. The method of use for each was illustrated above. From a South African / JSE perspective, control portfolios were used by van der Plas (2007), Mordant and Muller (2003), and Smit (2005) in their research, while Mushidzhi and Ward (2004) used the market and adjusted market models. However, they both have complexities and shortcomings. Both models were considered for use in this study to determine the benchmark for normal (expected) returns for various shares. A decision on which model to use was made during the execution of the project and the control portfolios method was selected. This decision was based on amongst other things the availability of information. The reasons for choosing the control portfolios methodology is discussed in greater detail in Chapter 4.7.1.

2.6. Types of significant announcements

There are two categories of announcements that could be analysed, scheduled and unscheduled announcements (Chae, 2005). The timing for scheduled announcements is publicly known in advance of the public announcement. Earnings announcements are typical scheduled announcements. The timing, magnitude, and direction of unscheduled announcements are not publicly known. According to Chae (2005), unscheduled announcements included acquisitions, targets, and Moody's bond rating announcements. These four announcements represented major corporate events that could have substantial impact on prices and trading volumes (Chae, 2005).

Mergers and acquisitions were also cited as significant announcements by Jarrell and Poulsen (1989), Ascioglu, McInish and Wood (2002), Keown and Pinkerton (1981), Sanders and Zdanowicz (1992), and Arnold *et al.* (2006). Annual general meetings and earnings announcements were identified as significant announcements by (Morse, 1981). Annual earnings announcements were also researched by Wong Kie, Sequeira and McAleer (2005). The releases of analysts' reports were also other significant events that could have impacted share prices and volume traded (Chordia, Subrahmanyam and Anshuman, 2001).

Ryan and Taffler (2004), and Fidrmuc, Goergen and Renneboog (2006) both broke down significant announcements into greater detail. Ryan and Taffler (2004) considered the following announcements to have a significant impact on volumes traded: analysts; share deals; director share dealings; bids; preliminary results; interim results; and financing issues. Fidrmuc, Goergen and Renneboog's (2006) selection of significant announcements included: change of CEO; change in executive directors; change in non-executive directors; mergers and acquisitions; asset disposals; capital structure changes; firm's prospects; and business events.

According to Meulbroek (1992), the different types of insider information included takeover related; earnings related (negative and positive); bankruptcy or financial fraud; miscellaneous news (good and bad); and all news (positive and negative). Givoly and Palmon (1985) cited earnings announcements;

management forecasts; dividend news; operational plans; and other events as significant corporate events.

In summary, there are two main categories of significant announcements – scheduled and unscheduled. Scheduled announcements included earnings announcements; interim results; preliminary results; and annual general meetings. Unscheduled announcements included mergers and acquisitions; analysts' reports (including rating agencies like Moody's); share deals; director share dealings; bids; financing issues; changes in directors; asset disposals; firm's prospects; and business events. In general, the information surrounding scheduled announcements would be priced into the market, and does not present a big opportunity for insider trading activities. As the aim of this research paper was to investigate the detection of insider trading by analysing daily volumes traded; only unscheduled events was investigated further.

2.7. Measuring volumes traded

The event study methodology was also the preferred method to identify and calculate abnormal volume traded (Chae, 2005). Therefore, the principles discussed in Section 2.5 regarding the identification of significant announcement dates would be applicable to measuring abnormal volumes traded as well. Actual volumes traded would have to be measured, benchmarks for normal (expected) volumes be determined, and then they would have to be tested to determine if they were statistically different. If there were statistically significant differences, it would indicate that there were abnormal volumes traded preannouncement. In order to determine the

expected volumes traded (benchmark) and the abnormal volumes traded, two approaches could be utilised – the original data sample could be used to make the inference or, as an alternative, a bootstrap technique could be used. These are both described below.

2.7.1. Measuring volumes traded using original data sample

As with the analysis of the share price returns, volumes traded can be analysed using the actual volumes traded or a logarithmic transformation. Measuring absolute volume traded would not allow the power of the normal distribution to be used.

By conducting a logarithmic transformation on volume traded, it would be transformed to an approximately normally distributed variable, and thus increasing the level of statistics that could be performed (Ajinkya and Jain, 1989). Following this research, the logarithmic transformation was used by many researchers to measure volume traded (Meulbroek, 1992; Ascioglu, McInish and Wood, 2002; Sanders and Zdanowicz, 1992; Jayaraman, Frye and Sabherwal 2001; and Chae, 2005).

Meulbroek (1992) used a regression equation to compute abnormal volumes traded for each stock. The regression equation considered a market index, days of the week variables, announcements, inside trades, news, and residual terms. It must be noted that Meulbroek (1992) used the Securities and Exchange Commission's (SEC's) confirmed insider trading information to

conduct her study. Since the proven occurrence of insider trading activity in South Africa was very low (only one conviction), this approach could not be used to research insider trading in South Africa – as the sample would have been too small.

Ascioglu, McInish and Wood (2002) used an event window of 147 days (t_{-105} to t_{41}) for their study. They designated t_0 as the day of the announcement. They calculated the benchmark for normal daily volumes traded by taking the mean of the volumes traded for days t_{-105} to t_{-21}. This value was then compared to the actual volume to determine if there was any excess volume. They then calculated the cumulative excess volume by summing all the excess volumes.

Sanders and Zdanowicz (1992) used an event window of 271 (t_{-210} to t_{60}) days for their study. They designated t_0 as the day of the public announcement. They calculated the benchmark for normal daily volumes traded by taking the mean of the volumes traded for days t_{-210} to t_{-61}. This value was then compared to the actual volume to determine if there was any abnormal volume. They then calculated the cumulative excess volume by summing all the abnormal volumes, and worked out the t-statistic. They also compensated for days of the week effect.

Although the research of Arnold *et al.* (2006) focused on the link between the option market and the stock market, they did study abnormal volumes traded on a non-option sample as well. They used an event window of 51 days (t_{-50} to t_0) for their study. They designated t_0 as the day of the announcement and

calculated the benchmark for normal daily volumes traded by taking the mean of the volumes traded for days t_{-50} to t_{-21}. This value was compared to the actual volume to determine if there was any abnormal volume. They then calculated the cumulative excess volume by summing all the abnormal volumes, and worked out the t-statistic. They did not compensate for days of the week effect.

Chae (2005) used the concept of log turnover as a basis for measuring volume traded. This methodology also corrected for outstanding shares (Chae, 2005). Therefore, it would be easier to make comparisons as this study standardised the volumes traded. He did not compensate for days of the week effect. He used an event window of 51 (t_{-40} to t_{10}) days for his study and designated t_0 as the day of the announcement. Chae (2005) calculated the benchmark for normal daily volumes traded by taking the mean of the volumes traded for days t_{-40} to t_{-11}.

He then compared this value to the actual volumes traded from days t_{-10} to t_{10} to determine if there was any abnormal volume. This cumulative excess volume was calculated by summing all the abnormal volumes, and finally the t-statistic was calculated. This calculation finally determined if there was any significant abnormal volumes traded or not (Chae, 2005).

The various methods that researchers have used to determine abnormal volumes traded (without utilising resampling) were discussed above. The options available to study abnormal volumes traded were limited when

compared to the choices available to study abnormal returns. The Chae model was used in this research paper, as the standardisation for the outstanding shares made it superior to the others. It must be noted, as in the case of Chae (2005), that unless otherwise noted, any reference in this paper to volume, trading volume, turnover hereafter all refer to log volume turnover as defined in the equations in chapter 4.7.2.

2.7.2. The use of the bootstrap methodology

The use of bootstrap techniques to analyse share data and expected share trading volumes is now discussed. A number of researchers from a variety of fields used bootstrap techniques to increase the level of statistical analysis that could be performed on non-parametric data where normality cannot be assumed. The bootstrap technique was first introduced by Bradley Efron in 1977, and since then had achieved prominence in both statistics and mainstream journals (Boos, 2003).

Moore, McCabe, Duckworth and Sclove (2003) provided a good description of the bootstrap technique, which is highlighted here. They stated that the bootstrap was way finding an approximate sampling distribution from just one sample. Hundreds of samples (called bootstrap samples or resamples) would be created by sampling with replacement from the original sample. Moore *et al.* (2003) further stated that each resample would be the same size as the original sample. The desired statistic was then worked out for each resample statistic. The distribution of the resample statistics is called the bootstrap distribution. This bootstrap distribution provides information on the

shape, centre, and spread of the sampling distribution (Moore *et al.,* 2003). This description was also confirmed by Boos (2003), Moore and McCabe (2006), Efron and Gong (1983), Efron and Tibshirani (1986), and Efron (2003).

Due to the increased statistical inferences that could be made using the bootstrap technique, it has been found to be useful in analysing stock returns. Cowan and Sergeant's (1997) working paper on interacting biases, non-normal return distributions investigated the performance of parametric and bootstrap tests for long-horizon event studies, and provided a detailed utilisation and analysis of the bootstrap techniques and their use in the investigation of event studies. Their research confirmed the greater power and specification that bootstrapping provides.

Lyon, Barber and Tsai (1999) conducted research into improved methods for tests of long-run abnormal stock returns. Their paper recommended the use of a bootstrapped skewness-adjusted t-statistic in order to eliminate skewness bias. They further concluded that using the bootstrap technique provided power advantages in all sampling situations (which included differing sample size, horizons, and non-random samples).

Ikenberry, Lakonishok and Vermaelen (1995) also used bootstrapping in their research on market under reaction to open market share repurchases in order to reduce the skewness of long-run returns. Iñiguez and Poveda (2004, p. 121) investigated the long-run abnormal returns and income smoothing in the Spanish stock market, and concluded that "that the best of the test results

presented is that of the t-statistic adjusted for asymmetry through the percentiles obtained from the bootstrap distribution of that statistic".

Bootstrapping has also become more popular in analysing daily returns. Locke and Gupta (2008) studied the performance of entrepreneurial companies post-listing on the New Zealand Stock Exchange. They compensated for the thin (small) market problem by creating 1000 bootstrap samples to use in their daily market analysis. Agrawal and Jaffe (1999) analysed daily returns in their study of post-merger performance of securities, where they adjusted for biases by using a bootstrap approach.

Aktas, De Bodt, Declerck and Van Oppens (2003) published a paper on "the probability of informed trading? Some evidences around corporate events" in which they used bootstrapping to calculate the p-value of the analysed data. Samitas, Kenourgios and Zounis (2008, p. 1576) used bootstrapping to determine Athens Olympic Games 2004 impact on sponsors' stock returns. They used the bootstrap in order to overcome the problems generally associated with the non-normality of stock returns such as skewness, kurtosis, and heteroskedasticity. They found that bootstrapping "reduces the mis-specification significantly and produces more accurate – and in our case – strong results".

Some researchers have also used bootstrap methods when analysing volumes traded. In their published paper "is volatility of equity markets a volume story? A nonparametric analysis", Giannikos, Guirguis and Ozenbas (2003) found that

bootstrapping improved the confidence levels of their statistical inferences and helped to compensate for the skewness, kurtosis and non-normality of their sample. McNally, Smith and Barnes (2006) investigated the price impacts of open market repurchase trades, where they used bootstrapping to analyse share repurchases as a percentage of outstanding shares and volumes traded.

However, not all researchers have accepted the virtues of bootstrapping, and it was not as widely utilised as might be expected. McWilliams and Siegel (1997) published an in-depth investigation into the empirical and theoretical issues surrounding event studies. They cited 29 studies with small sample sizes that examined effects on securities. They pointed out that none of them utilised bootstrapping in order to reduce the effects non-normality. In spite of this, they still advocated the use of bootstrap methods on small samples.

There seemed to be widespread support of the bootstrap technique's ability to compensate non-normality, skewness and kurtosis. The bootstrap technique was used to compensate for these effects in determining the relevant statistics for the expected volumes traded. As with the use of the original sample, in order to determine the abnormal volumes traded, the difference between the actual volumes traded and the bootstrap calculation of the expected volumes traded had to be calculated. If this difference was significant, then there were abnormal volumes traded in the preannouncement period (Aktas *et al.*, 2003).

As described in this section, both the original sample and bootstrapping had found application in the calculation of expected returns and volumes traded.

When considering using the original data sample, the method proposed by Chae (2005) was considered superior to the others discussed. The bootstrap resampling procedure allowed smaller samples to be used in the study. Some researchers used the bootstrap technique as their primary research methodology, while others used it as a validity check on the integrity of their results. This study used both the analysis of the original data sample (discussed in chapter 4.7.2) and bootstrapping (discussed in this chapter) as primary methodologies in order to test, increase the robustness, and cross-check the validity of the results obtained.

2.8. Summary and conclusions to the literature review

The literature review described the relevant aspects of insider trading and abnormal volumes traded. Insider trading is illegal in South Africa, and is policed by the FSB and JSE.

Both abnormal returns and abnormal volumes can be used to investigate insider trading activities. The analysis using abnormal volumes was less popular than the analysis of abnormal volumes. Although there was international evidence that supporting the detection of significant abnormal volumes traded preannouncement, no such study could be found published in South Africa.

It was also shown that public announcements generally fall on the day of the highest abnormal return. Thus, abnormal returns could be used to identify the appropriate announcement date. This study utilised the control portfolio

methodology because an already constructed control portfolio model was available for use in this study.

Some of the researchers identified different types of announcements that could be analysed separately. These included scheduled and unscheduled announcements. As this study considered insider trading, scheduled announcements and director's dealings were not analysed. All other types of unscheduled announcements were analysed. Abnormal volumes could be measured in two ways – using the original data sample to compare the abnormal volumes to the expected volumes, and using a bootstrap methodology. Both were used in this study in order to improve the robustness of the results.

In conclusion, the literature indicated why it is important to detect and statistically prove insider trading. It also showed that that abnormal volumes could be used to detect insider trading. No published South African study on detecting insider trading using abnormal volumes could be found. Therefore, it is hoped that this study will contribute to the body of knowledge on insider trading in South Africa.

3. Research Hypotheses

The purpose of this research was to determine whether the volumes traded in companies' shares increased substantially prior to significant announcements, in order to identify possible occurrences of insider trading. The literature review provided a description of the categories and types of significant announcements.

The literature review concluded that insider trading activities were more prevalent with unscheduled announcements when compared to scheduled announcements. Therefore, only unscheduled announcements would be investigated. In addition, announcements related to director's dealings were not analysed – as these were deemed not important in the detection of insider trading. A one-tailed t-test would be used to determine if there was an abnormal increase in volumes traded before the unscheduled announcement.

Hypotheses on three different levels would be tested.

- The main hypothesis would test if there was significant abnormal volumes traded prior to unscheduled announcements. The basis of the research hypotheses would be to test whether the average daily cumulative abnormal volume turnover was positive in the case of the complete sample.

- Then, a number of sub-hypotheses would test if there was significant abnormal volumes traded prior to unscheduled announcements according to announcement type. The various types of announcement types / categories were discussed in section 2.6. These formed the basis for individual sub-

hypotheses – one per announcement type. These research sub-hypotheses would test whether the average daily cumulative abnormal volume turnover was positive in each case.

- Finally, the study would investigate whether the calculated abnormal volume turnovers were the same for all the different types of the significant announcements, or if there were differences.

There was a large body of literature confirming that there were large, significant abnormal returns on the days of significant announcements. This was considered to be conclusive; therefore there was no specific validity tests addressing this.

3.1. Main hypothesis

The null hypothesis states that there is no significant positive average daily cumulative abnormal volume turnover (ACAVT) in the shares traded in companies prior to them making unscheduled announcements. The alternative hypothesis states that there is a significant positive average daily cumulative abnormal volume turnover (ACAVT) in the shares traded in companies prior to them making unscheduled announcements.

H_0: ACAVT ≤ 0

H_1: ACAVT > 0

3.2. Sub-hypotheses

The different announcements are categorised according to their different types. These categories are informed by those discussed in section 2.6 and also includes some uniquely South African announcement types, such as the announcement of a black economic empowerment (BEE) deal. The different categories are listed below.

- BEE and governance: includes announcements related to BEE and other compliance issues.
- Financial Structure: includes announcements such as share buybacks; share options; rights issues; obtaining additional debt; or paying a special dividend.
- Investment or disinvestment: includes announcements such as the purchase or sale of major assets such as equipment; property; or shares in companies.
- Key personnel: includes announcements that involve a change in the composition of the board of directors; chief executive officer; or other senior executives of the organisation.
- Mergers and acquisitions: includes announcements the relating to mergers and acquisitions (transactions that involve the entire company).
- Trading update: includes announcements that provide an update of business conditions or trading forecasts.
- Other: includes all other unscheduled announcements, excluding scheduled earnings and unscheduled directors' dealings.

Each of these sub-hypotheses is described below:

For announcement type 1 (BEE and governance):

The null hypothesis states that there is no significant positive average daily cumulative abnormal volume turnover ($ACAVT_1$) in the shares traded in companies prior to them making unscheduled BEE and governance announcements. The alternative hypothesis states that there is significant positive average daily cumulative abnormal volume turnover ($ACAVT_1$) in the shares traded in companies prior to them making unscheduled BEE and governance announcements.

H_0: $ACAVT_1 \leq 0$

H_1: $ACAVT_1 > 0$

For announcement type 2 (financial structure):

The null hypothesis states that there is no significant positive average daily cumulative abnormal volume turnover ($ACAVT_2$) in the shares traded in companies prior to them making unscheduled financial structure announcements. The alternative hypothesis states that there is significant positive average daily cumulative abnormal volume turnover ($ACAVT_2$) in the shares traded in companies prior to them making unscheduled financial structure announcements.

H_0: $ACAVT_2 \leq 0$

H_1: $ACAVT_2 > 0$

For announcement type 3 (investment or disinvestment):

The null hypothesis states that there is no significant positive average daily cumulative abnormal volume turnover ($ACAVT_3$) in the shares traded in companies prior to them making unscheduled investment or disinvestment announcements. The alternative hypothesis states that there is significant positive average daily cumulative abnormal volume turnover ($ACAVT_3$) in the shares traded in companies prior to them making unscheduled investment or disinvestment announcements.

H_0: $ACAVT_3 \leq 0$

H_1: $ACAVT_3 > 0$

For announcement type 4 (key personnel):

The null hypothesis states that there is no significant positive average daily cumulative abnormal volume turnover ($ACAVT_4$) in the shares traded in companies prior to them making unscheduled key personnel announcements. The alternative hypothesis states that there is significant positive average daily cumulative abnormal volume turnover ($ACAVT_4$) in the shares traded in companies prior to them making unscheduled key personnel announcements.

H_0: $ACAVT_4 \leq 0$

H_1: $ACAVT_4 > 0$

For announcement type 5 (mergers and acquisitions):

The null hypothesis states that there is no significant positive average daily cumulative abnormal volume turnover ($ACAVT_5$) in the shares traded in companies prior to them making unscheduled mergers and acquisitions announcements. The alternative hypothesis states that there is significant positive average daily cumulative abnormal volume turnover ($ACAVT_5$) in the shares traded in companies prior to them making unscheduled mergers and acquisitions announcements.

H_0: $ACAVT_5 \leq 0$

H_1: $ACAVT_5 > 0$

For announcement type 6 (trading update):

The null hypothesis states that there is no significant positive average daily cumulative abnormal volume turnover ($ACAVT_6$) in the shares traded in companies prior to them making unscheduled trading update announcements. The alternative hypothesis states that there is significant positive average daily cumulative abnormal volume turnover ($ACAVT_6$) in the shares traded in companies prior to them making unscheduled trading update announcements.

H_0: $ACAVT_6 \leq 0$

H_1: $ACAVT_6 > 0$

For announcement type 7 (other):

The null hypothesis states that there is no significant positive average daily cumulative abnormal volume turnover ($ACAVT_7$) in the shares traded in companies prior to them making unscheduled other announcements. The alternative hypothesis states that there is significant positive average daily cumulative abnormal volume turnover ($ACAVT_7$) in the shares traded in companies prior to them making unscheduled other announcements.

H_0: $ACAVT_7 \leq 0$

H_1: $ACAVT_7 > 0$

3.3. Differences between the means or medians

The null hypothesis states that the means or medians of the abnormal volume turnovers for the different types of significant unscheduled announcements are the same. The alternative hypothesis states that there is at least one mean or median of the abnormal volume turnovers for the different types of significant unscheduled announcements are different.

In the case of means:

H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6 = \mu_7$

H_1: $\mu_i \neq \mu_j$ for at least one pair (i,j), where $i \neq j$

In the case of means (M used as a symbol for median):

H_0: $M_1 = M_2 = M_3 = M_4 = M_5 = M_6 = M_7$

H_1: $M_i \neq M_j$ for at least one pair (i,j), where $i \neq j$

4. Research Methodology

4.1. Introduction to the research methodology

The aim of the research was to determine the occurrence of insider trading as indicated by the detection of abnormal volume traded in JSE listed companies prior to significant unscheduled announcements. The research was causal in nature. The data was quantitative, and consisted of information (secondary data) about JSE listed securities such as share prices, volumes traded, and number of outstanding shares. The measurement scale was ratio, which allowed powerful statistical tests to be performed (Zikmund, 2003). However, the assumption of normality was not taken for granted because of issues like skewness. For some tests, bootstrapping would be used to improve to the approximation of normality.

Only secondary data was utilised in the research, so there was no requirement to design a primary data collection instrument. Due to the nature of the study, generic research methodologies as discussed in Zikmund (2003) could not be used. The event study methodology was utilised for this research project, as it enabled the analysis and comparison of data around an event or announcement.

The event study methodology was pioneered by Fama *et al.* (1969) and refined by numerous other researchers. The event study methodology is the *de facto* standard for analysing shares' reactions to announcements (Binder, 1998). The next section discusses the research design employed. Then, the unit of

analysis, the population of relevance and the samples obtained are elaborated on. Next, the data collection process and data analysis approach are discussed. Finally, the data integrity is discussed.

4.2. Research design

The research was based on analysing publically available JSE share daily trading data in order to identify significant announcements and make statistical inferences on possible insider trading activities. It consisted of three phases. In phase one, significant announcements were identified; in phase two these announcements were analysed using the actual data sample to determine if there were possible insider trading activities; and in phase three this analysis was repeated using bootstrapping to compensate for non-normality. Possible insider trading activities were identified by establishing if statistically significant abnormal volumes traded in the preannouncement period. The phase one analysis was conducted on share price returns while in phases two and three it was conducted on volumes traded.

The announcements identified in phase one were grouped according to categories (BEE and governance; financial structure; investment or disinvestment; key personnel; mergers and acquisitions; trading update; and other) that would enable the testing of the sub-hypotheses. All announcements that did not fit into any identified categories were placed in the "other" category. After the testing of the main hypothesis, a statistical inference on whether insider trading activities preceded unscheduled announcements was made. The testing of the sub-hypotheses enabled the statistical inference of

which types of unscheduled announcements were preceded by possible insider trading.

Finally, the previous results were analysed to determine if different levels of insider trading occurred for the different types of unscheduled announcements. This was achieved by analysing the means or medians of the abnormal volumes traded per announcement category and comparing them with each other.

4.3. Unit of analysis

The unit of analysis for phase one was a single listed company included on the JSE All Share Index (ALSI or J203) on 24 June 2009 that made unscheduled announcements on the JSE's Security Exchange News Service (SENS). The unit of analysis for phases two and three was a single SENS announcement (identified in phase one) that could have a material impact on the share price of the listed company included on the ALSI on 24 June 2009.

4.4. Population of relevance

The population of relevance for phase one was companies listed on the JSE main board on 24 June 2009. For phases two and three, the population of relevance consisted of all the significant announcements identified in phase one.

4.5. Sampling method and size

For phase one, the judgement sample consisted of all companies listed on the JSE ALSI on 24 June 2009. The ALSI contains the top approximately 160

companies in the JSE and over 99 percent of the JSE market capitalisation. It was therefore judged to be a good proxy for the JSE, and it was believed that this sample would produce good results. The data for the above population was analysed from 01 January 2000 to 24 June 2009. It is acknowledged that the constituent members of the ALSI would have changed during this period, creating the possibility of survivorship bias (Mordant and Muller, 2003). This issue is addressed later.

In order to isolate the pre-effects and effects of particular announcements, the study corrected for confounding events as recommended by van der Plas (2007) and McWilliams and Siegel (1997). These confounding events were other events that could have a material impact on the share price on the company, and occurred in the event window. Examples of these included dividend payments; other significant announcements; or any other information that could materially impact the share price. Those announcements that were contaminated with confounding events were excluded from any sample. All qualifying announcements were included in the main sample and in one and only one subsample.

In phases two and three, the sample of the identified announcements were divided into subsamples, corresponding to the identified types of announcements. The announcements constituted judgement subsamples, as it represented those announcements that had the largest abnormal returns. These subsamples were completely exhaustive and mutually exclusive, as recommended by Albright, Winston and Zappe (2006).

There were seven subsamples, each representing a different announcement type. These subsamples were a census of all the qualifying announcements categorised as that particular unscheduled announcement type, excluding all confounding events. The subsamples were constituted in order to test each of the sub-hypotheses.

A differences of means or medians test was performed using each sub-sample of the entire population of phases two and three (which are identical). The means or medians of each sub-sample were compared with the means or medians of the other sub-samples in order to determine if there were significant differences between them. The data collection process is now discussed.

4.6. Data collection process

This study used publically available data and information. This data was primarily obtained from electronic databases that the Gordon Institute of Business Science (GIBS) had access to. This information was used to identify significant unscheduled announcements and confounding events; to construct bootstrap samples; and to determine if there were abnormal volumes traded.

The following sources of secondary data was used during this research:

- The McGregor BFANet Analyser Price database was used to obtain general information on the JSE listed companies, daily share prices, daily volumes traded, and daily outstanding shares values (McGregor BFANet, 2009b).

- Security Exchange News Service (SENS) announcements from the JSE was used to identify announcements. This was obtained from the McGregor BFA Analyser News Module from McGregor BFANet (2009a) and the www.imaraspreid.co.za website from Imara SP Reid (2009).

- SENS announcements from the JSE was also used to identify confounding events. This was obtained from the McGregor BFA Analyser News Module from McGregor BFANet (2009a) and the www.imaraspreid.co.za website from Imara SP Reid (2009).

- The event study model ("event engine") developed by Chris Muller and Professor Mike Ward was utilised to identify the days with the top five abnormal returns for shares listed on the JSE ALSI. The tool utilised control portfolios to determine these abnormal returns and would be discussed in greater detail in the next section. These abnormal returns were then used to identify the appropriate significant unscheduled announcement and date (Muller and Ward, 2009).

The above sources of data were selected, as they provided the information necessary to conduct the research. The data from these sources were collated and cross-checked to ensure that the relevant information around the announcement and event was available for analysis. This data was also used to disqualify announcements that had confounding events.

For the purposes of this study, confounding events were defined as those publically available events or information, which could have a significant influence on the value of a share or company and could influence investor behaviour. The following were classified as confounding events:

- Audited and unaudited financial statements that were released within the event window period used to detect abnormal volumes traded prior to the announcement date;

- Trading statements that were released within the event window period used to detect abnormal volumes traded prior to the announcement date;

- Updates to previously released unaudited financial statements in the event window period used to detect abnormal volumes traded prior to the announcement date that could have a material impact;

- Other events of information released in the event window period used to detect abnormal volumes traded prior to the public announcement that could have a material effect on the share or company.

4.7. Data analysis approach

As stated above, the data was analysed in three phases. The first phase identified the appropriate significant unscheduled announcements, and also corrected for confounding events. Phase two analysed the original data sample

in order to determine if there were abnormal volumes traded prior to the public announcement. Phase three performed similar analyses as phase two, but used a bootstrap technique instead. Phase one; and phases two and three had different aims, and therefore they had different requirements for data analysis, although they were all based on the event study methodology. The data analysis approach followed on each of the three phases is discussed in detail in the sections that follow.

4.7.1. Phase one: identification of significant unscheduled announcements

For phase one it was important to calculate daily returns, and model the daily benchmark expected return. The abnormal returns were determined from the difference between the two. As discussed during the literature review in section 2.5, two methods of determining abnormal returns were considered for this study, namely the CAPM and the control portfolio approaches. The control portfolio approach was eventually selected, as it provided a number of advantages over CAPM. Firstly, it considered the unique factors (especially the resource effect) that are important and significant to the JSE. Secondly, a number of South African researchers (as described in section 2.5) considered control portfolios to be superior to CAPM. Lastly, and most importantly, data from a twelve-factor control portfolio model was easily accessible, courtesy of Chris Muller and Professor Mike Ward (Muller and Ward, 2009).

The twelve-factor control portfolio model was developed from the Mordant and Muller's (2003) eight-factor model in order to provide greater accuracy in terms

of size. Muller and Ward (2009) constructed their control portfolios by placing each market effect into one of two or three states: a share's size was small, medium, or large; a share was either a value or growth; finally, a stock was classified as either resource or a non-resource counter (Ward, 2009). These market effects were used to inform the twelve control portfolios, as displayed in table 2 below.

Table 2: Twelve factor-mimicking control portfolios (Source: Ward 2009)

	LARGE		MEDIUM		SMALL	
	VALUE	**GROWTH**	**VALUE**	**GROWTH**	**VALUE**	**GROWTH**
RESOURCES	LVR	LGR	MVR	MGR	SVR	SGR
NON-RESOURCES	LVN	LGN	MVN	MGN	SVN	SGN

Key:	LVR	Large, Value, Resources
	LVN	Large, Value, Non-resources
	LGR	Large, Growth, Resources
	LGN	Large, Value, Non-resources
	MVR	Medium, Value, Resources
	MVN	Medium, Value, Non-resources
	MVN	Medium, Growth, Resources
	MGN	Medium, Value, Non-resources
	SVR	Small, Value, Resources
	SVN	Small, Value, Non-resources
	SGR	Small, Growth, Resources
	SGN	Small, Growth, Non-resources

Muller and Ward (2009) then estimated the 12 betas for each share against these 12 control portfolio indices, and used these to estimate expected returns, as indicated in equation 4 (Ward, 2009). The "event engine" compensated for survivorship bias. It was re-balanced quarterly to include new listings and drop de-listed companies.

The actual returns were calculated by comparing the current day's share price with the previous day's share price, as indicated in equation 5. A natural logarithmic transformation (ln) was performed in order to improve the level of statistical inference possible.

The actual returns were then compared to the expected returns in order to determine if there were abnormal returns. This was done by finding the difference between the actual returns and the expected returns, as indicated in equation 6. It must be noted that four years of start-up data was required to estimate the betas. Otherwise, "there may be some strange results in the early years" (Ward, 2009, p. 1). If any of the early data points produced strange results, they were excluded from further analysis.

$$\boldsymbol{E(R_{i,t})} = \boldsymbol{\alpha_{i,t}} + \boldsymbol{\beta_{i,1}}\,\boldsymbol{SVN_t} + \boldsymbol{\beta_{i,2}}\,\boldsymbol{SVR_t} + \boldsymbol{\beta_{i,3}}\,\boldsymbol{SGN_t} + \boldsymbol{\beta_{i,4}}\,\boldsymbol{SGR_t} + \boldsymbol{\beta_{i,5}}\,\boldsymbol{MVN_t} + \boldsymbol{\beta_{i,6}}\,\boldsymbol{MVR_t} + \boldsymbol{\beta_{i,7}}\,\boldsymbol{MGN_t} + \boldsymbol{\beta_{i,8}}\,\boldsymbol{MGR_t} + \boldsymbol{\beta_{i,9}}\,\boldsymbol{LVN_t} + \boldsymbol{\beta_{i,10}}\,\boldsymbol{LVR_t} + \boldsymbol{\beta_{i,11}}\,\boldsymbol{LGN_t} + \boldsymbol{\beta_{i,12}}\,\boldsymbol{LGR_t} + \boldsymbol{\varepsilon_{i,t}} \quad \text{(Equation 4)}$$

Where

$E(R_{i,t})$ $= expected\ return\ of\ stock_i\ in\ period_t$

$\alpha_{i,t}$ $= alpha\ intercept\ term\ of\ stock_i\ in\ period_t$

$\beta_{i,1} \ldots \beta_{i,12}$ $= beta\ coefficients\ or\ factor\ loadings\ on\ each\ control\ portfolio\ return$

$\varepsilon_{i,t}$ $= the\ error\ term$

$SVN_t \cdots LGR_t$ $= returns\ on\ each\ of\ the\ eight\ control\ porfolios\ as\ as\ described\ in\ Table\ 2\ above$

$$R_{i,t} = ln(P_{i,t}) - ln(P_{i,t-1}) \quad \text{(Equation 5)}$$

Where

$R_{i,t} = actual\ return\ of\ stock_i\ on\ day_t$

$P_{i,t} = price\ of\ stock_i\ at\ the\ end\ of\ day_t$

$P_{i,t-1} = price\ of\ stock_i\ at\ the\ end\ of\ day_{t-1}$

$$r_{i,t} = R_{i,t} - E(R_{i,t}) \quad \text{(Equation 6)}$$

Where

$r_{i,t} = abnormal\ \ return\ of\ stock_i\ on\ day_t$

The "event engine" of Muller and Ward was configured to output the top five abnormal returns (both positive and negative) in each company listed on the JSE ALSI (J203) from 1 January 2000 until 24 June 2009 (Muller and Ward, 2009). Therefore, there was no requirement to perform any other calculations to determine the abnormal returns. The "event engine" outputted the company code, short name, abnormal return and the date of the abnormal return (Ward, 2009). Also, since an already developed tool was utilised to generate the abnormal returns, the detailed design and construction of the control portfolios was not necessary.

The dates of these of these abnormal returns were used to identify the appropriate SENS announcement. The SENS announcements were obtained from the McGregor BFA Net database from McGregor BFANet (2009a) and the www.imaraspreid.co.za website from Imara SP Reid (2009). The appropriate SENS announcement was chosen using the following rules.

- If the abnormal return occurred on the day of the SENS announcement, the announcement was analysed further in phases two and three;

- If the abnormal return occurred within three trading days of the SENS announcement, it was analysed further. If it occurred after this, it was ignored; or

- If the abnormal return occurred at most 21 trading days (the period used to detect abnormal volumes traded) before the SENS announcement, it was analysed further in phases two and three. If it occurred before this, it was ignored.

- In addition, any announcements that contained confounding events in the period used to detect abnormal volumes traded were disqualified from the sample and not analysed any further.

The date of the announcement was designated t_0. The final task of the data analysis for phase one was to categorise the announcements according to the different announcement types. These different announcement types were then constituted into different subsamples, which were analysed individually and collectively as a complete sample. This process culminated in the identification of judgement sample and subsamples that were utilised to determine if there was abnormal volume turnover in the complete sample and the different subsamples. The data analysis approaches utilised in phases two and three are now discussed.

4.7.2. Phase two: abnormal volumes traded and the original data sample

The event study methodology used by Chae (2005) was used in the analysis. The actual announcement date (as identified in phase one) was used to create an event window. As discussed in section 4.5, each of announcements identified after phase one were categorised and placed in subsamples 1 to 7 (corresponding to the different announcement categories) after correcting for confounding events. The average daily cumulative abnormal volumes traded (ACAVT) were then calculated for the complete sample and then for each subsample.

The following discussion describes event study approach that was utilised to calculate the abnormal volumes traded. This process was first executed for the complete sample and then repeated for each subsample. In this way, the main hypothesis and all the sub-hypotheses were tested. The event window specification and applicable equations are presented below.

- The date of the announcement was designated day t_0.
- One day after the announcement was designated day t_1.
- The log turnover was a natural logarithmic measure of the volume traded, correcting for the number outstanding shares.
- The log expected turnover (EVT) was the mean log turnover calculated for the period t_{-84} to t_{-22} (a period of 63 trading days, which was roughly equivalent to three months).

- Abnormal volume turnover (AVT) was calculated by subtracting the log expected turnover from the log turnover.
- The pre-announcement period to check for average daily cumulative abnormal volume turnover (ACAVT) was from t_{-21} to t_{-1}. ACAVT was calculated by averaging AVT over this period. This was a period of approximately one month before the announcement and is consistent with van der Plas (2007).
- The total event window for consideration was 86 trading days (which is approximately equivalent to four months).
- A share could only belong to one and only one event for the duration of the event window.

The model proposed by Chae (2005) was adapted to measure the volume traded, as illustrated in the formulas below.

Log turnover

$$\boldsymbol{\tau_{i,t}} = \boldsymbol{ln}\left(\frac{\boldsymbol{Trading\ Volume_{i,t}}}{\boldsymbol{Outstanding\ Shares_{i,t}}}\right) \quad \text{(Equation 7)}$$

Log expected turnover

$$\boldsymbol{\overline{\tau}_{i,t}} = \left(\frac{\sum_{t=-84}^{t=-22}\boldsymbol{\tau_{i,t}}}{\boldsymbol{63}}\right) \quad \text{(Equation 8)}$$

Abnormal turnover ($\boldsymbol{\xi_{i,t}}$) = Log turnover – Log expected turnover

$$\boldsymbol{\xi_{i,t}} = \boldsymbol{\tau_{i,t}} - \boldsymbol{\overline{\tau}_{i,t}} \quad \text{(Equation 9)}$$

Average daily cumulative abnormal volume turnover (ACAVT)

$$\boldsymbol{ACAVT} = \frac{\left(\sum_{t=-21}^{t=-1} \xi_{i,t}\right)}{\mathbf{21}} \quad \text{(Equation 10)}$$

Where: i $= the\ share\ under\ consideration$

t $= event\ time\ in\ days$

Average daily percentage abnormal volume traded (APAV)

$$\boldsymbol{APAV} = \left(\boldsymbol{e}^{\boldsymbol{ACAVT}} - 1\right) * 100 \quad \text{(Equation 11)}$$

Initially, the equations were evaluated to analyse the data from each event/announcement separately. Then, t-tests were used to make statistical inferences about the hypotheses. The confidence level of the tests was 95 percent (a five percent significance level). This was in line with the literature reviewed, including Chae (2005). The tests measured if the ACAVT was statistically significantly more than zero. If it was significantly more than zero in the main sample or any of the subsamples, then this could be an indication of insider trading.

An ANOVA was performed to determine if there were differences with respect to the magnitudes of abnormal volumes traded for each announcement type (Zikmund, 2003; and Albright, Winston and Zappe, 2006). The means or medians of all the subsamples were compared with each other. The results of this test would show if there were statistically significant (95 percent confidence level) differences in insider trading volumes between the different announcement types. This ANOVA tested the final hypothesis.

In order to improve the approximation of normality, bootstrap techniques were used as well. These are discussed in the next section.

4.7.3. Phase three: abnormal volumes traded and the bootstrap technique

The data analysis performed using the bootstrap technique was almost the same as that performed in the previous section. The only difference between the two data analysis approaches was in the way that the expected volume turnover (EVT) and abnormal daily cumulative abnormal volume traded (ACAVT) were calculated. Therefore, the discussion contained in the previous section would not be repeated. Also, the sample used for phase three was identical to that of phase two.

The event window utilised for the bootstrapping was the same as that used in the previous section. To recap, the expected volume turnover was calculated as follows:

$$\overline{\tau}_{i,t} = \left(\frac{\sum_{t=-84}^{t=-22} \tau_{i,t}}{63}\right) \quad \text{(Equation 12)}$$

Therefore, for each security, the expected log volume turnover was calculated using 63 event data points. The bootstrap methodology applied is described below.

- Firstly, the data was resampled 5000 times with replacement from the original sample to form resamples or bootstrap samples. Each bootstrap

sample was the same size as the original sample (it contained 63 data points). Sampling with replacement resulted in certain data points being used more than once in the bootstrap sample. Equation 12 was rewritten as below to differentiate the bootstrap expected log turnover. The asterisk (*) was used to differentiate the bootstrapped sample from the original sample.

$$\overline{\tau}_{i,t}^{\,*} = \left(\frac{\sum_{t=-84}^{t=-21} \tau_{i,t}^{\,*}}{63}\right) \quad \text{(Equation 13)}$$

- According to equation 13, the mean expected log turnover was calculated for each bootstrap sample. This formed a bootstrap distribution of the means.

- The information from this distribution (its shape, mean, and spread) informed the calculation of the bootstrap distribution's mean and bootstrap error.

The bootstrap expected log turnover was then utilised as in section 4.7.2 to calculate the abnormal turnover. In this case also, the abnormal volumes traded was first calculated for the entire sample. Then, the calculation was performed for each subsample. Bootstrap t-tests were also used to calculate the value of ACAVT and to infer the statistical significance of the results. In the case of ACAVT, a one sample bootstrap t-test was executed on the AVT sample of 21 days.

This was followed by the ANOVA to test the difference between the means or medians of the different subsamples. It was tested to a 95 percent confidence level.

Finally, the results obtained from the bootstrap method was compared to the results obtained by using the original data sample. This was used as a robustness check. Based on this, an inference could be made on the significance of the results.

4.8. Data integrity

Although the data was sourced and analysed with care, it was not possible to obtain perfect data. The following potential data integrity problems were identified. These were mitigated where possible.

- Not all abnormal returns had corresponding SENS announcements. This implied that either the SENS databases had missing information or that there were other events, which were not SENS related, that had a material impact. The effects of this problem was minimised by using both the McGregor BFANet News database from McGregor BFANet (2009a) and the Imara SP Reid website from Imara SP Reid (2009). In the corresponding announcement could not be found, the data was not analysed further.

- The study analysed events in isolation as single independent entities. An attempt was made to isolate single announcements by correcting for confounding events, which minimised the impact of other announcements.

However, multiple events or announcements would have some influence and impact each other. It was therefore virtually impossible to isolate the effects of a single announcement. However, the impact of this was minimised by disqualifying announcements with confounding events in the period used to detect abnormal volumes traded.

- Care was taken to remove confounding events from the period used to calculate the abnormal volumes. However, these events are not removed from the period used to calculate the expected returns, as removing them could have increased the probability of type I errors. It was therefore decided to adopt a more conservative approach in order to minimise type I errors, at the potential cost of increasing type II errors.

- The output of the "event engine" of Muller and Ward (2009) was not verified during this study. The data integrity of this tool was deemed to be reliable (Ward, 2009).

5. Results

5.1. Introduction to the results

This section details the results of the research study. These results were used as evidence to either reject or not to reject the hypotheses presented in Chapter 3. This chapter only presents the results, while the next chapter provides a discussion of these results.

The chapter first presents the details of the sample to be analysed. Then, the analysis performed on each identified announcement in the sample is illustrated. This is done by reporting on the activities that were performed on an individual announcement. The validity of the chosen event window period was also tested. The results obtained from the analysis of each of the announcements that produced abnormal volumes traded were then summarised.

The results of the hypotheses testing are then presented. The results of the original sample and the bootstrap samples are also compared. Finally, the evidence was used to either to reject or not to reject the null hypotheses. After a visual inspection of the data, liquidity tests were also performed and reported.

5.2. Generation of the sample

The generation of the sample consisted of two distinct activities. Firstly, abnormal returns were used to identify SENS announcements. The event study model developed by Muller and Ward (2009) was used as the tool to identify

the dates that shares on the JSE produced abnormal returns, as discussed in Chapter 4.7.1. At the point the "event engine" was run, the JSE contained 147 companies listed on the ALSI (J203) (Ward, 2009). It was decided to investigate the top five abnormal returns of these companies – as these presented more opportunities for insider trading. This resulted in the "event engine" generating 735 discrete abnormal returns.

These 735 abnormal returns were then analysed manually and interrogated using the McGregor BFANet Analyser News database from McGregor BFANet (2009a) and Imara SP Reid database from Imara SP Reid (2009) to see if there was a SENS announcement associated with the abnormal return. The rules discussed in Chapter 4.7.1 were utilised to clean up the announcements. Part of this clean up was to ensure that there was only one generated abnormal return (and therefore only one announcement) in the window used to detect if there were abnormal volumes traded. In order to be conservative and prudent, all announcements that included confounding events in the period used to detect abnormal returns were disqualified.

By using this approach, the number of announcements identified for further analysis was reduced to 244 in the initial analysis. Because of confounding events in the period used to detect abnormal returns, and insufficient data, only 142 announcements eventually met the qualifying criteria and were finally analysed in order to determine if there were significant preannouncement abnormal volumes traded. The list of qualifying announcements is contained in

appendix 1. They were categorised as follows (the number of announcements per announcement type are provided next to the announcement category).

- BEE and governance (10);
- Financial structure (19);
- Investment or disinvestment (11);
- Key personnel (22);
- Mergers and acquisitions (15);
- Trading update (48); and
- Other (17).

Each of these announcements were then analysed separately. The next section provides insight into how each of these announcements were analysed by providing the detailed information on the analysis of a trading update SENS announcement made by Exxaro on 07/02/2008.

5.3. Analysis of Exxaro trading update SENS announcement of 07/02/2008

This discussion provides insight into the activities used to analyse each of the 142 announcements by describing in detail the process followed in analysing one of these announcements – the Exxaro trading update SENS announcement of 07/02/2008. The identification of the announcement is initially discussed. This followed by a description of the data used to analyse the announcement, and the analysis using the formulae of Chae (2005) as well a t-test with and without bootstraps. Graphs are also provided to illustrate the relationships.

Identification of the relevant announcement

The event study model of Muller and Ward (2009) indicated that there was an abnormal return on the Exxaro share price on 31/01/2008. Both the McGregor BFANet Analyser News database from McGregor BFANet (2009a) and Imara SP Reid database from Imara SP Reid (2009) were manually interrogated in order to find the relevant SENS announcement using the rules from in Chapter 4.7.1.

The relevant SENS announcement was identified as "EXX - Exxaro Resources Limited - Trading Statement For The 12 Months Ended 31 December 2007" which was released on 07/02/2008 (Imara SP Reid, 2009). This announcement qualified because the abnormal return occurred five trading days before the public SENS announcement. In this announcement, Exxaro provided information about their expected earnings, an increase predicted in earnings per share as well as other information such as updates on a BEE deal.

There was more than one category of information contained in the announcement. In this case, the trading updated category was deemed to be most appropriate. There were no confounding events in the entire event window period. An event window, as described in Chapter 4.7.2 was then constructed around this announcement.

Volumes traded in the event window

The event window was constructed in Microsoft Excel 2007®. The date of the announcement (07/02/2008) was designated as t_0. One day after the announcement was designated t_1. The days preceding the announcement were

designated from t_{-1}. The volume traded on Exxaro shares during the event window (t_{-84} to t_1) is displayed in figure 1 below. The vertical axis represents the daily volumes traded and the horizontal axis represents the event day.

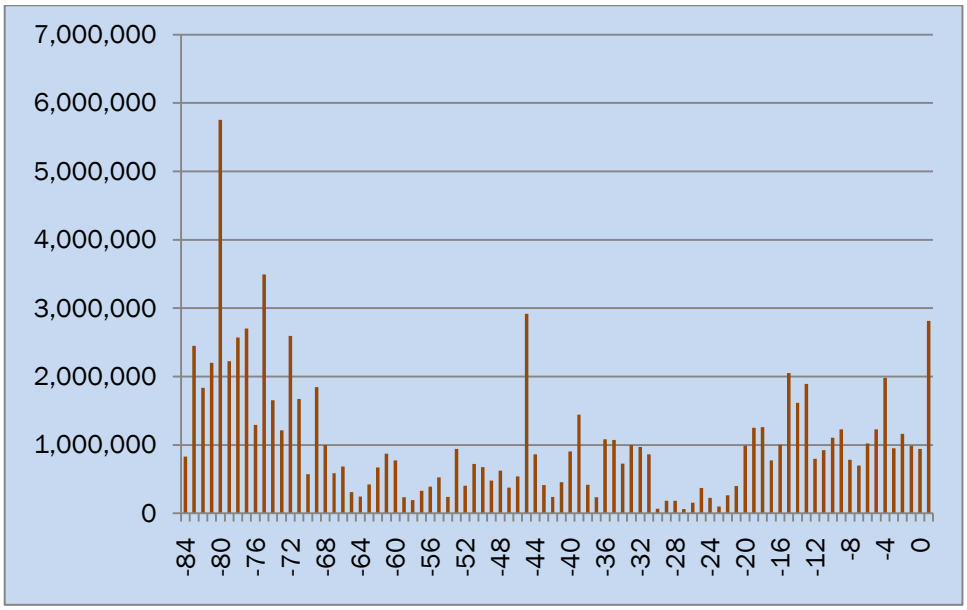

Figure 1: Volumes traded during the 86-day event window

A visual inspection of the graph indicated that there were large volumes traded in the period used to determine the benchmark as well at event days t_{-80}, t_{-75}, and t_{-45}. An inspection of both databases did not reveal any SENS announcements around these event days. However, announcements in the period used to calculate the expected returns would not infringe any of the rules implemented.

As stated before, the period between t_{-84} and t_{-22} was used to calculate the expected log turnover, while the period from t_{-21} to t_{-1} was used to detect if there were abnormal volumes traded. Figure 1 illustrated that there were consistent volumes traded in the period used to determine if there were abnormal volumes traded.

Figure 2 contains a graph of the abnormal log volume turnover (AVT) and a graph of the cumulative abnormal volume turnover (CAVT) of Exxaro shares during the event window period. The vertical axis represents the AVT and the CAVT, while the horizontal axis represents the event day.

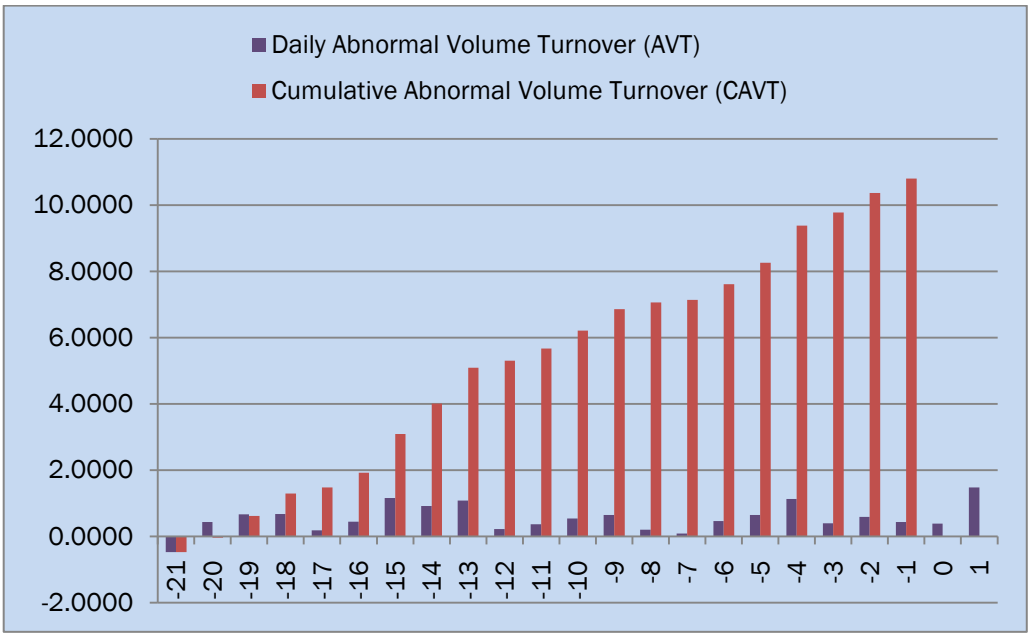

Figure 2: Daily abnormal volumes traded (AVT) and cumulative abnormal volumes traded (CAVT)

The above graph illustrated that there were consistent abnormal volumes traded in the period t_{-21} to t_{-1}. The CAVT showed a trend of increasing in the period leading up to the announcement. Visually, this graph indicated a definite increase in trading preannouncement, thus suggesting possible insider trading activities. In order to confirm whether the above graph was statistically significant, more statistical analysis was performed on this data.

Results of the statistical analysis

The statistical analyses for the announcements were carried out in three stages. The parameter of interest was the average daily cumulative abnormal volume

turnover (ACAVT), which was calculated in each case. Firstly, the equations from Chapter 4.7.2 were evaluated using Microsoft Excel 2007®. Next a t-test was performed. Finally, a bootstrap test was performed. The t-tests and bootstrap tests were executed with NCSS 2007®.

The log turnover was calculated for the entire event window (from t_{-84} to t_1), as described in Chapter 4.7.1. The log expected turnover was calculated for the period using event days t_{-84} to t_{-22}. The daily abnormal volume turnover (AVT) for the period t_{-21} to t_1 was calculated by subtracting the log expected turnover from daily log volume turnover. The mean and standard deviation of the AVT was then calculated for each of the announcements in order to obtain the average daily cumulative abnormal log volume turnover (ACAVT) and an indication of the variability.

The t-test was performed using the standard features of NCSS 2007® at a 95 percent confidence level (five percent significance level). NCSS 2007® reports the results of four different tests.

Based on the characteristics of the data, the result of the appropriate test was utilised to make the statistical inference. The different combinations of data and the statistical tests that were used to make the statistical inferences are reported in Table 3 below. The table also reports the relevant test statistic.

Table 3: Selection of the appropriate difference test

Data Characteristics		Appropriate difference test reported by NCSS 2007®	Appropriate test statistic reported by NCSS 2007®
Normal	Equal Variance		
Yes	Yes	Equal-Variance T-Test	T-value
Yes	No	Aspin-Welch Unequal-Variance Test	T-value
No	Yes	Mann-Whitney U or Wilcoxon Rank-Sum Test	Z-value
No	No	Kolmogorov-Smirnov Test	Dmn criterion value*

* Maximum difference between the two empirical distribution functions

The bootstrap test was executed using 5000 resamples. A 95 percent confidence level was used to make the statistical inferences. The standard error was also examined. If the standard error was less that the reported difference bootstrap mean and the lower confidence level was more than zero, the result of the bootstrap test was deemed to be statistically significant.

The results of the statistical analyses are summarised in table 4 below. This table contains the results of three different tests – the evaluation of the equations; the two sample t-test; and the bootstrap test. The table contains the following information: average daily cumulative abnormal volume turnover (ACAVT) and average daily percentage abnormal volume for each of the analyses. In addition, the standard deviation (SD) is reported for calculation performed using the equations; the test statistic and p-value are reported for the t-test; and the standard error (SE), the lower confidence limit (LCL) and the upper confidence limit (UCL) are reported for the bootstrap test.

Table 4: Summary of statistical analysis performed on the Exxaro SENS announcement of 07/02/2008

	Equations		T-test			Bootstrap test			
	ACAVT	SD	ACAVT	t-stat	p-value	ACAVT	SE	LCL	UCL
Value	0.5144	0.3798	0.5143968	3.4847	0.000402	0.5136	0.0804	0.2240	0.7981
APAV	67.26%		67.26%			67.45%			
Notes	Provides an indication that there might be significant ACAVT		1. Cannot reject normality 2. Reject equal variances 3. Statistically significant at 5% level using Aspin-Welch Unequal-Variance Test			1. The above data is for a 95% confidence level 2. The bootstrap test also indicates that the ACAVT is significant			

Table 4 above illustrated that the three tests produced results that were similar. The p-value for the t-test was 0.000402, while the lower confidence level for the bootstrap test was 0.2240. Therefore, both the t-test and the bootstrap test produced statistically significant results at a five percent significance level – thus confirming the robustness of the findings. The results confirmed that the Exxaro announcement exhibited significant ACAVT.

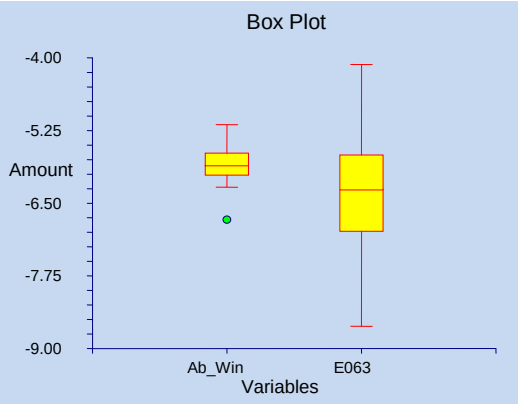

Figure 3: Box plot of the result of t-test

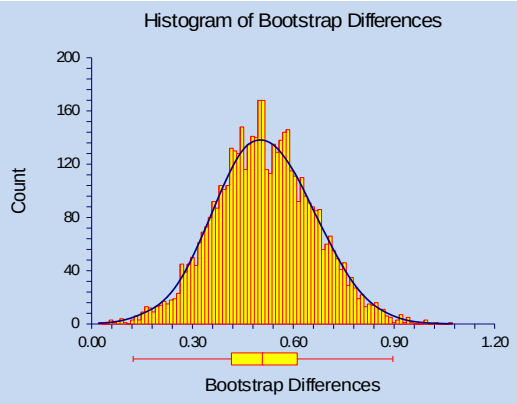

Figure 4: Distribution of AVT bootstrap samples

Figure 3 above demonstrated the results of the t-test by presenting it as a box plot. The box plot on the left of figure 3 represents the log turnover of the period used to detect abnormal log volume turnover, while the box plot on the

right represents the log turnover of the period used to detect expected log volume turnover. The figure illustrated the significance of the difference.

Figure 4 represents the distribution of the AVT bootstrap samples, which confirmed the confidence level and the bootstrap mean. It was concluded from figure 4 that the bootstrap distribution was approximately normally distributed.

The results and graphs of the t-test and bootstrap test were clear. Therefore, it was concluded with a 95 percent confidence level that in this particular case there were significant abnormal volumes traded in the preannouncement period. This procedure was followed for each of the 142 identified announcements.

The various researchers have used different periods to calculate the expected volume traded. For the purposes of this research, a period of 63 trading days (approximately three months) was used to calculate the expected volume traded. The next section tested whether using different window periods to calculate expected volume traded would have produced statistically different results.

5.4. Validity of the expected log turnover window

The Exxaro trading update SENS announcement of 07/02/2008 used in the previous section was also utilised to see if the length of the window employed to calculate the expected log volume turnover (EVT) made any statistical difference. The lengths of the window periods tested were 21, 42, 63, 84, 105,

126, 147, 168, 210, 252 and 315 trading days. The period used to detect abnormal volume traded was kept constant at 21 days.

The data was analysed by looking at the graphs of the volumes traded and the cumulative abnormal log volume turnover (CAVT). The box plots for various values of log expected turnover (EVT) and abnormal log volume turnover (AVT) for the different window periods were also analysed. Then statistical tests were performed to see if there were statistically differences between the different window periods in terms of EVT, and average daily abnormal log volume turnover (ACAVT) by using the result of the difference of means or medians test.

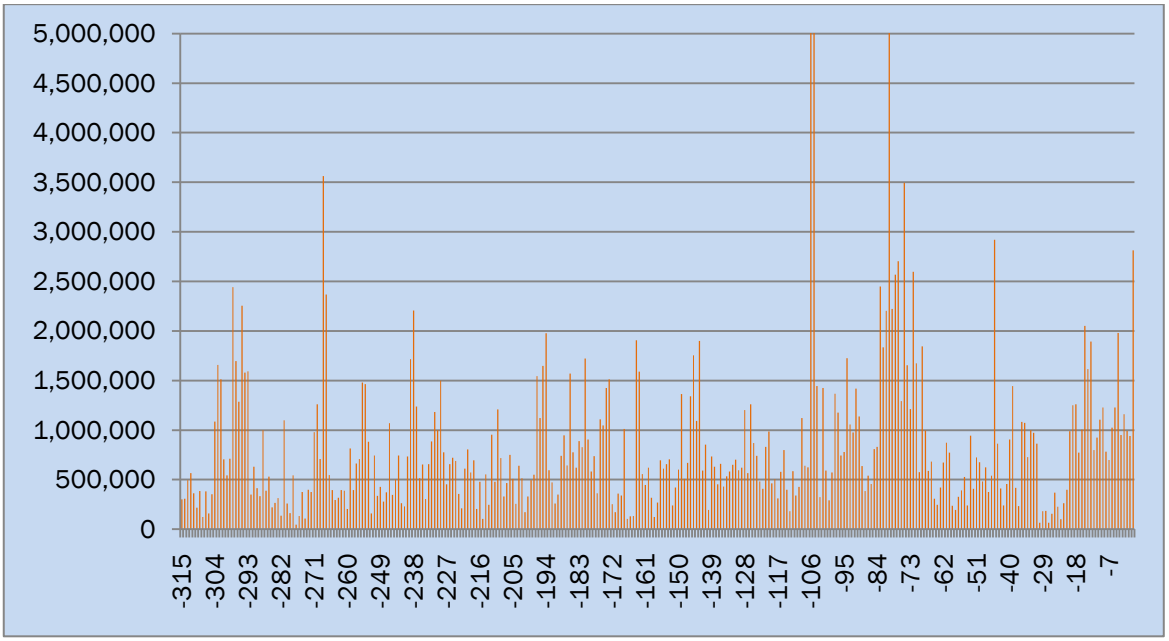

Figure 5: Volumes traded during the complete 338-day event window

Figure 5 above depicts the volumes traded over the entire event window period. The axes for this figure were the same as that for figure 1. In order to make the graph more informative, the vertical axis was set to a maximum volume traded value of five million.

There were three days where the volumes traded far exceeded this value. In fact, on event day t_{-106}, the volume traded was in excess of 24 million. Once again, there was consistent trading in the period leading up to the announcement. Figure 6 below graphs the cumulative abnormal log volume turnover (CAVT) calculated for each window period.

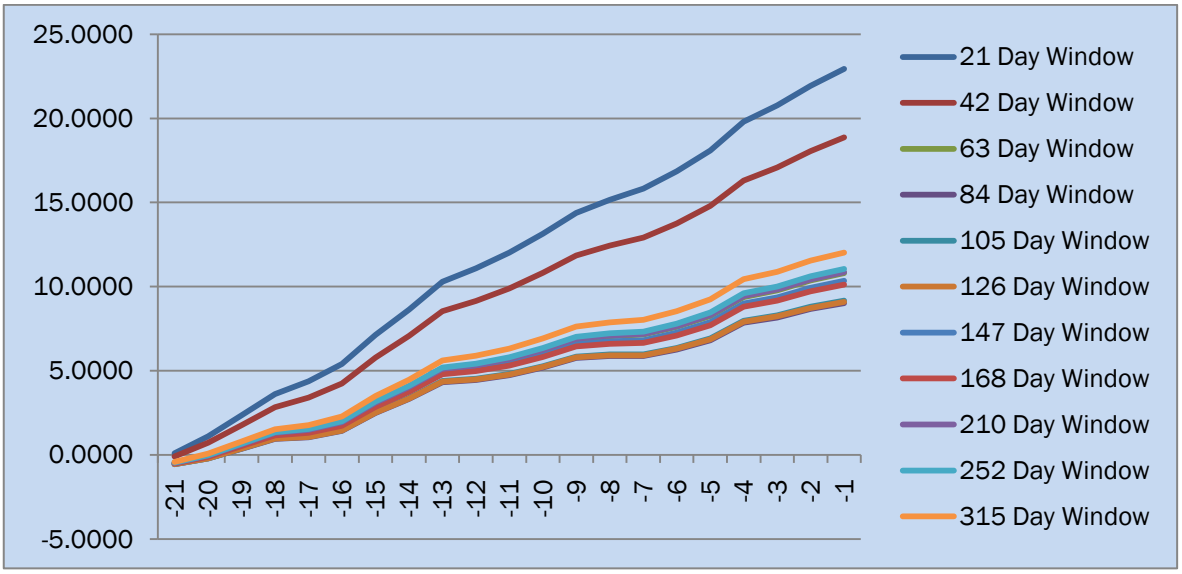

Figure 6: CAVT using the various periods for expected log volume turnover

From figure 6 above, it was visually seen that the CAVT for the 21-day and 42-day window was significantly higher than the others. The rest of the CAVT's were relatively close together. Statistical tests were then used to confirm the significance of the above graph.

In order to determine if there was a statistical difference between the various expected log turnovers (EVTs), an ANOVA test was performed with a five percent significance level. The same was also done for the daily abnormal log turnovers (AVTs). The box plots of the results are shown in figures 7 and 8 below. The box plots in figure 7 depict the various values of expected log

volume turnover calculated from the different window periods from 21 days to 315 days. The box plots in figure 8 depict the values calculated for AVT using these various values for expected log volume turnover.

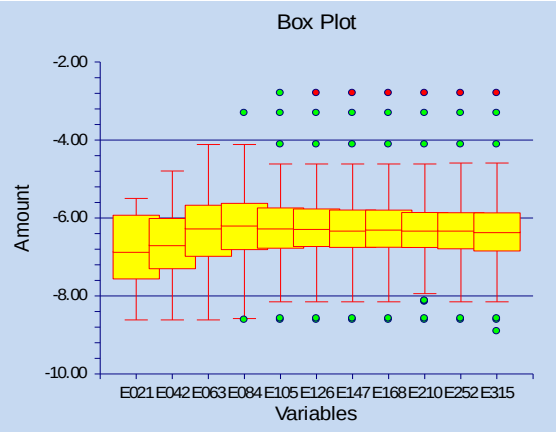

Figure 7: Box plot of expected log volume turnover (EVT) values

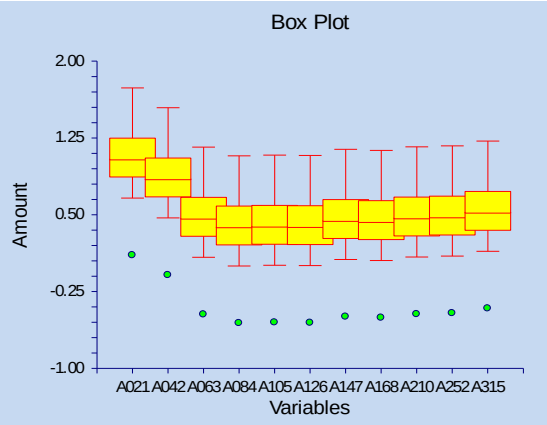

Figure 8: Box plot of abnormal log volume turnover (ACAVT) values

Figure 7 illustrated that there was not much difference between the means of the expected log volume turnover. Since the residuals violated normality, the Kruskal-Wallis One-Way ANOVA on Ranks test was the appropriate test. This showed with a 95 percent confidence that all the medians are equal. Pair wise t-tests were also run between all the different expected log volume turnover (EVT) variables.

The mean expected values for the 21 and 42-day window period were not statistically different from each other, and the means of all other window periods were not statistically different from each other. However, the means of the first two periods were statistically different from the means of the other periods.

Figure 8 shows that at least two of medians of the abnormal log volume turnovers are different. Pair wise t-tests were also run between all the different abnormal log volume turnover variables. The mean abnormal values using the 21 and 42-day window period were not statistically different from each other, and the means of all other window periods were not statistically different from each other. However, the means of the first two periods was statistically different from the means of the other periods.

It was also necessary to determine whether the average daily abnormal cumulative log volume turnover (ACAVT) was significant when using all of the expected log volume turnover (EVT) windows (i.e. from 21 days to 315 days). The values are presented in table 5 below. Table 5 contains the reports similar results as table 4, repeated for various window periods used to calculate EVT.

Table 5: Summary of statistical analysis performed on the Exxaro SENS announcement of 07/02/2008 using various periods to calculate expected log volume turnover

No of days	Equations		T-test			Bootstrap test			
	ACAVT	SD	ACAVT	Stat	p-value	ACAVT	SE	LCL	UCL
21	1.0926	0.3798	1.092562*	4.8657	0.000024	1.0896	0.2186	0.6407	1.5106
42	0.8988	0.3798	0.8987572*	5.9914	0.000000	0.8989	0.1484	0.6009	1.1917
63	0.5144	0.3798	0.5143968*	3.4847	0.000402	0.5136	0.0804	0.2240	0.7981
84	0.4295	0.3798	0.4294786*	3.2630	0.000805	0.4271	0.1299	0.1700	0.6834
105	0.4362	0.3798	0.4361533**	0.466667	0.0006	0.4336	0.1240	0.1932	0.6729
126	0.4329	0.3798	0.4328873**	0.484127	0.0002	0.4362	0.1116	0.2203	0.6490
147	0.4924	0.3798	0.4924456**	0.517007	0.0001	0.4904	0.1065	0.2832	0.7032
168	0.4820	0.3798	0.4819768**	0.500000	0.0001	0.4838	0.1035	0.2819	0.6877
210	0.5171	0.3798	0.5171129**	0.528571	0.0000	0.5176	0.0989	0.3259	0.7117
252	0.5264	0.3798	0.5263635**	0.539683	0.0000	0.5275	0.0941	0.3477	0.7118
315	0.5729	0.3798	0.5728511**	0.542857	0.0000	0.5736	0.0931	0.3920	0.7668
Notes	Provides an indication that there might be significant ACAVT in all of the cases		1. * Statistically significant at 5% level using Aspin-Welch Unequal-Variance Test 2. ** Statistically significant at 5% level using Kolmogorov-Smirnov Test 3. All values of ACAVT are statistically significant			1. The above data was for a 95% confidence level 2. The bootstrap test also indicates that the ACAVT was significant 3. All values of ACAVT are statistically significant			

The results confirmed that the p-values for the t-tests ranged from approximately zero to 0.000805. The lower confidence level for the bootstrap tests varied from 0.0931 to 0.2186. In summary, the following was established within a five percent significance level (95 percent confidence level): there was no statistical difference between the expected log volume turnover values when using window periods of 63 days or greater; there was no statistical difference between the average daily abnormal log volume turnover (ACAVT) values when using window periods of 63 days or greater for expected values; and for all values of expected log volume turnover, ACAVT was significantly more than zero.

When calculating the values for ACAVT, the distribution of the variables used in the first four periods exhibited equal variances, while the distributions used in the rest of the periods did not. However, all the tests produced results that were similar. Therefore, it was concluded that it was acceptable to use a window period of 63 days or longer to calculate expected log volume turnover.

5.5. Announcements with significant ACAVT

Each of the 142 announcements were analysed as described in chapter 5.3. This analysis produced 34 announcements that exhibited significant abnormal volumes traded, listed in table 6 below. Similar to table 4, this table contains the results of three different tests – the evaluation of the equations; the two sample t-test; and the bootstrap test. This table also highlighted the average daily cumulative volume turnover (ACAVT) and the average daily percentage abnormal volumes traded (APAV). Further details of the announcements and

the relevant statistics including the p-values and confidence limits are contained in appendix 2.

Table 6: Summary of the announcements that exhibited significant ACAVT and APAV

No.	Share Code	Company	Date	Equation ACAVT	Equation APAV	T-test ACAVT	T-Test APAV	Bootstrap ACAVT	Bootstrap APAV
1	ASA	Absa Group	2009/03/26	0.44143	55.49%	0.44143	55.49%	0.43890	55.10%
2	NHM	Northam Platinum	2008/08/19	0.71968	105.38%	0.71968	105.38%	0.72480	106.43%
3	BVT	Bidvest Group	2008/11/17	0.21823	24.39%	0.21823	24.39%	0.21930*	24.52%
4	DSY	Discovery Holdings	2001/06/29	1.00303	172.65%	1.00304	172.66%	1.00580	173.41%
5	SOL	Sasol	2008/11/28	1.66138	426.66%	1.66138	426.66%	1.66720**	429.73%
6	AXC	ApexHi-C	2008/02/06	1.11927	206.26%	1.11926	206.26%	1.11890	206.15%
7	SPP	Spar Group	2006/06/27	0.54298	72.11%	0.54299	72.11%	0.54400	72.29%
8	SPP	Spar Group	2006/02/08	0.39372	48.25%	0.39371	48.25%	0.39740	48.80%
9	TRE	Trencor	2004/11/25	1.51413	354.55%	1.51413	354.54%	1.50640*	351.05%
10	MRF	Merafe Resources	2001/02/27	2.07427	695.87%	2.07430	695.89%	2.07340	695.18%
11	SLM	Sanlam	2008/10/01	0.26291	30.07%	0.26290	30.07%	0.26460	30.29%
12	ALT	Altech	2008/12/17	0.19827	21.93%	0.19827	21.93%	0.19100***	21.05%
13	NPN	Naspers	2008/11/10	0.36296	43.76%	0.36296	43.76%	0.36430	43.95%
14	TKG	Telkom SA	2009/05/18	0.66786	95.01%	0.66787	95.01%	0.66750	94.94%
15	ABL	ABIL	2009/03/31	0.41427	51.33%	0.41427	51.33%	0.41290	51.12%
16	KGM	Kagiso Media	2003/04/01	3.30973	2637.78%	3.30975	2637.83%	3.28530	2571.70%
17	TON	Tongaat Hulett	2003/05/26	0.39076	47.81%	0.39075	47.81%	0.39420***	48.32%
18	ALT	Altech	2007/10/24	0.64456	90.51%	0.64456	90.52%	0.65060	91.67%
19	IMP	Impala Platinum Holdings	2001/03/26	0.34298	40.91%	0.34297	40.91%	0.34350	40.99%
20	LON	Lonmin	2008/08/06	0.55700	74.54%	0.55700	74.54%	0.55440	74.09%
21	RBW	Rainbow Chicken	2007/03/22	1.55339	372.75%	1.55339	372.75%	1.55600	373.98%
22	SBK	Standard Bank Group	2008/03/27	0.22495	25.23%	0.22495	25.23%	0.22220	24.88%
23	TBS	Tiger Brands	2006/07/07	0.28476	32.94%	0.28476	32.94%	0.28400	32.84%
24	ACP	Acucap Properties	2003/09/18	2.03974	668.86%	2.03974	668.86%	2.04650	674.08%
25	EXX	Exxaro Resources	2008/02/07	0.51440	67.26%	0.51440	67.26%	0.51550	67.45%
26	ILA	Iliad Africa	2001/08/30	5.37710	21539.46%	5.37710	21539.36%	5.36870	21358.37%
27	IMP	Impala Platinum Holdings	2008/08/06	0.47857	61.38%	0.47856	61.37%	0.47540	60.87%
28	MTN	MTN Group	2008/10/31	0.52813	69.58%	0.52813	69.58%	0.52970	69.84%
29	MUR	Murray and Roberts	2008/11/25	0.68567	98.51%	0.68567	98.51%	0.68800	98.97%

No.	Share Code	Company	Date	Equation ACAVT	Equation APAV	T-Test ACAVT	T-Test APAV	Bootstrap ACAVT	Bootstrap APAV
30	RBX	Raubex	2008/10/21	1.23732	244.64%	1.23733	244.64%	1.24300	246.60%
31	SPP	Spar Group	2008/10/31	0.82032	127.12%	0.82032	127.12%	0.81630	126.21%
32	ATN	Altron	2009/04/01	1.32610	276.63%	1.32609	276.63%	1.32550	276.41%
33	DRD	DRDGold	2008/01/25	0.75903	113.62%	0.75902	113.62%	0.75680	113.14%
34	WHL	Woolworths Holdings	2007/12/14	0.44828	56.56%	0.44829	56.56%	0.44920	56.71%
Mean				**0.97404**	**164.86%**	**0.97404**	**164.86%**	**0.97356**	**164.74%**
Standard deviation				**1.02951**		**1.02951**		**1.02703**	

Note
1. * 92.5% Confidence level
2. ** 90.0% Confidence level
3. *** Negative lower confidence level
4. All other figures have a 95% confidence level
5. The p-values for the difference of means/medians tests ranged from 0.00000 to 0.03934

The above analysis showed that the results were similar for the three different tests performed i.e. a mean ACAVT of approximately 0.974 and APAV of about 165 percent. The p-values (from appendix 2) ranged from approximately zero to 0.03934 and indicated that the results were significant. It must be noted that the standard deviation of the different announcements was quite large and the individual announcements exhibited a large variation.

In addition, the bootstrap analysis exhibited the following anomalies: two of the events had a 92.5 percent confidence level; one event exhibited a 90.0 percent confidence level; and two of the events had a negative lower confidence limit. However, since the emphasis in these tests was on the individual announcements and not on the sample, more reliance was given to the results of the t-test rather than the bootstrap test.

Therefore, all of the 34 announcements contained in table 6 were statistically significant for a five percent significance level. The number of significant ACAVT events and the percentage of ACAVT events per announcement category is summarised in table 7 below.

Table 7: Number of significant results per announcement category

Category	Number of significant ACAVT			Percentage significant ACAVT		
	No	Yes	Total	No	Yes	Total
BEE and Governance	5	5	10	50.0%	50.0%	100.0%
Financial Structure	13	6	19	68.4%	31.6%	100.0%
Investment/Disinvestment	8	3	11	72.7%	27.3%	100.0%
Key Personnel	19	3	22	86.4%	13.6%	100.0%
Mergers and acquisitions	9	6	15	60.0%	40.0%	100.0%
Other	14	3	17	82.4%	17.6%	100.0%
Trading update	40	8	48	83.3%	16.7%	100.0%
Total	108	34	142	76.1%	23.9%	100.0%

The above table illustrated that the different announcement types had proportionately different numbers of significant ACAVTs associated with them. Half of the qualifying BEE and governance announcements exhibited significant ACAVT, while two out of every five qualifying mergers and acquisition announcements showed significant ACAVT. On the other end of the scale, only 13.6 percent of qualifying key personnel announcements were accompanied by significant ACAVT.

However, due to the low count of significant ACAVTs in some of the announcements (counts of three), the difference in results could not be statistically verified by using a chi-squared test.

The entire significant sample was analysed collectively as presented in table 8. This was done by analysing all of the data, in the 21 day abnormal volumes traded detection window, of the significant sample of 34 (714 data points). A one-sample t-test and a bootstrap test (with 5000 resamples) using the daily abnormal volume turnover (AVT) were executed. In addition, the tests were executed separately for each of the categories.

Table 8: T-test and bootstrap results for the events with significant volumes traded

Category	T-test				Bootstrap test				
	ACAVT	Stat	p-value	APAV	ACAVT	SE	LCL	UCL	APAV
BEE and Governance	0.8087524*	5.3131	0.000000	124.51%	0.8112	0.1966	0.4399	1.2050	125.06%
Financial Structure	0.9845516*	7.5113	0.000000	167.66%	0.9882	0.1540	0.7046	1.3133	168.64%
Investment or Disinvestment	0.4097079*	4.7888	0.000001	50.64%	0.4081	0.2009	0.0861	0.8531	50.40%
Key Personnel	1.371589*	2.0918	0.018227	294.16%	1.3711	0.4451	0.4695	2.1951	293.97%
Mergers and Acquisitions	0.6012698*	7.1655	0.000000	82.44%	0.6028	0.0746	0.4576	0.7477	82.72%
Trading Update	1.460151*	9.9120	0.000000	330.66%	1.4623	0.1635	1.1373	1.7782	331.59%
Other	0.844473*	4.6862	0.000001	132.68%	0.8432	0.1594	0.5498	1.1722	132.38%
All	0.9740356*	16.4895	0.000000	164.86%	0.9748	0.0741	0.8256	1.1186	165.06%
Notes	1. * Statistically significant at 5% level using Wilcoxon Signed-Rank Test for Difference in Medians Test 2. All values of ACAVT are statistically significant				1. The above data was for a 95% confidence level 2. The bootstrap test also indicates that the ACAVT was significant				

The was basically no difference between analysing the events individually or collectively as a sample. In both cases the average daily cumulative volume turnover (ACAVT) was approximately 0.974 and the average daily percentage abnormal volume (APAV) was in the region of 165 percent. The p-values for the t-tests ranged from approximately zero to 0.018227. The lower confidence level for the bootstrap tests varied from 0.0861 to 1.1373. These results confirmed the expected result – i.e. all the different categories exhibited significant preannouncement ACAVT when the sample from table 6 was considered.

Looking at the different values of the ACAVT obtained for the different announcement categories (when there were significant abnormal volumes traded), it seemed as though the different categories had different values for

ACAVT. Trading updates exhibited the highest value, and investment or disinvestment had the lowest value. An ANOVA was executed to confirm this.

Since the data was non-parametric, the Kruskal-Wallis one-way ANOVA on ranks test result was used to make the inference. For both the standard and the bootstrap samples, the tests showed that the medians were significantly different. The results are reported in table 9.

Table 9: ANOVA results for the events with significant volumes traded

Significant sample	Deg. of Freedom	Chi-square	p-value	Decision
Standard	7	31.53593	0.000050	Reject H_0
Bootstrap	7	31.56823	0.000049	Reject H_0

A pair wise comparisons Kruskal-Wallis multiple-comparison Z-value test (Dunn's Test) was executed to discover the relationship between the different subsamples. The details are contained in appendix 3. This tests show that there are significant differences between the medians of most of the samples when using the more rigorous regular test. Even the less rigorous Bonferroni test confirmed that there were significant differences in the medians.

The next few sections focus on the results obtained when testing the research hypotheses.

5.6. Results for the main research hypothesis

The main hypothesis tested whether there were abnormal volumes traded before qualifying SENS announcements. In order to test this, a one-sample t-test and a bootstrap test were performed using all of the abnormal volumes

calculated for every qualifying announcement. This resulted in a sample size of 2982 abnormal log volume turnover (AVT) values (21 values for each of the 142 announcements).

Most of the samples tested exhibited skewness and kurtosis. The non-normality of the complete sample was also confirmed. In order to overcome some of the limitations of non-normality, the sample was subjected to bootstrapping as well. The distribution of the complete sample is displayed in figure 9 below, while the bootstrap distribution is shown in figure 10.

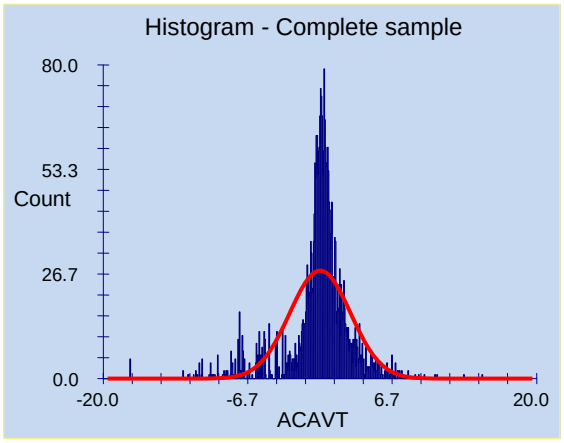

Figure 9: Distribution of complete AVT sample

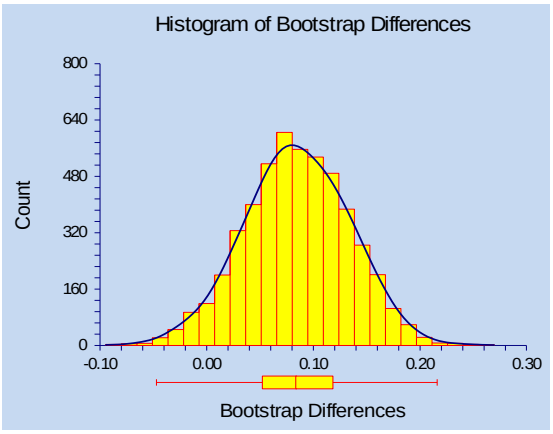

Figure 10: Bootstrap distributions of the complete AVT samples

The skewness and kurtosis was clearly illustrated in figure 9. The ability the bootstrap technique to correct for non-normality was demonstrated in figure 10. The results of the tests are presented in table 10 below. This table compared the results using the entire qualifying sample with the sample that exhibited significant abnormal volume turnover preannouncement (listed in tables 6 and 8).

Table 10: T-test and bootstrap test with complete and significant abnormal volume turnover (AVT) sample

Panel 1 Sample	Sample size	T-test			Bootstrap test		
		Std Dev	Dist	Stat	SE	LCL	UCL
Complete sample	2982	2.804888	Non Normal	7.7678	0.0486	-0.0102	0.1787
Significant sample	714	1.973855	Non Normal	16.4895	0.0741	0.8256	1.1186
Panel 2 Sample	**T-test**				**Bootstrap test**		
	ACAVT	**p-value**	**APAV**	**Decision**	**ACAVT**	**APAV**	**Decision**
Complete sample	0.00841643*	0.000000	0.85%	Reject H_0	0.0846	0.85%	Do NOT Reject H_0
Significant sample	0.9740356*	0.000000	164.86%	Reject H_0	0.9748**	165.06%	Reject H_0
Notes	* Statistically significant at 5% level using the Wilcoxon Signed-Rank Test for Difference in Medians				** Statistically significant for a 95% confidence level		

The above table illustrated the results for the main hypothesis. Since the sample was not normally distributed, the Wilcoxon signed-rank test for difference in medians was utilised when analysing the complete sample. The p-value for the t-test was approximately zero, while the lower confidence level for the bootstrap was -0.0102. Therefore, the null hypothesis was rejected when using difference of medians test on the complete actual sample, but it could not be rejected when utilising a bootstrap test. The AVCAT for the complete sample was also very close to zero, and the APAV was about 0.9 percent.

The significant sample rejected the null hypothesis when using both the difference of medians (p-value approximately zero) and bootstrap tests (lower confidence level 0.8256). The figures for the daily AVT and CAVT are presented in the table 11 below for the period from t_{-21} to t_1 for both the complete and the significant samples.

Table 11: Daily AVT and CAVT for complete and significant sample

AVT CAVT	t_{-21}	t_{-20}	t_{-19}	t_{-18}	t_{-17}	t_{-16}	t_{-15}	t_{-14}	t_{-13}	t_{-12}	t_{-11}	t_{-10}
Complete sample	-0.3599 -0.3599	-0.2094 -0.5693	0.0255 -0.5438	0.0814 -0.4624	0.1514 -0.3110	-0.3793 -0.6903	0.0763 -0.6141	0.3688 -0.2453	-0.1275 -0.3728	-0.1729 -0.5456	0.1141 -0.4315	0.3624 -0.0691
Significant sample	-0.2159 -0.2159	0.2613 0.0454	0.6848 0.7302	1.1398 1.8700	0.9585 2.8285	0.6035 3.4320	1.0033 4.4354	1.0264 5.4618	1.2869 6.7487	0.9872 7.7359	1.5098 9.2457	1.2089 10.4546
AVT CAVT	**t_{-9}**	**t_{-8}**	**t_{-7}**	**t_{-6}**	**t_{-5}**	**t_{-4}**	**t_{-3}**	**t_{-2}**	**t_{-1}**	**t_0**	**t_1**	
Complete sample	0.0709 0.0018	0.3887 0.3905	0.2818 0.6724	-0.0682 0.6042	0.2972 0.9013	0.5409 1.4422	0.2850 1.7273	0.0161 1.7434	0.0276 1.7710	0.8595 2.6305	0.4318 3.0623	**AVT CAVT**
Significant sample	1.6775 12.1321	0.8348 12.9670	0.7039 13.6708	0.7352 14.4061	1.3622 15.7683	1.1779 16.9462	1.2522 18.1984	1.0169 19.2153	1.2394 20.4547	1.0220 21.4767	1.1100 22.5867	**AVT CAVT**

The above table demonstrated that the CAVT for the complete sample was about seven times lower than that for the significant sample. The AVT for the complete sample was mainly negative in the early part of the detection window, becoming more positive as the announcement date approached. The significant sample only had a negative AVT on day t_{-21} and it was strongly positive on the other days. This relationship is more clearly illustrated in the graph in figure 11 below.

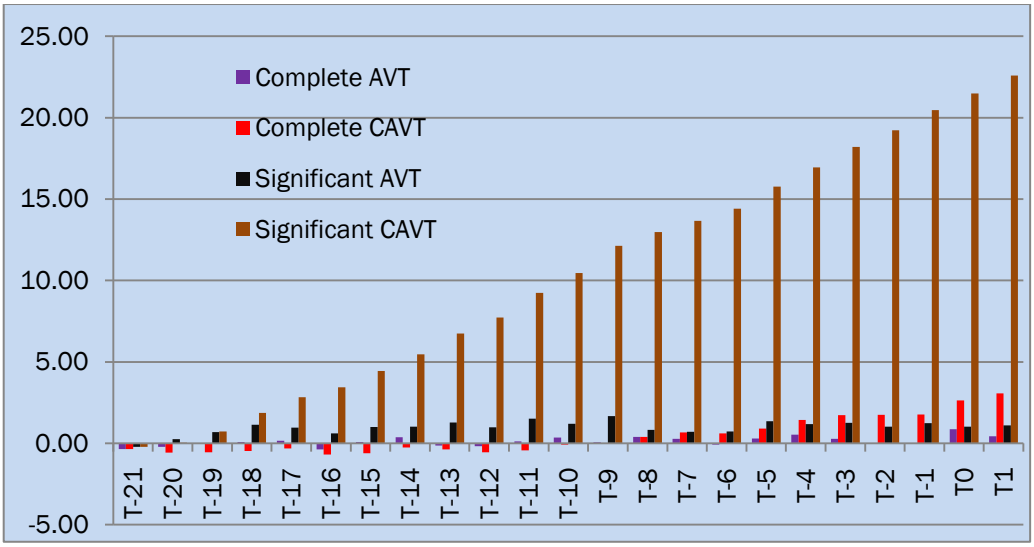

Figure 11: AVT and CAVT for the complete and significant samples

The complete sample only exhibited a positive CAVT from about t_{-8} while the significant sample exhibited positive CAVT for almost the entire event window. In addition, the significant sample had a significant amount of abnormal volume traded for almost the entire event window.

In summary, the evidence to reject the null hypothesis was not conclusive. More reliance was placed on the bootstrap test, as the analysis of the sample was the focus. In addition, due to the approach of minimising type I errors, it was concluded that the null hypothesis could not be rejected.

Therefore, when the complete qualifying sample was considered, there was no significant ACAVT in the preannouncement period, and the following was concluded for the main hypothesis:

All announcements: $ACAVT \leq 0$

5.7. Results for the sub hypotheses

The sub hypotheses tested whether there were abnormal volumes traded before different categories of significant SENS announcements. In order to test these, a one-sample t-test and a bootstrap test were executed using all of the abnormal volume turnovers calculated for every qualifying announcement in each of the categories.

The sample sizes and results are presented in table 12 below. This table compared the complete qualifying sample with the subsamples of each announcement category. For the t-tests, the standard deviation, normality of

distributions, the p-value and the relevant test statistic were reported, while the bootstrap results reported the standard error and lower and upper confidence limits. Both tests reported the ACAVT, and the APAV.

Table 12: T-test and bootstrap test with complete qualifying sample and category subsamples

Panel 1 Sample	Sample size	T-test			Bootstrap test		
		Std Dev	Dist	Stat	SE	LCL	UCL
Complete sample	2982	2.804888	Non Normal	7.7678	0.0486	-0.0102	0.1787
BEE and governance	210	1.973404	Non Normal	4.4463	0.1352	0.1342	0.6631
Financial structure	399	3.25083	Non Normal	4.4264	0.1630	-0.1294	0.5123
Investment or disinvestment	231	2.702377	Non Normal	1.5362	0.1734	-0.5414	0.1383
Key personnel	462	3.017895	Non Normal	3.6804	0.1405	0.0777	0.6282
Mergers and acquisitions	315	1.939898	Non Normal	2.8175	0.1101	-0.2451	0.1884
Trading update	1008	2.502503	Non Normal	2.6616	0.0783	-0.0969	0.2113
Other	357	2.741051	Non Normal	1.1047	0.1459	-0.4468	0.1188

Panel 2 Sample	T-test				Bootstrap test		
	ACAVT	p-value	APAV	Decision	ACAVT	APAV	Decision
Complete sample	0.00841643*	0.000000	0.85%	Reject H_0	0.0846#	0.85%	Do NOT Reject H_0
BEE and governance	0.3883176*	0.000004	47.45%	Reject H_0	0.3910***	47.85%	Reject H_0
Financial structure	0.1881672*	0.000005	20.70%	Reject H_0	0.1878#	20.66%	Do NOT Reject H_0
Investment or disinvestment	-0.2094459**	0.062244	-18.90%	Do NOT Reject H_0	-0.2114#	-19.05%	Do NOT Reject H_0
Key personnel	0.3532457*	0.000116	42.37%	Reject H_0	0.3542***	42.50%	Reject H_0
Mergers and acquisitions	-0.037697*	0.002420	-3.70%	Reject H_0	-0.0383#	-3.76%	Do NOT Reject H_0
Trading update	0.05321984*	0.000029	5.47%	Reject H_0	0.0540#	5.55%	Do NOT Reject H_0
Other	-0.1729196**	0.134654	-15.88%	Do NOT Reject H_0	-0.1733#	-15.91%	Do NOT Reject H_0
Notes	1. Statistically significant at 5% level using the Wilcoxon Signed-Rank Test for Difference in Medians 2. ** Not statistically significant for rejecting H_0				3. *** Statistically significant for a 95% confidence level 4. # Not statistically significant for rejecting H_0		

The above table illustrated that in all cases the samples were not normally distributed. Therefore, the non-parametric Wilcoxon signed-rank test for

difference in medians was used to determine if there were significant abnormal volumes traded preannouncement (ACAVT and APAV). Five out of the seven category samples exhibited significant abnormal volumes traded preannouncement according to the non-parametric test, thus rejecting the null hypotheses. The p-values ranged from approximately zero to 0.134654. However, the bootstrap test indicated that the null hypotheses could only be rejected in two of the seven samples, with the lower confidence levels ranging from -0.5414 to 0.1342.

In this case as well, more reliance was placed on the bootstrap test, as the analysis of the subsample was the focus. To minimise type I errors, the null hypothesis was rejected only when both tests reject it. In all other cases, the null hypothesis was not rejected.

For each of the different sub hypotheses, based on the evidence the following was concluded.

- BEE and governance: $ACAVT_1 > 0$
- Financial structure: $ACAVT_2 \leq 0$
- Investment or disinvestment: $ACAVT_3 \leq 0$
- Key personnel: $ACAVT_4 > 0$
- Mergers and acquisitions: $ACAVT_5 \leq 0$
- Trading update: $ACAVT_6 \leq 0$
- Other: $ACAVT_7 \leq 0$

Thus, only BEE and governance (p-value 0.000004, bootstrap lower confidence level 0.1342), and key personnel announcements (p-value 0.000116, bootstrap lower confidence level 0.0777) exhibited significant abnormal volumes traded preannouncement. For these announcement types the APAV were 47.45 percent and 42.37 percent.

While BEE and governance, and key personnel produced the highest magnitude of significant preannouncement ACAVT from all the different subsamples; BEE and governance, and mergers and acquisitions had the highest percentage of the number of significant ACAVT announcements from the different categories. Interestingly, the key personnel announcement category exhibited the lowest prevalence of significant ACAVT announcements.

The above results suggested that the different announcement types produced different results. The tests and results to statistically evaluate this hypothesis is discussed in the following section.

5.8. Results of the difference tests

In order to determine if there were significant differences between the different samples, the different samples were analysed in two steps. In the first step, the value of CAVT for the entire sample and the different subsamples was visually presented on a graph to see the impact on CAVT during the different event days. In the second part, a difference test was performed to determine if the samples were statistically different. The CAVT per event day for the period

t_{-21} to t_1 is depicted in figure 12. The daily values of CAVT for the different subsamples are contained in Appendix 4.

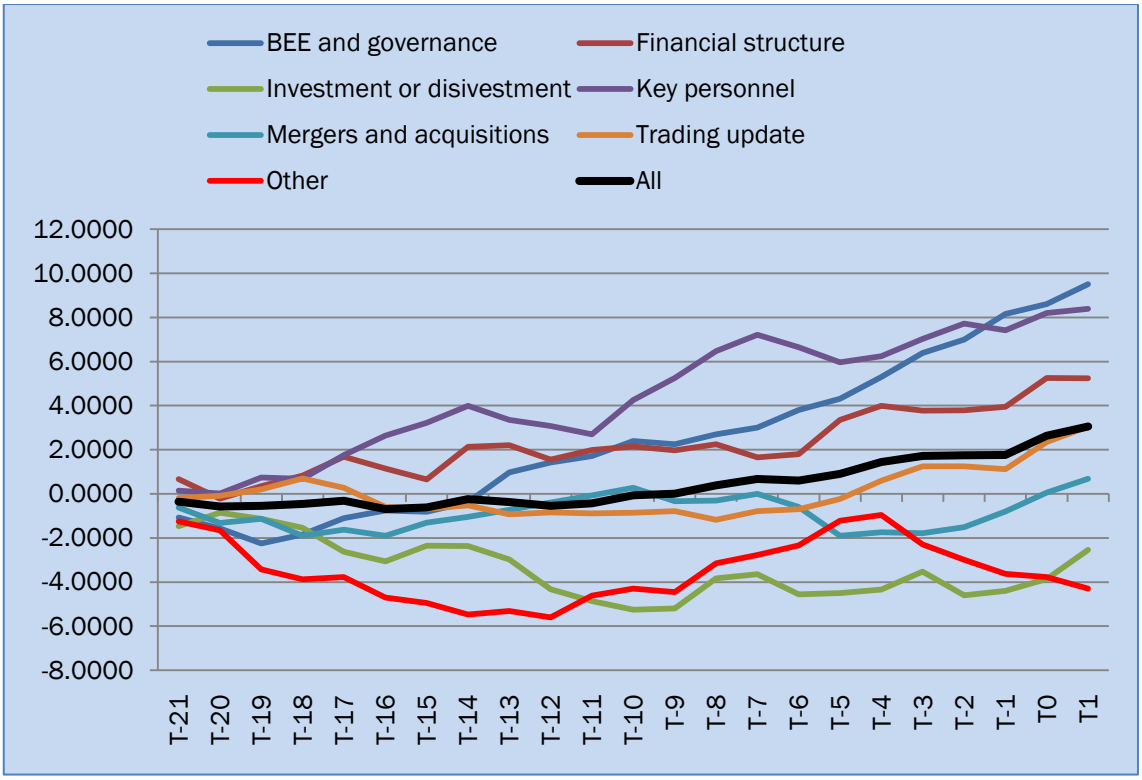

Figure 12: CAVT for the complete and all category samples

The above figure indicated that there were significant differences between the various subsamples. In order to confirm this statistically, a difference test was utilised. Since all the samples were not normal, the non-parametric the Kruskal-Wallis one-way ANOVA on ranks test was used to determine if was a significant difference in the medians. This was done for both the standard and bootstrap samples, and the results are shown in table 13 below.

Table 13: ANOVA results for the events in the complete qualifying sample and the category subsamples

Significant sample	Deg. of Freedom	Chi-square	p-value	Decision
Standard	7	29.06367	0.000141	Reject H_0
Bootstrap	7	28.90079	0.000151	Reject H_0

The test results confirm that for both the standard (p-value 0.000141) and bootstrap (p-value 0.000151) samples, at least two of the sample medians were significantly different.

A pair wise comparisons Kruskal-Wallis multiple-comparison Z-value test (Dunn's Test) was executed to discover the relationship between the different samples. The details are presented in table 14 below.

Table 14: Kruskal-Wallis multiple-comparison z-value test (Dunn's Test) on the complete sample and category subsamples

Standard Sample	All	BG	FS	ID	KP	MA	O	TU
All	0.0000	1.6112	3.9294	1.4719	1.4577	1.1170	1.3416	0.8084
BEE and governance (BG)	1.6112	0.0000	1.1076	2.2608	0.5065	2.0341	2.1867	1.9048
Financial Structure (FS)	3.9294	1.1076	0.0000	3.7495	1.9985	3.6571	3.9065	4.0394
Investment/ Disinvestment (ID)	1.4719	2.2608	3.7495	0.0000	2.1520	0.3965	0.3007	0.9743
Key Personnel (KP)	1.4577	0.5065	1.9985	2.1520	0.0000	1.9032	2.1005	1.8215
Mergers and Acquisitions (MA)	1.1170	2.0341	3.6571	0.3965	1.9032	0.0000	0.1158	0.5689
Other (O)	1.3416	2.1867	3.9065	0.3007	2.1005	0.1158	0.0000	0.7417
Trading Update (TU)	0.8084	1.9048	4.0394	0.9743	1.8215	0.5689	0.7417	0.0000

Regular Test: Medians significantly different if z-value > 1.9600
Bonferroni Test: Medians significantly different if z-value > 3.1237

Bootstrap Sample	All	BG	FS	ID	KP	MA	O	TU
All	0.0000	1.4175	3.6772	1.6730	1.1932	1.3578	1.5968	1.1808
BEE and governance (BG)	1.4175	0.0000	1.1121	2.2598	0.4992	2.0390	2.1921	1.9013
Financial Structure (FS)	3.6772	1.1121	0.0000	3.7529	1.9952	3.6680	3.9182	4.0414
Investment/ Disinvestment (ID)	1.6730	2.2598	3.7529	0.0000	2.1582	0.3904	0.2940	0.9766
Key Personnel (KP)	1.1932	0.4992	1.9952	2.1582	0.0000	1.9174	2.1157	1.8275
Mergers and Acquisitions (MA)	1.3578	2.0390	3.6680	0.3904	1.9174	0.0000	0.1162	0.5798
Other (O)	1.5968	2.1921	3.9182	0.2940	2.1157	0.1162	0.0000	0.7535
Trading Update (TU)	1.1808	1.9013	4.0414	0.9766	1.8275	0.5798	0.7535	0.0000

Regular Test: Medians significantly different if z-value > 1.9600
Bonferroni Test: Medians significantly different if z-value > 3.1237

These tests showed that there were significant differences between the medians of most of the samples when using the more rigorous regular test. Even the less rigorous Bonferroni test confirmed that there were significant

differences in the medians. The relationship between the different medians using the regular test is displayed below (M was used as a symbol for median). The statistical significance of the results were the same for the original and bootstrap samples.

- BEE and governance: $M_{BG} \neq M_{ID} \neq M_{MA} \neq M_O$
- Financial structure: $M_{FS} \neq M_{ID} \neq M_{KP} \neq M_{MA} \neq M_O \neq M_{TU}$
- Investment or disinvestment: $M_{ID} \neq M_{BG} \neq M_{FS} \neq M_{KP}$
- Key personnel: $M_{KP} \neq M_{FS} \neq M_{ID} \neq M_O$
- Mergers and acquisitions: $M_{MA} \neq M_{BG} \neq M_{FS}$
- Trading update: $M_{TU} \neq M_{FS}$
- Other: $M_O \neq M_{BG} \neq M_{FS} \neq M_{KP}$

In summary, all tests confirmed that the at least two of the medians were different. Therefore, it was concluded that there were significant differences between the medians of the different category subsamples.

5.9. Relationship between EVT and ACAVT

The results were inspected to see if there were any obvious trends. It was felt that there was a relationship between the expected volume turnover (EVT) and the average daily cumulative volume turnover (ACAVT). A visual inspection of the results indicated that the prevalence of significant ACAVT announcements increased with higher values of EVT.

Since EVT was a measure of the expected volumes traded normalised for the number of outstanding shares, it was considered as a proxy for liquidity. Hence, a visual inspection of the data seemed to suggest that increased liquidity would result in the detection of a greater number of preannouncement ACAVT events. Therefore, it was decided to determine if this relationship was statistically significant. Firstly, the EVTs of the complete sample was ranked from largest to smallest. The sample was split into two around the median – thus resulting in a more liquid and a less liquid subsample. Then, the above relationship was interrogated in two ways.

A two-tailed two-sample t-test and bootstrap test were performed on the ACVAT values of the subsamples. The test was done at a five percent significance level. It must be noted that only significant ACAVT values were included. If the value of ACAVT was insignificant or negative, then it was set to zero. The sample used for these tests is contained in appendix 5. The results of this test are presented in tables 15 below.

Table 15: T-test and bootstrap test comparing the ACAVT of high EVT and low EVT shares

Panel 1 Sample	**Sample size**	**Descriptive statistics**			**Bootstrap test**		
		Mean	**Std dev**	**Distribution**	**Mean**	**LCL**	**UCL**
ACAVT (High EVT)	71	0.1495938	0.261518	Non Normal	0.1493	0.0855	0.2062
ACAVT (Low EVT)	71	0.3168043	0.8760736	Non Normal	0.3172	0.1016	0.4958
Difference		-0.1672106	0.9142739	Non Normal	-0.1679	-0.3587	0.0560
Panel 2 Sample Statistics	**T-test**				**Bootstrap test**		
	Test	**p-value**	**Dmn Criterion**	**Decision**	**Standard error**	**No of samples**	**Decision**
Difference	Kolmogorov-Smirnov	0.6219	0.126761	Do NOT Reject H0	0.1071	5000	Do NOT Reject H_0

The subsample with the high EVT had a lower mean than that with a low EVT. However, the low EVT subsample had a much higher standard deviation. It also had much larger bootstrap confidence levels. The results of both the t-test (p-value 0.6219) and the bootstrap test (upper confidence level 0.0560) suggested that the null hypothesis should not be rejected.

Based on the agreement in the results of the t-test and the bootstrap test, the null hypothesis was not rejected. Therefore, it was concluded that there were no significant differences in the value of ACAVT between the high EVT and low EVT subsamples.

A chi-squared test was executed to determine if there was a statistical difference in the number of significant ACAVT announcements from each subsample. The test compared the number of significant ACAVT announcements between the high EVT and low EVT subsamples. The results are presented in table 16 below.

Table 16: Number of significant results per EVT subsample (high and low)

Subsample	Number of significant ACAVT			Percentage significant ACAVT		
	No	Yes	Total	No	Yes	Total
Low EVT subsample	58	13	71	81.7	18.3	100.0
High EVT subsample	50	21	71	70.4	29.6	100.0
Total	**108**	**34**	**142**	**76.1**	**23.9**	**100.0**
Statistics						
Chi –square	**Degrees of freedom**		**Probability**		**Decision**	
2.474946	1		0.115673		Do not reject H_0	

The above results illustrated that there were 21 significant ACAVT announcements in the high EVT subsample, while there were 13 significant

ACAVT announcements in the low EVT subsample. However, this difference was found not to be significant by the chi-squared test at a five percent significance level.

In fact, the p-value was a high 0.115673 – which showed that the difference was not even significant at a ten percent level. Therefore, it was concluded that the level of EVT did not play a significant role in determining the magnitude and number of significant ACAVT announcements when the sample was split about the median.

These two tests were then repeated using the top and bottom quartiles of the ranks to determine if this had any influence on the results. The results of the quartile two sample t-test is presented in table 17 below.

Table 17: T-test and bootstrap test comparing the ACAVT of upper quartile EVT and lower quartile EVT shares

Panel 1 Sample	**Sample size**	**Descriptive statistics**			**Bootstrap test**		
		Mean	**Std dev**	**Distribution**	**Mean**	**LCL**	**UCL**
ACAVT (Top Quartile EVT)	35	0.1815068	0.2518295	Non Normal	0.1819	0.0990	0.2614
ACAVT (Bottom Quartile EVT)	35	0.3972027	0.3972027	Non Normal	0.3172	-0.0124	0.7078
Difference		-0.2156959	1.159554	Non Normal	-0.2149	-0.5504	0.2119
Panel 2 Sample	**T-test**				**Bootstrap test**		
	Test	**p-value**	**Dmn Criterion**	**Decision**	**Std error**	**No of samples**	**Decision**
Difference	Kolmogorov -Smirnov	0.1991	0.257143	Do NOT Reject H_0	0.1966	5000	Do NOT Reject H_0

Once again, the subsample with the top quartile EVT had a lower mean than that with the bottom quartile EVT. However, the bottom quartile EVT subsample had a much higher standard deviation. It also had much larger bootstrap confidence levels. The results of both the t-test (p-value 0.1991) and

the bootstrap test (upper confidence level 0.2119) both suggested that the null hypothesis should not be rejected.

Based on the agreement of the results of the t-test and bootstrap test, the null hypothesis was not rejected. Therefore, it was concluded that there were no significant differences in the value of ACAVT between the top quartile EVT and bottom quartile EVT subsamples.

A chi-squared test was executed to determine if there was a statistical difference in the number of significant ACAVTs from each of the top quartile EVT and the bottom quartile EVT subsamples. The results are presented in table 18 below.

Table 18: Number of significant results per EVT subsample (upper and lower quartile)

Subsample	Number of significant ACAVT			Percentage significant ACAVT		
	No	Yes	Total	No	Yes	Total
Bottom quartile EVT subsample	30	5	35	85.7	14.3	100.0
Top quartile EVT subsample	21	14	35	60.0	40.0	100.0
Total	**51**	**19**	**70**	**72.9**	**27.1**	**100.0**
Statistics						
Chi –square	**Degrees of freedom**		**Probability**		**Decision**	
5.851393	1		0.015565		Reject H_0	

The above results illustrated that there were 14 significant ACAVT announcements in the top quartile EVT subsample, while there were five significant ACAVT announcements in the bottom quartile EVT subsample. This difference was found to be significant by the chi-square test at a five percent significance level.

In fact, the p-value was a low 0.0156 – which showed that the difference was even significant at a two percent level as well. Therefore, in this case the level of EVT did play a significant role in determining number of significant ACAVT announcements, but not in the magnitude.

In summary, with a median split, both the magnitude of the significant ACAVT and the number of significant ACAVT announcements detected were insensitive to the level of EVT (and hence liquidity). Yet, if the top and bottom quartiles of EVT were considered, then the results showed that the number of significant ACAVT announcements detected became sensitive to the level of EVT, while the magnitude remained insensitive.

6. Discussion of Results

6.1. Introduction to the discussion of the results

This chapter provides a discussion on the results reported on in the previous chapter. Therefore, the discussion would follow a similar structure as chapter 5. Firstly, there would be a discussion on the sample used and a few observations on the sample. This would be followed by a discussion on the analysis performed on individual announcements.

The results obtained for the various hypotheses would then be discussed. Where appropriate, these results were also compared with results obtained by other researchers. Similarities and differences would be highlighted, as well as reasons for these. Then, the overall results and the implications for the JSE and FSB would be discussed. Finally, this section concludes with a discussion on results that were observed, but which were not directly related to this study.

6.2. Generating an appropriate sample

The generation of an appropriate sample to analyse was one of the most difficult, but also one of the most important tasks required for a project of this nature. Due to the short duration of the project, it was decided to produce a qualifying sample in the shortest possible timeframe - using the event engine of Muller and Ward (2009). This decision had the following implications:

- The initial population was restricted to the top five abnormal returns of the shares listed on the JSE ALSI in the period from January 2000 to June 2009.

This should have ensured a higher proportion of significant ACAVT announcements. Other announcements and periods which could have had an impact on the results were ignored.

- SENS announcements were used as the only source of events or announcements that made information public. This obviously ignored announcements made on other media such as analyst reports and press releases and other press reports, and their impact on the results. However, SENS announcements normally preceded company press releases and were the only official mechanism to release news about listed companies.

SENS announcements were not identified for every abnormal return. Therefore, there may have been some other information in the market to explain these abnormal returns. A more rigorous approach would have been to analyse every SENS; analyst report; and press announcement – but this would have been too time consuming for the brevity of this project.

Another important aspect of determining the appropriate sample was to ensure that confounding events were corrected for. The process of removing confounding events was not an exact science. The choices made in this regard would influence the magnitude of type I and type II errors. Due to the nature of the research (identifying possible occurrences of insider trading), it was decided to minimise type I errors.

This conservative approach had the impact of reducing the number of detected cases of significant abnormal volumes traded preannouncement on the one hand. While, on the other hand, the analysis of only the top five abnormal price movements per ALSI share should have increased the probability of detecting significant abnormal volumes traded preannouncement. The end effect of these two issues was not determined, but it could have biased the results.

In addition, the model used to analyse the volumes traded around the events did not cater for more than one announcement to be analysed simultaneously. This resulted in a smaller sample being selected because of these confounding events. Therefore, in some cases, announcements that were preceded by insider trading would have been ignored because it formed part of a multiple or compound announcement.

The categories of announcements selected seemed to be appropriate, as each category (except trading update) had a similar amount of announcements placed in them. Even the placement of an announcement into a category presented challenges and was not straightforward. There were occasions where there was more than one announcement on a particular day. In that case a choice had to made as to which was the most significant announcement. At times some of the announcements were described as "cautionary announcement". In this case, the announcement was classified as "other", even though it might eventually have ended up being for example a "mergers and acquisitions" announcement. In the light of the above discussion, and

given the constraints, the best possible sample was generated for analysis in this study.

6.3. Individual announcements event windows

Some of the most important decisions considered when analysing individual announcements included the period used to detect abnormal volumes traded and the period used to determine the expected volumes traded. The choice of these periods would have influenced the results obtained. However, the literature did not provide good guidelines, as each researcher chose the periods individually, and there was no consensus. Table 19 below summaries the periods various researchers used to detect abnormal volumes traded and calculate expected volumes traded.

Table 19: Event windows used by the various researchers

Research paper	Event window to calculate expected volumes traded	Event window to detect abnormal volumes traded
Ajinkya and Jain (1989)	$t_{-55} - t_{-6}$; $t_6 - t_{55}$ (100 days) $t_{-90} - t_{-6}$; $t_6 - t_{90}$ (170 days) $t_{-124} - t_{-6}$; $t_6 - t_{124}$ (238 days) [for 5 day detection period]	$t_{-5} - t_{-1}$ (5 days) $t_{-3} - t_{-1}$ (3 days) $t_{-1} - t_{-1}$ (1 day)
Meulbroek (1992)	150 days before interim announcement or first insider trade	Period between first insider trade and public announcement
Ryan and Taffler (2004)	Calculated daily based on volumes traded in the entire stock market	Seven day window based on the identification of the abnormal price movement
Jarrell and Poulsen (1989)	$t_{-170} - t_{-20}$ (150 days)	$t_{-20} - t_{-1}$ (20 days)
Ascioglu, McInish and Wood (2002)	$t_{-105} - t_{-21}$ (85 days)	$t_{-105} - t_{-1}$ (105 days)
Keown and Pinkerton (1981)	$t_{-125} - t_{-26}$ (100 days)	$t_{-125} - t_{-1}$ (125 days)
Sanders and Zdanowicz (1992)	$t_{-210} - t_{-61}$ (150 days) Initiation and announcement dates used to determine event widow.	$t_{-60} - t_{-1}$ (60 days) Initiation and announcement dates used to determine event widow.
Arnold *et al.* (2006)	$t_{-50} - t_{-21}$ (30 days)	$t_{-20} - t_{-1}$ (20 days)
Jayaraman, Frye and Sabherwal (2001)	$t_{-140} - t_{-41}$ (100 days)	$t_{-30} - t_{-1}$ (30 days) $t_{-10} - t_{-1}$ (10 days)

Research paper	Event window to calculate expected volumes traded	Event window to detect abnormal volumes traded
Cao, Chen and Griffin (2005)	$t_{-200} - t_{-100}$ (101 days)	$t_{-30} - t_{-1}$ (30 days)
Chae (2005)	$t_{-40} - t_{-11}$ (30 days) $t_{-55} - t_{-11}$ (45 days)	$t_{-10} - t_{-1}$ (10 days)
This study	$t_{-84} - t_{-22}$ (63 days)	$t_{-21} - t_{-1}$ (21 days)

The research conducted by Sanders and Zdanowicz (1992) utilised two different dates, an initiation date and announcement date, which were separated by a variable period. It was therefore difficult to make direct comparisons between their study and the other research papers. Ajinkya and Jain (1989) found that the qualitative results do not change when the length of the estimation period was changed. They were also the only researchers reviewed to use post event data in order to calculate expected volumes traded.

In order to perform a robustness check, Chae (2005) used a second (longer) event period to calculate expected volumes traded. He found that the longer period provided an even stronger result. He also stated that he used various estimation periods of up to a year in order to perform the tests, and obtained similar results. The other researchers quoted in the above table did not use any robustness tests. They based their estimation window periods on literature they reviewed and personal preferences.

Due to time constraints, this study only performed a robustness check on a single announcement. The results of this test were reported in Figure 6 and Table 5 of chapter 5.5. As indicated, expected values for volumes traded were calculated for 11 different periods. Although the results obtained using the two shorter periods, 21 and 42 days, were significantly more that the results

obtained using the longer periods, 63 days and more, they had not altered the confirmation of significant ACAVT in any of the cases. This finding agreed with Ajinkya and Jain (1989) and Chae (2005).

This study used just one event to test the effect of the event window period. This approach was not statistically robust, but gave a good confidence indication. Time permitting, it would have been better to test all of the announcements using the other periods. However, it was reassuring that the different periods did not result in major changes on the announcement analysed.

6.4. Comparison with results from other studies

The results reported by other studies were compared to the results of this study. In order to make meaningful comparisons with the results of the other studies, the results, where feasible, were transformed to average daily cumulative abnormal volume turnover (ACAVT) or average daily percentage abnormal volume (APAV) calculated until day t_{-1}. Table 20 summarises the results from the different studies reviewed. Only those studies with empirical results were analysed and compared in order to ensure that there was consistency. However, all the studies reviewed were listed in the table in order to present a complete list.

Table 20: Findings of comparable studies

Research paper	Markets	Sample size	Announce Category	AVACT	APAV
Ajinkya and Jain (1989)	NYSE	2,000 - 20,000	N/A	Simulation	Simulation
Meulbroek (1992)	NYSE, Nasdaq, AMEX, CBOT	131	N/A	Not reported.	93% (0.09 Standard error)
Ryan and Taffler (2004)	LSE	215	1. Share deals 2. Interim results 3. Preliminary results 4. Bids 5. Financing 6. Director share dealing 7. Analysts	Not reported. However, the rank order of the different events was provided instead.	
Jarrell and Poulsen (1989)	NYSE, AMEX	161	Mergers and acquisitions	Not reported. However, they do report that 34.7% of the sampled firms reported significantly greater than usual volumes the day before the announcement.	
Ascioglu, McInish and Wood (2002)	NYSE, Nasdaq	54	Mergers and acquisitions	(5.414+0.960) /21 (days from data) = 0.3035	35.46% (10% Significance)
Keown and Pinkerton (1981)	NYSE & AMEX, Over The Counter	101 93	Mergers and acquisitions	Not reported. However, 79% of the acquired firms exhibited higher volumes one week prior to the announcement date. The increase in volume traded in this period was 247%.	
Sanders and Zdanowicz (1992)	NYSE, AMEX	30	Mergers and acquisitions	It was difficult to derive ACAVT as they use two dates, and the difference between the two dates was not fixed. However, they do report a CAVT of 0.829 until two days before the announcement. This figure was not statistically significant.	
Arnold *et al.* (2006)	CBOE, Phil, AMEX, Pacific, NYSE	356	Mergers and acquisitions (non-option sample reported)	(0.85+0.02)/ 20 (days from data) =0.0435 (1% significance)	4.45% (1% significance)
Jayaraman, Frye and Sabherwal (2001)	CBOE (Chicago Board Options Exchange)	33	Mergers and acquisitions (stock sample volume reported)	0.95/30 (days from data) =0.031667 (1% significance)	3.22% (1% significance)

Research paper	Markets	Sample size	Announce Category	AVACT	APAV
Cao, Chen and Griffin (2005)	CBOE	78	Mergers and acquisitions (stock sample volume reported)		36.8% (5% significance)
Chae (2005)	NYSE, AMEX	22,930	Acquisition	4.1277 (1% Significance)	6,687%
		11,255	Target	18.2416 (1% Significance)	8,360,383,816%
		330	Moody's	3.7902 (10% Significance)	4,327%
		34,515	All	8.7867 (Weighted Average.)	654,538%
This study	JSE	10	BEE and governance	0.3883176*	47.45%*
		19	Financial structure	0.1881672	20.70%
		11	Investment or disinvestment	-0.2094459	-18.90%
		22	Key personnel	0.3532457*	42.37%*
		15	Mergers and acquisitions	-0.037697	-3.70%
		48	Trading update	0.05321984	5.47%
		17	Other	-0.1729196	-15.88%
		142	Complete sample	0.00841643	0.85%
				*5% Significance level; other results in the study are not significant.	

The above table illustrated that all other studies were conducted either in the United States (US) (ten) or in the United Kingdom (UK) (one). Most of the researchers (seven out of eleven) focused only on mergers and acquisitions.

Two others considered mergers and acquisitions as a specific category. Comparison between the different studies was made more difficult because the different researchers presented their results differently. Direct comparisons were only possible in a few of the cases with the results from studies in the US.

The complete sample of 142 used in this study was comparable to the sample sizes in the other studies. However, the sample sizes for the individual announcement categories in this study were low (except for the trading update category, they are all below 25). The smallest sample size used by the other researchers was 30. This was one of the reasons the bootstrap test was utilised.

The results obtained by previous researchers were not consistent. They range from Sanders and Zdanowicz (1992) finding that there was no significant volumes traded preannouncement to Chae (2005), whose sample exhibited an APAV of 650 percent (with the target category exhibiting a APAV of $8*10^9$ percent). It must be noted that the results of Chae (2005) were orders of magnitude greater than the results obtained by the other researchers. No reasonable explanation to address this difference in results could be found.

The wide range of results obtained indicated that there were significant amounts of variability in the way the different researchers qualified their sample and the different techniques they used to determine if there was abnormal volumes traded. However, it must be noted that with the exception of Sanders

and Zdanowicz (1992), all the researchers detected significant abnormal normal volumes traded preannouncement.

The results of this study presented differences per announcement type. The results obtained from the complete sample indicated that there was no significant abnormal volumes traded, thus confirming the findings of Sanders and Zdanowicz (1992). The same deduction was applicable to the following subsamples as well: financial structure; investment or disinvestment; mergers and acquisitions; trading update; and other. The BEE and governance; and key personnel categories, however, did exhibit significant abnormal volumes traded in the preannouncement period.

As stated above, most of the researchers considered only one category (mainly mergers and acquisitions). However, Ryan and Taffler (2004) and Chae (2005) reported on abnormal volumes traded for different announcement types. Both studies confirmed that there were significant differences in the values of the average daily percentage abnormal volumes (APAV) per announcement category. Their results concurred with the results of this study.

While it was acknowledged that location could influence results, it must be noted that most of the researchers used samples that contained shares that were listed on the NYSE and AMEX exchanges. Therefore, location could not be the only explanatory variable. The different methodologies employed by the different researchers, the complexity of the environment and the inability to

control for extraneous factors could provide some more clues to explain the differences.

The method of constructing the sample had a huge influence. The choice of the event window, and the rules used to qualify an event as being acceptable varied between the different researchers. The method of treating confounding events and they way they were used to disqualify events from the sample was also key.

A sample could have been constructed such that it minimised either type I or type II errors, or did something in between. This obviously influenced the results. This study minimised type I errors, thus was conservative in the detection of preannouncement abnormal volumes traded.

It was difficult to generalise about possible insider trading activities. The amount of preannouncement activity was very dependent on the shares and announcements analysed and the perceived magnitude of the announcement. It was therefore felt from a JSE and FSB perspective that it was more intuitive to analyse insider trading activities individually in addition to collectively as a complete sample.

In this study, the two categories that showed significant ACAVT were BEE and governance, and key personnel. BEE and governance was a uniquely South African category – and the results illustrate the significance of these announcements. The results also indicated the perceived importance of leadership in South Africa.

It seemed as though South African investors believe that the performance of companies was highly dependent on its leadership. Changes in leadership and announcements relating to BEE and governance did have a significant impact on companies – a situation which could have been exploited by insiders for profit. Another possible explanation was that the information about these types of announcements leaked out more easily compared to other types.

In their study, Jarrell and Poulsen (1989) did not calculate ACAVT. However, they found that 35 percent of their mergers and acquisitions sample exhibited ACAVT preannouncement. Table 7 reports similar results for this study. When the complete sample was considered, ACAVT preannouncement was detected in 24 percent of the sample. However, when the mergers and acquisitions subsample was considered, ACAVT was significant 40 percent of the time.

Therefore, the results obtained were comparable to the findings of Jarrell and Poulsen (1989). Also, half of the qualifying BEE and governance announcements resulted in significant preannouncement volumes traded. However, as this is a uniquely South African category, it could not be compared with any other study. It was noted earlier the key personnel announcement had the lowest percentage significant ACAVT from all the categories, yet it had about the highest magnitude of significant ACAVT. This implied that while the number of even though there may be fewer significant key personnel announcements, the impact of these announcements on insider trading can be huge. The magnitude of the ACAVT in these types of announcements seemed to be very dependent on the detail of the announcement.

The figure of a 24 percent prevalence of significant ACAVT preannouncement seemed to be high at first glance. However, this figure was based on a biased sampling method that was geared to having the highest probability detecting significant preannouncement ACAVTs in the qualifying sample. Therefore, a high prevalence of ACAVT was to be expected. If all qualifying SENS announcements were analysed, the sample size would have been much larger. It is felt in that case, the prevalence of significant ACAVTs would have been lower, but it would be difficult to speculate by how much.

Based on the evidence obtained, it was concluded that insider trading was not endemic or widely prevalent on the JSE. This must also be considered in the context of the sample used – which was constructed to maximise the probability of detecting possible insider trading activities.

6.5. Summary of the results and its implications

The fact that the JSE All Share Index did not display significant ACAVT preannouncement would be regarded as a positive indicator for the JSE. The results of this study could be used to enhance the reputation of the JSE – especially if compared with the NYSE and the AMEX (the results of which were presented table 18).

The JSE stated that it vital that eradicate insider trading – as it does not give all the market participants equal opportunities (JSE, 2006). The results of study could have implications for the JSE and the FSB and help them to achieve this

aim. Based on the sample tested, the following was noted about the results obtained for the different announcements.

- In terms of prevalence of preannouncement abnormal volumes traded, in the BEE and governance category, half of the qualifying sample indicated significant average daily cumulative abnormal volume turnover (ACAVT); while in the mergers and acquisitions category, forty percent of the qualifying sample indicated significant ACAVT. The prevalence in the other categories was lower.

- In terms of the magnitude of preannouncement abnormal volumes traded, the BEE and governance category, the qualifying subsample indicated a significant ACAVT of 0.388 and average daily percentage abnormal turnover (APAV) of 47%; while in the key personnel category, the qualifying subsample indicated a significant ACAVT of 0.353 and average daily percentage abnormal turnover (APAV) of 42%. The magnitude in the other categories was not significant.

- As stated above in table 6, 24 percent of the qualifying sample (34 announcements) exhibited significant ACAVT. For these individual announcements, ACAVT ranged from 0.198 to 5.377, with a mean of 0.973 and a standard deviation of 1.02. The values for APAV for the significant sample ranged from 22 percent to 21 500 percent, with a mean of 165 percent.

The above results indicated that variability does not only exist between stock exchanges, but within shares in a single exchange as well. It was therefore extremely difficult to generalise about insider trading activities. The magnitude of the preannouncement abnormal volume activity depended on the announcement category, the actual announcement, and the company making the announcement.

It was important to analyse the announcements individually and as a part of a sample. This dual analysis enabled a better understanding of preannouncement volume activity and helped with the clarification and characterisation of the problem. This study highlighted the announcement categories that have the highest prevalence or magnitude of preannouncement volume activity. The BEE and governance category were on the top of both lists. Therefore, of all the categories of announcements investigated, the uniquely South African category was the most prone to significant preannouncement ACAVT, and therefore possible insider trading activities.

This information could be used by the JSE and the FSB in order to improve their ability to detect, diagnose, analyse, and prosecute insider trading activities. However, each announcement must also be analysed individually to obtain the most complete analysis of the individual announcements suspected of insider trading activity.

6.6. Additional observations

The above sections provided a discussion on the results that directly affect the scope of this study. However, some further related observations were made, and are discussed in this section. The implications of these observations are discussed in Chapter 7.

Relationship between EVT and ACAVT

In chapter 5.9, it was demonstrated via two sample t-tests that there was no significant difference in the magnitude of significant ACAVT in the high/low (median split) expected volume turnover (EVT) and the top/bottom quartile EVT samples – thus confirming that liquidity did not play a role in the determining the magnitude of the preannouncement abnormal volume activity within this sample.

However, the chi-squared tests indicated that while there were no significant differences in the prevalence of significant ACAVT announcements in the high/low (median split) EVT sample; there was a significant difference in the number of significant ACAVT announcements in the top/bottom quartile EVT sample. This contradiction indicated that the sample utilised did not fully explain the effect of liquidity on the number of significant ACAVT events.

The sample selected had an influence on this result. As the sample selected was from the ALSI, it contained shares that were in the upper half of the JSE in terms of market capitalisation. Jefferis and Smith (2004) concluded that in the JSE, large capitalisation indices are more liquid than small capitalisation indices.

They also stated that while large capitalisation indices are weak form efficient, small capitalisation indices are not. Since the sample did not contain many small capitalisation shares, it was difficult to test the effect of liquidity properly.

Shares versus secondary markets

This study focused on the share market at the JSE. However, some of the studies reviewed included results from other asset classes such as options. In order to make meaningful comparisons between the results of the other studies, the results, where feasible, were transformed to average daily cumulative abnormal volume turnover (ACAVT) or average daily percentage abnormal volume (APAV).

Table 21 summarises the results from the different studies that considered abnormal preannouncement volume activity in both shares and options.

Table 21: Findings of shares versus options

Research paper	Markets	Sample size	Announce Category	AVACT	APAV
Arnold *et al.* (2006)	CBOE, Phil, AMEX, Pacific, NYSE	356	Non option	(0.85+0.02)/ 20 (days from data) =0.0435	4.45% (1% significance)
		45	Options	(1.18-0.15)/ 20 (days from data) =0.0515	5.28% (1% significance)
		45	Call options	(6.25)/ 20 (days from data) =0.3125 (All 1% significance)	31.25% (1% significance)

Research paper	Markets	Sample size	Announce Category	AVACT	APAV
Jayaraman, Frye and Sabherwal (2001)	CBOE	33	Stock sample	0.95/30 (days from data) =0.031667	3.22% (1% significance)
		33	Call options	2.907/30 (days) =0.0969	10.18% (1% significance)
		33	Put options	2.838/30 (days) =0.0946	9.92% (1% significance)
				(All 1% significance)	
Cao, Chen and Griffin (2005)	CBOE	78	Stock sample		36.8%
		78	Call options		1,328%
		78	Put options		76.6%
					(All 5% significance)

All three studies reported significant ACAVTs and APAVs for both shares and options (put and call) in the preannouncement period. The studies indicated that call options have the largest magnitude of ACAVTs and APAVs preannouncement, followed by put options and finally by shares.

Once again, there was a large amount of variability in the results – even though the options were traded on the Chicago Board Options Exchange (CBOE) in each case. It was also noticed that the magnitude of the results obtained in Cao, Chen and Griffin (2005) was much larger than the other two. These results were noted, but not discussed any further here, as the analysis of options was beyond the scope of this study.

7. Conclusions and recommendations

7.1. Summary and conclusions

This study investigated whether abnormal volumes traded could be an indication of insider trading in JSE listed companies. As far as could be ascertained, this was the only South African study that investigated the occurrence of insider trading by analysing abnormal volumes traded preannouncement.

The literature reviewed provided a definition of insider trading and discussed its regulation in the South African context. The literature review showed that most of the studies were based in the United States of America and that most researchers detected abnormal volumes traded preannouncement. Abnormal returns were used to identify the appropriate SENS announcement. The control portfolios technique was used in this study to identify abnormal returns for further analysis (Mordant and Muller, 2003).

Announcements were identified from abnormal returns provided by the "event engine" developed by Muller and Ward (2009). These abnormal returns were analysed together with SENS announcements databases to find the most appropriate SENS announcement that explained the abnormal return. The data was inspected for confounding events. Any announcement with confounding events was removed from the sample. Eventually, this process yielded a qualifying sample of 142 announcements. These announcements were classified into seven categories: BEE and governance; financial structure;

investment/disinvestment, key personnel, mergers and acquisitions; trading update; and other.

The event study methodology was used to analyse the data. The statistical analysis was done on three levels. Firstly, the sample was evaluated in terms of the equations presented by Chae (2005). Then t-tests were performed on the sample and finally bootstrap techniques were used. The different tests provided very similar results, thus providing confidence in the process followed. Where appropriate (to measure for differences in samples) ANOVAs and chi-squared tests were also utilised.

The data analysis procedure was demonstrated by examining a single announcement in detail. For this particular announcement, different window periods were used to calculate expected volume turnover (EVT) as a robustness check. It was found that while the magnitude of the EVT and ACAVT changed slightly with the different periods, the changes did not significantly alter the detection of preannouncement significant abnormal volumes traded. The analysis of the individual announcements resulted in 34 of the 142 (24 percent) announcements exhibiting significant ACAVT and average daily percentage abnormal volume (APAV) traded.

The percentage of significant ACAVT announcements was dependent on the sample selected. Since the sample was biased to increase the probability of detecting significant ACAVT announcements, it was concluded that this figure would be lower if all qualifying SENS announcements were analysed.

When the significant announcements were analysed as a group, it was found to have a mean ACAVT of 0.974 and APAV of 165%. However, there was a large amount of variability between the different announcements. The Kruskal-Wallis multiple-comparison Z-value test (Dunn's Test) also confirmed the difference in magnitudes between the different categories. The prevalence of the number of significant announcements also seemed to differ per announcement category. However, this could not be proved statistically via a chi-squared test due to small sample sizes in some of the categories.

The main hypothesis tested whether there was significant preannouncement ACAVT in the JSE. The results of t-test contradicted the results of the bootstrap test. In order resolve this contradiction, it was decided to minimise the type I error and not to reject the null hypothesis. Therefore, it was concluded that for the complete sample, there was no significant preannouncement ACAVT.

This finding should be a positive for the JSE, as it indicated that for the sample tested, insider trading was not the norm and was restricted to isolated individual cases. This compared favourably with the studies conducted in the United States, where there was significant preannouncement ACAVT in all but one of the studies. The evidence in this study supported the findings of Sanders and Zdanowicz (1992) and did not support those of the other researchers.

There were seven sub-hypotheses tested – one for each announcement category. Once again, there were discrepancies between the results of the t-

tests and the bootstrap tests. The t-tests indicated that five of the seven categories had significant preannouncement ACAVT, while the bootstrap test indicated that this figure was only two of the seven. For the reasons discussed above, it was decided to reject the null hypothesis only when the results of both tests concurred that there was significant ACAVT. Therefore, the study concluded that there was significant preannouncement ACAVT in the case of BEE and governance, and key personnel announcements.

These results highlight the perceived importance of BEE and governance as well as leadership issues in South Africa. The JSE and FSB should be extra vigilant when there are important BEE, governance, and changes in key personnel announcements being made. The data had illustrated that large any insider trading activities were more likely to be associated with these types of announcements.

In addition, as 50 percent of BEE and governance, and 40 percent of mergers and acquisitions announcements exhibited ACAVT, these types of announcements must also be closely monitored by the JSE and FSB, as they were associated with an increased prevalence of significant ACAVT announcements. It was also noted that BEE and governance was at the top of both ACAVT lists (significance and prevalence).

The contradiction between the t-test and the bootstrap test results indicated that the findings for most of the categories was close to being significant. As the results were not clear-cut, it would be wise to carry out similar tests with a

larger sample size. The results obtained was dependent on the exact sample used. Two others issues needs to be taken into consideration. Firstly, the sample was selected using the top five abnormal returns as its basis. This would have had the impact of increasing the probability of detecting significant preannouncement ACAVT.

In addition, a decision was taken to minimise the occurrence of type I errors by ensuring all possible confounding events in the period used to detect abnormal volumes traded were identified and those announcements with confounding events were disqualified. These two actions countered one another, but the end effect on the sample was not known. However, the analysis performed on individual announcements was robust and the associated findings conclusive.

The Kruskal-Wallis test confirmed that there were significant differences in the medians of the various categories. The results obtained were expected, as they were dependent on the constituents of the subsample. In addition, especially in South Africa, certain types of announcements (e.g. BEE) were bound to be considered more important than others. These results confirm the findings of Ryan and Taffler (2004), and Chae (2005), who also reported significant differences in the categories that they tested.

In chapter 1, the question posed was whether abnormal volumes traded could be used as an indication of insider trading. The analysis conducted in this study confirmed that it can. The techniques used in this study were shown to be effective in detecting abnormal volumes traded preannouncement – which

could be used to diagnose and analyse insider trading activities – and thus help address "one of the worst forms of theft" (Urmson, 2009, p. 1). The event study methodology employed has been proven effective in analysing announcements for a long period and is the *de facto* standard (Binder, 1998).

Chapters 1 and 2 also discussed the difficulty in proving and prosecuting insider traders. There are probably still a number of unscrupulous insiders who are practising insider trading and not being caught. Therefore, it would be naïve to think that the techniques proposed here would provide all the answers with respect to insider trading. This research is considered as a tool, which forms part of the toolbox that could be used to detect, diagnose, analyse, and prosecute insider trading. Therefore, the volume analysis presented here must be complemented with other techniques such as share price analysis.

Generally, the JSE or FSB would look to analyse individual announcements where they suspect there was insider trading activity. The techniques utilised in this study would be able to support this process and help determine the level of preannouncement abnormal volumes traded around that announcement. This together with share price analysis should provide compelling evidence to delve deeper into certain suspicious activities. However, any sample has to chosen carefully in order to properly characterise the JSE. When evaluating a complete sample, rather than individual announcements, the following issues would have to be carefully considered:

- Sample selection: Issues like the period of the study, the number of shares that would be analysed, the information sources, the definition of confounding events, and removal of confounding events needs to be addressed.

- Event window: At this stage, no guidelines could be found on how to construct an event window. The decisions made on the window period used to benchmark and detect abnormal volumes would influence the results.

7.2. Research limitations

The research had limitations, which are discussed below. The study covered the period from 01 January 2000 to 24 June 2009, and therefore was not representative of all time. The research only also considered shares in the JSE ALSI as at 24 June 2009. All other shares on the JSE were ignored.

Abnormal returns were used to identify significant announcements. Effectively the dependent variable was being used to identify the independent variable. Therefore, some significant announcements may have been missed.

This analysis only considered a single event window, with the detection period fixed to 21 days and the benchmark period fixed to 63 days. Since these were the only periods used, it was not known if there were more suitable periods that may have produced better results.

The "event engine" developed by Muller and Ward (2009) was used to generate the top five abnormal returns for companies on the All Share Index. Therefore, the analysis did not methodically analyse all of the SENS announcements. The sample generated was biased in that it was geared to increase the probability of detecting significant preannouncement abnormal volumes traded.

The research only considered SENS announcements. There may have been other announcements made on other platforms that were not analysed. Insider trading activities could have also preceded these announcements.

Due to the limitations of the statistical model used, only single announcements could be analysed. Therefore, the research ignored compound effect of multiple announcements. The analysis of these multiple announcements could have materially affected the results.

Only shares were considered for this research. Options, derivatives, and other secondary assets classes were considered out of scope for this research. These assets classes could be subject to insider trading activities as well.

This research focused on the analysis of volumes traded preannouncement. However, in order to obtain a more complete analysis, one would need to consider the movement of share prices as well.

As this research was performed as partial fulfilment of a MBA degree requirement, time was also a limitation for this project. The tight time schedule

restricted the amount of analyses – which could have revealed more insights - that could be performed.

7.3. Recommendations for further research

As stated above, the characterising and diagnosing insider trading is very complex. Many tools are required to be able to win the battle against this crime. This research added another tool to the toolbox. This section recommends some further research that may help develop a few more tools for this toolbox.

Firstly, the best periods to use for the event window in the JSE needs to determined. This would involve determining the best possible windows to use for the benchmark for expected volumes traded and for the detection of significant abnormal volumes traded. It may involve developing some type of market model or control portfolio to characterise the expected volumes traded for the different shares on the JSE. The effects with different detection periods could also be investigated – and eventually arrive at the best possible parameters to investigate significant preannouncement abnormal volumes traded. These event windows would then help inform other researchers who want to study insider trading in South Africa.

The SENS announcements contain quite a bit of secondary information such as the name of the lawyers, accountants, merchant bankers, and financiers, etc. involved with the announcement. According to the act, these would be considered as insiders (RSA 2004). It would be interesting to investigate which

parties are involved when there is significant preannouncement activity. The authorities would be interested to know if primarily the same people or organisations are involved when there is significant preannouncement activity.

As described in chapter 6.6, in the United States of America researchers have investigated significant preannouncement abnormal volumes in options, in addition to investigating shares. They confirmed that the magnitude of abnormal activity was more pronounced than in the case of shares (Arnold *et al.,* 2006; Jayaraman, Frye and Sabherwal, 2001; and Cao, Chen and Griffin, 2005). Thus, it seems as though the secondary market cannot be ignored (even though it is not as well developed in South Africa) if a more complete picture of insider trading has to be developed. It is therefore recommended further research be undertaken to investigate the preannouncement activity within the secondary market in South Africa.

The sample investigated (in chapters 5.9 and 6.6) confirmed that there were insignificant differences between the prevalence of significant preannouncement volume activity between the more liquid half and the less liquid half of the sample. However, this difference become significant when the top quartile was compared to the bottom quartile. Although not significant, the results also showed that the magnitude of the significant preannouncement volume activity was greater in the less liquid shares. These tests were done in order to help understand the results obtained in this study. However, from the evidence obtained, it seems as though liquidity could play a role in characterising insider trading. It is therefore recommend that the relationship

between liquidity and preannouncement volume activity be investigated. Different indices or even the JSE with the Alt-X exchange could be compared with each other during the investigation.

The research investigated abnormal volume activity around SENS announcements. Therefore, other types of announcements – such as analysts reports and press announcements were not considered. These announcements could have a bearing on the results. Consequently, it is recommended that preannouncement volume activity around other announcements (including analyst reports and press releases) be researched.

As stated above, this research is but one tool that could be used to investigate insider trading. Abnormal returns on share prices is another tool that has usefulness in investigating insider trading. Together, these two techniques could help the JSE and FSB police insider trading more effectively. It is therefore recommended that combined effect of preannouncement abnormal returns and abnormal volumes traded in the JSE be researched.

At this stage, the effectiveness of the insider trading penalties in South Africa is not known (especially when compared to the rest of the world). There have been some international studies, but none published from a South African perspective. It would be useful to benchmark the penalties imposed by countries in the rest of the world and their success in curbing insider trading with those in South Africa. The findings of this study could be used to make recommendations to the JSE and FSB.

Finally, the techniques presented in this paper are of a diagnostic nature. This would be useful investigating insider trading activities after the fact i.e. retrospectively. It would be useful to look at ways to try to detect possible insider trading activities earlier in the process, by implementing some sort of early warning system. This would probably take the form of determining thresholds and using techniques such as using moving averages. These could then be used to initiate investigations a lot sooner, thus allowing the JSE and FSB to preside over these cases and settle them while all the details are still fresh. Research that helps build this model would have a huge positive impact in the fight against insider trading.

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Appendices

Appendix 1: Final list of announcements analysed

This appendix contains the list of announcements that qualified for further analysis after employing the rules of chapter 4.7.1. The following information was captured: the number of the announcement; the share code; the company name; the date of the announcement; the description of the announcement; and the category of the announcement. As discussed previously, only SENS announcements were analysed.

No.	Share Code	Company	Date	SENS Announcement	Category
1	ASA	Absa	2009/03/26	ABSA's Black Economic Empowerment transaction with the Batho Bonke Consortium	BEE and Governance
2	MKL	Makalani	2005/12/14	Makalani to Provide Funding for the Metropolitan BEE transaction and to Mvela Group	BEE and Governance
3	NHM	Northam	2008/08/19	Notice of trading of new Northam and Mvela Resources ordinary shares and Booysendal Transaction update	BEE and Governance
4	PSG	PSGI	2004/04/22	BEE Transaction by way of Issue of Shares for Cash: Result	BEE and Governance
5	SHF	Steinhoff	2008/12/01	Results of the Annual General Meeting, Chief Executive's Statement and Broad Based Black Economic "BBBEE" Transaction	BEE and Governance
6	ABL	Abil	2003/07/23	Hacking Of ABIL Internet Site	BEE and Governance
7	BVT	Bidvest	2008/11/17	Statement Following The Bidvest Annual General Meeting	BEE and Governance
8	DSY	Discovery	2001/06/29	Announcement	BEE and Governance
9	EXX	Exxaro	2007/03/14	Exxaro suspends underground Mining at new clydesdale	BEE and Governance
10	SOL	Sasol	2008/11/28	Sasol To Appeal Decision Of The European Commission	BEE and Governance

No.	Share Code	Company	Date	SENS Announcement	Category
11	AEG	Aveng	2001/05/22	Unsecured Automatically Convertible Subordinated Debentures	Financial Structure
12	AFT	Afrimat	2009/03/19	Closed Period Share Repurchase Programme	Financial Structure
13	APA	ApexHi-A	2004/05/06	Distribution	Financial Structure
14	APN	Aspen	2001/03/30	Proposed Specific Repurchase of Ordinary Shares	Financial Structure
15	AXC	Apexhi C	2008/02/06	Reviewed Interim Results For The Six Months Ended 31 December 2007 And Quarterly Interest Distribution Declaration For The Three Months Ended 31 December 2007	Financial Structure
16	CAT	Cat	2002/11/21	RESULTS OF GENERAL MEETING OF CTP SHAREHOLDERS	Financial Structure
17	DAW	Dawn	2002/06/26	Announcement - DAWN will acquire from the sellers 98 193 669 ordinary shares ("shares")	Financial Structure
18	DEL	Delta	2008/10/24	Declaration of a special dividend and shareholder update	Financial Structure
19	EMI	Emira	2005/06/29	Trading Statement - Change to Criteria	Financial Structure
20	GND	Grindrod	2002/04/24	Repurchase Of Ordinary And n Ordinary Shares On The Open Market	Financial Structure
21	HYP	Hyprop	2002/03/15	Amendment Of Dates Relating To The Hyprop Distribution	Financial Structure
22	NTC	Netcare	2006/01/24	Proposed Simplification of Shareholding Structure and Cautionary Announcement	Financial Structure
23	PAM	Palamin	2003/03/27	Underground Production Delays Lead To Additional Finance Requirements	Financial Structure
24	PGR	Pergrin	2003/08/20	Repurchase of Shares in terms of the General Authority Granted	Financial Structure
25	SPP	Spar	2006/06/27	Report on proceedings at General Meeting	Financial Structure
26	SPP	Spar	2006/02/08	Revision of dividend policy	Financial Structure
27	TRE	Trencor	2004/11/25	6% Unsecured Automatically Convertible Subordinated Debentures	Financial Structure
28	MRF	Merafe	2001/02/27	Results Of Share Issue	Financial Structure
29	SLM	Sanlam	2008/10/01	Amendment to Employee Incentive Plans	Financial Structure
30	ALT	Altech	2008/12/17	Altech to Sell Namitech South Africa to Gemalto	Investment / Disinvestment

No.	Share Code	Company	Date	SENS Announcement	Category
31	APB	ApexHi-B	2002/01/22	Furhter Cautionary Announcement	Investment / Disinvestment
32	AVI	AVI	2001/12/13	AVI Subsidiary, Consol Limited, Announces R200m New Furnace Investment	Investment / Disinvestment
33	IFR	IFour Properties	2003/05/28	Further Cautionary Announcement	Investment / Disinvestment
34	NPN	Naspers	2008/11/10	Further Announcement Disposal Of Internet Service Provider Business (MWEB)	Investment / Disinvestment
35	NTC	Netcare	2008/12/11	Sale of Units and Claims in Ampath Group	Investment / Disinvestment
36	PHM	Phumelela	2004/06/30	Voluntary Announcement	Investment / Disinvestment
37	SAC	SA Corp	2008/10/10	Announcement	Investment / Disinvestment
38	SLM	Sanlam	2008/02/12	Sanlam Acquires UK Private Client Business	Investment / Disinvestment
39	SLM	Sanlam	2002/02/14	Sanlam and Banking Services	Investment / Disinvestment
40	TKG	Telkom	2009/05/18	Announcement Regarding Urgent Application by COSATU and ICASA	Investment / Disinvestment
41	ABL	Abil	2009/03/31	Changes to the board of directors and board committees	Key Personnel
42	AFE	AECI	2009/03/02	Resignation of Company Secretary and Appointment of Acting Company Secretary	Key Personnel
43	AFE	AECI	2007/05/02	Appointment Of Non-Executive Director	Key Personnel
44	AMA	Amap	2001/12/20	Resignation of Director	Key Personnel
45	APK	Astrapak	2003/09/25	Change To The Board Of Directors	Key Personnel
46	ASA	Absa	2001/05/16	Appointment of Non-Executive Directors	Key Personnel
47	CPL	Capital	2002/02/07	Change in Board of Directors / Audited Annual Financial Statements and Final Dividend Determination	Key Personnel
48	CRM	Ceramic	2008/03/04	Change Of Sponsor	Key Personnel
49	GND	Grindrod	2002/10/25	New Directors	Key Personnel
50	HDC	Hudaco	2008/11/25	Resignation Of Company Secretary	Key Personnel
51	IMP	Implats	2009/04/01	Directorate	Key Personnel
52	IPL	Imperial	2008/10/09	Changes To The Imperial Holdings Board, Executive Committee and Senior Management	Key Personnel
53	IVT	Invicta	2005/01/26	Change to the board of directors	Key Personnel
54	JDG	JD Group	2001/04/02	Appointment Of Additional Directors	Key Personnel
55	KGM	KG Media	2003/04/01	Changes to the Board	Key Personnel
56	MET	Metropolitan	2002/03/04	Metropolitan Health Group Restructures	Key Personnel

No.	Share Code	Company	Date	SENS Announcement	Category
57	MKL	Makalani	2006/11/06	Changes to the Board of Directors	Key Personnel
58	NED	Nedcor	2003/09/15	Richard Laubscher Announces Plans to Step Down by Year End	Key Personnel
59	OCE	Oceana	2009/04/02	Appointment of Chief Executive Officer	Key Personnel
60	SAC	SA Corp	2009/04/01	Changes In Executive And Senior Management Of The Fund	Key Personnel
61	TON	Tongaat	2003/05/26	Changes in Directorate	Key Personnel
62	TRE	Trencor	2003/04/04	Appointment of Managing Director	Key Personnel
63	ALT	Altech	2007/10/24	Firm Intention of Altron to make an offer to acquire the issued ordinary share and withdrawal of cautionary announcements	Mergers and Acquisitions
64	AMA	Amap	2001/01/30	Acquisition of Additional Shares in Amap by Salton Inc.	Mergers and Acquisitions
65	AVI	AVI	2008/11/17	AVI Response to the Announcement By Tiger Brands Limited of a Potential Offer for AVI	Mergers and Acquisitions
66	HAR	Harmony	2001/03/23	Notice regarding the fulfilment of certain conditions precedent relating to the proposed acquisition by Harmony of the Elandsrand and Deelkraal mines (the "acquisition") from Anglogold Limited	Mergers and Acquisitions
67	HVL	Highveld	2001/10/08	Further cautionary announcement	Mergers and Acquisitions
68	IMP	Implats	2001/03/26	Acquisition of a stake in Zimplats and Zimplats Ngezi project	Mergers and Acquisitions
69	IMP	Implats	2009/01/07	Mvela Resources/Northam/Implats - Joint Renewal of cautionary announcement	Mergers and Acquisitions
70	LON	Lonmin	2008/08/06	Statement re Pre-Conditional Offer - notes the unsolicited, pre-conditional offer announced this morning by Xstrata	Mergers and Acquisitions
71	PGR	Pergrin	2009/01/09	Withdrawal of Interest in Acquiring the Issued Shares of Peregrine	Mergers and Acquisitions
72	RBW	Rainbow	2007/03/22	Firm Intention to Make an Offer by Remgro to Acquire the Entire issued share capital of Rainbow	Mergers and Acquisitions

No.	Share Code	Company	Date	SENS Announcement	Category
73	SAB	SABMiller	2005/07/19	SABMiller & Bavaria Announce A Major Transaction in Latin America	Mergers and Acquisitions
74	SBK	Stanbank	2008/03/27	Acquisition by Liberty of 50% of the Asset Management Operations in relation to Fountainhead Property Trust	Mergers and Acquisitions
75	SUI	Sun Int	2001/02/26	Further Joint Cautionary Announcement	Mergers and Acquisitions
76	TBS	Tiger Brands	2006/07/07	Proposed Waiver of Mandatory Offer	Mergers and Acquisitions
77	WBO	Wbhovco	2005/06/20	Offer For Concor Limited	Mergers and Acquisitions
78	APK	Astrapak	2002/02/28	Cautionary Announcement	Other
79	ATN	Altron	2009/04/01	Altron Asset Reunification Programme	Other
80	ATNP	Altron Pref	2005/01/28	Cautionary Announcement	Other
81	CDZ	Cadiz	2002/05/29	Cadiz Ranked Top Derivatives House For Sixth Successive Year	Other
82	CRM	Ceramic	2004/09/08	Index Change Advice - September 2004 Quarterly Index Review	Other
83	DRD	Drdgold	2008/01/25	Electricity supply update by DrdGold South African	Other
84	MTX	Metorex	2008/11/10	Metorex has entered into negotiations which may have an effect on the price of the company`s securities	Other
85	MUR	M & R	2008/01/28	The South African Power Situation	Other
86	MVG	Mvelaphanda Group	2006/07/03	Cautionary Announcement	Other
87	OCT	Octodec	2001/03/22	Cautionary Announcement	Other
88	RDF	Redefine	2001/03/27	Cautionary Announcement	Other
89	RLO	Reunert	2003/03/12	FTSE / JSE Africa Index Series - Quarterly Review	Other
90	SAP	Sappi	2009/04/01	Voting rights and capital	Other
91	SBK	Stanbank	2001/09/27	Standard Bank has no links to Sudanese Bank	Other
92	SHP	Shoprite	2006/07/04	Renewal of cautionary announcement	Other
93	TAL	TiAuto	2007/10/18	Cautionary Announcement	Other
94	WHL	Woolworths	2007/12/14	Cautionary announcement	Other
95	ACL	ArcMittal	2004/01/26	Trading Statement And Cautionary Announcement	Trading Update
96	ACP	Acucap	2003/09/18	Acquisition of a Turnkey Development in Kempton Park	Trading Update
97	ADR	Adcorp	2001/11/09	Review of Trading Operations	Trading Update
98	ADR	Adcorp	2004/05/26	Trading Statement and Cautionary Announcement	Trading Update
99	AFR	Afgri	2008/09/16	Large Maize Crops as AFGRI Reports 18,7% increase in HEPS	Trading Update

No.	Share Code	Company	Date	SENS Announcement	Category
100	AFR	Afgri	2005/01/31	Trading Statement	Trading Update
101	AFX	Afrox	2009/02/11	Trading update	Trading Update
102	AMS	Angloplats	2008/10/23	Anglo Platinum Quarterly Review And Production Report For The Period	Trading Update
103	APK	Astrapak	2008/10/17	Updated Trading Statement	Trading Update
104	ARL	Astral	2008/11/03	Trading Statement	Trading Update
105	ART	Argent	2004/05/04	Trading Update And Cautionary Announcement	Trading Update
106	ASO	Austro	2009/05/06	Trading Statement	Trading Update
107	DDT	Didata	2003/03/06	Update on Trading Conditions	Trading Update
108	DTC	Datatec	2001/03/15	Shareholder Update	Trading Update
109	DTC	Datatec	2002/09/25	Trading Update and Reorganisation	Trading Update
110	EXX	Exxaro	2008/02/07	Trading Statement For The 12 Months Ended 31 December 2007	Trading Update
111	FBR	FamBrands	2001/09/28	Profit Warning	Trading Update
112	FOS	Foschini	2001/02/06	Profit Warning	Trading Update
113	GFI	GFields	2001/05/10	Gold Fields Limited Earns R261 Million and Continues Profitable Performance in March Quarter	Trading Update
114	GRT	Growthpoint	2001/07/04	Acquisition by Growthpoint of a portfolio of properties from the Sentinel Mining Industry Retirement Fund ("Sentinel") and the Mine Employees Pension Fund ("MEPF")	Trading Update
115	HLM	Hulamin	2008/12/11	Trading Statement For The Year To December 2008	Trading Update
116	ILA	Iliad	2001/08/30	Releases Improved Results	Trading Update
117	IMP	Implats	2009/05/18	Implats - Third Quarter Production Report For The Period 1 January	Trading Update
118	IMP	Implats	2008/08/06	Impala Platinum Holdings Limited - Trading statement	Trading Update
119	JDG	JD Group	2008/11/04	Trading statement	Trading Update
120	KIO	KIO	2008/10/03	Kumba benchmark price negotiations for the 2008/2009 iron ore year	Trading Update
121	LEW	Lewis	2008/08/15	Results Of AGM and statement by chief executive officer	Trading Update

No.	Share Code	Company	Date	SENS Announcement	Category
122	MPC	Mr Price	2001/01/16	Mr Price Group Achieves Sales Increase For Christmas Period	Trading Update
123	MPC	Mr Price	2002/07/29	Mr Price Group Reports Strong First Quarter	Trading Update
124	MSM	Massmart	2002/02/22	Results For The 26 Weeks To 23 December 2001	Trading Update
125	MST	Mustek	2008/02/21	Trading Statement	Trading Update
126	MTN	MTN	2008/10/31	Release of Subscriber Numbers For the Quarter Ended 30 September 2008	Trading Update
127	MUR	M & R	2008/11/25	Business update	Trading Update
128	MVG	Mvelaphanda Group	2008/08/19	Trading Statement In Respect Of The Year Ended 30 June 2008	Trading Update
129	NPK	Nampak	2001/01/25	Profit Warning	Trading Update
130	OCE	Oceana	2008/04/02	Trading Statement	Trading Update
131	PAM	Palamin	2003/10/20	Third Quarter Production Statistics	Trading Update
132	PPC	PP Cement	2002/01/25	Chairmans Statement	Trading Update
133	PPC	PP Cement	2005/01/14	Am Trading Update	Trading Update
134	RBW	Rainbow	2005/02/07	Voluntary Trading Statement	Trading Update
135	RBX	Raubex	2009/03/26	Trading update in respect of the year ended 28 February 2009	Trading Update
136	RBX	Raubex	2008/10/21	Presentation to Investors and Analysts	Trading Update
137	REI	Reinet	2009/03/10	Press Release for Immediate Release	Trading Update
138	SAP	Sappi	2009/03/02	Sappi Trading Update as at the Annual General Meeting of 02 March 2009	Trading Update
139	SPP	Spar	2008/10/31	Trading Statement	Trading Update
140	SUI	Sun Int	2008/11/04	Business Update For the Quarter to 30 September 2008	Trading Update
141	TRU	Truworths	2001/01/10	Truworths On Track For Increased Earnings	Trading Update
142	WHL	Woolworths	2003/11/20	Trading Statement	Trading Update

Appendix 2: Summarised statistics for the significant sample

This appendix contains the summary of the statistical analysis performed on the announcements identified as having significant abnormal volumes traded in the period used to detect abnormal returns.

No.	Share Code	Company	Data	Difference of means test	Category	Equation ACAVT	Standard deviation	Equation APAV	T-test ACAVT	Statistic	p-value	T-test APAV	Bootstrap ACAVT	Lower conf level (LCL)	Upper conf level (UCL)	Bootstrap APAV
1	ASA	Absa Group	2009/03/26	Mann-Whitney U Test	BEE and Governance	0.44143	0.52594	55.49%	0.44143	2.61350	0.00448	55.49%	0.43890	0.16620	0.69850	55.10%
2	NHM	Northam Platinum	2008/08/19	Equal-Variance T-Test	BEE and Governance	0.71968	0.61372	105.38%	0.71968	3.79620	0.00014	105.38%	0.72480	0.40840	1.06230	106.43%
3	BVT	Bidvest Group	2008/11/17	Equal-Variance T-Test	BEE and Governance	0.21823	0.44225	24.39%	0.21823	1.78060	0.03934	24.39%	0.21930	0.0116*	0.4206*	24.52%
4	DSY	Discovery Holdings	2001/06/29	Mann-Whitney U Test	BEE and Governance	1.00303	1.97675	172.65%	1.00304	1.98340	0.02366	172.66%	1.00580	0.05140	1.99460	173.41%
5	SOL	Sasol	2008/11/28	Mann-Whitney U Test	BEE and Governance	1.66138	3.85108	426.66%	1.66138	1.98580	0.02353	426.66%	1.66720	0.0412**	3.383**	429.73%
6	AXC	ApexHi-C	2008/02/06	Equal-Variance T-Test	Financial Structure	1.11927	1.00530	206.26%	1.11926	3.50470	0.00037	206.26%	1.11890	0.60540	1.65720	206.15%
7	SPP	Spar Group	2006/06/27	Equal-Variance T-Test	Financial Structure	0.54298	0.92670	72.11%	0.54299	2.45630	0.00807	72.11%	0.54400	0.10720	0.98570	72.29%
8	SPP	Spar Group	2006/02/08	Equal-Variance T-Test	Financial Structure	0.39372	0.76342	48.25%	0.39371	1.84530	0.03430	48.25%	0.39740	0.02270	0.77770	48.80%
9	TRE	Trencor	2004/11/25	Mann-Whitney U Test	Financial Structure	1.51413	3.53534	354.55%	1.51413	2.44860	0.00717	354.54%	1.50640	0.0758*	3.1776*	351.05%
10	MRF	Merafe Resources	2001/02/27	Kolmogorov-Smirnov Test	Financial Structure	2.07427	0.92975	695.87%	2.07430	0.53968	0.00010	695.89%	2.07340	1.17220	2.89210	695.18%
11	SLM	Sanlam	2008/10/01	Equal-Variance T-Test	Financial Structure	0.26291	0.45381	30.07%	0.26290	2.15740	0.01695	30.07%	0.26460	0.03890	0.48430	30.29%
12	ALT	Altech	2008/12/17	Kolmogorov-Smirnov Test	Investment/ Disinvestment	0.19827	2.71118	21.93%	0.19827	0.39683	0.01140	21.93%	0.19100	-0.8027***	1.4795***	21.05%
13	NPN	Naspers	2008/11/10	Aspin-Welch Unequal-Variance Test	Investment/ Disinvestment	0.36296	0.34764	43.76%	0.36296	3.17440	0.00113	43.76%	0.36430	0.14330	0.58300	43.95%
14	TKG	Telkom SA	2009/05/18	Equal-Variance T-Test	Investment/ Disinvestment	0.66786	0.55029	95.01%	0.66787	4.66100	0.00001	95.01%	0.66750	0.39220	0.97330	94.94%

No.	Share Code	Company	Data	Difference of means test	Category	Equation ACAVT	Standard deviation	Equation APAV	T-test ACAVT	Statistic	p-value	T-test APAV	Bootstrap ACAVT	Lower conf level (LCL)	Upper conf level (UCL)	Bootstrap APAV
15	ABL	African Bank Investments	2009/03/31	Kolmogorov-Smirnov Test	Key Personnel	0.41427	0.42835	51.33%	0.41427	0.34921	0.03710	51.33%	0.41290	0.16230	0.66680	51.12%
16	KGM	Kagiso Media	2003/04/01	Kolmogorov-Smirnov Test	Key Personnel	3.30973	5.71019	2637.78%	3.30975	0.34921	0.03710	2637.83%	3.28530	0.75750	5.77870	2571.70%
17	TON	Tongaat Hulett	2003/05/26	Equal-Variance T-Test	Key Personnel	0.39076	1.00962	47.81%	0.39075	1.86210	0.03309	47.81%	0.39420	-0.0793***	0.8408***	48.32%
18	ALT	Altech	2007/10/24	Equal-Variance T-Test	Mergers and acquisitions	0.64456	0.95129	90.51%	0.64456	1.99580	0.02464	90.52%	0.65060	0.14240	1.18270	91.67%
19	IMP	Impala Platinum Holdings	2001/03/26	Kolmogorov-Smirnov Test	Mergers and acquisitions	0.34298	0.43837	40.91%	0.34297	0.34921	0.03710	40.91%	0.34350	0.10050	0.58720	40.99%
20	LON	Lonmin	2008/08/06	Equal-Variance T-Test	Mergers and acquisitions	0.55700	0.94643	74.54%	0.55700	2.48280	0.00754	74.54%	0.55440	0.09400	1.01330	74.09%
21	RBW	Rainbow Chicken	2007/03/22	Equal-Variance T-Test	Mergers and acquisitions	1.55339	0.93145	372.75%	1.55339	5.10100	0.00000	372.75%	1.55600	1.04480	2.04330	373.98%
22	SBK	Standard Bank Group	2008/03/27	Aspin-Welch Unequal-Variance Test	Mergers and acquisitions	0.22495	0.27193	25.23%	0.22495	2.57590	0.00614	25.23%	0.22220	0.05300	0.39400	24.88%
23	TBS	Tiger Brands	2006/07/07	Mann-Whitney U Test	Mergers and acquisitions	0.28476	0.44636	32.94%	0.28476	2.15900	0.01543	32.94%	0.28400	0.07650	0.48580	32.84%
24	ACP	Acucap Properties	2003/09/18	Kolmogorov-Smirnov Test	Trading update	2.03974	3.36718	668.86%	2.03974	0.41270	0.00740	668.86%	2.04650	0.31480	3.90300	674.08%
25	EXX	Exxaro Resources	2008/02/07	Aspin-Welch Unequal-Variance Test	Trading update	0.51440	0.37984	67.26%	0.51440	3.48470	0.00040	67.26%	0.51550	0.19390	0.84350	67.45%
26	ILA	Iliad Africa	2001/08/30	Kolmogorov-Smirnov Test	Trading update	5.37710	1.70117	21539.46%	5.37710	0.55556	0.00010	21539.36%	5.36870	3.87890	6.81830	21358.37%
27	IMP	Impala Platinum Holdings	2008/08/06	Equal-Variance T-Test	Trading update	0.47857	0.53659	61.38%	0.47856	4.02620	0.00006	61.37%	0.47540	0.19420	0.75600	60.87%
28	MTN	MTN Group	2008/10/31	Mann-Whitney U Test	Trading update	0.52813	0.40849	69.58%	0.52813	4.38510	0.00001	69.58%	0.52970	0.30060	0.74510	69.84%
29	MUR	Murray and Roberts	2008/11/25	Equal-Variance T-Test	Trading update	0.68567	0.53951	98.51%	0.68567	4.43890	0.00001	98.51%	0.68800	0.41280	0.96780	98.97%
30	RBX	Raubex	2008/10/21	Kolmogorov-Smirnov Test	Trading update	1.23732	1.23732	244.64%	1.23733	0.34921	0.03710	244.64%	1.24300	0.44290	1.98760	246.60%
31	SPP	Spar Group	2008/10/31	Equal-Variance T-Test	Trading update	0.82032	0.64247	127.12%	0.82032	4.82020	0.00002	127.12%	0.81630	0.48110	1.13020	126.21%

No.	Share Code	Company	Data	Difference of means / medians test	Category	Equation ACAVT	Standard deviation	Equation APAV	T-test ACAVT	Statistic	p-value	T-test APAV	Bootstrap ACAVT	Lower conf level (LCL)	Upper conf level (UCL)	Bootstrap APAV
32	ATN	Altron	2009/04/01	Mann-Whitney U Test	Other	1.32610	1.45264	276.63%	1.32609	0.49206	0.00060	276.63%	1.32550	0.59440	2.09440	276.41%
33	DRD	DRDGold	2008/01/25	Aspin-Welch Unequal-Variance Test	Other	0.75903	1.50863	113.62%	0.75902	2.19270	0.01906	113.62%	0.75680	0.11480	1.44800	113.14%
34	WHL	Woolworths Holdings	2007/12/14	Aspin-Welch Unequal-Variance Test	Other	0.44828	0.38259	56.56%	0.44829	3.55920	0.00034	56.56%	0.44920	0.17870	0.73780	56.71%
Mean						**0.97404**		**164.86%**	**0.97404**			**164.86%**	**0.97356**			**164.74%**
Standard Deviation						**1.02951**			**1.02950**				**1.02703**			

Notes:
1. * 92.50% Confidence level
2. ** 90.00% Confidence level
3. *** Negative lower confidence level
4. All other tests significant to 95% confidence level

Appendix 3: Multiple-comparison test on the significant sample

This appendix the results for the Kruskal-Wallis multiple-comparison Z-value test (Dunn's Test) for both the standard and bootstrap significant samples.

Standard significant sample

Sample	All	BG	FS	ID	KP	MA	O	TU
All	0.0000	0.5690	1.7854	1.6190	2.3181	2.5010	0.5439	2.9886
BEE and governance (BG)	0.5690	0.0000	1.7557	0.9620	1.5386	1.3789	0.8217	2.5380
Financial Structure (FS)	1.7854	1.7557	0.0000	2.4971	3.0925	3.2876	0.6548	0.7106
Investment/ Disinvestment (ID)	1.6190	0.9620	2.4971	0.0000	0.5157	0.1872	1.5954	3.1750
Key Personnel (KP)	2.3181	1.5386	3.0925	0.5157	0.0000	0.4082	2.1111	3.7969
Mergers and Acquisitions (MA)	2.5010	1.3789	3.2876	0.1872	0.4082	0.0000	2.0295	4.2252
Other (O)	0.5439	0.8217	0.6548	1.5954	2.1111	2.0295	0.0000	1.2508
Trading Update (TU)	2.9886	2.5380	0.7106	3.1750	3.7969	4.2252	1.2508	0.0000

Regular Test: Medians significantly different if z-value > 1.9600
Bonferroni Test: Medians significantly different if z-value > 3.1237

Bootstrap significant sample

Sample	All	BG	FS	ID	KP	MA	O	TU
All	0.0000	0.5683	1.7852	1.6184	2.3198	2.5026	0.5421	2.9913
BEE and governance (BG)	0.5683	0.0000	1.7550	0.9620	1.5405	1.3806	0.8198	2.5393
Financial Structure (FS)	1.7852	1.7550	0.0000	2.4964	3.0939	3.2886	0.6562	0.7128
Investment/ Disinvestment (ID)	1.6184	0.9620	2.4964	0.0000	0.5174	0.1887	1.5937	3.1760
Key Personnel (KP)	2.3198	1.5405	3.0939	0.5174	0.0000	0.4087	2.1111	3.8000
Mergers and Acquisitions (MA)	2.5026	1.3806	3.2886	0.1887	0.4087	0.0000	2.0290	4.2284
Other (O)	0.5421	0.8198	0.6562	1.5937	2.1111	2.0290	0.0000	1.2540
Trading Update (TU)	2.9913	2.5393	0.7128	3.1760	3.8000	4.2284	1.2540	0.0000

Regular Test: Medians significantly different if z-value > 1.9600
Bonferroni Test: Medians significantly different if z-value > 3.1237

Appendix 4: AVT and CAVT for all samples

The table below indicates the value for AVT and CAVT for the complete qualifying sample and all the category subsamples in the event period from t_{-21} to t_1.

AVT CAVT	T-21	T-20	T-19	T-18	T-17	T-16	T-15	T-14	T-13	T-12	T-11	T-10	T-9	T-8	T-7	T-6	T-5	T-4	T-3	T-2	T-1	T0	T1
BEE and governance	-1.0746	-0.4904	-0.6834	0.4017	0.7487	0.3499	-0.0637	0.4416	1.3452	0.4534	0.2808	0.6894	-0.1473	0.4452	0.3023	0.8009	0.5172	0.9772	1.0999	0.5964	1.1643	0.4475	0.9067
	-1.0746	-1.5650	-2.2484	-1.8467	-1.0980	-0.7481	-0.8118	-0.3703	0.9750	1.4284	1.7091	2.3986	2.2513	2.6964	2.9987	3.7996	4.3168	5.2940	6.3940	6.9904	8.1547	8.6021	9.5088
Financial structure	0.6750	-0.8907	0.5627	0.4817	0.8627	-0.5381	-0.5026	1.4889	0.0716	-0.6630	0.4435	0.1635	-0.1858	0.2805	-0.5919	0.1359	1.5541	0.6409	-0.2117	0.0101	0.1641	1.2995	-0.0149
	0.6750	-0.2157	0.3470	0.8287	1.6914	1.1532	0.6506	2.1395	2.2111	1.5481	1.9916	2.1551	1.9693	2.2498	1.6579	1.7938	3.3479	3.9889	3.7772	3.7873	3.9514	5.2510	5.2361
Investment or disinvestment	-1.4724	0.6228	-0.2786	-0.4087	-1.0923	-0.4299	0.7109	-0.0202	-0.6023	-1.3533	-0.5378	-0.3865	0.0495	1.3623	0.1921	-0.9184	0.0656	0.1640	0.8119	-1.0855	0.2081	0.5359	1.3168
	-1.4724	-0.8495	-1.1281	-1.5368	-2.6292	-3.0591	-2.3481	-2.3684	-2.9706	-4.3239	-4.8618	-5.2483	-5.1987	-3.8364	-3.6442	-4.5626	-4.4970	-4.3330	-3.5211	-4.6066	-4.3985	-3.8626	-2.5458
Key personnel	0.1413	-0.1235	0.7245	-0.0588	1.0681	0.8948	0.5699	0.7767	-0.6400	-0.2714	-0.3822	1.5503	1.0046	1.2226	0.7454	-0.5744	-0.6815	0.2698	0.7840	0.7066	-0.3086	0.7908	0.1830
	0.1413	0.0178	0.7422	0.6834	1.7515	2.6463	3.2162	3.9929	3.3529	3.0816	2.6993	4.2496	5.2543	6.4768	7.2223	6.6478	5.9664	6.2362	7.0202	7.7268	7.4181	8.2089	8.3919
Mergers and acquisitions	-0.6303	-0.6874	0.1901	-0.7745	0.2835	-0.2771	0.5945	0.2505	0.3181	0.3367	0.3282	0.3376	-0.6085	0.0401	0.3033	-0.6031	-1.3056	0.1617	-0.0494	0.2836	0.7164	0.8482	0.6234
	-0.6303	-1.3177	-1.1276	-1.9021	-1.6186	-1.8957	-1.3011	-1.0506	-0.7325	-0.3959	-0.0677	0.2699	-0.3386	-0.2985	0.0049	-0.5982	-1.9039	-1.7422	-1.7916	-1.5080	-0.7916	0.0566	0.6800
Trading update	-0.1951	0.1052	0.2938	0.4928	-0.4146	-0.8797	-0.0839	0.1652	-0.4092	0.0868	-0.0479	0.0238	0.0848	-0.4010	0.3922	0.0841	0.4691	0.8348	0.6424	0.0055	-0.1314	1.2370	0.6952
	-0.1752	0.0748	0.2926	0.4889	-0.4249	-0.8692	-0.1062	0.1593	-0.4340	0.0939	-0.0329	0.0418	0.1119	-0.4053	0.3704	0.0674	0.4750	0.8353	0.6114	-0.0102	-0.1472	1.2265	0.7005
Other	-1.2519	-0.3984	-1.7685	-0.4617	0.10465	-0.9243	-0.2491	-0.5224	0.15636	-0.2849	0.98093	0.31752	-0.1484	1.30497	0.3738	0.43963	1.10802	0.27197	-1.3398	-0.7055	-0.6338	-0.1474	-0.5117
	-1.2519	-1.6503	-3.4188	-3.8806	-3.7759	-4.7003	-4.9494	-5.4719	-5.3155	-5.6004	-4.6195	-4.3020	-4.4504	-3.1455	-2.7717	-2.3320	-1.2240	-0.9520	-2.2919	-2.9974	-3.6312	-3.7787	-4.2904
All	-0.3599	-0.2094	0.0255	0.0814	0.1514	-0.3793	0.0763	0.3688	-0.1275	-0.1729	0.1141	0.3624	0.0709	0.3887	0.2818	-0.0682	0.2972	0.5409	0.2850	0.0161	0.0276	0.8595	0.4318
	-0.3599	-0.5693	-0.5438	-0.4624	-0.3110	-0.6903	-0.6141	-0.2453	-0.3728	-0.5456	-0.4315	-0.0691	0.0018	0.3905	0.6724	0.6042	0.9013	1.4422	1.7273	1.7434	1.7710	2.6305	3.0623

Appendix 5: Final list of announcements used to compare EVT with ACAVT

This appendix contains the table that was used to analyse the relationship between expected volume turnover (EVT) and average daily cumulative abnormal turnover. The information in the table lists the share code, share name, the value of expected volume turnover (EVT), the value of the average daily cumulative abnormal volume turnover (ACAVT) for significant events, and an indication whether an event was significant or not.

No.	Share Code	Company	EVT	Significant ACAVT	Significant Indicator YES; or NO
1	ASA	Absa	-5.90276	0.441428992	YES
2	MKL	Makalani	-9.62307	0	NO
3	NHM	Northam	-6.51626	0.719681066	YES
4	PSG	PSGI	-7.73691	0	NO
5	SHF	Steinhoff	-5.64205	0	NO
6	ABL	Abil	-5.98639	0	NO
7	BVT	Bidvest	-5.78959	0.218226222	YES
8	DSY	Discovery	-9.37793	1.000104945	YES
9	EXX	Exxaro	-6.50278	0	NO
10	SOL	Sasol	-11.6976	1.661382293	YES
11	AEG	Aveng	-7.25675	0	NO
12	AFT	Afrimat	-8.92633	0	NO
13	APA	ApexHi-A	-6.30054	0	NO
14	APN	Aspen	-9.60566	0	NO
15	AXC	Apexhi C	-7.21388	1.119266319	YES
16	CAT	Cat	-11.5366	0	NO
17	DAW	Dawn	-12.0254	0	NO
18	DEL	Delta	-10.5659	0	NO
19	EMI	Emira	-8.58831	0	NO
20	GND	Grindrod	-13.4628	0	NO
21	HYP	Hyprop	-12.1348	0	NO
22	NTC	Netcare	-6.46395	0	NO
23	PAM	Palamin	-11.6812	0	NO
24	PGR	Pergrin	-9.20778	0	NO
25	SPP	Spar	-6.47679	0.542983566	YES
26	SPP	Spar	-6.54313	0.393724615	YES
27	TRE	Trencor	-10.1814	1.51413423	YES
28	MRF	Merafe	-7.7425	2.074269245	YES
29	SLM	Sanlam	-6.13227	0.262910122	YES
30	ALT	Altech	-8.51964	0.198271918	YES

No.	Share Code	Company	EVT	Significant ACAVT	Significant Indicator YES; or NO
31	APB	ApexHi-B	-7.31992	0	NO
32	AVI	AVI	-7.01938	0	NO
33	IFR	IFour Properties	-12.1651	0	NO
34	NPN	Naspers	-5.47222	0.362957941	YES
35	NTC	Netcare	-5.90526	0	NO
36	PHM	Phumelela	-9.86728	0	NO
37	SAC	SA Corp	-7.12504	0	NO
38	SLM	Sanlam	-6.16145	0	NO
39	SLM	Sanlam	-6.467	0	NO
40	TKG	Telkom	-5.92231	0.66786361	YES
41	ABL	Abil	-5.54912	0.41426926	YES
42	AFE	AECI	-7.30308	0	NO
43	AFE	AECI	-6.62832	0	NO
44	AMA	Amap	-11.0562	0	NO
45	APK	Astrapak	-9.88973	0	NO
46	ASA	Absa	-6.715	0	NO
47	CPL	Capital	-15.327	0	NO
48	CRM	Ceramic	-12.7493	0	NO
49	GND	Grindrod	-14.3807	0	NO
50	HDC	Hudaco	-7.82937	0	NO
51	IMP	Implats	-5.61915	0	NO
52	IPL	Imperial	-5.17047	0	NO
53	IVT	Invicta	-10.4261	0	NO
54	JDG	JD Group	-6.81333	0	NO
55	KGM	KG Media	-17.1016	3.309733715	YES
56	MET	Metropolitan	-7.82112	0	NO
57	MKL	Makalani	-9.59834	0	NO
58	NED	Nedcor	-5.98317	0	NO
59	OCE	Oceana	-11.6224	0	NO
60	SAC	SA Corp	-7.45083	0	NO
61	TON	Tongaat	-7.15312	0.390760093	YES
62	TRE	Trencor	-10.7335	0	NO
63	ALT	Altech	-8.0481	0.644557805	YES
64	AMA	Amap	-8.9308	0	NO
65	AVI	AVI	-6.41673	0	NO
66	HAR	Harmony	-9.44027	0	NO
67	HVL	Highveld	-9.89197	0	NO
68	IMP	Implats	-6.33351	0.342975738	YES
69	IMP	Implats	-5.09596	0	NO
70	LON	Lonmin	-8.65885	0.556996982	YES
71	PGR	Pergrin	-6.60609	0	NO
72	RBW	Rainbow	-8.02995	1.553390516	YES
73	SAB	SABMiller	-6.41004	0	NO
74	SBK	Stanbank	-5.7556	0.224946792	YES
75	SUI	Sun Int	-7.51902	0	NO
76	TBS	Tiger Brands	-5.69007	0.284756879	YES
77	WBO	Wbhovco	-7.99254	0	NO
78	APK	Astrapak	-13.3701	0	NO
79	ATN	Altron	-8.55786	1.3261004	YES

No.	Share Code	Company	EVT	Significant ACAVT	Significant Indicator YES; or NO
80	ATNP	Altron Pref	-8.00254	0	NO
81	CDZ	Cadiz	-9.86128	0	NO
82	CRM	Ceramic	-11.4003	0	NO
83	DRD	Drdgold	-6.5612	0.759027055	YES
84	MTX	Metorex	-5.89709	0	NO
85	MUR	M & R	-5.40589	0	NO
86	MVG	Mvelaphanda Group	-7.03151	0	NO
87	OCT	Octodec	-12.3412	0	NO
88	RDF	Redefine	-6.68078	0	NO
89	RLO	Reunert	-7.07022	0	NO
90	SAP	Sappi	-5.63168	0	NO
91	SBK	Stanbank	-6.84465	0	NO
92	SHP	Shoprite	-6.56918	0	NO
93	TAL	TiAuto	-8.23175	0	NO
94	WHL	Woolworths	-5.4501	0.448282215	YES
95	ACL	ArcMittal	-6.28614	0	NO
96	ACP	Acucap	-10.4227	2.0397414	YES
97	ADR	Adcorp	-10.4393	0	NO
98	ADR	Adcorp	-10.7802	0	NO
99	AFR	Afgri	-7.54326	0	NO
100	AFR	Afgri	-6.92317	0	NO
101	AFX	Afrox	-8.55701	0	NO
102	AMS	Angloplats	-6.37156	0	NO
103	APK	Astrapak	-8.94071	0	NO
104	ARL	Astral	-6.59282	0	NO
105	ART	Argent	-7.1597	0	NO
106	ASO	Austro	-12.3561	0	NO
107	DDT	Didata	-6.53239	0	NO
108	DTC	Datatec	-5.99924	0	NO
109	DTC	Datatec	-6.20955	0	NO
110	EXX	Exxaro	-6.30882	0.514400981	YES
111	FBR	FamBrands	-12.8742	0	NO
112	FOS	Foschini	-6.23731	0	NO
113	GFI	GFields	-6.41565	0	NO
114	GRT	Growthpoint	-12.6426	0	NO
115	HLM	Hulamin	-8.13792	0	NO
116	ILA	Iliad	-12.9054	5.377103675	YES
117	IMP	Implats	-5.29804	0	NO
118	IMP	Implats	-5.73742	0.478570537	YES
119	JDG	JD Group	-5.37847	0	NO
120	KIO	KIO	-6.3351	0	NO
121	LEW	Lewis	-5.73248	0	NO
122	MPC	Mr Price	-7.85963	0	NO
123	MPC	Mr Price	-7.76544	0	NO
124	MSM	Massmart	-8.15738	0	NO
125	MST	Mustek	-8.97644	0	NO
126	MTN	MTN	-5.58632	0.528134915	YES
127	MUR	M & R	-5.09095	0.685665166	YES

No.	Share Code	Company	EVT	Significant ACAVT	Significant Indicator YES; or NO
128	MVG	Mvelaphanda Group	-7.80088	0	NO
129	NPK	Nampak	-6.46191	0	NO
130	OCE	Oceana	-10.5607	0	NO
131	PAM	Palamin	-10.6827	0	NO
132	PPC	PP Cement	-9.60653	0	NO
133	PPC	PP Cement	-7.4945	0	NO
134	RBW	Rainbow	-8.1696	0	NO
135	RBX	Raubex	-7.17757	0	NO
136	RBX	Raubex	-7.65911	1.237320389	YES
137	REI	Reinet	-5.08502	0	NO
138	SAP	Sappi	-5.44462	0	NO
139	SPP	Spar	-6.26043	0.820324065	YES
140	SUI	Sun Int	-6.62528	0	NO
141	TRU	Truworths	-8.01715	0	NO
142	WHL	Woolworths	-7.08123	0	NO