

Short-term share price overreaction: Evidence from the Johannesburg Stock Exchange



RUSHIKESH ALUR

ALRRUS001

Department of Finance and Tax
University of Cape Town

March 2016

Submitted to the Department of Finance and Tax at the University of Cape Town in fulfilment of the academic requirements for a Master of Commerce degree in Finance.

Key Words: DAILY; WEEKLY; OVERREACTION; REVERSALS; JSE; TRADING

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

Declaration

I, Rushikesh Alur, hereby declare that the work on which this dissertation is based is my original work (except where acknowledgments indicate otherwise) and that:

- I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.
- I have used the required Harvard convention for citation and referencing. Each contribution to and quotation in this assignment from the work(s) of other people has been attributed, and has been cited and referenced.
- I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.
- I acknowledge that copying someone else's assignment or essay, or part of it, is wrong, and declare that this is my own work.

Neither the whole work nor any part of this dissertation has been, is being or is to be submitted for another degree in this or any other University. I empower the University of Cape Town to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

Signed by candidate

Rushikesh Alur

March 2016

Acknowledgements

My profound thanks to the Lord for blessing me with sustained will and ambition to undertake this work, as well as the resources and health to follow it through to completion.

There are no words or expressions to convey my gratitude to My Beloved parents and brother for their oasis of support and well wishes and for always standing by me. Their encouragement and goodwill always provided me with all that I needed to accomplish anything.

I hope to express my profound gratitude to my supervisor, Associate Professor Francois Toerien for his insights and guidance. His challenges and unrelenting high standards always pushed me beyond my expectations. His ability to work at all hours and pay no heed to his personal convenience in pursuit of his work are traits that I can only aspire to. There is little doubt that he is one of the most hardworking individuals I will ever know.

My thanks to Professor Anton Eberhard for believing in me and providing me with a dream opportunity in my first research job. The experience groomed me into a capable researcher and built valuable experience.

Many thanks to my close friends and associates who provide me with enthusiasm for the field and to Bilal Mirza for much welcome good humour and positivity in challenging times.

Finally, I would like to express my thanks to all those who have contributed knowingly or unknowingly in helping me enrich my outlook through their association and develop as a person.

Abstract

The Overreaction Hypothesis and share price overreaction has been a widely researched phenomenon since the 1980s, although most work has focused on longer-term share return reversals. As an emerging market and part of the BRICS collective, South Africa provides an interesting investment environment within which to investigate this phenomenon. Limited research has been done in South Africa on share price overreaction, again nearly all focusing on the longer term. This dissertation examined short term overreaction (over 1 and 5-day periods) on the Johannesburg Stock Exchange (JSE) over the period July 2000 to June 2015. Furthermore, periods of financial crisis were isolated from the full sample period and tested separately, in order to assess whether periods of financial instability affect the magnitude of share price overreaction on the JSE.

Whereas the common approach in this field is to investigate overreaction on a relative basis (for example by ranking share returns over a prior period and focusing on extreme relative performances), this thesis follows other literature that examines share return reversals following extreme one-day share price changes beyond absolute cut-off values (in this case $\pm 5\%$ and $\pm 10\%$). The methodology considered an abnormal returns measure based on total return index values, and used a multivariate regression to test for one day and five day share return reversals. The effect of average prior returns, market volatility, company size, value, price-to-earnings and book-to-market ratios on abnormal returns were also considered. Lastly, a portfolio strategy based on one day and five day return reversals following large positive or negative one-day returns was investigated to test for usability as a possible trading strategy.

Significant evidence was collected in support of short-term reversals. The results remained valid after robustness checks, and consistent coefficients were obtained for all variables, except the book-to-market ratio. A notable portion of the observed abnormal returns were unexplained by the conventional effects of company size and value. There was no statistically significant effect due to the Global Financial Crisis, in spite of a higher frequency of large price shifts during this

period. A trading strategy employing these insights did not provide statistically significant risk-adjusted excess returns relative to the All Share Index when traded frequently, thus supporting the view that the JSE is at least weak-form efficient given transaction costs.

This study contributes to the market efficiency literature on the JSE, but also for the first time investigates very short term share return reversals and overreaction within the South African context using an absolute extreme share return approach, as opposed to a relative share performance approach.

Table of Contents

List of Tables.....	1
List of Figures.....	2
Chapter 1: Background and Introduction.....	3
1.1 Purpose and Nature of the Study.....	4
1.2 Research Contribution.....	6
1.3 Research questions.....	7
1.4 Structure of the Study.....	7
Chapter 2: Literature Study.....	9
2.1 Introduction.....	9
2.2. Theoretical Overview.....	9
2.2.1 The Efficient Market Hypothesis.....	10
2.2.2 The Overreaction Hypothesis and Return reversals.....	11
2.2.3 The Uncertain Information Hypothesis.....	12
2.2.4 Behavioural Finance.....	13
2.3 Anomalies, Style Based Effects and other explanations of observed Overreaction.....	15
2.3.1 The Effect of Bid Ask Bounce.....	16
2.3.2 January/Turn of the Year Effect and Tax.....	17
2.3.3 The Company Value Effect.....	18
2.3.4 The Size Effect.....	19
2.3.5 Transaction Costs.....	20
2.3.6 Time Varying Risk Premiums.....	20
2.4 International Prior Research on Short Term Share Price Reversal / Overreaction.....	21
2.4.1 Evidence from Germany.....	21
2.4.2 Evidence from Hong Kong.....	22
2.4.3 Evidence from India.....	23
2.4.4 Evidence from Japan.....	24
2.4.5 Evidence from New Zealand.....	24
2.4.6 Evidence from Pakistan.....	25
2.4.7 Evidence from Taiwan.....	26
2.4.8 Evidence from the USA.....	26
2.5 Evidence from South Africa.....	29
2.5.1 Prior Research on Overreaction.....	29

2.5.2 South African Returns Modelling	33
2.6. Empirical test used in Short Term Overreaction studies	35
2.6.1 Event Studies	35
2.6.2 Volatility and Variance Testing	37
2.6.3 Multivariate Regressions	40
2.7 Conclusion	43
Chapter 3: Data and Sampling	45
3.1 Introduction	45
3.2 Sample Selection	45
3.3 Screening	46
3.4 Data	48
3.5 Sample Distribution and Descriptive Statistics	49
3.6 Conclusion	56
Chapter 4: Hypothesis Development and Methodology	57
4.1 Introduction	57
4.2 Hypothesis Development	57
4.2.1 Hypothesis 1: Short term share return reversals exist on the JSE	58
4.2.2 Hypothesis 2: Upward and downward share return reversals differ	58
4.2.3 Hypothesis 3: Short term share return reversals are altered in times of financial turmoil ...	59
4.2.4 Hypothesis 4: An economically significant reversals trading strategy exists	60
4.3 Regression Model Specifications	61
4.3.1 Base Model	61
4.3.1.1 Return Measures ($Y_i, [t, t + 1]$ and R_i, t)	62
4.3.1.2 Average Return (ARI, t)	62
4.3.1.3 Return Volatility (Vi, t) and the Volatility Index ($SAVIt$)	63
4.3.1.4 Price-Earnings Ratio ($LOG(PE)_i, t$)	63
4.3.1.5 Company Size as proxied by Market Value ($LOGMVi, t$)	64
4.3.1.6 Book-to-Market Value ($LOGBTMi, t$)	65
4.3.2 Alternative Model Specifications	65
4.4 Regression Assumptions Tests	66
4.4.1 Linear Relationship and Additivity	67
4.4.2 Multicollinearity	67
4.4.3 Serial autocorrelation of the Error term	68

4.4.4 Normal distribution of the error term	69
4.4.5 Constant variance of the error terms	71
4.5 Trading Strategy Testing	72
4.5.1 Share allocation and trading process	72
4.5.2 Contrarian and Momentum trading strategies	74
4.5.3 Return Measures	74
4.5.4 Transaction Costs	76
4.6 Conclusion	78
Chapter 5: Regression Results and Empirical Analysis.....	79
5.1 Introduction.....	79
5.2 Regression Outputs and Results	79
5.2.1 Return Reversals (R_i, t).....	82
5.2.2 Average Return (AR_i, t)	83
5.2.3 Return Volatility(V_i, t) and the Volatility Index ($SAVIt$)	84
5.2.4 Price-Earnings Ratio ($Log(PE)_i, t$)	86
5.2.5 Market Value/Company Size ($LogMV_i, t$).....	87
5.2.6 Book-to-Market Value ($LogBTM_i, t$)	88
5.3 Robustness Checks by Coefficient Persistence Testing.....	89
5.4 Further Analysis and Discussion	94
5.4.1 Hypothesis 1: Short Term Share Return reversals Exist on the JSE.....	94
5.4.2 Hypothesis 2: Upward and Downward Share Return reversals differ in magnitude	96
5.4.3 Hypothesis 3: Short Term Share Return reversals are exaggerated in times of Financial Turmoil	100
5.5 Conclusion	102
Chapter 6: Trading Strategy Testing	103
6.1 Introduction.....	103
6.2 Results and Analysis	103
6.2.1 Portfolio Descriptive Statistics.....	104
6.2.1.1 Daily Data	104
6.2.1.2 Weekly Data	105
6.2.1.3 Monthly Data	107
6.2.1.4 Annual Data.....	108
6.2.2 Hypothesis 4: An economically significant reversals trading strategy exists.....	110

6.2.2.1 One Day Holding Period Performance.....	111
6.2.2.2 Five Day Holding Period Performance.....	114
6.3 Conclusion	117
Chapter 7: Limitations and Suggestions for Further Research	118
7.1 The Joint Hypothesis Problem	118
7.2 Limited Economic Significance.....	118
7.3 The study does not investigate Behavioural Aspects	119
7.4 Non-Event attribution and specification	119
7.5 Price impact on the reliability of the trading strategy	119
7.6 Non-attribution to rational structural uncertainty	120
7.7 Suggestions for further research	120
Chapter 8: Conclusion	122
References	126
Appendices	132
Appendix A: Residuals Versus Independent Variable Plots.....	132

List of Tables

Table 1: Summary of South African studies	30
Table 2: Summary of Models used In Event Studies of Short Term Overreaction.....	37
Table 3: Summary of volatility tests of short Term overreaction and reversals.....	40
Table 4: Summary Statistics for Large Price Movements, Increases and Decreases	49
Table 5: Correlation matrix of coefficient estimates	68
Table 6: Summary of share selection and trading process	73
Table 7: Summary of JSE share transaction costs	77
Table 8: Summary Statistics for Large Price Movements, Increases and Decreases	80
Table 9: Summary of regression variables.....	80
Table 10: Summary of regression models	81
Table 11: Regression Statistics for $(R_{i,t})$	83
Table 12: Regression Statistics for $(AR_{i,t})$,	84
Table 13: Regression Statistics for Return Volatility $(V_{i,t})$	85
Table 14: Regression Statistics for $Log\left(\frac{P}{E}\right)_{i,t}$	87
Table 15: Regression Statistics for $Log(MV_{i,t})$.....	88
Table 16: Regression Statistics for $Log(BTM_{i,t})$	89
Table 17: Model 1 coefficients at different cut-offs.....	91
Table 18: Model 2 coefficients at different cut-offs.....	92
Table 19: Model 3 coefficients at different cut-offs.....	93
Table 20: Model 4 coefficients at different cut-offs.....	94
Table 21: One day reversal coefficients.....	95
Table 22: Five day reversal coefficients.....	96
Table 23: Regression coefficients, Increases and Decreases 5% and 10% cut-off points	97
Table 24: Result of t-test for 5% and -5% cut-off	99
Table 25: Result of t-test for 10% and -10% cut-off	99
Table 26: Regression coefficients for the 5% and -5% cut-offs aggregated	100
Table 27: Regression coefficients for the 10% and -10% cut-offs aggregated	101
Table 28: Daily Portfolio Returns Summary for One Day Holding Periods	105
Table 29: Weekly Portfolio Returns Summary for One Day Holding Periods	106

Table 30: Weekly Portfolio Returns Summary for Five Day Holding Periods	106
Table 31: Monthly Portfolio Returns Summary for One Day Holding Periods	107
Table 32: Monthly Portfolio Returns Summary for Five Day Holding Periods	102
Table 33: Annual Portfolio Returns Summary for One Day Holding Periods	108
Table 34: Annual Portfolio Returns Summary for Five Day Holding Periods	109
Table 35: Annual Sharpe Ratio Summary for One Day Holding Periods	110
Table 36: Test 1 and 2 results for a one day holding period	113
Table 37: t test for gainers portfolio and ALSI (one day)	114
Table 38: t test for losers portfolio and ALSI (one day)	114
Table 39: Annual Sharpe Ratio Summary for Five Day Holding Periods	115
Table 40: Test 1 and 2 results for a five day holding period	116
Table 41: t test for gainers portfolio and ALSI (five days)	116
Table 42: t test for losers portfolio and ALSI (five days)	116

List of Figures

Figure 1: Directional Comparison of Event Frequencies (2000-2015)	50
Figure 2: Event Frequencies for Upward Events (2000-2015)	51
Figure 3: Event Frequencies for Downward Events (2000-2015)	51
Figure 4: Frequency of All Abnormal Returns (July 2000-June 2015)	53
Figure 5: Frequency of Upward Abnormal Returns (July 2000-June 2015)	54
Figure 6: Frequency of Downward Events (July 2000 - June 2015)	55
Figure 7: Serial Autocorrelation diagnostic plot	69
Figure 8: Q-Q plot	70

Chapter 1: Background and Introduction

Equities are a highly speculative and interesting asset class, even more so in a developing economy with sophisticated financial markets such as South Africa. Understanding what variables drive and sustain abnormal returns is the subject of much research, and the ability to predict investment opportunities based on discernible patterns is a strategic advantage for any investor, institutional or individual alike. In this regard, there have been numerous studies internationally on the phenomenon of stock price overreaction and a subsequent reversal effect. In South Africa there are many examples of large price movements which reversed within a very short period. For instance, Lonmin Plc gained 23.13% on March 7th 2016, but lost 9.98% the following day¹. Events like these lead to the question of whether extreme absolute movements in daily share prices on the JSE are in general the result of investor overreaction, and hence can function as the basis for a possible trading strategy. This forms the underlying rationale for this study.

The stock market overreaction hypothesis states that, following a sharp increase or decrease in price, a stock price movement usually reverses itself (De Bondt & Thaler, 1985). This overreaction may be due to market participants potentially weighting information asymmetrically as a result of behavioural biases (Kahneman & Tversky, 1982). Less extreme changes may be attributed to investor needs which mandate portfolio or other changes, but large price shifts are more likely due to new information or the expectations that surround such information. Bowman and Iverson (1998) posit that the behaviour of equities that experience large price shifts provide an opportunity to test if new information is quickly and completely incorporated into these prices, or if there is actually overreaction. If this is a consistent phenomenon then there is scope to inform trading when equity prices deviate from what fundamental analysis would estimate to be the fair value. The ability to establish the extent and timeline of this could inform short, medium or long term equity dealings.

¹ Source: Google Finance

The focus of most previous studies (mentioned in Chapter 2) has been on testing for the Overreaction Hypothesis and the identification of possible trading strategies within the overall market, or even within a specific industry or sector. A limited number of studies investigated the South African equity market or other African equity markets in general. Existing research on share return reversals in South Africa focus on the long term and is mainly concerned with examining portfolio strategies and their performance over months or years. Furthermore, although some studies have looked at this phenomenon during the Global Financial Crisis and in other countries, this has not been done for short-term reversals for South Africa, especially as a comparative study of the periods before and after the crisis. This study extends prior literature by focusing on short term return reversals, the returns behaviour as influenced by the Global Financial Crisis, and a comparative study of positive and negative price shocks within the context of South Africa's Johannesburg Stock Exchange (JSE).

The JSE which was founded in 1887, has a market capitalisation in excess of \$ 1007 billion, and is operated by the JSE Limited, a company which is itself listed on the JSE (JSE, 2015). It is a highly active market with the average number of trades per day in 2014 being 185,936 and an average daily trading value of R 281 million in 2015 (Parsons, 2015). The JSE has for the last five years in a row been ranked as the best regulated exchange globally by the World Economic Forum (Global Competitiveness Report, 2014), and is South Africa's only licensed, full service exchange, and Africa's largest.

1.1 Purpose and Nature of the Study

This study will investigate equity price behaviour and short term share return reversals on the Johannesburg Stock Exchange (JSE) from July 2000 to June 2015, which contains the tail end of the post-Dot Com bubble and the entire Global Financial Crisis, as well as the post-Global Crisis Recovery period to mid-2015. The Global Financial Crisis from 2007 to 2008 was a

turning point for financial markets and economic systems the world over. It had the potential to change investment and credit allocation as well as alter investor behaviour and decision making if there was contagion in the JSE from the Sub Prime mortgage crisis and Global Financial Crisis. As a result, this analysis will span both the full period mentioned above, as well as pre-, post- and the so-called financial crisis period of 2007-8. The main focus will be on the existence and size of return reversals in the short term (one day to one trading week) and the other key variables that may predict and influence extreme price changes. The rationale for looking specifically at short term reversals is to fill a gap in theory surrounding this phenomenon in South Africa, since all prior South African research² has been limited to long term overreaction. The theoretical benefits of investigating reversals in the short term rather than over a longer period are that issues such as time-varying risk premiums are seldom of any significance in the short term, and survivorship bias is also likely to be less relevant (Bowman & Iverson, 1998). This analysis will make use of total returns, and will be performed primarily for the South African stocks that constituted the largest hundred shares by market capitalisation at six-monthly intervals across the period of investigation. Smaller stocks were intentionally excluded from this study due to the potential biases introduced by their generally low levels of low liquidity, and the lack of really satisfactory methods of addressing this problem. In addition, as the asset management industry is most concerned with the larger capitalisation stocks, this limitation should not be very detrimental to the practical value of this research. The study will have applications in terms of testing for market efficiency if the results are used for further study, but the core objective is to investigate overreaction and perform a comparative study of large increases and decreases to check for similarities and differences in characteristics as well as test the performance of portfolios which use a reversals strategy.

² See, for example, Page and Way (1993), Okeahalam and Jeffries (1999), Appiah-Kusi and Menyah (2003), Hsieh and Hodnett (2011), and Frisch et al (2014).

1.2 Research Contribution

As per my knowledge, this is original research within the South African national context, with a short term return window of up to one trading week as the focal point. In contrast to prior South African studies, which generally considered shares that significantly under- or outperformed on a relative basis, this research investigates short term overreaction in the context of large one-day share price movements (specifically in excess of $\pm 5\%$ and $\pm 10\%$), as well as trading strategies based on these absolute price movements. Although there are other share price reversal studies that focus on the local market (mostly using pre-2010 data), such as the studies of Okeahalam and Jeffries (1999), Appiah-Kusi and Menyah (2003), Jefferis and Smith (2005), Hsieh and Hodnett (2011) and Itaka (2015), these tend to explore different aspects and longer horizons compared to this study.

With the exception of the last two studies, most of these studies therefore do not cover the financial crisis period of 2007-8, or indeed subsequent events. The most recent study on the overreaction phenomenon in South Africa is that of Itaka (2015), which focused on short term and long-term overreaction, but used monthly returns as opposed to the daily returns used in this dissertation. An additional difference is the absence of an absolute returns cut-off as basis for the prior study, but which is a key factor in sample selection in this dissertation. This latter approach is thematically similar to the work of Frisch et al (2014), which focused on long term overreaction over one month periods.. The findings from this dissertation may be applied in practice to tactical asset allocation or market timing strategies with a contrarian view, which is the main practical application of the results related to return reversals.

1.3 Research questions

The main research questions of this study are as follows:

- (i) Do short term overreaction and share return reversals exist in the South African equity market? Is this effect consistent within the overall and sub periods?
- (ii) If reversals exist, do they occur within a day and persist for a trading week?
- (iii) Is there any difference in this effect before, during and after the Global Financial Crisis? If so, is there an exaggeration or a dampening of this effect?
- (iv) Is there a difference between reversals for the stocks that have positive price shocks and those that have negative shocks?
- (v) What variables have consistent explanatory power in the stock overreaction models?
- (vi) Are there opportunities to trade on these findings and earn abnormal returns when compared with the market?

1.4 Structure of the Study

The remainder of this dissertation is structured as follows. Chapter 2 provides a theoretical overview and a literature review of relevant research on the Overreaction Hypothesis in developing and developed countries, and discusses other anomalies which may confound the results associated with overreaction. This chapter also highlights some additional factors to consider when investigating stock price overreaction. Chapter 3 focuses on the sources of

data, the timeframe for which the sample is required, screening criteria, and the justification for the choice of return measure used. This leads into Chapter 4 (Methodology) which discusses the hypothesis development and provides the model specifications and an outline of the statistical procedures used.

The results and analysis chapter (Chapter 5) provides the quantitative output and qualitative discussion of the statistical results relating to short term overreaction. Empirical answers to the research hypotheses are provided and are analysed in line with the existing theory and possible insights offered by this study. In order to test the practical and economic significance of this studies' findings for return reversals, a portfolio allocation exercise was performed as discussed in Chapter 6, in order to provide a comparative measure by testing the performance relative to a market benchmark. The limitations of the study and its results along with suggestions for further study follow in Chapter 7. The final chapter (Chapter 8) is a summary of the main findings and conclusions obtained from this research project.

Chapter 2: Literature Study

2.1 Introduction

This chapter will provide the theoretical foundation and empirical basis for the investigation. The first section provides a summary of the main theories that are relevant to the central topic of research, namely the Efficient Market Hypothesis (EMH) and the concept of share price overreaction. This is followed by an explanation of relevant effects (the January and value and size effects) which have been presented as possible contributors to observed share price overreaction in previous studies. Other significant factors which possibly contribute to share price overreaction, such as transaction costs and time varying risk premiums, are also discussed. The final sections focus on prior research conducted on share price overreaction and price reversal over the short term internationally, and over the long and short term in South Africa specifically. Some of the key findings of different, yet related, work is presented, including separate sections on the empirical tests for short term overreaction that were used, as well as general returns modelling in South Africa. A summary of the key themes concludes this chapter.

2.2. Theoretical Overview

This section expands on some background theory to contextualise the work in this research project. Share price overreaction and the Efficient Market Hypothesis are linked concepts, as the existence of the former directly challenges the latter. The Uncertain Information Hypothesis suggests an altered model for resulting price movements inconsistent with the Overreaction Hypothesis. Behavioural Finance provides explanations for share price overreaction in terms of psychological biases.

2.2.1 The Efficient Market Hypothesis

The efficient market hypothesis (EMH) states that a market in which all publicly available and private information is reflected in the market prices of assets is efficient. There are three forms of efficiency. In order of increasing strictness, these are the weak, semi-strong and strong forms of market efficiency (Fama, 1970). The weak form version of the EMH asserts that the current market prices will capture and reflect all historical publicly available price data, and hence it also implies that a market participant cannot outperform the market on the basis of past data using technical analysis (Rhode & Strumpf, 2004). The semi-strong version additionally assumes that all other forms of past information are also accounted for in current prices (Rhode & Strumpf, 2004). Hence, this is a stricter form of market efficiency and implies that neither technical nor fundamental analysis have scope to provide superior returns. The final and strictest version of market efficiency is the strong form, which is based on the asset prices reflecting all privately held and publicly available information, and hence it is not possible to outperform the market using this information (Rhode & Strumpf, 2004). Various tests have been devised to test whether equity markets are strong, semi-strong or weak form efficient.

The key assumptions for the EMH, which are related to perfect markets, are summarised by Gilson and Kraakman (2003), as is described below. In practice, these are all debatable (or unrealistic) assumptions.

- Perfect information is available in the market and it arrives randomly.
- Investors are rational agents and act rationally when they respond to news.
- No transaction costs are incurred when acting in the market.

The basic implication of market efficiency is that past information is already accounted for in the present prices, and any changes are reflected swiftly by movement in share prices to account for them. The EMH implies that it is not possible to predict future prices, since the

price behaviour follows a random walk and as a result future price movements are unpredictable. Fundamentally, these implications stem from the combined notions of rational market behaviour and random variation in asset prices.

Alternative pricing concepts that arise in relation to the efficient market hypothesis are arbitrage-free pricing and the law of one price. Arbitrage-free pricing holds that it is not possible to make risk free profits (arbitrage) by simultaneously trading assets to exploit mispricing, since markets would price these assets accurately (Rhode & Strumpf, 2004). The logic is that if prices reflect public information, then all investors have access to this information, and hence any mispricing would be instantly noticed and trading activity would adjust demand and price to the fair value. The law of one price is a similar idea, and states that prices for the same asset in different locations should be the same after trading and other costs have been taken into consideration. This therefore suggests that arbitrage opportunities are not available by sourcing similar securities from different locations (Mankiw, 2011).

2.2.2 The Overreaction Hypothesis and Return reversals

The earliest works documenting research on the Overreaction Hypothesis were studies by Beaver and Landsman (1981), Kahneman and Tversky (1982), and DeBondt and Thaler (1985), and it has since gained the reputation of possibly being an anomaly to the efficient market hypothesis (Ma, Tang & Hasan, 2005). When considering a short horizon for overreaction, biases in the reaction to unanticipated information are cited as explanations, whereas for longer term overreaction, waves of investor sentiment may cause the deviations in price (Otchere & Chan, 2003). In essence, this hypothesis implies that investors are unable to rationally update their expectations as suggested by Bayes' rule. There has been a great deal of technological, institutional and transactional development in the financial markets since their work, which has greatly expanded the trading environment - however the fundamental behaviour of market participants is assumed similar and rational. Historically, research on the stock market overreaction hypothesis has directed researchers to two

significant implications. Firstly, if this phenomenon exists in the market, then it comes up against the conventional theory of market efficiency, especially weak form efficiency (De Bondt & Thaler, 1985). Secondly, the magnitude of the subsequent price reversal appears to be directly linked to the size of the initial shift in price (De Bondt & Thaler, 1985).

The Overreaction Hypothesis contradicts weak-form efficiency, and consequently also the semi-strong and strong form hypotheses, since they both build on the basic assumptions of weak form efficiency. A related area of interest is the persistence of this overreaction phenomenon and mean reverting price behaviour. Although direct tests of the Efficient Market Hypothesis are not a core objective of this research project, consideration of some of the evidence for the Efficient Market Hypothesis in South Africa is worthwhile.

Okeahalam and Jeffries (1999) researched the speed at which company announcements are captured in the price of shares of JSE listed shares. Based on data that covered weekly performance, their findings supported that theory that the market displayed the semi-strong version of efficiency over the period tested. Appiah-Kusi and Menyah (2003) similarly used weekly returns based on an index and found that the JSE was not weak-form market efficient, which contradicts the findings of Okeahalam and Jeffries (1999). This result was then debated when Jeffries and Smith (2005) found that returns on the JSE followed a random walk which in turn implied that there was weak-form efficiency. The findings from a later study of the JSE by Smith (2008) further supported this result. Overall the evidence remains mixed on market efficiency as seen from the differences in the studies mentioned here

2.2.3 The Uncertain Information Hypothesis

The uncertain information hypothesis (UIH) asserts that the abnormal returns following both positive and negative price movements or events should remain positive for some time (Ketcher & Jordan, 1994), and was first investigated by Brown et al (1988). Hence, there is a

similarity in the predictions of overreaction and the UIH for negative price shocks, as they both anticipate positive abnormal returns. The reasoning derived from the UIH is that price shocks (regardless of whether positive or negative) lead to changes in estimates of systematic risk, causing an increase in expected returns after the price shock. To differentiate between the two hypotheses requires considering both positive and negative shocks, for which the overreaction hypothesis posits reversals, whereas the UIH predicts positive abnormal returns for either shock.

2.2.4 Behavioural Finance

Behavioural finance may offer some insights into the patterns or behavioural biases that would explain the deviation from expected prices that occur due to over- and under reaction. There is an emphasis on psychological and cognitive principles which are outside the scope of this research, but are still material in understanding this phenomenon. Basically, if biases exist and are consistent, this would imply that individuals systematically alter their decisions based on these, and consequently affect stock prices through their trading activity. This section seeks to briefly cover some research into theories and models that have been developed in behavioural finance to explain overreaction.

The representative heuristic (representativeness) is defined as a tendency which causes individuals to take an instance or event as representative of the probability of a specific thing in general. In the context of stock overreaction, this implies that investors observe good or bad news related to a stock, and then alter their view of, and dealings in, the stock. Based on how they incorporate this representation, investors may act in ways that feeds into overreaction due to the bias introduced. As found in the investigation by Kahneman and Tsversky (1982), there are predictable and systematic errors due to this heuristic when subjects evaluate uncertain events.

A related concept is uncertainty avoidance, which is the degree to which a society or culture can deal comfortably with ambiguity and uncertainty, and the extent of this leads some to feel more pressed for action than others (Hofstede, 2001). It was concluded by Cyert and March (1963) that members in cultures with high avoidance focus on short term responses, and try to resolve immediate issues rather than plan and develop long run strategies. Based on this myopic tendency, such investors react in a way that would move share prices specifically in the short run after negative or positive news, thus giving rise to overreaction price patterns.

Investor overconfidence was investigated by Daniel, Hirshleifer and Subrahmanyam (1998), who held that investors are overconfident about the information they have, and by self-attribution bias this overconfidence increases with confirmatory news, and consequently drives the observed overreaction. Hong and Stein (1999) posited a model which incorporated initial underreaction, followed by overreaction, which causes a stock price reversal in the future. Included in this model are two types of participants, namely momentum traders and news watchers. They are distinguished based on the type of information they exclusively use: news watchers favour private information, and momentum traders solely use information of past price changes (Hong & Stein, 1999).

According to this model, the implied sequence of events is that initial price changes are caused by the actions of news watchers, which are then followed by momentum traders, who observe these initial changes. According to Hong and Stein (1999), the potential outcome of this would be initial under-reaction based on trading by the news watchers, and then subsequent overreaction when the momentum traders act, with prices returning to fundamental value in the long run. A possible explanation for profits from trading on overreaction is market inefficiency, but Locke and Gupta (2009) have noted that it is debatable whether investor activity is due to anomalies or rational behaviour.

Further research in these behavioural aspects in addition to quantitative empirical investigations may provide a more complete understanding of the drivers behind observed

overreaction. The next section discusses some theory and evidence around effects that have explained observed overreaction in the past.

2.3 Anomalies, Style Based Effects and other explanations of observed Overreaction

Market anomalies are deviations of observable characteristics which are inconsistent with conventional theory. The term itself in this context originated from Kuhn (1970). Anomalies are relative to some assumed equilibrium model within an efficient market such as the CAPM model, so although they suggest inefficiencies they are not direct evidence that the market is inefficient.

Style based effects cover some of the main anomalies in this section, and are categorised by Van Rensburg and Robertson (2003) into measures of value, future earnings growth, and of irrationality and regret. Consideration of the full inventory of effects is beyond the scope of this study, and hence the analysis is restricted to the January, firm value and size effects. Note that bid ask bounce, which is also discussed below, is not a member of the style based classification.

Some of these discrepancies may be due to market inefficiencies, gaps in empirical models or irrational behaviour that produces unconventional outcomes. If such anomalies are persistent, best practice would require their integration into market analyses to allow for more informed investment decisions. The following subsections explain some of the most common market anomalies, style based effects and other empirical explanations that may account for observed share price overreaction, and discuss some of the evidence from prior research.

2.3.1 The Effect of Bid Ask Bounce

According to this concept, a share price reversal can be caused by a shift or 'bounce' in the bid-ask spread (Cox and Peterson, 1994). The bid and ask prices are market determined and not pegged to mirror exact movements in each other. A scenario to illustrate this would be as follows: assume bad news related to a stock comes to the market, causing some individuals to sell the stock and others to not buy the stock - hence the bid price begins to decrease and the ask price to increase. Trading on the following day will probably occur at prices in between the previous day's bid and ask range, and these shifts may appear to be overreaction and/or reversal effects. The widening and movement of the bid-ask spread in the direction of the reversal is a possible explanation for what may appear to be stock overreaction, or may at least explain some portion of this phenomenon. Campbell, Lo and MacKinlay (1997) found that a bid-ask bounce and returns are negatively serially correlated, which means that increases in the bounce would reduce returns and a reduced bounce would increase potential returns.

Another line of reasoning is that if firms are smaller and are traded less (*i.e.* are less liquid), this would be reflected in a relatively larger bid-ask spread, which in turn would affect trading returns. This may feed into perceived overreaction, as there would be spurious correlation between the observed factors and the stock price reversal, since it accumulates the upward biases with the returns and exaggerates the observed mean reversion in share prices (DeBondt and Thaler, 1985). A suggestion to mitigate this issue is to use the buy and hold return instead of the cumulative abnormal returns that were used in studies such as that of DeBondt and Thaler (1985) as a measure of performance. Loughram and Ritter (1996) questioned the above results of DeBondt and Thaler (1985) and of Conrad and Kaul (1993) with respect to their propositions based on the bid ask bounce. Their challenge to DeBondt and Thaler's (1985) methodology is that there was no significant difference if either buy-and-hold returns or cumulative abnormal returns were used as return measures. When comparing Conrad and Kaul (1993) with DeBondt and Thaler (1985), they attributed their different results for cumulative abnormal returns to survivorship bias in the sample.

2.3.2 January/Turn of the Year Effect and Tax

Capital gains tax is due on the profits from the sale of shares which have increased in value, hence there is a benefit in deferring the sale of these until the nominal tax is minimised. The beginning and end of the tax year is significant in this regard as it determines a date of sale which would reduce taxes (all else equal) given that the tax assessment considers income in the tax year. The USA, for example, has a tax year that ends in December and abnormal returns that arise around December/January may be attributed to this tax benefit.

This anomaly was first documented by Keim (1983) and Reinganum (1983), who found that a significant portion of observed abnormal returns for small firms actually were realised during the initial half of January in their study. DeBondt and Thaler (1985) also noted this calendar effect in their seminal work on share price overreaction. A subsequent study by these authors found a negative relationship between excess returns in January and December for gainers, but no relationship for losers (DeBondt & Thaler 1987).

Pettengill and Jordan (1990) found that the set of return reversals that could be attributed to the Overreaction Hypothesis, were in fact limited to being observed solely in January. Similarly, using a size matching methodology, in which gainer and loser portfolios were matched with similar portfolios that consisted of companies with comparable sizes, Zarowin (1990) showed in this case performance differentials were also limited to January only.

Conrad and Kaul (1993) found similar results when they employed a buy and hold trading strategy, in particular that when focusing on the observed abnormal returns in January alone, these could not be attributed to the past performance of the securities and was in fact due to January effect. Conrad and Kaul (1993) furthermore challenged the overreaction documented by DeBondt and Thaler (1985) in their seminal work on the topic, on the basis of using December as the month for portfolio formation, as this was not consistent with the findings of the latter's study when June or August were used instead.

Hsieh and Hodnett (2011) point out that in South African case, these calendar effects are less pronounced due to two reasons: in contrast to many international jurisdictions, in South Africa companies have a choice in their tax reporting month, and the fact that most shares are held by institutional portfolios rather than individuals. The former implies that there should be no discernible tax lock-in effect limited to January or any other specific month.

2.3.3 The Company Value Effect

Value in this context refers to the ratio of a fundamental metric to a market proxy (for instance, book-to-market or earnings-to-price) that measures a similar attribute. The value effect, which is also termed the Book-to-Market anomaly, refers to the observation that low market value stocks (higher book-to-market) are documented to perform better than those with higher market value, and earn positive abnormal returns. This effect is commonly tested to explain share price overreaction or deviations of empirical returns from the CAPM model, as noted in the studies below.

Basu (1977) tested the theory that this effect was an explanation for empirical deviations from the CAPM. His results showed a statistically significant positive relation between earnings-to-price and unexplained returns for stocks in the US market. This result was further observed by Basu (1983) and Keim (1983). Fama and French (1992) found similar evidence over a longer period (early 1960s to 1990) in the US market and strong evidence in international markets in their 1998 study. The value effect was particularly notable during the turn of the century when prices were adjusting after the Dot Com crisis.

The value effect in South Africa has been documented by Mutooni and Muller (2007) over the period from 1986 to 2006, where value shares generally outperformed growth shares. Although Van Rensburg and Robertson (2003) could not unearth a significant value effect in their study of the JSE, when Auret and Sinclair (2006) added book-to-market to their size and P/E model, its effect subsumed the effect of size and P/E. Hoffman (2012) found evidence of the book-to-

market anomaly in addition to the momentum and size effects. Lastly, Hodnett, Hsieh and Van Rensburg (2012) determined that shares with higher fundamental values relative to price, provide consistently higher payoffs.

A theory used to explain this anomaly is that low value stocks have more potential growth available, and this opportunity results in higher realised returns in the future. An alternative explanation is that these low book-to-market stocks perform better due to a risk commensurate compensation (Mutooni & Miller, 2007). Lower book-to-market may be firms with volatile or weak financial performance and higher returns would be required to account for this added risk.

2.3.4 The Size Effect

The size effect is characterised by smaller firms' stocks having better performance over time, as compared to larger capitalisation firms. There seems to be a link between the size of a firm and how much information is available and disseminated, in part due to larger firms having more research coverage. The following studies report on empirical results when testing for the size effect as an explanation for observed overreaction.

Chopra et al (1992) found that after controlling for firm size, overreaction was greater for smaller companies relative to larger companies. This may be due to a larger share of individuals as opposed to institutions investing in these smaller shares, and individuals are more likely to overreact than a group of investors (Chopra et al, 1992). DeBondt and Thaler (1987) revisited their previous work to analyse the findings after accounting for, among others, the size effect. These authors reported that when ranked by market value the average of the high performing quintiles was substantially larger (up to thirty times) than that of the smallest quintiles, hence contradicting the idea of the size effect explaining the overreaction.

A contrasting result to that of the methodology of Zarowin (section 2.2.2), was put forward by Albert and Henderson (1995). This study showed that there was a bias in ranks in the size matching attempt, and when a different approach was used there was a clear distinction between the size effect and price overreaction.

2.3.5 Transaction Costs

Atkins and Dyl (1990) criticised past research on the Overreaction Hypothesis as not accounting for transaction costs when looking at available trading strategies. These authors did not find contradictory evidence regarding overreaction itself, but rather did not find economic benefits from trading on this phenomenon. Based on daily returns, these authors found weak support for an overreaction to positive news, but strong evidence for overreaction to unfavourable information. The implication was that transaction costs (using the bid ask spread as proxy) eliminate potential profits from reversals, and hence the conclusion was that the efficient market hypothesis holds for the overreaction hypothesis as well. A later study by Akhigbe et al (1998) challenged the use of the bid-ask spread for transaction costs as being an incomplete measure of the latter. Using daily closing bid-ask spreads, Akhigbe et al (1998) found similar results, which supported the simultaneous existence of the EMH and the Overreaction Hypothesis, and that except for the most extreme 'losers', there were no excess profits made through trading.

2.3.6 Time Varying Risk Premiums

An implicit assumption of some of the prior research linked to the Overreaction Hypothesis is that there is no change in asset risk over the testing period. This may be unrealistic, especially if the stock has undergone an extreme price change in one day. The Theory of Time Varying Rational Expectation is relevant in this regard. If perceived changes in risk are priced into the asset value via their beta, then this may explain some or all of the excess returns realised by

trading, since higher risk would require a higher return in the market, as argued by Chan (1988), as well as Ball and Kothari (1989).

Jegadeesh (1990), on the other hand, finds that any assumed premium due to time varying risk could not explain the profitability of trading based on contrarian views. Similarly, Dissanaikie (1997) found no evidence that time varying risk was significant in explaining excess returns, in spite of using two different measures: estimating risk relative to the log version of the CAPM model³ and CAPM-adjusted returns⁴. The mixed evidence when contrasting the empirical evidence suggests that further examination of the standard CAPM model is required, and also questions whether beta is a sufficient risk measure on its own.

2.4 International Prior Research on Short Term Share Price Reversal / Overreaction

This section summarises the international empirical evidence related to short term share price overreaction, while the methodologies used in these studies are elaborated on in Section 2.6.

2.4.1 Evidence from Germany

Lobe and Rieks (2011) searched for evidence of short term overreaction on the Frankfurt Stock Exchange for the 20 year period 1988 to 2007. These researchers used 10% as the cut-off for share price changes (to classify them as abnormal returns), and found significant evidence of short term overreaction, which was not limited to small cap securities. In addition, the possible contribution of anomalies to the overreaction was tested for, but only the size effect seemed relevant. When the latter was controlled for, reversals could mostly explain the overreaction to price shocks. However, because of transaction costs and random investor sentiment, the above authors believe that these anomalies cannot be used

³ Model: $\ln r_{pt} - \ln r_{ft} = a_p + b_p r_{mt} - \ln r_{ft} + e_t$

⁴ Model: $r_{pt}(T) - r_{ft}(T) = a'_p(T) + b'_p(T)(r_{mt} - r_{ft}) + e_{pt}(T)$, where T is the event year.

consistently as a market-beating strategy. Furthermore, return reversals after sharp price changes did not diminish over time, which implies that neither limited liquidity nor a bid-ask bounce can fully explain this phenomenon. In addition, it was found that abnormal returns after negative shocks were greater than those after positive shocks. Overall though, the above researchers did not find conclusive evidence that the efficient market hypothesis was violated, despite of their evidence for short term overreaction.

2.4.2 Evidence from Hong Kong

Otchere and Chan (2003) investigated both short term overreaction and tested a contrarian trading strategy in the sub-periods before and after the Asian Financial Crisis, covering the period March 1996 to June 1998. It was found that the overreaction was more notable for the stocks which had large positive shifts in price compared to the stocks that had a large drop in price. In addition, although evidence of overreaction was found, once transaction costs were adjusted for, there were no excess returns available and hence weak form efficiency appears to hold in the Hong Kong equities market. Consideration was also given as to whether the company size, bid ask bounce and day-of-week effects had something to do with the overreaction. No significant relationship for company size was found, but a small positive correlation between bid-ask spreads and reversals of gainers was found, and also that calendar effects such as the day-of-the-week effect only explained a trivial portion of the differences in abnormal returns (Otchere & Chan, 2003).

The methodology involved models that benchmarked abnormal returns - the capital pricing model (CAPM), mean adjusted model and the market model of returns. Significant return reversals were determined to occur at 2.1 days for the gainers, whereas significant return reversals for the losers occur after 2 days. When comparing results for the pre-crisis and intra-crisis periods, overreaction appeared to be more pronounced in the pre-crisis period, which suggests that market efficiency was more stable during the Asian financial crisis, contrary to what may be expected in periods of financial distress. In contrast to other studies

on short term reversal (conducted in the USA), such as Atkins & Dyl (1990) and Cox & Peterson (1994), which found reversals occurred in one day, the time for reversals took about 2 days for gainers and losers in this study, which may be due to a possible lesser extent of informational efficiency in the Hong Kong stock exchange (Otchere & Chan, 2003). The authors cite cultural differences in risk and return as a possible explanation to differences in the time and magnitude of reversals compared to other studies, which was also documented by Ji et al (2001).

2.4.3 Evidence from India

The short term price behaviour of selected Indian stock indices was investigated by Maher & Parikh (2011), to determine whether the driver was short term overreaction, uncertainty avoidance, or anticipation. It is useful to note that analyses were conducted on both the before- and after crisis periods, and that results differed depending on which of these periods the data originated from. A GJR-GARCH specification and a model that used mean adjusted returns of cumulative abnormal returns was employed, and under- reaction in small and midcap stocks in periods other than post crises was found, as well as slight evidence of overreaction before the 2008 financial crisis.

Choudhary and Sethi (2014) examined overreaction in the Indian equity market by investigating the Bombay Stock Exchange's 1427 listed companies over the period 1990 to 2012, while also focusing on size, seasonality and value effects. This study is more useful for its treatment of the size and value effect rather than solely the overreaction aspect, since the main focus is more on long term overreaction. Specifically, these authors utilised model specifications that controlled for the size and/or value of the companies, and this methodology informs some of the techniques that can be adapted for this study.

2.4.4 Evidence from Japan

Bremer et al (1997) examined price overreactions on the Tokyo Stock Exchange using firms listed on the Nikkei 300 for the 10 year period January 1981 to December 1991. Although these authors only found substantial evidence for one side of overreaction (negative price shocks), there is still relevance to this study since it has been noted that the reversals may not be symmetrical⁵, and this makes the case for examining decreases and increases separately. Although the size and duration of these reversals created potential profits, the probability of earning excess returns based in this approach was again considered much reduced by transaction and other costs. The bid-ask effect was not considered in this analysis as the Tokyo Stock Exchange operates on a single price, and no special quotes are used to reduce the rate of price changes and also to limit large shifts in price. According to Bremer et al (1997), an interesting possible cultural distinction is that bigger players in the dealer market and members of the Tokyo Stock Exchange protect large customers by not taking advantage of opportunities one day and later.

2.4.5 Evidence from New Zealand

In contrast to some of the studies mentioned earlier, Bowman and Iverson (1998) researched short term overreaction on a weekly basis on the New Zealand stock exchange using event study methodology and a cumulative abnormal returns model. The cut off to select the sample of gainers and losers that these researchers used was a 10% price change over a week,. In this instance evidence of overreaction was found for shares that had experienced one-day price changes of 10% or more, which was more significant for the losers group (reversals of 2.4% within a week), than for the gainers (reversals of -1.5% within a week).The magnitude of the reversal appeared to be proportionate to the initial price change. In order to determine the effect of penny stocks (share price <NZ\$1.00) on the results, samples both with and without penny stocks were examined, but no significant differences in reversals

⁵ For instance Lobe and Rieks (2011) find very different coefficients for increases versus decreases.

were found between the two samples. Additional tests were also conducted to investigate the role of other effects that may have affected the results, including time period, risk estimates, seasonality, size and bid-ask spreads, as well as to ensure robustness and consistency.

To check for internal consistency across time, the sample period was divided into three and the initial tests for overreaction was repeated for each period. A statistically significant reversal effects was, however, found regardless of which sub period was tested. To analyse any possible impact of seasonality on share return reversals, the sample was retested using monthly periods, resulting in the finding that reversals were still consistently present on a monthly basis. Furthermore, no significant association between company size or the bid-ask spread and share return reversals were found, thereby eliminating these anomalies as possible causes for the results. To test for the size effect, data on size was inaccessible hence share price was used as a proxy, based on correlation beliefs between the two measures. No statistically significance was found between company size (as proxied here) and reversals. Finally, considering bid-ask spread movements and their potential effect on reversals, similarly share price was again used as a proxy, based on an assumed negative correlation with bid-ask. No significant difference from their initial results was found by this test.

2.4.6 Evidence from Pakistan

Sohail and Javid (2014) investigated short term under and overreaction effect on the Karachi Stock Exchange amidst the Global Financial Crisis, over the period from September 2007 to September 2009. The results suggested an absence of significant evidence of under or overreaction effect both during and after the period of financial turmoil. The abnormal returns overall indicate some significant overreaction for non-financial sector shares in the first two weeks. Furthermore, the evidence showed that financial sector shares that experienced a positive price shock did not exhibit any significant overreaction, at least for one month following news of the crisis. In general, all shares that experienced large price declines did not

significantly under or overreact. When looking at the gainer and the loser portfolios individually, neither showed any indication of either under or overreaction (Sohail & Javid, 2014). This suggested the presence of dampened under and overreaction after the financial crisis which may be attributed to the momentum effect and limited international financial market linkages that averted the crisis contagion (Sohail & Javid, 2014).

2.4.7 Evidence from Taiwan

Huang (1998) investigated short term overreaction in the Taiwan Stock Exchange after changes in the price limits in the share market, using the 6657 trading day period from 1971 to 1993 as the sample. An event study approach was used, by comparing cumulative abnormal returns as a proxy for reversals, and expected returns estimated by the market model. It was concluded that for both increases and decreases in the daily price limits, there were statistically significant reversals, with abnormal returns of -0.249% on day two for limit increases, and 0.35% on day two for limit decreases (Huang, 1998). These results remained statistically significant, even after adjustment for the impact of the size effect.

2.4.8 Evidence from the USA

A useful methodological point of interest is the use of the average of the bid-ask prices to calculate price returns, as used by Park (1995). The study found that for a short investment horizon, systematic abnormal return patterns following price shocks were observed, and these return reversals persisted even after systematic trading patterns had been adjusted for. However, trading strategies based on these short-run reversals indicated that consistent profits cannot be earned when accounting for transaction costs and the bid-ask difference.

Lasfer et al (2003) analysed a global basket of share indices, ranging from the All Share index in the UK to the NYSE All Share index in the USA, for the period 1989 to 1998. This study found that large positive price movements precede notably large and positive abnormal

returns, and that large negative price movements precede negative abnormal returns. This is a similar result to that of a study by Cox and Peterson (1994), which examined share returns following large one-day price declines. These authors also discovered that effect of bid-ask bounce and the liquidity for buying and selling shares explained return reversals over a short horizon. On the other hand, Lasfer et al (2003) were unable to uncover evidence in support of overreaction, In addition, shares which experienced large one-day negative returns continued to have negative returns over an extended of time. Conrad et al (1994) provided evidence for a link between transaction frequency and subsequent auto-covariances in weekly returns such that highly actively traded shares would have return reversals (negative auto-covariances), while the returns of low activity shares did not.

Ma et al (2005) investigated the overreaction hypothesis for the shares with the largest daily price movements (positive and negative) between January 1996 and December 1997. They selected shares listed on the New York Stock Exchange and NASDAQ, which were divided into groups of gainers and losers. Significant evidence supporting the overreaction hypothesis were found for both the NASDAQ gainer and loser groups. However, neither of the NYSE groups provided similar evidence. The reversals of share prices and their associated returns was found to occur within a 48 hour window after the initial price shift, and the regression analysis showed that the reversals were inversely proportional to the magnitude of the initial price shift after accounting for differences in company size.

Simpson et al (2011) examined the nexus of individual stock return reversals and industry momentum. The results showed that individual stock return reversals tend to be related to return reversions within different industries. Thus, the predictions of the overreaction hypothesis held market-wide and within industries. This led to a different trading strategy than those suggested by either the overreaction hypothesis or by industry momentum. This modified strategy involved a long position on the losers from the industry that gained in the last month, and took a short position on the gainers from the industry that lost in the last month. This strategy was found to significantly outperform the other two strategies.

Kudryavtsey (2012) examined the intraday behaviour of share prices in terms of short-term reversals using the method employed by Becker et al. (2008) which used intraday upside and downside volatilities to measure reversals. For the sample, it was found that the average daily returns were higher after a day when a share's upside volatility was equal to or greater than its downside volatility, than when the downside volatility was stronger. This was explained as a short term 'reversals of reversals'.

Da et al (2014) investigated the portion of short run reversals that were unexplained by news. The authors found that if analyst forecast revisions⁶ were used as a proxy for news relating to cash flow, an adapted strategy based on reversals of this generated an excess return four times larger than the conventional price reversal strategy. Specifically separating and focusing on the portion of past returns (cash flow news) which excludes other fundamentals allows for a different analysis of short term reversals. Through this method, these authors found that both liquidity shocks and the behavioural aspects contributed to the overreaction and reversals-sentiment on the short side due to short sale restrictions which delay instantaneous overvaluations, and on the long side since panic sales require immediate liquidity.

⁶ See Section 2.6.3.

2.5 Evidence from South Africa

2.5.1 Prior Research on Overreaction

The earliest exploration of stock price overreaction in South Africa was by Page and Way (1993), whose study covered 204 JSE-stocks over the 15 year period between July 1974 and June 1989. This is different from the other studies below since it was conducted exclusively in the market of the Apartheid era when the nation faced imposed sanctions and other market related limitations. Monthly data was used, which was justified based on perceived bias avoidance from nonsynchronous and infrequent trading, as well as the 'bid-ask effect' that was discussed in section 2.2.1.

The screening process excluded companies which did not have at least 30 trading weeks of data in any given calendar year, which introduces a possible survivorship bias in the sample that was tested. To represent the market index an equally weighted portfolio of the 204 shares was used, and the index return calculated as an arithmetic average return. This portfolio composition method, instead of a value based approach, was used since it was feared that an upward pressure on portfolio returns would be introduced with time via the latter method.

Page and Way (1993) specifically focused on stock price efficiency with respect to incorporating positive or negative earnings announcements. The emphasis was on long term reversals, using a smaller sample and a different trading environment. Page and Way (1993) found that there were inefficiencies at the weak form level, and that there was notable overreaction in the South Africa equities market. These authors further found that excess profits were realised within two to three years, and also noted the presence of a January effect.

Hsieh and Hodnett (2011) investigated overreaction and the timing of mean reversals from January 1993 to March 2009, using gainer and loser portfolios. Monthly returns based on the total return index of companies listed on the FTSE/JSE index were used in equally weighted portfolios to avoid mean-variance inefficiencies associated with cap weighted versions. The test metric was a cumulative average residual return over three years after portfolio formation, based on a momentum return variable. Using portfolio performance measures, correlation analysis and cumulative spreads, the authors found that losers exhibited stronger reversals than gainers. It was suggested that this difference was due to behavioural biases and that the magnitude of reversals was cyclical and fluctuated around the local business cycle. Two key observations were made that are relevant to this study - the majority of shares are held by institutional investors, and firms have complete discretion on the choice of their tax year end, which in effect greatly diminishes the possibility of the January effect.

Frisch et al (2014) tested for under and overreaction in the South African share market by testing abnormal returns on the FTSE Group JSE Top 40 index after large price changes over monthly periods. During the sample period (January 2003 to December 2011), these authors noted that 68 different companies constituted the top 40, with the index's membership established based on quarterly revisions. The rationale for limiting the sample to the largest 40 companies was to exclude significant size and liquidity differences. Time varying risk was adjusted for and consistency was tested within subsamples, but by focusing on a select group, a large part of the market is still left untested.

Frisch et al (2014) used changes of more than 20% in closing prices over a month to narrow the sample. This monthly return was calculated using total returns, and an 'event' month was defined as one which experienced a greater change than 20% in either direction. A total of 150 company specific events were identified over the testing period, of which 56 were price declines, and 94 price increases. The majority of events occurred before 2010, with 56% occurring either in 2008 or 2009, which is significant given that this is the period during which the Global Financial Crisis may have affected South Africa.

The methodology used incorporated the cumulative abnormal returns measure and a GARCH (1, 1) specification to analyse a market and market adjusted model. The sample was divided into two sub-periods: January 2003 up to December 2007 (prior to the Financial crisis) and January 2008 up to December 2011 (including and after the crisis). Dividing the sample to compare prior to, during and after the crisis did not show a significant trend for large price increases, but provided a highlight for price decreases: the crisis period exhibited significant reversals. Frisch et al (2014) found that negative and positive price shocks are followed by positive average cumulative abnormal returns (ACARs). When comparing positive and negative price shocks, the ACATs were smaller for price declines. Furthermore, when an event cut-off of 30% was used, the ACARs remained significant. Investigating risk changes with time showed that risk was higher in the second sub period, but reverted to previous levels within a two year window. However, Frisch et al (2014) remained sceptical as to whether these anomalies can be consistently used profitably, given liquidity concerns in the South African market relative to other markets.

Itaka (2015) examined short and long-term overreaction over the period January 2002 to December 2009 in a Masters research project. The short horizon was in terms of months, which is much longer than the daily and weekly investigation in this current study. The analysis was based on the cumulative abnormal returns (CARs) over a one-year holding period for either winner or loser portfolios. The study found no evidence of mean reversion for winner and loser portfolios that were formed based on prior returns of a year or less, but there was significant mean reversion based on two and three year returns. The former was consistent with short term momentum, whereas the latter provided support for long term reversals. The returns from a contrarian strategy declined during and after the global financial crisis.

Table 1: Summary of South African studies

Author	Specific area of research	Period	Methodology	Results
Page and Way (1993)	Stock price efficiency with respect to incorporating positive or negative earnings announcements. The emphasis was on long term reversals	July 1974 to June 1989	Formation of winner and loser portfolios and use of average cumulative abnormal returns as well as t-tests with a pooled variance.	Inefficiencies at the weak form level, and that there was notable overreaction in the South Africa equities market. These authors further found that excess profits were realised within two to three years, and also noted the presence of a January effect.
Hsieh and Hodnett (2011)	Overreaction and the timing of mean reversals	January 1993 to March 2009	Formation of winner and loser portfolios and use of average cumulative abnormal returns to determine long, short and relative strength strategies. A regression using the market model was also performed.	Losers exhibited stronger reversals than the gainers. It was suggested that this difference was due to behavioural biases and that the magnitude of reversals was cyclical and fluctuated around the local business cycle.
Frisch et al (2014)	Tested for under and overreaction in the South African share market by testing abnormal returns on the FTSE Group JSE Top 40	January 2003 to December 2011	Calculated average abnormal returns and cumulative abnormal returns and a GARCH (1,1) model for an event study.	For price decreases: the crisis period exhibited significant reversals. Frisch et al (2014) found that negative and positive price shocks are followed by positive average cumulative abnormal returns (ACARs). When comparing positive and negative price shocks, the ACARs were smaller for price declines.
Itaka (2015)	Short and long-term overreaction	January 2002 to December 2009	Formation of winner and loser portfolios to obtain average cumulative abnormal returns.	The study found no evidence of mean reversion for winner and loser portfolios that were formed based on prior returns of a year or less, but there was significant mean reversion based on two and three year returns. The former was consistent with short term momentum, whereas the latter provided support for long term reversals. The returns from a contrarian strategy declined during and after the global financial crisis.

2.5.2 South African Returns Modelling

This section will discuss prior research that inform which variables are relevant in South Africa for incorporation into the empirical models to be used. Several studies have investigated hypothetical models to explain returns on the JSE. Much of the work has focused on style based effects, and testing Fama and French's return models, including the extended three factor model. This collection of work aims to provide an adequate empirical basis as to the relevance of some variables in South Africa. Although there also exists extensive literature on macroeconomic models, these are not relevant to this study, whose focus is not on modelling returns broadly, but rather only large abnormal returns relative to the market. Macroeconomic models are excluded from this study as the top down analysis is not suitable for the scope of work and the answers that are sought here.

Van Rensburg and Robertson (2003) investigated the interaction of company size, price-to-earnings and beta on returns in the JSE following on from their previous work that looked at style based effects. Incorporating a dual sorting procedure based on size, the authors found that small firms have a smaller beta and earn higher returns. A similar conclusion was obtained regarding low P/E firms, which is that they presented higher average returns and had a smaller beta. The effects of size and P/E were found to operate in isolation from each other.

Basiewicz and Auret (2010) tested the explanatory power of the Fama and French three factor model on the JSE with respect to the company size and value effects. Using data that was grouped and arranged for time-series tests, the authors found evidence that the three factor model explains a significant amount of variation in returns, while yielding small pricing errors. When similar tests were performed on ungrouped data, the model's ability to capture the value effect was maintained, and managed to capture the size effect to some extent.

Strugnell, Gilbert and Kruger (2011) built on the study by Van Rensburg and Robertson (2003) through testing of the size and price-to-earnings effects as well as beta using a dataset from

1994 to 2007. The authors found similarly statistically significant and persistent size and P/E effects (independent), but contrary to the evidence of Van Rensburg and Robertson (2003), there was no statistical significance found for beta when compensating for thin trading. The latter implies model misspecification, and that the CAPM model is inadequate in capturing returns in the JSE.

Hoffman (2012) researched a collection⁷ of share return anomalies in the JSE, over the period 1985 to 2010, using equal and value weighted portfolios. Of particular interest to this thesis are the results related to company size and the book-to-market ratio. Employing a method of cross-sectional regression, significant evidence was obtained in support of the book-to-market, size and momentum effects after adjusting for risk. Limited support was also found for the earnings-to-book effect and for newly issued shares.

In a comprehensive study of several style based effects, Muller and Ward (2013) found slightly different evidence regarding the size effect while providing support for other influential variables. The portfolio of style based effects tested included financial ratio styles,⁸ market based styles,⁹ as well as behavioural styles¹⁰. Of key interest were the conclusions related to liquidity and size; poor liquidity was associated with persistent excess returns, whereas size had no significant effect aside from 'fledgling' companies. Although limited evidence was found in support of the size effect, its complete absence is not certain given the evidence for very small companies found in this study.

Collectively, these studies provide consensus on influential variables that should be included in the investigation of returns in South Africa. Variables that function as proxies for size and value (such as the P/E and BTM ratio of individual companies) will be included in the empirical models.

⁷ market capitalisation, book-to-market, momentum, net share issues, yield-to-book, accrual of operational assets and growth in total assets

⁸ interest cover, net asset growth, return on capital and equity

⁹ cash flow-to-price, dividend yield, earnings yield, industry, liquidity, price-to-NAV and size

¹⁰ momentum

2.6. Empirical test used in Short Term Overreaction studies

Analysis of prior research on short term share price overreaction shows that there are broadly three types of statistical procedures that have been used, namely multivariate regressions, event studies, and volatility and variance testing (serial covariances and GARCH models). It should be noted that these approaches can be used in combination, but the key decision factor is the research objective. The following subsections expand on the methodologies used in prior literature.

2.6.1 Event Studies

Event studies offer a simple process to test a hypothesis based on a t statistic. The models that are required vary depending on their explanatory power but cumulative abnormal return (CAR) is the common dependent variable. This section will summarise the process of event studies and the key features of some event studies as applied to testing the Short Term Share Price Overreaction Hypothesis. The event study methodology involves the following sequence of steps.

1. Collect time series data of the daily returns of a company's shares and the market.
2. For each event day - this being a day where abnormal returns (those in excess of some cut-off in either direction e.g $\pm 5\%$) were observed - identify all the data points for the company share returns and the market returns on the same day. This will be used in the sample that will be tested for the specific estimation window.
3. In order to estimate the intercept and slope coefficients which model the returns relationships, a statistical analysis using a multivariate regression based on the CAPM, market or other specified expected returns model is used.

4. Using the estimates from the previous step, expected returns are computed for all data points on the days which have been included in the estimation window.
5. The abnormal returns are calculated by subtracting the estimates for expected returns from the actual returns. Other variants of abnormal returns are also calculated and used for further analysis, such as cumulative abnormal returns or average abnormal returns.
6. A statistical test is implemented to determine if the abnormal returns are significantly different from zero, and the other metrics (for instance abnormal, cumulative abnormal, average abnormal or cumulative average abnormal returns) are also available. The Student's two sided t-test is usually used. It can be stated as follows:

Null Hypothesis $H_0: \mu_1 = \mu_2$

Alternative Hypothesis $H_1: \mu_1 \neq \mu_2$

Reject the null hypothesis if: $t \text{ statistic} > \text{critical value of } t$ or $(-)t < (-) \text{critical value}$.

The table below lists some of the prior short term share price overreaction studies that utilised an event-study type methodology.

Table 2: Summary of Models used In Event Studies of Short Term Overreaction

Author	Purpose	Measure
Bremer and Sweeney (1991)	Examine two-day return reversals following on from 10 consecutive days of negative returns.	Cumulative Excess Return
Huang (1998)	Investigate Short Term Overreaction in the Taiwan Stock Exchange to changes in daily price limits	Abnormal returns and CAR* Market Model
Bowman and Iverson (1998)	Test bid ask bounce, risk, seasonality and size in connection to Short Term Overreaction in New Zealand	CAR
Otchere and Chan (2003)	Test Short Term Overreaction in Hong Kong in wake of Asian financial crisis	CAAR**
Ma et al (2005)	Test Short Term Overreaction in the NYSE and NASDAQ	CAR 2 day Market model

* Cumulative abnormal return ** Cumulative average abnormal return

2.6.2 Volatility and Variance Testing

In investigating short-term share price overreaction, one of the most common approaches is volatility testing, which includes tests of serial correlation and covariances, GARCH model specifications, and modified volatility measures. This section will expand on these methods in that order.

Kaul and Nimalendran (1990) investigated whether observed return reversals were due to overreaction or bid-ask errors in price measurement. Variances and autocorrelations are tested in two ways, the first being the use the variance ratio to test the variability over k periods such that:

$$VR(k) = \left(\frac{1}{k}\right) \left(\frac{var(R_t^k)}{var(R_t)}\right) \quad (2.1)$$

Where:

R_t is the return for day t,

R_t^k is the return over k periods

The second method is to use bid-ask errors to test their effect on returns volatility, by means of two tests on a bid-ask error variable RD_t . The first sub-test involves time independence testing by estimating the daily autocorrelations of RD_t , and whether these are equal to -1/2. The second sub-test measures the contribution of RD_t to returns volatility using:

$$VRD(k) = \left(\frac{1}{k}\right) \left(\frac{var(RD_t^k)}{var(R_t^k)}\right) \quad \text{where } k = 1,2,3 \dots \quad (2.2)$$

Jegadeesh and Titman (1995) employed a set of different tests in analysing short term reversals and the bid ask spread. Essentially, the overarching process involved testing the relationship between serial covariances and the bid-ask spread, but broadly three types of empirical tests were used. These involved estimation of serial covariances, comparing the quoted spread and Roll's (1984) implicit measure,¹¹ and regression of the serial covariances.

¹¹ This measure of effective bid-ask spread: $spread = 2\sqrt{-(1st \text{ order serial covariance of price changes})}$

Maher and Parikh (2011) investigated short term share price overreaction in India using three size conditioned market indices: the BSE 30 (Sensex), the BSE Midcap, and the BSE Smallcap. The authors used both an event study based on the average cumulative abnormal returns, but citing the limitations of this approach, the focus was also placed on a Glosten-Jagannathan-Runkle GARCH model using dummy variables.

Kudryavtsev (2013) went a step further in terms of the short term, and investigated intraday reversals of return reversals on the Dow Jones Industrial Index constituents using upside and downside volatility in response to positive and negative news. Three portfolios were formed for both of these volatility measures, namely previous day, average and median volatility. The measures used were:

$$\text{Upside Volatility: } UV_{it} = R_{OH,it} * 100 * R_{HC,it} * 100 \quad (2.3)$$

$$\text{Downside Volatility: } UV_{it} = R_{OL,it} * 100 * R_{LC,it} * 100 \quad (2.4)$$

Where:

$R_{OH,it}$ is the open-to-high price difference

$R_{OL,it}$ is the open-to-low price difference

$R_{HC,it}$ is close-to-high price difference

$R_{LC,it}$ is the close-to-low price difference

The table below summarises the salient features of the studies that used volatility tests:

Table 3: Summary of volatility tests of short Term overreaction and reversals

Author	Topic of research	Test
Kaul and Nimalendran (1990)	Return reversals due to bid ask error or overreaction	Variance-Ratio Test
Jegadeesh and Titman (1995)	Short term reversals and the bid ask spread	Serial Covariance Modelling
Maher and Parikh (2011)	Short term overreaction as a possible driver of price behaviour	Glosten-Jagannathan-Runkle GARCH model
Kudryavetsev (2013)	Intraday reversals of return reversals	Intraday Volatility Modelling

2.6.3 Multivariate Regressions

Lobe and Rieks (2011) employed a multivariate regression to investigate short term share price overreaction on the Frankfurt Stock Exchange from 1998 to 2007, using a 10% cut-off for price increases or decreases. Essentially the method used was an extended and modified version of the three factor model. The models incorporated variables to test for one day (Equation 1) and five day reversals (Equation 2), as well as for the impact of the size, value and book-to-market effects. Equations 3 and 4 were used for sub samples with similar sized companies, and therefore the size variable was excluded. In addition, the authors used the dummy variable R (=15) in Equations 5 and 6 for each year which had more than 20 events. Methodologically the Lobe and Rieks (2011) paper is the basis for the testing that was done in this research project.

The model specifications are as follows:

$$AR_{i,t+1} = \beta_0 + \beta_1 ER_{i,t} + \beta_2 MV_{i,t} + \beta_3 BTM_{i,t} + \beta_4 RET_{i,t} + \beta_5 PE_{i,t} + \beta_6 VO_{i,t} + \varepsilon_{i,t} \quad (2.5)$$

$$AR_{i,[t+1,t+5]} = \beta_0 + \beta_1 ER_{i,t} + \beta_2 MV_{i,t} + \beta_3 BTM_{i,t} + \beta_4 RET_{i,t} + \beta_5 PE_{i,t} + \beta_6 VO_{i,t} + \varepsilon_{i,t} \quad (2.6)$$

$$AR_{i,t+1} = \beta_0 + \beta_1 ER_{i,t} + \beta_2 BTM_{i,t} + \beta_3 RET_{i,t} + \beta_4 PE_{i,t} + \beta_5 VO_{i,t} + \varepsilon_{i,t} \quad (2.7)$$

$$AR_{i,[t+1,t+5]} = \beta_0 + \beta_1 ER_{i,t} + \beta_2 BTM_{i,t} + \beta_3 RET_{i,t} + \beta_4 PE_{i,t} + \beta_5 VO_{i,t} + \varepsilon_{i,t} \quad (2.8)$$

$$AR_{i,t+1} = \beta_0 + \beta_1 ER_{i,t} + \beta_2 MV_{i,t} + \beta_3 BTM_{i,t} + \beta_4 RET_{i,t} + \beta_5 PE_{i,t} + \beta_6 VO_{i,t} + B'DRELYEAR + \varepsilon_{i,t} \quad (2.9)$$

$$AR_{i,[t+1,t+5]} = \beta_0 + \beta_1 ER_{i,t} + \beta_2 MV_{i,t} + \beta_3 BTM_{i,t} + \beta_4 RET_{i,t} + \beta_5 PE_{i,t} + \beta_6 VO_{i,t} + B'DRELYEAR + \varepsilon_{i,t} \quad (2.10)$$

Where:

$AR_{i,t+1}$ is the 1 day abnormal return,

$AR_{i,[t+1,t+5]}$ is the 5 day abnormal return,

$ER_{i,t}$ is the one day return pf share i at time t ,

$MV_{i,t}$ is the log of the market value of company i ,

$BTM_{i,t}$ is the log of the book – to – market ratio of company i ,

$RET_{i,t}$ is the average return over the previous 3 months of company i ,

$PE_{i,t}$ is the log of the price – to – earnings ratio of company i ,

$VO_{i,t}$ is the sample returns volatility over the previous 3 months of company i ,

$B'DRELYEAR$ is the dummy variable for years with more than 20 events

Cox and Peterson (1994) examined price behaviour following large one day price declines of AMEX, MASADAQ and NMS securities. To test for any differences in return reversals arising from the size effect or from being listed on a particular exchange (which influences liquidity as well) and for the existence of an overreaction effect, Equation 7 was used. The use of the size variable here is significant, in combination with the size effect documented in South Africa, in reinforcing the need to account for this in the model used in this thesis. Notably, this is a different model to that of Lobe and Rieks (2014), which is expected given the 20 year gap between the research.

$$CAR_i = \delta_0 + \delta_1 ARO_i + \delta_2 SIZE_i + \delta_3 D_{AMEX,i} + \delta_4 D_{NMS,i} + \varepsilon_i \quad (2.11)$$

Where:

CAR_i is the post drop cumulative abnormal return for security *i*,

ARO_i is the event day abnormal return for security *i*,

SIZE_i is the size index variable for security *i*, calculated six days prior to the event day,

D_{AMEX,i} is a dummy variable equal to 1 if security *i* is an AMEX firm, and equal to 0 otherwise,

D_{NMS,i} is a dummy variable equal to 1 if security *i* is an NMS firm, and equal to 0 otherwise

Da et al (2014) utilised a novel approach in studying short term share return reversals in the US market. Analyst forecast revisions were used as a proxy to approximate the effect of cash flow news, which provided a means to separate the portion of returns not driven by the underlying fundamental variables. This differs from the other studies in this section as it used the CAPM, the three factor Fama and French Model, and augmented five factor models on four groups based on portfolio strategies: standard, within industries, within industries using residuals, and residuals based without industry controls.

The models used are listed below:

$$Y_t = \beta_0 + \beta_1(MKT - r_f)_t + \beta_2SMB_t + \beta_3HML_t + \varepsilon_{i,t} \quad (2.12)$$

$$Y_t = \beta_0 + \beta_1(MKT - r_f)_t + \beta_2SMB_t + \beta_3HML_t + \beta_4MOM_t + \beta_5DMU_t + \varepsilon_t \quad (2.13)$$

Where:

$(MKT - r_f)_t$ is the market premium

SMB_t is the size of the company

HML_t is the value of the company

MOM_t is the momentum effect

DMU_t is the short run reversal effect

2.7 Conclusion

This chapter provided the theoretical basis for this investigation and its methodology going forward. Section 2.2 provided a summary of the Overreaction, Efficient Market and Uncertain Information Hypotheses, as well as the role of behavioural finance in explaining share price overreaction. The efficient market hypothesis (EMH) states that a market in which all publicly available information is reflected in the market prices of assets is efficient. If overreaction exists in the JSE, then it comes up against the conventional theory of market efficiency, especially weak form efficiency (De Bondt & Thaler, 1985). The uncertain information hypothesis (UIH) asserts that the abnormal returns following both positive and negative price movements should remain positive for some time (Ketcher & Jordan, 1994).

Section 2.3 discussed several factors that could either cause or account for observed overreaction, and provided some empirical evidence on these factors. This included the bid-ask bounce, January, value and size effects, as well as transaction costs and time varying risk premiums. Bid ask bounce suggests that a share price reversal can be caused by a shift or

'bounce' in the bid-ask spread (Cox and Peterson, 1994). The January effect suggests a sell-off in December to reduce profits and tax leading to a reversal in January. In contrast to the US, this is not a real issue in South Africa due to flexibility in choosing the individual tax year end. The value effect, which is also termed the Book-to-Market anomaly, refers to the observation that low market value stocks (higher book-to-market) are documented to perform better than those with higher market value, and earn positive abnormal returns. The size effect is characterised by smaller firms' stocks having better performance over time, as compared to larger capitalisation firms. The transaction costs of a trade can erode profits and it can be argued that large bid ask spreads can significantly increase these. If perceived changes in risk over the time periods are priced into the asset value via their beta, then this may explain some or all of the excess returns from trading, as higher risk would require a higher return.

Section 2.4 focused on prior research conducted over the short term internationally, highlighting the differing evidence gathered over different time periods and geographies. Section 2.5 presented evidence from work on overreaction and reversals in South Africa, and was followed by thematic studies on general returns modelling in South Africa. Section 2.6 discussed the common methodologies used in all the studies of short term overreaction, namely event studies, variance modelling and regressions. The following chapter will deal with the data and sampling approach used in this research project.

Chapter 3: Data and Sampling

3.1 Introduction

This chapter discusses the data used in this study in terms of selection, screening and demographics. Section 3.2 explains the sample selection and also includes consideration on two of the key practical issues which may influence the analysis, and how this study has attempted to address these challenges. Section 3.3 provides a summary of the main screening criteria that were used in sample selection to ensure an adequate and representative sample was refined as per the research needs. Section 3.4 discusses the data requirements and data sources relevant to this study. Section 3.5 provides an exploratory analysis of the sample and includes key descriptive statistics and demographics.

3.2 Sample Selection

The sample period is July 2000 to June 2015. This test period, which includes the Global Financial crisis, allows for a comparison of three periods- pre, during and post crisis. The length of this period is also in accordance with the requirements of the study as it is similar to the longer end of recent short term studies - for instance, Lobe and Rieks (2011) used 20 years, Choudhary and Sethi (2012) used 12 years and so on, which also allows for a more robust test of consistency across time.

Liquidity is not uniform across shares, and this has some effects on their pricing and return characteristics, especially if they are thinly traded, as is the case for most of the smaller stocks listed on the JSE. Price movements may not follow a smooth path in response to demand and supply dynamics in the market. Furthermore, low liquidity shares may indicate other company attributes which are not explicitly modelled for in standard models. As mentioned in the previous chapter, there may be consequences to the bid-ask spread, as well as an effect when combined with low priced stocks. To avoid these issues in this research project, the sample is

selected as the top 100 JSE-listed shares as measured by market capitalisation at each six month interval within the sample period. These shares generally are very liquid, especially compared to the larger number of smaller stocks.

Survivorship bias is a sampling issue that may occur with studies that involve only using data related to companies that are visible at the time of data collection. In their study, which was the first exploration of stock price overreaction in South Africa, Page and Way (1993) excluded companies which did not have at least 30 trading weeks in any given calendar year, as they might otherwise possibly introduce this bias. When comparing the study of Conrad and Kaul (1993) with DeBondt and Thaler's (1985) seminal study, which both focused on long term overreaction using identical data, Loughram and Ritter (1996) attributed the differences in cumulative abnormal returns to survivorship bias. In this particular study, given that the sample comprises the top 100 companies by market capitalisation as selected at 6-monthly periods throughout the sample period and not only at its end, survivorship bias is not considered a problem. In addition to this, any company which was a member of this custom group of the top 100 at any point were included in the sample to capture their potential contribution.

3.3 Screening

There were 372,817 observations in the raw sample. Broadly speaking the following were the main criteria implemented in the filtering of raw data prior to its selection, by screening all equities for inclusion and exclusion in the sample as follows:

- (i) Noting of consistent high gainers and losers with these being individually investigated as potential outliers. This led to the exclusion of 542 of the observations based on further investigation that uncovered data collection issues.

- (ii) Companies with less than 60 trading days of return history in a specific 6-month window were excluded for that window only, but included in subsequent windows. This was done in order to exclude the volatility effects of new IPOs. This occurred for two of the companies for one period. This led to the exclusion of 245 observations.
- (iii) Identification of shares with 60 or more trading days of data missing within the entire period. This did not lead to any exclusions from the sample.
- (iv) Check for very low value shares, *i.e.* penny stocks that may exhibit large price changes relative to share price. As mentioned in the previous chapter, there may be consequences to the bid-ask spread, as well as an effect when combined with low priced stocks. This was consistent with the studies by Lobe and Rieks (2011)¹² and Bremer and Sweeney (1991)¹² which screened for shares with very low prices. In this study there was no exclusion based on this criteria, as none of the top 100 shares at any point over the sample period were at less than R 10 for more than half of its trading life.

To summarise the outcomes of the screening criteria, the original sample of 372,817 daily return observations was reduced to 372,030 observations, which therefore represents the sample data used in this study.

¹² Lobe and Rieks (2011) used 10 Euros, while Bremer and Sweeney (1991) used \$10.

3.4 Data

Total returns data and other company specific data for the 125 JSE-listed companies that together constituted the largest 100 companies on the JSE at any particular 6-month interval over the study period, was collected. This study used daily total returns and daily total returns rolled over five days, calculated from the total return index values, to investigate stock overreaction. It is important to note that because total returns were used (as opposed to share price returns), the confounding effects of dividends on share price changes were implicitly accounted for. In other words, total returns automatically corrected for the price impact of shares trading ex-dividend. The sample population consisted of all abnormal daily total returns greater than 5% and less than -5%, over the period July 2000 to June 2015. Primarily Thomson Reuters Datastream International was used as a source of data, but other financial databases such as Bloomberg and McGregor Bureau of Financial Analysis were relied upon to fill any blanks in raw data. The following is a list of all the data that was required:

- Daily total return index values for all companies in the sample, this being used to calculate returns and return volatilities from July 2000- June 2015. This was required for all companies that are amongst the top 100 by market capitalisation.
- Company price-earnings ratios
- Daily All Share Index (ALSI) total return index values for the period, to be used a market benchmark.
- Daily South African Volatility Index (SAVI) values from 2007 to 2009. This is defined in Section 4.3.1.3.

- Market values for all the companies (or, alternatively, the number of shares outstanding) which was used in conjunction with the price data to calculate company market capitalisations
- Book values of equity (to be used to determine the book to market ratios of the individual shares).

3.5 Sample Distribution and Descriptive Statistics

The working sample used in the analytics process was further filtered down based on return cut-offs. These were -5%, 5%, -10% and 10% which yielded two test samples, one based on absolute daily share price movements of 5% and, the other based on absolute daily movements of 10%. The former consisted of 9117 daily observations and the latter had 855 observations. The following table summarises some information about these subsamples.

Table 4: Summary Statistics for Large Price Movements, Increases and Decreases

Return cut-off (%)	Total Observations	Maximum (%)	Minimum (%)	Mean (%)	Probability*
5 and -5	9117	34.48	-39.54	0.73	2.45%
10 and -10	855	34.48	-39.54	3.19	0.23%

*This is the average incidence of these events over the period, calculated as:

$$Probability = \frac{Number\ of\ observations}{Total\ number\ of\ observations}$$

The figure below depicts a comparison of the monthly absolute frequencies of excess returns (defined as daily total returns of >5% and <-5%) by month across the entire sample period. For all months except June, there are more excess increases than decreases. More extreme daily return events are observed in the second half of the year, with a notable increase in extreme daily returns (negative or positive) in the months October to December. From the observable

behaviour in the figure there seems to be no indication of a typical calendar effect, which is consistent with the hypothesis that a discretionary tax month (as is the case in South Africa) would eliminate the January or similar effect. Figures 2 and 3 display the event frequencies for upward and downward events separately with a common observation that the first three months and last three months of the year have the highest event frequencies.

Figure 1: Directional Comparison of Event Frequencies (2000-2015)

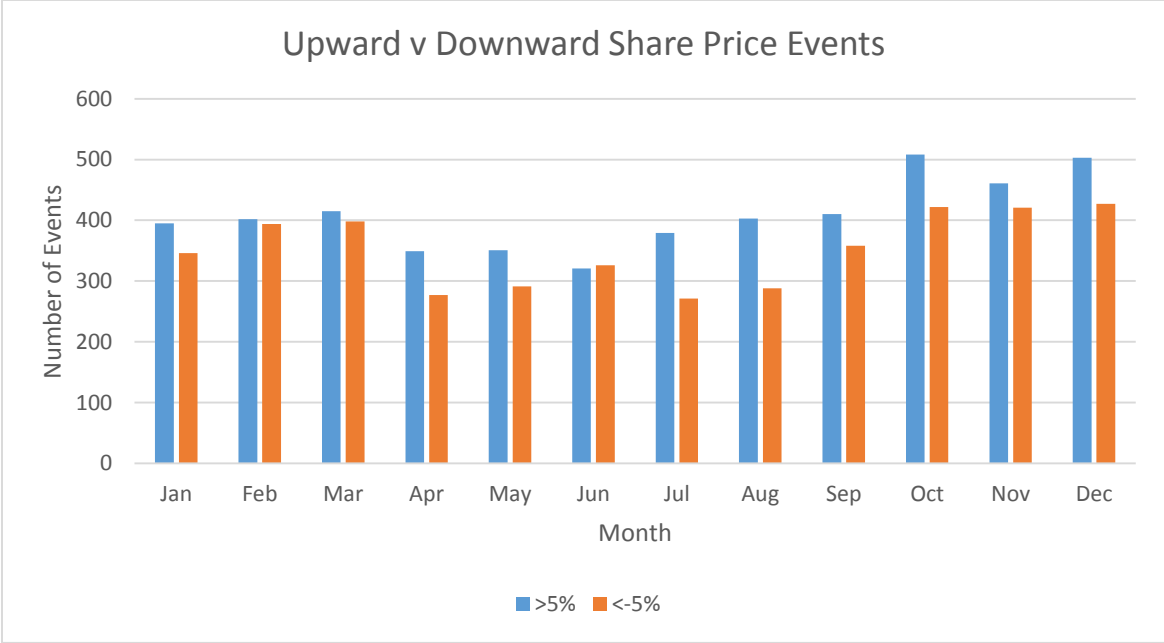


Figure 2: Event Frequencies for Upward Events (2000-2015)

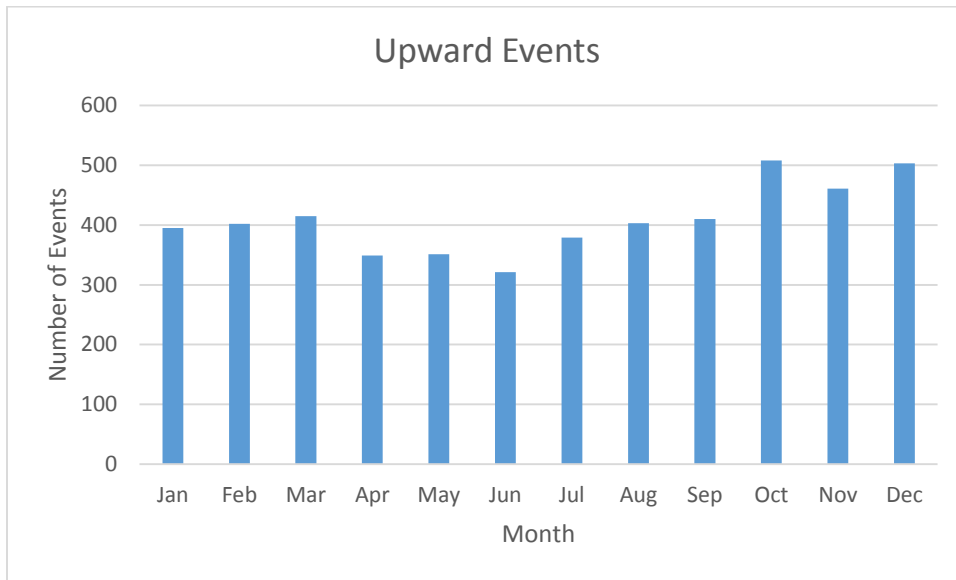


Figure 3: Event Frequencies for Downward Events (2000-2015)

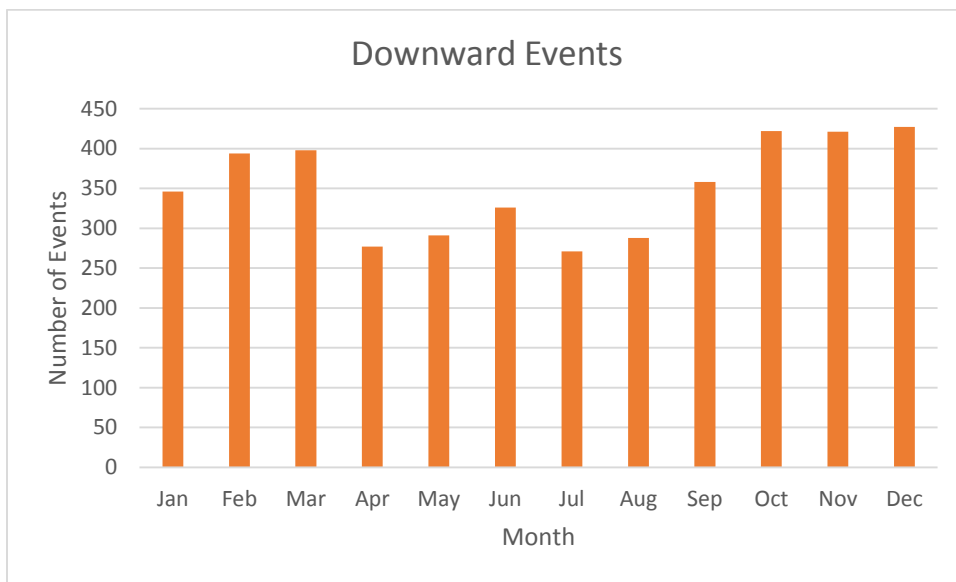


Figure 4 below shows the distribution of events by month over the period July 2000 to June 2015. High frequencies of abnormal return events are noted in the years 2000-2002 in the wake of the Dot-Com bubble. Extremely high frequencies are observed between 2008 and 2009 when the Global Financial crisis was at its peak. These dual observations provide some basis on which

to investigate share price overreaction in times of financial turmoil, where investor behaviour and rationality are challenged.

A consistent pattern is detectable in both Figures 3 and 4, which split the sample on the basis of upward and downward movements. The period mid-2000 to mid-2003 is moderately active with low frequencies until early 2008, with the exception of a spike in June 2006. Early 2008 until mid-2009 exhibits large numbers of decreases and increases followed by low frequencies until mid2015. The decomposition of events into upward and downward profiles provides confirmation of the returns behaviour in the vicinity of financial crises.

Figure 4: Frequency of All Abnormal Returns (July 2000-June 2015)

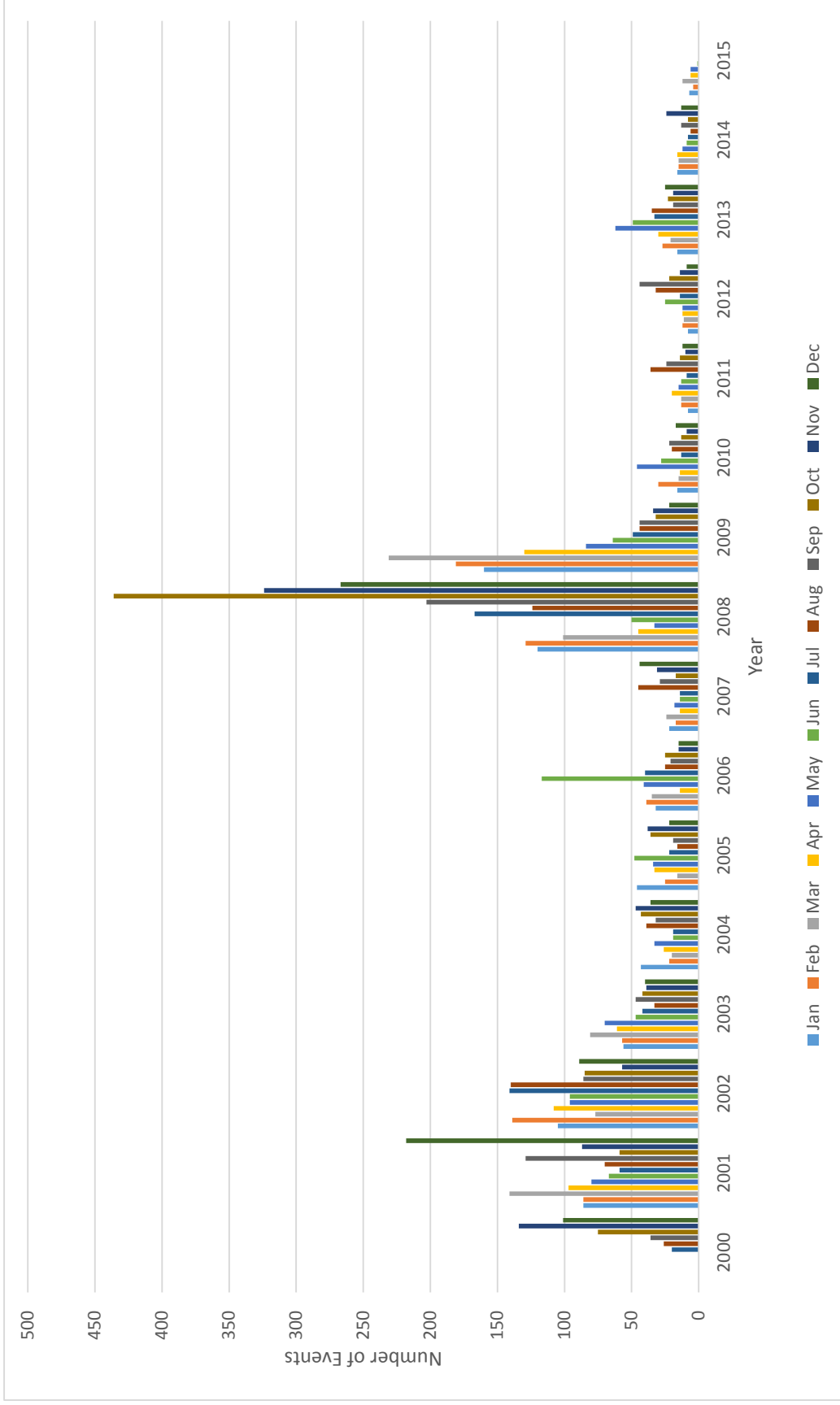


Figure 5: Frequency of Upward Abnormal Returns (July 2000-June 2015)

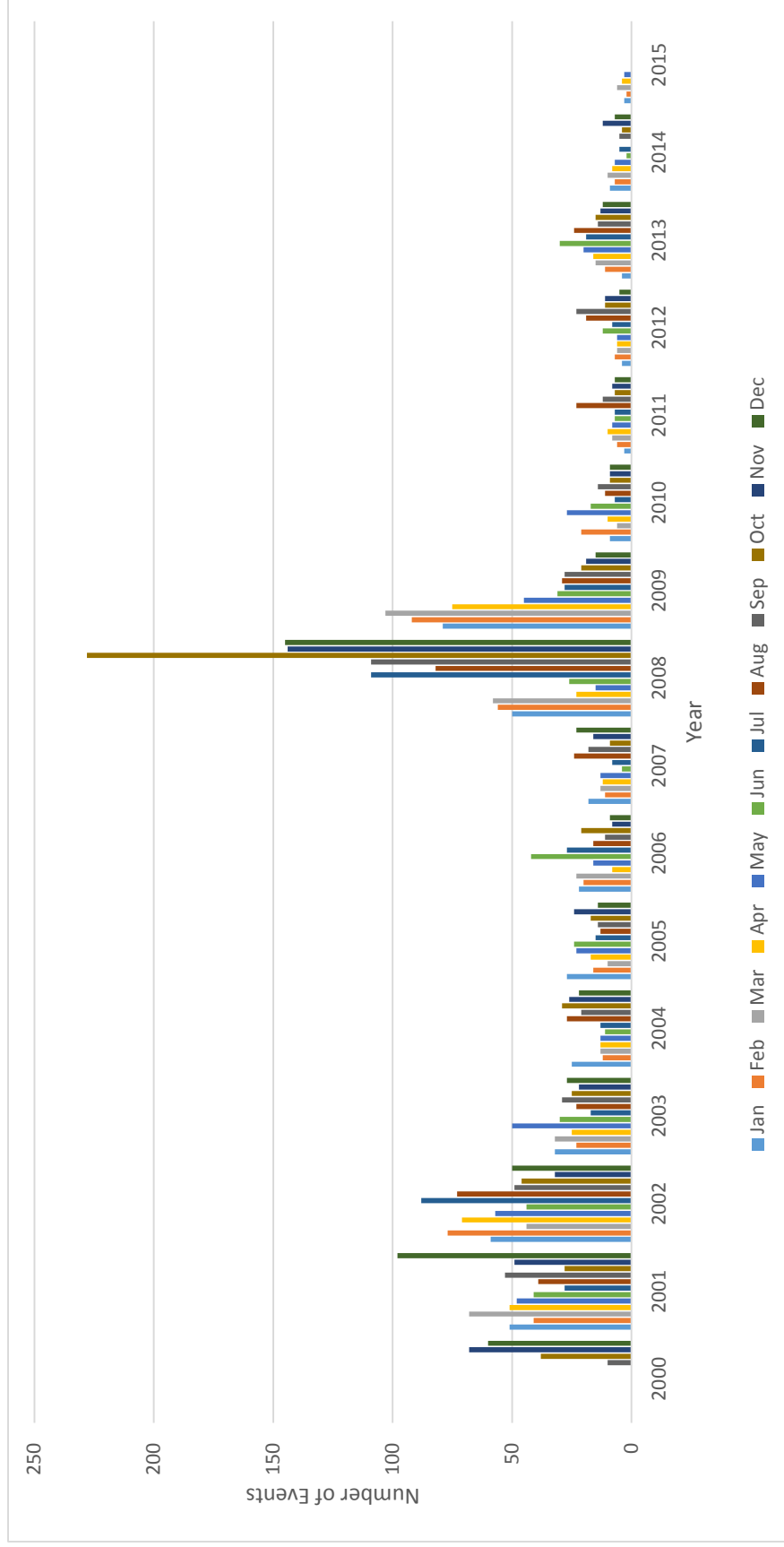
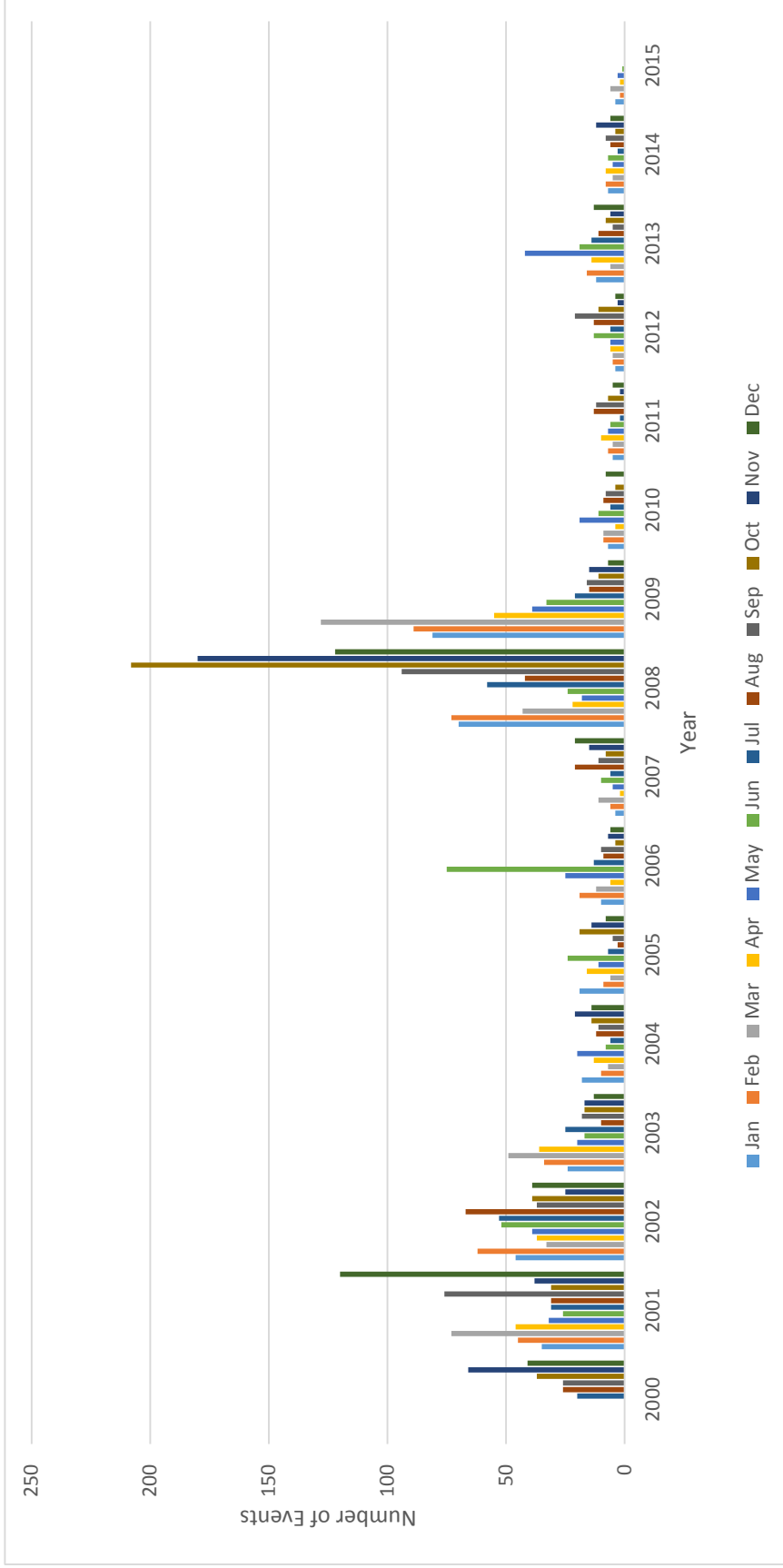


Figure 6: Frequency of Downward Events (July 2000 - June 2015)



3.6 Conclusion

This chapter provided an overview of the data collection process. The sample period is July 2000 to June 2015. The required data was sourced from Thomson Reuters Datastream International as well as Bloomberg and McGregor Bureau of Financial Analysis. The key issues of share liquidity and survivorship bias were considered, and measures were instituted to address these, including the selection of the top 100 shares based on market capitalisation. A summary was provided of the screening criteria that was used in refining the sample based on the outliers. This included how long the company had been listed and identification of penny shares which led to the exclusion of 787 observations out of 372,817 from the raw data. The final sample consisted of 9117 daily observations for the $\pm 5\%$ daily total return cut-off, and 855 observations for $\pm 10\%$ daily total return cut-off. Some information regarding the test samples and other demographic details were also provided.

Chapter 4: Hypothesis Development and Methodology

4.1 Introduction

Research on South African returns modelling is discussed in Section 2.5, which highlights empirical work on the influential variables that form part of the model specifications. This, combined with the empirical tests described in Section 2.6, informed the choice to use a multivariate regression to analyse the data. Section 4.2 provides the research hypotheses developed for empirical analysis along with their rationale. Section 4.3 explains the base and alternative model specifications and each of the variables included in the empirical analysis to generate the results that are analysed in Chapter 5. Section 4.4 covers the comprehensive range of regression suitability tests and results which validated the appropriateness of a multivariate regression as the analytical method. Finally, Section 4.5 summarises the chapter and condenses the highlights into a conclusion.

4.2 Hypothesis Development

Based on a combination of analysis of prior literature and exploratory data analysis, some areas of specific research have been developed as hypotheses for this research project. The research questions have been developed into testable hypotheses. This section will state the hypotheses which were tested via multivariate regressions.

4.2.1 Hypothesis 1: Short term share return reversals exist on the JSE

Research Question 1: Is there overreaction and return reversals in the short term in the South African listed equity market?

This is core and foremost research question in this thesis. Studies have been conducted that focus on medium to long term in South Africa, but not on the shorter time horizons (one day and one week) that are evaluated here. However, evidence for overreaction, even if over a longer term, provides a basis for testing over a shorter horizon. When investigating share price overreaction on the JSE using monthly abnormal returns, Page and Way (1993) found significant evidence in support of this phenomenon at the 1% level for the period July 1974 to June 1989. On the other hand, Frisch et al (2014) found that both large price increases and declines are likely to be followed by positive share returns when investigating a similar horizon which does not lend support to reversals, which lends support to the uncertain information hypothesis. To answer this research question, reversals are tested extensively using regression analysis.

4.2.2 Hypothesis 2: Upward and downward share return reversals differ

Research Question 2: Are there share price reversal differences between large share price increases, and large share price decreases?

In the remainder of this thesis companies whose shares experienced large positive price shifts are referred to as 'gainers', while those that experienced the opposite are referred to as 'losers'. As seen in Figures 1, 3 and 4, based on visual inspection there are definitely differences over time in upward and downward large price movements. The separation of price movements based on their directionality is relatively common in studies of this nature, as seen in the work by Lobe and Rieks (2011) and Frisch et al (2014). They are not paired movements and will be assumed as independent for the alternative hypothesis when testing. In addition to providing an additional test of robustness by separating upward and downward movements,

this also explores the possibility of which directional trade, if any, is over time more profitable. Furthermore, if there are identical price adjustments in either case, this would lend support to the Uncertain Information Hypothesis.

This will be tested by running separate regressions for price increases and decreases using all the model specifications across the period. A comparison of the coefficients in terms of their size and significance, as well as a two sample t-test, will provide insight on any important differences which may exist.

4.2.3 Hypothesis 3: Short term share return reversals are altered in times of financial turmoil

Research Question 3: Is share price overreaction on the JSE enhanced or diminished in times of financial turmoil?

There may be different effects at work in periods of financial crisis. The viewpoint here is derived from the behavioural aspects of investor decision making. For instance, when considering Asian financial crisis (ten years prior to the recent financial crisis), offshore traders were buying and selling based on if the market was bullish or bearish. These investors mirrored the actions of similar traders at the expense of accounting for fundamental data. This was noted by Kim and Wei (2002), who found significant evidence of this “herding” behaviour in Korean during this crisis. On the other hand, in times of financial turmoil, investors who take a contrarian view will attempt to benefit from this herding mentality by buying and selling from these positive feedback traders. Furthermore, Kim and Wei (2002) concluded that these actions may have exaggerated the crisis beyond what was reasonably expected. When investigating the Hong Kong market during the same crisis, Otchere and Chan (2003) found that the extent of overreaction seemed to have been dampened during the crisis period, which could have been due to lower activity in noise trading.

Frisch et al (2014) found that the beta coefficients for both positive and negative price shocks increase notably in the period after the financial crisis, which implied higher levels of systematic market risk in the JSE. The regressions will be performed for the entire periods as well as for the pre-, intra- and post financial crisis periods, to test for any differences in reversals and the impact of the other variables. In times of financial turmoil, if there is a behavioural driver for overreaction, this may manifest differently from more stable or optimistic periods. The extent of this can be proxied by examining reversals over the different periods, separated by the crisis.

4.2.4 Hypothesis 4: An economically significant reversals trading strategy exists

Research Question 4: Are there opportunities to trade on the JSE on these findings and earn excess returns when compared with the market?

Building on from the results of the previous hypotheses, the next step will be to determine if there exists any practical value to these findings, at least in theory. This is a common area of analysis for the majority of studies on overreaction for all the different horizons. In fact, especially for longer term studies, direct comparison of the gainer and loser portfolio performance is itself a test for overreaction and reversals. Page and Way (1993) found that loser portfolios outperformed gainers by between 10% to 20% over three years on the JSE. Otchere and Chan (2003) found that a contrarian strategy of trading on historical price information in Hong Kong did not yield profits in excess of transaction costs. On the other hand, Hsieh and Hodnett (2011) concluded that a contrarian trading strategy may have been a 'safe haven' in the JSE during the financial crisis because of lower correlation with the market. However, Frisch et al (2014) remained sceptical of whether overreaction could offer a profitable opportunity with low risk due to liquidity issues providing limitations on this. In order to test this hypothesis, a portfolio allocation strategy is used to determine buy and sell transactions over one and five trading days to compare the performance with the All Share Index using historical data.

4.3 Regression Model Specifications

The statistical procedure employed for the analytical process in this study was multivariate regression, which used abnormal returns as the dependent variable. There are two model specifications used to test the linear relationships over one trading day and one trading week. These regressions are performed for the overall period July 2000 to June 2015, as well as the periods July 2000 to June 2008, July 2008 to December 2009 and January 2010 to June 2015– the middle two being, respectively, the period following the bursting of the dot.com bubble, and the time of the Global Financial Crisis.

4.3.1 Base Model

The base and alternative model specifications that were used in this study are similar to those developed and used by Lobe and Rieks (2011) in their study of the short term share price overreaction in the German share market. Its suitability as a model to investigate short term overreaction is supported by recent South African returns research, which validate the variables for size, value and book-to-market¹³. The model, through the use of the aforementioned variables, is also suitable to simultaneously test the associated effects which have been debated as explanations for observed share price overreaction and reversal. The base regression model is as specified below:

$$Y_{i,[t,t+1]} = \beta_0 + \beta_1(\text{Return})_{it} + \beta_2(\text{Average Return})_{i,t} + \beta_3(\text{Return Volatility})_{i,t} + \beta_4\left(\text{LOG}\left(\frac{P}{E}\right)_{i,t}\right) + \beta_5\left(\text{LOG}(\text{Market Value}_{i,t})\right) + \beta_6\left(\text{LOG}(\text{Book} - \text{to} - \text{Market}_{i,t})\right) + \varepsilon_{i,t} \quad (4.1)$$

¹³ See Van Rensburg and Robertson (2003), Basiewicz and Auret (2010), Strugnell, Gilbert and Kruger (2011) and Hoffman (2012).

4.3.1.1 Return Measures ($Y_{i,[t,t+1]}$ and $R_{i,t}$)

The dependent variable $Y_{i,[t,t+1]}$, which is the abnormal return, is calculated relative to an index reference value as follows:

$$Y_{i,[t,t+1]} = R_{i,t+1} - R_{ALSI,t+1} \quad (4.2)$$

Where:

$$R_{i,t} = \left(\frac{TRI_{i,t}}{TRI_{i,t-1}} \right) - 1 \quad (4.3)$$

which is the actual return of stock i at time t,

after a 1 day holding period, and TRI_{it} and TRI_{it-1} are the total returns index for share i

$R_{ALSI,t+1}$ is the 1 day holding period total index return from the JSE All Share Index

$R_{i,t}$ is the previous period's return, which is used as a base on which to test for a one day or one week reversal.

4.3.1.2 Average Return ($AR_{i,t}$)

Standard returns modelling is based on a stochastic model of mean and volatility. Normally distributed returns are assumed to vary about the mean within a band based on the standard deviation (volatility) of the sample. The inclusion of this variable allows a test of how influential average returns have been on large price movements in the JSE.

$$AR_{i,t} = \frac{1}{60} \sum_{t=-60}^{t=-1} R_{i,t} \quad (4.4)$$

4.3.1.3 Return Volatility ($V_{i,t}$) and the Volatility Index ($SAVI_t$)

The share's return volatility is included (in line with the work of Lobe and Rieks, 2011) as an explanatory variable due to the possibility that at times when its volatility is high, there could be incidences of high returns. This variable is calculated using the sample standard deviation based on three trading months (60 trading days) of share returns before an abnormal return day. The formula used was:

$$V_{i,t} = \frac{1}{59} \sum_{t=-60}^{t=-1} (R_{i,t} - AR_{i,t}) \quad (4.5)$$

In addition to this, the market volatility index (the South African Volatility Index or SAVI) will be used as a separate explanatory variable to compare which volatility measure is more indicative for abnormal returns during the period 2008 to 2009. The SAVI is not available for the entire period, hence this comparison will only be made for the period of the financial crisis as it measures the market risk conditions during that time. The SAVI Top 40 is the specific index used here, and is an estimate modelled on the VIX. Similar to ($V_{i,t}$) it also uses a three month horizon, with the main difference being that the SAVI is forward looking and is obtained from the implied daily volatilities of the top 40 options in the market rather than using individual share's historical return volatilities.

4.3.1.4 Price-Earnings Ratio ($LOG\left(\frac{P}{E}\right)_{i,t}$)

The early work of Basu (1977) investigated and found empirical support for the idea that portfolios with low P/E ratios could provide greater abnormal returns than otherwise similar portfolios with higher P/E ratios. However, once adjustments for transaction costs and taxes were made, these higher returns were greatly diminished. A study by Banz and Breen (1986) found no such effect after adjusting for the survivorship and look ahead biases, but this was

later contradicted by a response paper from Jaffe, Keirn and Westerfield (1989), which used a longer period and found a P/E effect that was in fact more pronounced than the size effect.

Considering South African work on the topic, Page (1996) found a similar result to Jaffe, Keirn and Westerfield (1989), and observed a P/E effect that is stronger than the size effect.

Additionally, Van Rensburg and Robertson (2003), as well as Strugnell, Gilbert and Kruger (2011), found empirical support on the JSE for the hypothesis that low P/E companies offer abnormal returns.

The historical trailing one month price earnings ratio was used in this study for each day. This was a key consideration to avoid issues of look ahead bias given a key aim of this study was to back test trading strategies over the 15 year period. This measure ensures that there is no assumption of information which investors would not have had on each day.

4.3.1.5 Company Size as proxied by Market Value ($LOG(MV_{i,t})$)

The inclusion of this variable is supported by Section 2.2.4, which documented the size effect in international work as well as Section 3.6, through the body of work of Van Rensburg and Robertson (2003), Basiewicz and Auret (2010), Strugnell, Gilbert and Kruger (2011), and Hoffman (2012). Muller and Ward (2013), however, do not find evidence of the size effect, except for 'fledgling' companies. This variable is estimated by the log values of the companies' market value.

4.3.1.6 Book-to-Market Value ($LOG(BTM_{i,t})$)

As mentioned previously, prior research has provided positive evidence of the influence of the book-to-market ratio (through the value effect) on abnormal returns, both internationally and in the South African market. Recently, South African empirical evidence was supplied by Hoffman (2012) as discussed in Section 3.6, while other international evidence was presented in Section 2.2.3. This measure was calculated as follows:

$$LOG(BTM_{i,t}) = LOG(Book\ Value)_{i,t} - LOG(MV_{i,t}) \quad (4.6)$$

4.3.2 Alternative Model Specifications

In addition to the base model specification, other models were used to test overreaction for a one week holding period (this being tested for the period 2000 to 2015), as well as to compare market and company volatility over the period 2008-2009. The former is tested using Equation 4.7, with the latter being examined by Equations 4.8 and 4.9.

$$Y_{i,[t+1,t+5]} = \beta_0 + \beta_1 R_{i,t} + \beta_2 AR_{i,t} + \beta_3 V_{i,t} + \beta_4 LOG\left(\frac{P}{E}\right)_{i,t} + \beta_5 LOG(MV_{i,t}) + \beta_6 LOG(BTM_{i,t}) + \varepsilon_{i,t} \quad (4.7)$$

$$Y_{i,[t+1,t+5]} = \beta_0 + \beta_1 R_{i,t} + \beta_2 AR_{i,t} + \beta_3 SAVI_t + \beta_4 LOG\left(\frac{P}{E}\right)_{i,t} + \beta_5 LOG(MV_{i,t}) + \beta_6 LOG(BTM_{i,t}) + \varepsilon_{i,t} \quad (4.8)$$

$$Y_{i,[t,t+1]} = \beta_0 + \beta_1 R_{i,t} + \beta_2 AR_{i,t} + \beta_3 SAVI_t + \beta_4 LOG\left(\frac{P}{E}\right)_{i,t} + \beta_5 LOG(MV_{i,t}) + \beta_6 LOG(BTM_{i,t}) + \varepsilon_{i,t} \quad (4.9)$$

Where:

$Y_{i,[t,t+1]}$ is the one day abnormal return

$Y_{i,[t+1,t+5]}$ is the five day abnormal return

$R_{i,t}$ is the return for share i at time t calculated from the total returns index

$AR_{i,t}$ is the average return for share i at time t

$V_{i,t}$ is the volatility of returns for share i at time t

$SAVI_t$ is the South African Volatility Index at time t

$LOG\left(\frac{P}{E}\right)_{i,t}$ is the logarithm of the Price – to – Earnings ratio of share i at time t

$LOG(MV_{i,t})$ is the proxy for the size of share i

$LOG(BTM_{i,t})$ is the proxy for the value effect of share i

$\varepsilon_{i,t}$

4.4 Regression Assumptions Tests

A selection of exploratory and diagnostic checks were performed on the raw data to determine the sample quality and identify problem areas that would require further work and refinement to ensure that meaningful regression results were obtained. If any of these assumptions are violated, then any statistical insights derived from the models may be misleading or unjustified.

The tests performed verify suitability based on compliance with five principal regression assumptions, as follows:

- There is a linear relationship between dependent and independent variables
- No multicollinearity exists between the independent variables,
- No serial autocorrelation is present
- The data is normally distributed, and
- There is constant variance of error terms (homoscedasticity).

The following subsections will provide some context for these assumptions, discuss the tests of the sample for compliance, and analyse the results of these checks.

4.4.1 Linear Relationship and Additivity

The linearity assumption implies that the relationship between the dependent and independent variables can be captured and modelled linearly when all else is constant. In addition, the effects as measured by the independent variables, are additive. The last implication is that the coefficient for one variable is not determined by specific values of another independent variables. Violation of this assumption is highly problematic as it results in biased estimates of the coefficients due to complete model misspecification. This is a major problem compared to other violations of assumptions which do not introduce a bias and only lead to less efficient estimates. The diagnostic check for non-linearity is a collection of regression error values (residuals) plotted against the different independent variables. A systematic pattern in these plots indicates some non-linearity. The figures in Appendix A represent the matrix of these residual plots and there are no systematic patterns discernible lending support to the notion that there are no issues with linearity.

4.4.2 Multicollinearity

In multivariate regressions it is possible to have correlated independent variables. This issue would limit the predictive power of the model with respect to conclusions about individual variables, or how they relate to other independent variables, even if their overall effect on the dependent variable was accurate. A small degree of multicollinearity may be acceptable, but greater multicollinearity is problematic. One issue is that higher multicollinearity may produce inaccurate estimates for coefficients and hence introduce large errors in the predictions (Chatterjee et al, 2000). Another implication is that the correlated variables duplicate some of the effect and this renders one of them somewhat redundant. Of greater concern is that the standard errors of the affected estimates may be much larger and cause a type two error (failure to reject the null hypothesis, when it is false). Lastly, small changes in the independent

variables may lead to unjustified large changes in the predicted values due to more than one variable being affected as a consequence of the correlation (Belsley, 1991).

A correlation matrix was used to detect any multicollinearity, the results of which are noted in the table below.

Table 5: Correlation matrix of coefficient estimates

Variable	Constant	Ave_R	BTM	log MV	log PE	R	Vol
Constant	1						
Ave_R	-0.037	1					
BTM	0.132	-0.054	1				
log MV	-0.185	0.107	-0.183	1			
log PE	-0.134	-0.222	0.231	-0.267	1		
R	-0.01	-0.126	-0.006	0.015	-0.003	1	
Vol	-0.302	0.024	0.028	0.032	0.103	-0.026	1

Correlations are small between independent variables, ranging from -0.267 to 0.231. There is no cause for corrective measures (such as model reformation), since there do not seem to be any significant relationships between these variables.

4.4.3 Serial autocorrelation of the Error term

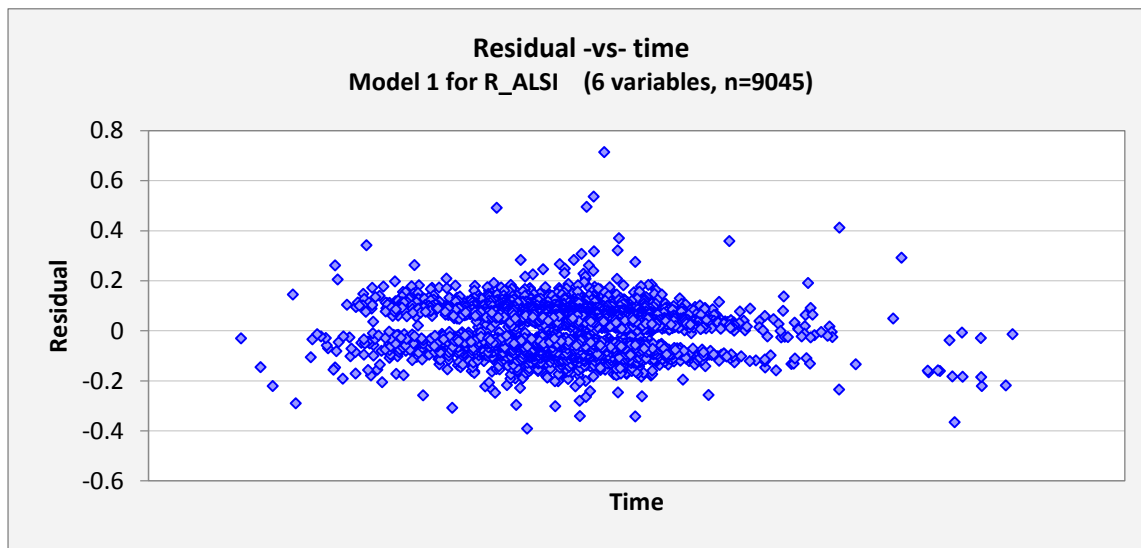
Regressions of time series assume that there is statistical independence of the error terms, which implies no serial correlation (no relationship between consecutive errors). If this assumption is violated, then the coefficient estimators will not remain the best unbiased versions and the standard errors will tend to be larger leading to smaller observed t-values. There are two tests used to detect autocorrelation, the residuals versus time plot and the Durbin-Watson statistic. The latter is a test of significance at lag t-1, and approximately equal to $2(1-r)$, where r is the lag-1 residual autocorrelation.

It is calculated as follows:

$$D - W \text{ statistic} = \frac{\sum_{t=2}^T (e_t - e_{t-1})^2}{\sum_{t=1}^T e_t^2} \quad (4.10)$$

For this sample the Durbin-Watson statistic was 1.701, which implies no significant autocorrelation. The residuals versus time plot is shown below. Considering the diagram, there is no apparent relationship between sequential errors. This adds support to the conclusion from the Durbin-Watson test.

Figure 7: Serial Autocorrelation diagnostic plot

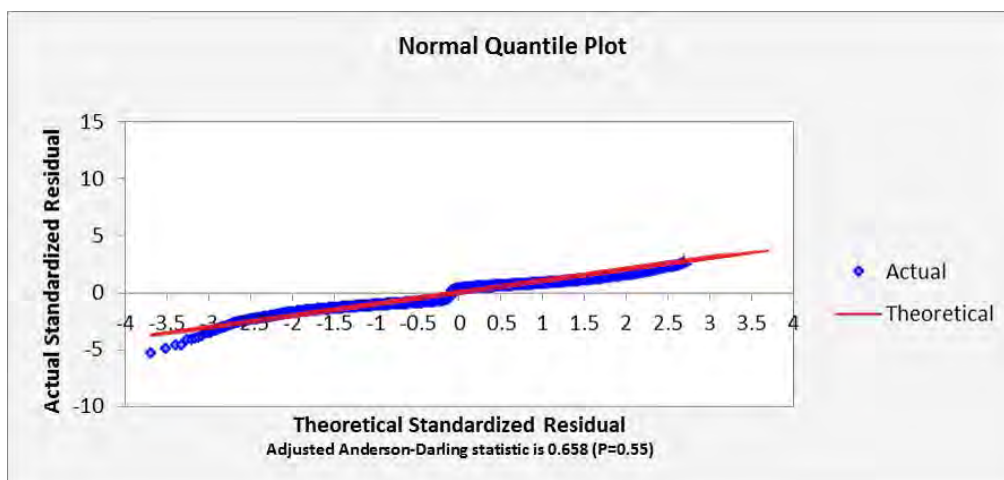


4.4.4 Normal distribution of the error term

The error term is assumed to be normally and randomly distributed such that $e_i \sim N(0, \sigma^2)$. This is an assumption introduced to strengthen the t-tests and is usually only an important consideration for small samples. There are limited issues due to a violation of the normality assumption, as it does not introduce bias or inefficiency to the coefficient estimates. It is mainly useful for the determination of the observed p-values. When the sample has a sufficiently large number of observations (which is the case here), the Central Limit Theorem provides for approximate normality.

Three tests were used to test for this regression assumption with regards to the underlying data, namely the normal probability and quantity plots, and the Anderson-Darling test. If the errors are follow the assumed distribution, then the plotted points should deviate very little from the diagonal line. If there is a bow-shaped pattern, this would suggest excessive skewness. A concern may be that there are not enough data points on either side of the mean or that there are significant outliers. The Anderson-Darling test is a statistical test for normality which adds another layer of testing to the visual tests from the plots. Whereas the plots only consider skewness and kurtosis, the Anderson-Darling test analyses the entire distribution. Below are the results for all the tests and the analysis thereof.

Figure 8: Q-Q plot



The Q-Q plot shows a reasonably good fit to the theoretical normal distribution. There is limited deviation from the reference line suggesting that at least on visual inspection there are no major issues.

The Anderson-Darling test uses a statistic to capture the degree of distributional fit makes no assumptions of distribution parameter values. It provides a numerical estimate of distributional deviation from an assumed distribution based on the frequency of observations following a uniform distribution. The test statistic A^2 is calculated as follows:

$$A^2 = -n - \sum_{i=1}^n (2i - 1) / n (\ln(F(Y_i)) + \ln(1 - F(Y_{n+1-i}))) \quad (4.11)$$

An adjusted measure is suggested by D'Agostino (1986) which was used in this study:

$$A^{*2} = A^2 \left(1 + \frac{0.75}{n} + \frac{2.25}{n^2} \right) \quad (4.12)$$

The null hypothesis is rejected at the 5% significance level if $A^{*2} > 0.752$. This sample yielded an $A^{*2} = 0.658$, which implies that the assumption of a normal error distribution is not rejected.

4.4.5 Constant variance of the error terms

The variance of the error term is assumed to be homoscedastic, which implies that these terms display constant variance, irrespective of variation in time or values of the independent terms. Similar to serial autocorrelation, a violation of this assumption will render the current coefficient estimators no longer the best linear unbiased estimator. In addition to this, the standard errors of the coefficient estimators may become biased and cause inferences to become inaccurate as well. Two plots are used to test for this assumption- residuals versus time, and residuals versus independent variables. The first plot checks for any trend in an error variance as a function of time. The latter is used as a substitute instead of a residuals versus predicted values plot, since errors may be slightly larger for predicted values generated by extreme values for the dependent variables. In any case, errors that are systematically larger or smaller are a worrying observation. The residuals versus time plot was included in Section 4.3.3, and had no time related trend. The matrix of residuals versus independent variables was similarly included in Appendix A, and also had no visible trend. These combined depictions from these charts suggest no issues related to variance.

4.5 Trading Strategy Testing

In order to extend any insights from the statistical analysis to practical applications, there is a need to test the profit potential for share price return reversals on the JSE. A contrarian strategy is used to capture returns due to short term reversals of large single-day share price movements, using one day and five day holding periods for included shares. There are two types of portfolios created, namely the portfolio of gainers (companies that experience single day share price increases in excess of 5% or 10%, depending on the specific model used), and a portfolio of losers (companies that experience single day share price declines in excess of 5% or , or 10%). This is based on an absolute prior day return value trade selection process, which is in contrast to the commonly used relative performance share selection process, which selects shares lying at the extremes of daily price performance relative to other shares. The trading style is based on a contrarian view that relies on short term return reversals. The portfolio returns are compared with a market benchmark, the JSE All Share Index (ALSI), and are adjusted for risk using the Sharpe ratio. The analysis covers different periods and includes the Global Financial Crisis of 2008. The treatment of transaction costs is as a hurdle used to ascertain realistic returns from such short term trading horizons, if significant profits are found.

4.5.1 Share allocation and trading process

A two-step approach was used to form three 'portfolio'¹⁴ types as described below. The first step involved the identification and selection of securities with large single day price movements. This was based on the same criteria used to include companies in the sample for the share price overreaction analysis described earlier in this thesis. These were companies with large single day price movements. The one day returns and five day returns (based on daily returns rolled over) subsequent to these shifts were also recorded.

¹⁴ A portfolio in the sense of a collection of shares held concurrently and traded similarly.

The second step was the allocation of these shares to either of two portfolios, namely the gainers (shares that closed up by more than the cut-off amount in a single day) and losers (shares that went down by more than the cut-off amount in a single day) portfolios. Henceforth these two groups will respectively be referred to as the “gainers” and the “losers”. The third portfolio only contained the All Share index instrument.

The strategy for the gainers involves taking a short position on the shares that have increased in excess of the cut-offs, and subsequently buying them back at the end of previously defined holding period (one or five days) to cover the short position. Similarly, the losers are bought and held for either one or five days, and then sold. For one day holding periods, the portfolios would in practice be recomposed daily after selling the previous day’s shares and calculating the holding period return. The difference between the one day holding period and the five day holding period strategy is that the latter would be allocated five times more frequently than the former. Essentially this is summarized via the following rules in the table below:

Table 6: Summary of share selection and trading process

Rule	5% and 10% cut-off	-5% and -10% cut-off
Selection Rule	Share has the previous day’s return in excess of the cut-off	Share has the previous day’s return more negative than the cut-off
Allocation Rule	Assign to the gainers portfolio	Assign to the losers portfolio
Trading Rule (Contrarian)	Take a short position on the share and cover short within one day or five trading days	Buy the share and sell it within one day or five trading days

An equally weighted portfolio allocation method was used for all the eligible shares based on their previous day’s return. This weighting is used here as it avoids any performance attribution issues arising from the choice of initial weights. In addition, Plyakha, Uppal and Vilkov (2012) noted in their study on why equally weighted portfolios outperform other methods, that the

higher excess returns were due to the rebalancing required to maintain equal weights, which is a contrarian strategy that uses reversals as well as unsystematic risk. In practice, there are of course limitations to such a portfolio allocation method when using small market cap shares and those with low liquidity. The next section will elaborate on the methodology for portfolio returns measurement.

4.5.2 Contrarian and Momentum trading strategies

The existence of contrarian profits can be explained to some extent by the overreaction hypothesis, as a negative autocorrelation in returns is the common assumption for most overreaction theories (Lo & MacKinlay, 1990). Contrarian strategies can benefit from overreaction to an isolated event, which results in a return reversal. There are however, some overreaction studies such as that of Choi and Jayaraman (2009) which attempt to explain the contrarian profits only after large price falls. This uses a weaker condition, as returns do not have to be negatively auto-correlated. On the other hand, momentum strategies benefit from gradually spreading news about the event among investors, which results in the same sign of returns after the event as during the event (Forner & Marhuenda, 2003). In this dissertation, the investigation is whether a contrarian strategy based on return reversals in conjunction with non-standard holding periods might provide an advantage when compared to a more passive market strategy.

4.5.3 Return Measures

The fact that South African listed equities are the only asset class in the portfolios reduces the amount of asset performance attribution issues as it circumvents differences in asset return components and other asset variations.

To measure the returns of the individual shares that made up the portfolios, the one day and five day holding period returns calculated on the total returns index. The portfolio performance

was evaluated using the Sharpe ratio to provide a risk adjusted returns measure. Based on modern portfolio theory, the portfolio return is calculated from the individual share holding period returns (R_i) as:

$$E(R_p) = \sum_i w_i E(R_i) \quad (4.13)$$

This simplifies to the following due to the equally weighted portfolio allocation:

$$\text{Portfolio Return} = \frac{\sum_{i=1}^n \text{share returns}}{n} \quad (4.14)$$

As a standalone measure, the portfolio returns do not provide a complete or relative performance measure. To allow for a meaningful benchmarking investigation on any value added through the use of the short term reversals strategy, the Sharpe ratio is used.

The basis for the Sharpe ratio was provided by Roy (1952) in the maximisation of:

$$\frac{\text{gross return} - \text{minimum acceptable return}}{\text{standard deviation of returns}} \quad (4.15)$$

Sharpe (1966) then formalised this as the return-to-volatility ratio as follows:

$$S = E(R - r_f) / \sqrt{\text{var}(R)} \quad (4.16)$$

This was later amended to the modern Sharpe ratio which allowed the use of any benchmark:

$$S = E(R - r_{\text{benchmark}}) / \sqrt{\text{var}(R - r_{\text{benchmark}})} \quad (4.17)$$

The Sharpe ratio's suitability is based on its simplicity and limited computational requirements as it can be calculated from the returns without the need to ascertain their sources, for instance, the portfolio manager's skill or other difficult to quantify characteristics. It is also usable for any holding period as the frequency is not an issue as long as the returns and variances are for the same investment horizon. The Sharpe ratio also accounts for both unsystematic and systematic portfolio risk and hence is preferred to the Treynor ratio, which only accounts for the latter.

4.5.4 Transaction Costs

A limited number of studies consider transaction costs when testing trading strategies based on overreaction. Choudhary and Sethi (2014), for instance, reason that transaction costs may be offset by the share dividend yields, if these are excluded from the return calculations. For relatively higher frequency trading activity such as that suggested in the one day and five day holding periods, the transaction costs have to be noted due to the very short horizon portfolio rebalancing requirements. There has been evidence of short term profits in excess of transaction costs, such as was found by Bowman and Iverson (1998) in the first week of one portfolio in their overreaction study in New Zealand, or Zi et al (2014) in the USA. These transaction costs will be deducted as a final level of testing if statistically significant ALSI-adjusted returns are uncovered through the t-tests. This is consistent with Atkins and Dyl (1990) in their study of daily reversals in the United States, which only considered transaction costs for observed significant and profitable trading returns.

There are several mandatory charges as well as a brokerage commission, which is often the largest component of transaction costs. The minimum transaction costs available for an individual investor in South Africa trading shares are approximately as indicated in Table 7 on the following page:

Table 7: Summary of JSE share transaction costs

Description	% of Traded Value
Broker commission*	0.25
Settlement and administration	0.075
Investor protection levy (IPL) and administration	0.0002
Value-added tax (VAT)	0.0455
Securities transfer tax and administration**	0.25
Total costs for the buy side of the trade	0.6207
Total costs for the sell side of the trade	0.3707
Total cost including the buy and sell transaction (round trip expense)	0.9914

*Varies greatly based on the brokerage firm. The commission indicated here is as per www.easyequities.co.za.

** This is only charged for buying shares and not for selling.

Source:<https://www.jse.co.za/content/JSEpricingItems/Equity%20Market%20Price%20List%202015.pdf>

4.6 Conclusion

Based on a combination of analysis of prior literature and exploratory data analysis, some areas of specific research have been developed as testable hypotheses to address the key research questions. These are summarised as follows:

- Hypothesis 1: Short term share return reversals exist on the JSE
- Hypothesis 2: Upward and downward share return reversals differ
- Hypothesis 3: Short term share return reversals are altered in times of financial turmoil
- Hypothesis 4: An economically significant reversals trading strategy exists.

The statistical procedure employed for the analytical process in this study was multivariate regression, which used abnormal returns as the dependent variable. A discussion of South Africans returns research informed the choice and validated the key variables $(R_{i,t}, AR_{i,t}, V_{i,t}, SAVI_t, \text{Log}(\frac{P}{E})_{i,t}, \text{Log}(MV_{i,t}) \text{ and } \text{Log}(BTM_{i,t}))$ used in the empirical models. There were two model specifications used to test the linear relationships over one trading day, and two that cover one trading week. These regressions are performed for the periods July 2000 to December 2002, June 2008 to December 2009, and the overall period July 2000 to June 2015. The regression assumptions were tested using diagnostic checks and the data did not reveal any violations.

The final sections provided the methodology to test the practical applications if significant reversals are found. A contrarian strategy based on absolute price movements on the previous day is suggested with a one day or five day buy and sell window for each share. Portfolios are formed using an equal weight allocation and Sharpe ratios are calculated over different horizons to compare the performance with that of the ALSI. Transaction costs are calculated as approximately 1% of trade value (0.9914%) and will be deducted if statistically significant profits are available over and above the market benchmark.

Chapter 5: Regression Results and Empirical Analysis

5.1 Introduction

This chapter will present the results and conclusions from the empirical analysis of the sample data. Section 5.2 will present the regression outputs of the various models and explain the key findings in terms of the regression variables used. This section will also present the findings in relation to similar work from past literature. Robustness checks on the results were performed and their outputs are then used in Section 5.3 to check for the reliability of the results. In addition, the regression models will be validated using statistical analyses. Section 5.4 contextualises the results in relation to the Research Hypotheses. Finally, Section 5.5 summarises the most salient details of this chapter and summarises the research findings.

5.2 Regression Outputs and Results

This section will highlight the evidence for the regression variables. First, the multivariate regression findings will be compared with those from related studies in different countries on the basis of important effects and variables. These are presented variable by variable, which should not be taken to imply that they are the results from univariate regressions, as this was not the case. There were four core regressions based on the four models specifications outlined in Chapter 4. The table below highlights some of the descriptive summary statistics relating to the maximum and minimum values, as well as the mean and event probabilities of returns that exceeded the cut-offs. The large price shifts range from about 59.48% to -39.54, with a probability of 2.45% for a share price movement in excess of 5% in either direction, and a 0.23% probability of a share price move beyond the 10% and -10% cut-off values. These probability values suggest that such significant movements are uncommon for the most part.

Table 8: Summary Statistics for Large Price Movements, Increases and Decreases

N=372817	Total Observations	Return cut-off	Maximum	Minimum	Mean	Probability
Model 1 and 2	9117	5% and -5%	59.48%	-39.54%	0.73%	2.45%
Model 3 and 4	855	10% and -10%	59.48%	-39.54%	3.19%	0.23%

A summary of the models and description of the variables are provided below:

Table 9: Summary of regression variables

Variable	Symbol	Description
Abnormal Return	$Y_{i,[t,t+1]}$ or $Y_{i,[t+1,t+5]}$	Abnormal Returns = Holding Period return – ALSI return
Previous Day's Return	$R_{i,t}$	Return for that share the day before the holding period
Average Return	$AR_{i,t}$	Sample average of last 60 trading days for the share
Volatility	$V_{i,t}$ or $SAVI_t$	Volatility over the last 60 trading days for that share.
Price-to-earnings ratio	$Log\left(\frac{P}{E}\right)_{i,t}$	Log of the P/E ratio
Market Value	$Log(MV_{i,t})$	Proxy for firm size effect, log of Market value
Book-to-market ratio	$Log(BTM_{i,t})$	Proxy for firm value effect, log of Book to Market ratio

Table 10: Summary of regression models

Model	Cut-off Values	Description
Model 1	5% and -5%	One day abnormal returns and uses return volatility
Model 2	10% and -10%	Five day abnormal returns and uses return volatility
Model 3	5% and -5%	One day abnormal returns and uses market volatility
Model 4	10% and -10%	Five day abnormal returns and uses market volatility

$$\mathbf{Model\ 1: } Y_{i,[t,t+1]} = \beta_0 + \beta_1 R_{i,t} + \beta_2 AR_{i,t} + \beta_3 V_{i,t} + \beta_4 \text{Log}\left(\frac{P}{E}\right)_{i,t} + \beta_5 \text{Log}(MV_{i,t}) + \beta_6 \text{Log}(BTM_{i,t}) + \varepsilon_{i,t} \quad (4.1)$$

$$\mathbf{Model\ 2: } Y_{i,[t+1,t+5]} = \beta_0 + \beta_1 R_{i,t} + \beta_2 AR_{i,t} + \beta_3 V_{i,t} + \beta_4 \text{Log}\left(\frac{P}{E}\right)_{i,t} + \beta_5 \text{Log}(MV_{i,t}) + \beta_6 \text{Log}(BTM_{i,t}) + \varepsilon_{i,t} \quad (4.7)$$

$$\mathbf{Model\ 3: } Y_{i,[t+1,t+5]} = \beta_0 + \beta_1 R_{i,t} + \beta_2 AR_{i,t} + \beta_3 VIX_t + \beta_4 \text{Log}\left(\frac{P}{E}\right)_{i,t} + \beta_5 \text{Log}(MV_{i,t}) + \beta_6 \text{Log}(BTM_{i,t}) + \varepsilon_{i,t} \quad (4.8)$$

$$\mathbf{Model\ 4: } Y_{i,[t,t+1]} = \beta_0 + \beta_1 R_{i,t} + \beta_2 AR_{i,t} + \beta_3 VIX_t + \beta_4 \text{Log}\left(\frac{P}{E}\right)_{i,t} + \beta_5 \text{Log}(MV_{i,t}) + \beta_6 \text{Log}(BTM_{i,t}) + \varepsilon_{i,t} \quad (4.9)$$

5.2.1 Return Reversals ($R_{i,t}$)

$R_{i,t}$ is the previous period's return which is used as a base on which to test for a one day or one week reversal. The regression coefficient's value estimates the effect of a 1% increase in $R_{i,t}$ on the dependent variable. A negative coefficient would suggest a reversal effect for the relevant holding or trading period. Considering reversals for the aggregate of events (large upward and downward share return events), there was strong evidence for reversals over a one day holding period as seen in Table 11 for Model 1. The coefficients were consistently negative and significant at the 1% level for Models 1 to 4, regardless of whether cut-offs of 5% or 10% were used. Most notably, the coefficient for the 10% cut-off was nearly three to four times larger than that of the 5% cut-off for all the models. This suggests that for more extreme price movements, stronger reversals are more likely. This is consistent with the initial formulation of the overreaction hypothesis as provided by DeBondt and Thaler (1985). The coefficients varied from -0.0727% to -0.4058%, showing a slight to moderate effect of returns on the day prior to the holding period. These are much smaller than the coefficients obtained by Lobe and Rieks (2011) in their German study, which indicated reversal values of 1.75% to 3.03%. When comparing the Return Volatility and Volatility Index Models, there are no large differences between the results for this variable, either in terms of magnitude, significance or directionality. The results are summarised in the table 11 on the next page.

Table 11: Regression Statistics for ($R_{i,t}$), coefficients are in percentage (%) terms

	5% and -5% cut-off			10% and -10% cut-off		
	Coefficient	t statistic	p value	Coefficient	t statistic	p value
Model 1	-0.0727***	-3.84308	0.000122	-0.2026***	-2.97106	0.003051
Model 2	-0.1132***	-5.9881	2.2E-09	-0.3979***	-5.65013	2.21E-08
Model 3 (SAVI)	-0.0793***	-4.1238	3.760E-05	-0.4058***	-5.75409	1.22E-08
Model 4 (SAVI)	-0.1039***	-5.17398	2.34E-07	-0.3137***	-3.85102	0.000127

***Significant at 1% significance level

5.2.2 Average Return ($AR_{i,t}$)

The average return is the sample mean of each share's returns over the 60 trading days prior to a large price movement beyond either $\pm 5\%$ or $\pm 10\%$. The average return appeared to be one of the most influential and consistently significant variable when explaining abnormal returns. This consistency is aligned with the results of Lobe and Rieks (2011), where the average return is found quite a significant and influential variable. This relationship is positive with the dependent variable and would suggest a momentum effect to some extent. For Models 1 and 2, all the coefficients were significant at 1% and were more pronounced when cut-offs of 10% were used. Model 1 provided coefficients from 2.72% and 6.82%, whereas Model 2 had values of 2.69% and 6.91% for the 5% and 10% cut-offs, respectively. The notably high contribution of average returns might suggest that an increasingly positive or negative average return prior to a large price shift signals a breakout of price behaviour from the norm. For the SAVI models very similar results were obtained, which is expected, given that only the volatility measure was different. The results are summarised below:

Table 12: Regression Statistics for $(AR_{i,t})$, coefficients are in percentage (%) terms

	5% and -5% cut-off			10% and -10% cut-off		
	Coefficient	t statistic	p value	Coefficient	t statistic	p value
Model 1	2.72004***	14.4243	1.2E-46	6.82276***	8.006581	3.88E-15
Model 2	2.69221***	14.62283	7.08E-48	6.91722***	8.535116	6.73E-17
Model 3 (SAVI)	2.84966***	14.56021	1.79E-47	7.00411***	8.633143	3.02E-17
Model 4 (SAVI)	2.79058***	14.87469	1.85E-49	7.09709***	8.662491	2.51E-17

***Significant at 1% significance level

5.2.3 Return Volatility ($V_{i,t}$) and the Volatility Index ($SAVI_t$)

This variable is calculated based on the sample standard deviation using three trading months (60 trading days) of share returns before an abnormal return day. In addition to this, the market volatility index (SAVI) was used as a separate explanatory variable to determine which volatility measure is more indicative for abnormal returns during the period 2008 to 2009. Return volatility is a significant predictor of excess abnormal returns in the context of overreaction for only two of the eight regressions. These are all for Model 1, which used one day abnormal returns as the dependent variable, and returns volatility as the volatility measure. For the 5% and 10% cut-offs, the coefficients were 1.62 % and 6.83 %, and both were significant at a 1.25% level. Notably, the 10% cut-off yields an estimate that is nearly four times larger than the 5% cut-off. This is a similar observation to the results for return reversals and average return, further supporting the idea that larger price movements as a subset, are more sensitive to these variables.

In drawing a comparison between the predictive power of the two volatility measures, it is found that the SAVI measure is not statistically significant when considering increases and decreases together. In Section 5.4.3, both measures are used in providing a conclusion for Hypothesis 3, which suggested that a significant impact of financial turmoil on share price overreaction exists. The table below summarises key regression results for this variable.

Table 13: Regression Statistics for Return Volatility ($V_{i,t}$) and the Volatility Index ($SAVI_t$), coefficients are in percentage (%) terms

	5% and -5% cut-off			10% and -10% cut-off		
	Coefficient	t statistic	p value	Coefficient	t statistic	p value
Model 1	1.61842***	2.969899	0.002987	0.682788**	2.540491	0.011247
Model 2	-0.01328	-0.24765	0.804409	-0.25661	-0.96716	0.333747
Model 3 (SAVI)	-0.0005	-1.37657	0.16868	-0.00083	-0.63209	0.527502
Model 4 (SAVI)	0.000587	2.155117	0.31179	-0.00101	-0.75022	0.453344

***Significant at 1% significance level

**Significant at 2.5% significance level

5.2.4 Price-Earnings Ratio ($\text{Log}(\frac{P}{E})_{i,t}$)

The price-to-earnings ratio provides an estimate for how expensive a share is relative to its earnings potential, and is computed by dividing the share price by its earnings per share value. Some slightly contradictory results were obtained for the effect of the price-to-earnings ratio. All the models had highly statistically significant and positive coefficients for this variable when the 5% and -5% cut-offs were used, but for share price change cut-offs of 10% and -10% the coefficients were not statistically significant at the 1% level. The latter values ranged from 0.011451% to 0.014592%. For the higher ($\pm 10\%$) cut-offs the coefficients for the log (P/E) variable were not statistically significant for all four models, but interestingly were negative in all cases except Model 1.

Conventional South African returns modelling results support a negative coefficient for the price-to-earnings variable, based on the works of Van Rensburg and Robertson (2003), which is contradictory to these results. The coefficients for size and price-to-earnings are only marginally different in the results here, which is a different pattern to that shown by Page (1996) and Jaffe, Keirn and Westerfield (1989), all of whom found that the effect of the price-to-earnings ratio on returns was stronger and more significant than the size effect. These results are also different from those of Strugnell, Gilbert and Kruger (2011), who found empirical support on the JSE for the hypothesis that low P/E companies offer abnormal returns. Most of the work has been on basic returns modelling and not overreaction specifically, so although they offer some basis for comparison, they are not an absolute benchmark.

Table 14: Regression Statistics for $Log\left(\frac{P}{E}\right)_{i,t}$, coefficients are in percentage (%) terms

	5% and -5% cut-off			10% and -10% cut-off		
	Coefficient	t statistic	p value	Coefficient	t statistic	p value
Model 1	0.014592***	5.687806	1.33E-08	0.018536	1.305856	0.191956
Model 2	0.011451***	4.582848	4.65E-06	-0.004	-0.29951	0.764626
Model 3 (SAVI)	0.013615***	5.268572	1.41E-07	-0.00123	-0.09255	0.926287
Model 4 (SAVI)	0.012805***	5.02376	5.16E-07	-0.00974	-0.72408	0.469229

***Significant at 1% significance level

5.2.5 Market Value/Company Size ($Log(MV_{i,t})$)

The inclusion of this variable is supported by Section 2.2.4, which documented the size effect in international work, as well as Section 3.6 – in South Africa through the body of work of Van Rensburg and Robertson (2003), Basiewicz and Auret (2010), Strugnell, Gilbert and Kruger (2011) and Hoffman (2012). This variable is an important component of returns regression, since it is a factor to measure the size effect of a company, and is part of the three factor CAPM model. Consistent evidence was obtained for a negative relationship between company size and abnormal returns when a 5% and -5% cut-off was used for large price movements. The coefficient values ranged from -0.01546% to -0.02526% for the four models, with observed significance levels very close to zero. This is consistent with international evidence in this regard, such as that as the findings of Lobe and Rieks (2011) on the Frankfurt Share Exchange over the period 1988 to 2007, of a significant size effect for short term overreaction. Similarly, there is extensive South African evidence of a statistically significant impact of company size on returns in the JSE as per the works of Van Rensburg and Robertson (2003), Basiewicz and Auret

(2010), Strugnell, Gilbert and Kruger (2011) and Hoffman (2012). However, very different evidence was obtained when 10% and -10% cut-offs were used. The coefficients were much smaller in magnitude (-0.0006% to 0.0002%) and the observed p-values were extremely large, implying that the size coefficient is not statistically significant for this cut-off.

Table 15: Regression Statistics for $\text{Log}(MV_{i,t})$, coefficients are in percentage (%) terms

	5% and -5% cut-off			10% and -10% cut-off		
	Coefficient	t statistic	p value	Coefficient	t statistic	p value
Model 1	-0.0162***	-15.6264	2.47E-54	-0.00709	-1.1502	0.250384
Model 2	-0.02526***	-15.125	4.68E-51	-0.0006	-0.10412	0.917097
Model 3 (SAVI)	-0.01586***	-15.1627	2.77E-51	0.0002	0.034394	0.972571
Model 4 (SAVI)	-0.01546***	-15.0137	2.42E-50	0.000228	0.039011	0.968892

***Significant at 1% significance level

5.2.6 Book-to-Market Value ($\text{Log}(BTM_{i,t})$)

This variable measures the company value effect as measured in the three factor CAPM model. As mentioned previously, prior research has provided positive evidence of the influence of book-to-market (through the value effect) on abnormal returns, both internationally and in the South African market. Considering the results when using a 5% and -5% cut-off, all the models (with the exception of Model 2) yielded statistically significant coefficients at the 5% significance level. The coefficients themselves ranged from 0.001636% to 0.002715%, suggesting a weakly positive relationship. Prior work on the contribution of the value effect to short-term share price overreaction in South Africa is not available, but nonetheless Basiewicz and Auret (2010) and Hoffman (2012) found that the value effect is a significant factor in predicting share returns. This is to some extent consistent with the findings of this study.

When cut-offs of 10% and -10% were used, much stronger and significant values were obtained, with the exception of Model 1. This suggests that for more extreme price movements, the abnormal returns are better explained by the value effect.

Table 16: Regression Statistics for $\text{Log}(BTM_{i,t})$, coefficients are in percentage (%) terms

	5% and -5% cut-off			10% and -10% cut-off		
	Coefficient	t statistic	p value	Coefficient	t statistic	p value
Model 1	0.002334*	1.981289	0.047589	-0.01119	-1.27761	0.201736
Model 2	0.001636	1.428571	0.153162	-0.01709*	-2.10768	0.035361
Model 3 (SAVI)	0.002715**	2.288634	0.022124	-0.01566	-1.92358	0.054749
Model 4 (SAVI)	0.0022	1.886002	0.059327	-0.01704*	-2.09573	0.036418

**Significant at 2.5% significance level

*Significant at 5% significance level

5.3 Robustness Checks by Coefficient Persistence Testing

In order to check the consistency and reliability of the results, some checks were implemented to assess how persistent the statistical significance of the variables were, and the latter was used to confirm the differences between large price increases and decreases.

In addition to the basic one day share price return cut-offs (5% and 10%) that were part of the core regression testing, additional regressions were used with return cut-offs of 7.5%, 12.5% and 15%. This tested the consistency of the statistical significance and magnitude of the variables at different abnormal return determination levels. In addition, the division of the sample into different periods (Section 5.4.3) also allowed for a check on whether the

phenomenon was consistent across the entire sample period of 2000 – 2015, specifically considering that this period included both bull and bear market periods, as well as the global financial crisis of 2008. Therefore, both magnitudinal and periodic consistency were addressed in providing confirmation or refuting any of the hypotheses.

Considering Model 1 regressions, there are two variables that exhibit a clear trend as the cut-offs are varied, namely the return reversals ($R_{i,t}$) and average return variables ($AR_{i,t}$), which both show consistently increasing coefficient values at higher cut-offs. This is consistent for all the remaining models as well, with no difference in the sign and slight differences in statistical significance for both of these variables. Return Volatility ($V_{i,t}$) and the Volatility Index ($SAVI_t$) are only significant at the smallest (5%) cut-off, with a value of 1.6184%, suggesting very limited explanatory power for a one day holding period.

The effect of Price-to-earnings ($(\text{Log}(\frac{P}{E}))_{i,t}$) is slight and loses statistical significance after the 10% and -10% cut-off, suggesting that it is not that relevant for larger price shifts. The size effect $\text{Log}(MV_{i,t})$ is also not statistically significant after the 10% cut-off, but maintained a small yet negative value, while being statistically significant at the smaller cut-offs. The book-to-market ratio ($\text{Log}(BTM_{i,t})$) was the least influential and significant of all the variables. Statistical significance was only achieved at the 5% and -5% cut-off, and the size of the coefficient was 0.00233%.

Table 17: Model 1 coefficients at different cut-offs

	$\pm 5\%$ cut-off	$\pm 7.5\%$ cut-off	$\pm 10\%$ cut-off	$\pm 12.5\%$ cut-off	$\pm 15\%$ cut-off
$\beta(\text{Return}_t)$	-0.0727***	-0.26473***	-0.20264***	-0.54384**	-0.66458*
$\beta(\text{ave R})$	2.72004***	4.466007***	6.822762***	8.567904	8.82973
$\beta(\text{volatility})$	1.618416***	0.56891	0.682788	0.005628	0.00072
$\beta(\log(\text{PE}))$	0.014592***	0.007862*	0.018536*	0.002399	-0.00754
$\beta(\log(\text{MV}))$	-0.0162***	-0.01286**	-0.00709*	0.010283*	0.009491*
$\beta \log(\text{Book-to-Market})$	0.002334*	-0.00167	-0.01119	-0.01441	-0.07577

***Significant at 1% significance level

**Significant at 2.5% significance level

*Significant at 5% significance level

Similar to Model 1, for Model 2 the coefficients for return reversals and average return proved to be consistent and robust irrespective of the different cut-offs. Another similarity was the generally increasing values as the cut-offs were increased. The volatility measure is not even significant at the 5% level at the smallest cut-off, and as such is a relatively minor effect. P/E was significant for the 5% and 10% cut-off, while the size effect was consistently negative and significant (although to a diminishing extent) for the 5%, 7.5% and 10% cut-off. The book-to-market ratio was only significant at the 10% cut-off.

Table 18: Model 2 coefficients at different cut-offs

	±5% cut-off	±7.5% cut-off	±10% cut-off	±12.5% cut-off	±15% cut-off
$\beta(\text{Return}_t)$	-0.11316***	-0.25893***	-0.39787***	-0.52398**	-0.64416*
$\beta(\text{ave R})$	2.692208***	4.740092***	6.917217***	8.690143*	8.493423*
$\beta(\text{volatility})$	-0.01328	-0.00089	-0.25661	-0.23677	-1.16208
$\beta(\log(\text{PE}))$	0.011451***	0.010873	-0.004*	-0.00534	-0.03053
$\beta(\log(\text{MV}))$	-0.01526***	-0.01163**	-0.0006*	0.006604	-4.4E-05
$\beta \log(\text{Book-to-})$	0.001636	-0.00143	-0.01709*	-0.01424	-0.08762

***Significant at 1% significance level

**Significant at 2.5% significance level

*Significant at 5% significance level

Consistent with Models 1 and 2, the reversal and average return variables are statistically significant at the 5% level for all the cut-off values for Model 3. Larger cut-offs correspond to larger coefficients in the case of both variables. Volatility is not significant at any of the cut-offs as used in this five day holding period model. P/E and the company size variables are again relatively trivial in size and only significant at the 5% and 7.5% cut-offs. The book-to-market ratio is the second smallest coefficient at 0.002715%, and is only statistically significant at the 5% level or better at the 5% cut-off.

Table 19: Model 3 coefficients at different cut-offs

	$\pm 5\%$ cut-off	$\pm 7.5\%$ cut-off	$\pm 10\%$ cut-off	$\pm 12.5\%$ cut-off	$\pm 15\%$ cut-off
$\beta(\text{Return}_t)$	-0.07928***	-0.25893***	-0.40584***	-0.53162*	-0.6504*
$\beta(\text{ave R})$	2.849656***	4.740092***	7.00411***	8.782616*	8.884399*
$\beta(\text{volatility})$	-0.0005	-0.00089	-0.00083	-0.00088	-0.00485
$\beta(\log(\text{PE}))$	0.013615***	0.010873*	-0.00123	0.001979	-0.009
$\beta(\log(\text{MV}))$	-0.01586***	-0.01163*	0.0002	0.010184	0.00763
$\beta \log(\text{Book-to-Market})$	0.002715**	-0.00143	-0.01566	-0.01077	-0.06926

***Significant at 1% significance level

**Significant at 2.5% significance level

*Significant at 5% significance level

Combining the analysis of the three models above, there are a few consolidated conclusions, given that the results of Model 4 mirror those of Model 3. The reversal variable and average return were consistently statistically significant at $\alpha=5\%$ for all models at all the cut-offs. Average return was always the largest coefficient. Book-to-market ratio and the volatility measures had the most limited significance and also happened to have the smallest coefficients. Size and P/E were significant for smaller cut-offs and had small magnitudes in general. In conclusion, the reversal, average return, size and P/E variables are significant over one day and five day holding periods, whereas the book-to-market and volatility variables were trivial in explaining short term overreaction. This is consistent with, and lends support to, the analysis presented in Section 5.2.

Table 20: Model 4 coefficients at different cut-offs

	$\pm 5\%$ cut-off	$\pm 7.5\%$ cut-off	$\pm 10\%$ cut-off	$\pm 12.5\%$ cut-off	$\pm 15\%$ cut-off
$\beta(\text{Return}_t)$	-0.1039***	-0.1714***	-0.31373***	-0.38656*	-0.39141*
$\beta(\text{ave R})$	2.79058***	4.638873***	7.09709***	8.988697*	8.771837*
$\beta(\text{volatility})$	0.000587	-3.3E-05	-0.00101	-0.00087	-0.00484
$\beta(\log(\text{PE}))$	0.012805***	0.010813*	-0.00974	-0.01384	-0.04821
$\beta(\log(\text{MV}))$	-0.01546***	-0.01374	0.000228	0.009181	0.005996
$\beta \log(\text{Book-to-Market})$	0.0022	-0.00058	-0.01704*	-0.01842	-0.09804

***Significant at 1% significance level

*Significant at 5% significance level

5.4 Further Analysis and Discussion

Overall, the results align with the majority of prior work in this area. Conclusive findings were obtained for all the hypotheses with additional robustness checks performed to ensure reliability. The following sections will expand on the hypothesis-specific evidence.

5.4.1 Hypothesis 1: Short Term Share Return reversals Exist on the JSE

In this research project substantial evidence was found in support of short term share return reversals on the JSE. All the model specifications yielded meaningful estimates for the reversal variable ($R_{i,t}$). Reversals were tested over one and five day holding periods and in all cases, reversal coefficients were predominantly negative and statistically significant at the 1% level. In

the South African context there are no studies to directly compare the reversals to. Tables 21 and 22 below summarises the coefficients relating to short term reversals for all the model specifications. An analysis of these is provided in this section.

Considering the regression results for the return prior to a one day holding period, robust and consistent results were obtained for both the return volatility and the SAVI models. Excluding the 10% and -10% cut-offs, there are only marginal differences in the coefficient values, all of which are highly statistically significant. The negative sign in both models and at all cut-offs lends strong support to a one day reversal of large price movements.

Table 21: One day reversal coefficients

	±5% cut-off	±7.5% cut-off	±10% cut-off	±12.5% cut-off	±15% cut-off
Model 1	-0.0727***	-0.26473***	-0.20264***	-0.54384**	-0.66458*
Model 3	-0.07928***	-0.25893***	-0.40584***	-0.53162*	-0.6504*

***Significant at 1% significance level

**Significant at 2.5% significance level

*Significant at 5% significance level

Focusing on the five day reversals, similar observations are noted. All the values are negative and highly significant, with an increasing value for larger cut-offs. This supports the hypothesis of short term reversals, and suggests that the larger the price movement, the larger the reversal. The values exhibit large differences between Models 2 and 4 at the 12.5% and 15% cut-offs. However given that the periods the models cover are different (15 years versus 8 years) this may be expected. Given the evidence for short term reversals, there is sufficient support to not reject Hypothesis 1.

The next section discusses and presents evidence for the Hypothesis that the reversals for upward and downward large price shifts differ (Hypothesis 2). Furthermore, Section 5.4.3 contains the evidence for Hypothesis 3, which asserts that short term reversals are affected by financial crises.

Table 22: Five day reversal coefficients

	$\pm 5\%$ cut-off	$\pm 7.5\%$ cut-off	$\pm 10\%$ cut-off	$\pm 12.5\%$ cut-off	$\pm 15\%$ cut-off
Model 2	-0.11316***	-0.25893***	-0.39787***	-0.52398**	-0.64416*
Model 4	-0.1039***	-0.1714***	-0.31373***	-0.38656*	-0.39141*

***Significant at 1% significance level

**Significant at 2.5% significance level

*Significant at 5% significance level

5.4.2 Hypothesis 2: Upward and Downward Share Return reversals differ in magnitude

This section covers the comparison of reversals for upward and downward price shocks, with the null hypothesis stating that there exists a difference in magnitude between the upwards and downwards share return reversals on the JSE. Two types of analyses are performed, namely a coefficient comparison at different cut-offs, and a two sample means test for the 5% and 10% cut-offs. The table below juxtaposes the various coefficients at the different cut-offs to provide a direct comparison at standardised levels.

As observed in Table 23, the coefficients vary greatly when comparing increases and decreases and across cut-offs. These differences are both in magnitude and direction as several instances of opposite directionality are noted. Although not a conclusive test on its own, these observations motivate the case for further statistical testing to conclude on the extent of the differences, which is done via a t-test.

Table 23: Regression coefficients, Increases and Decreases 5% and 10% cut-off points

Variable	Model 1	Model 3	Model 2	Model 4
>5% increases	-0.028484%	-0.01899%	-0.00557%	0.088426%
>-5% decreases	-0.0269%	-0.00232%	-0.07053%	-0.08917%
>10% increases	0.132295%	-0.04056%	0.029298%	0.035026%
>-10% decreases	0.000348%	-0.116225%	-0.13258%	-0.00887%

Student's t-test

Test 1: two sided

$$H_0: \mu_{UPWARD} = \mu_{DOWNWARD}$$

$$H_1: \mu_{UPWARD} \neq \mu_{DOWNWARD}$$

Reject the null hypothesis if: t statistic > critical value of t or (-)t < (-) critical value

The statistics are calculated from the price changes as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s_{\bar{X}_1 - \bar{X}_2}} \quad (5.1)$$

Where:

$$s_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}. \quad (5.2)$$

\bar{X}_1 is the Mean Upward Reversal of returns

\bar{X}_2 is the Mean Downward Reversal of returns

s_1^2 is the Upward Reversal Sample Variance

s_2^2 is the Downward Reversal Variance

n_1 is the number of observations of Upward Reversal

n_2 is the number of observations of Downward Reversal

The tables below summarise the results from the t-tests performed and the return reversals data for both the primary cut-offs. In both cases, based on the calculated t-statistics and observed p-values, the null hypothesis was rejected in favour of the alternative hypothesis of inequality. These findings lend support to Hypothesis 2 and it is not rejected. This is not a very surprising result given that there is no clear theoretical reason which asserts equality of reversals.

These findings contrast with the results of JSE overreaction study by Frisch et al (2014), which focused on a longer horizon and found that both positive and negative price shifts were likely to be followed by positive returns, which implied that only large declines experienced reversals while large price increases exhibited momentum afterwards.

Table 24: Result of t-test for 5% and -5% cut-off

	Gainers	Losers
Mean of Reversal term	0.000838	0.002338
Variance of Reversal term	0.001769	0.001712
Observations	4915	4130
Hypothesized Mean Difference	0	
Degrees of freedom	8823	
t Stat	-2.7044	
P(T<=t) two-sided test	0.04416	
t Critical two-sided test	1.961033	
RESULT	Reject null hypothesis since t stat = -2.7044 < -1.96	

Table 25: Result of t-test for 10% and -10% cut-off

	Gainers	Losers
Mean of Reversal term	-0.0048	0.009402
Variance of Reversal term	0.005141	0.004515
Observations	522	333
Hypothesized Mean Difference	0	
Degrees of freedom	741	
t Stat	-2.935	
P(T<=t) two-sided test	0.003437	
t Critical two-sided test	1.961033	
RESULT	Reject null hypothesis since t stat = -2.935 < -1.96	

5.4.3 Hypothesis 3: Short Term Share Return reversals are exaggerated in times of Financial Turmoil

Given the possible behavioural drivers of the share price overreaction phenomenon, it is conceivable that in times of high market uncertainty there would be amplified share price overreaction and subsequent reversals, due to distressed or erratic short term trading. Hsieh and Hodnett (2011) showed that mean reversals in the JSE due to overreaction, were most pronounced immediately after the financial crisis. To test this theory, the core regressions were implemented separately for the pre-, intra- and post financial crisis period as described previously.

The results for the 5% and -5% cut-off point to stronger reversals during the crisis period (defined as 2008 to 2009) when considering one day reversals (Models 1 and 3). This was not the case for five day reversals (Models 2 and 4), which had stronger reversals post the crisis period. This difference may be due to stronger behavioural drivers for smaller holding periods or a lower inclination to hold shares for longer leading to swifter reversals. As for the stronger reversals over five days post the crisis, it is possibly an artefact of longer holding periods in the market recovery in the years since the crisis, as the markets corrected themselves and became relatively more bullish.

Table 26: ($R_{i,t}$) Regression coefficients for the 5% and -5% cut-offs aggregated

	Model 1	Model 3	Model 2	Model 4
Pre-crisis period (2000-2007)	-0.07948***	-0.0269***	-0.08541***	-0.02445***
Intra-Crisis period (2008-2009)	-0.41241***	-0.41914***	-0.15228***	-0.15697***
Post-Crisis period (2010-2015)	-0.04052***	-0.02445***	-0.17716***	-0.18638***

Note: For Models 3 and 4 the Pre-crisis period is 2007-2008 since the SAVI was only established in 2007

***Significant at 1% significance level

Further analysing the crisis impact based on the 10% and -10% cut-offs yields similar results to the smaller cut-off above with respect to the one day reversals. The coefficient values are still much larger during the crisis period than before or after. Mixed results are obtained for this cut-off when using Models 2 and 4, which use five day holding periods. Model 2 presents a slightly higher coefficient during the crisis whereas Model 4 has its largest coefficient pre crisis (however this is not statistically significant). In any case, there is limited evidence for stronger reversals during the period when using this higher cut-off in combination with a five day holding period.

Table 27: ($R_{i,t}$) Regression coefficients for the 10% and -10% cut-offs aggregated

	Model 1	Model 3	Model 2	Model 4
Pre-crisis period (2000-2007)	-0.1588***	-0.1896***	-0.02445***	-0.09981**
Intra-Crisis period (2008-2009)	-0.49599***	-0.4023**	-0.03366***	-0.0572***
Post-Crisis period (2010-2015)	-0.04052***	-0.1052***	-0.00697**	-0.00319**

Note: For Models 3 and 4 the Pre-crisis period is 2007-2008 since the SAVI was only established in 2007

***Significant at 1% significance level

**Significant at 2.5% significance level

5.5 Conclusion

This chapter presented the results and key findings from the statistical analysis of the data. Section 5.2 considered the evidence from each of the four regression models, and explained the results in terms of the regression variables that measured the various effects. The reversal, average return, size and P/E variables are significant over the one day and five day holding periods and were a useful suite of factors, whereas the book-to-market and volatility variables were trivial in explaining short term overreaction. This section also compared the findings from prior literature, and found agreement with some of the prevailing evidence from other markets - for instance the works of Lobe and Rieks (2011) and Choudhary and Sethi (2014).

Robustness checks were then used in Section 5.3 to check for the reliability of the results, and the regression models were validated using statistical analyses. Coefficient persistence checks were used to check the robustness of the results, which were not diminished through these checks. Therefore, consistent coefficients were obtained for all variables except the book-to-market ratio.

Section 5.4 positioned the results in relation to the research hypotheses 1 to 3. Hypothesis 1 assumed the existence of short term reversals and there were robust and consistent results for all the models support this. Excluding the 10% and -10% cut-offs, there are only marginal differences in the coefficient values, all of which are highly statistically significant. Hypothesis 2 assumed differences in upward and downward reversals. The coefficients varied greatly when comparing increases and decreases across cut-offs. Two sided t-tests confirmed this, and that the differences were both in magnitude and direction. Hypothesis 3 held that the reversals were exaggerated in times of Financial Turmoil. There was limited evidence for stronger reversals during the period when using this higher cut-off in combination with a five day holding period.

Chapter 6: Trading Strategy Testing

6.1 Introduction

In order to test the practical and economic significance of this study's findings for share price return reversals on the JSE, a portfolio allocation exercise was performed to provide a comparative measure by testing performance relative to a market benchmark. A contrarian strategy is used to capture returns due to short term reversals of large single-day share price movements, using one day and five day holding periods for included shares. Two portfolios are created, namely the portfolio of gainers (companies that experience single day share price increases of 5% or more), and a portfolio of losers (companies that experience single day share price declines of 5% or more). These are compared with a market benchmark, the JSE All Share Index (ALSI), over different periods and in the context of the Global Financial Crisis of 2008. Section 6.2 will explain the methodology of the process and highlight the important points, including portfolio weighting and returns assessment. Section 6.3 will then present the results and provide an analysis on the findings with respect to Hypothesis 4. The conclusion of this chapter then follows in Section 6.4. Monthly and annual returns are based on rolling returns which are the periodic average for the respective period and allowed the holding periods to match those actually experienced by individuals who would hold these portfolios.

6.2 Results and Analysis

This section will present the summarised results and analysis of the portfolio comparison exercise. Different performance measures were used and the comparisons are for the one day and five day holding period returns and cover four periods. These are the entire period (July 2000 to June 2015), as well as pre-, intra- and post-crisis, as divided in Hypothesis 3.

6.2.1 Portfolio Descriptive Statistics

Some of the key statistics representing the portfolios are included in this section. Daily, weekly, monthly and yearly portfolio performance is summarised through the maximum, minimum and average portfolio returns. These are categorised into the gainers and losers portfolios and are provided for the pre, intra- and post Global Financial Crisis period.

6.2.1.1 Daily Data

Daily portfolio returns for all the three portfolios were calculated for the one day holding period as seen in Table 28 below. For the whole sample period, the losers portfolio provided larger upside and downside potential compared to the gainers portfolio. This is illustrated by a maximum daily return value which was nearly double that of the gainers portfolio (63.63% versus 34.24%), and a minimum daily return value which was also more extreme (-24.47% versus -19.13%). The daily mean return of 0.167% was also nearly three times larger than that of the gainers portfolio (0.056%). These trends were consistent for all three sub-periods when considered separately as well. Collectively, these results suggest that if absolute one day returns are the main concern, a contrarian strategy using the losers portfolio would offer better returns on average. The most extreme portfolio losses were experienced by both portfolios during the intra-crisis period, which was also the case for portfolio gains. This is possibly due to the higher uncertainty and market turmoil pushing extremes past previous highs and lows. Trading on these assumptions would only suit highly speculative traders with high risk appetite and limited need for long term gains.

Table 28: Daily Portfolio Returns Summary for One Day Holding Periods

Returns	Whole period (2000-2015)		Pre-crisis period (2000- 2007)		Intra-Crisis period (2008-2009)		Post-Crisis period (2010-2015)	
	Gainers	Losers	Gainers	Losers	Gainers	Losers	Gainers	Losers
Minimum	-0.1912	-0.2446	-0.07651	-0.09787	-0.1912	-0.24466	-0.06312	-0.08074
Maximum	0.34241	0.63634	0.136966	0.254536	0.34241	0.636341	0.1130	0.20999
Mean	0.00056	0.00167	0.000225	0.000667	0.00067	0.002669	0.000185	0.00055

6.2.1.2 Weekly Data

Weekly portfolio returns were calculated for both the one day and five day holding periods as seen in Tables 29 and 30 below. For the one day holding period, over the period July 2000 to June 2015, the gainers portfolio offered larger upside and lower downside potential when compared to the losers portfolio. The maximum weekly return was 24.47%, which was nearly double that of the losers portfolio of 12.41%. The minimum weekly return for the gainers portfolio was -11.38%, nearly a third lower than the other portfolio's value of -19.13%. The mean portfolio return of 11.80% was more than double that of the losers portfolio (5.15%). Both portfolios experienced their largest losses in the pre-crisis period but experienced their largest gains in different periods. This suggests better returns for gainers in times of crisis due to the larger reversals in a crisis period, and better returns for losers in a period of market recovery when considering the gains rolled over for a week. Portfolios are essentially reconstituted five times over the five days, since the holding period is only a day here, which probably allowed for a strategy that sold previous gainers to take advantage of the market volatility.

Table 29: Weekly Portfolio Returns Summary for One Day Holding Periods

Returns	Whole period (2000-2015)		Pre-crisis period (2000-2007)		Intra-Crisis period (2008-2009)		Post-Crisis period (2010-2015)	
	Gainers	Losers	Gainers	Losers	Gainers	Losers	Gainers	Losers
Minimum	-0.11384	-0.19127	-0.11384	-0.19127	-0.06830	-0.11476	-0.03757	-0.06312
Maximum	0.24466	0.12414	0.04966	0.08690	0.24466	-0.17126	-0.09787	0.12414
Mean	0.11797	0.05151	0.020605	-0.08719	0.07727	-0.32695	0.016999	-0.07193

The weekly returns for a five day holding period presents slightly different results to the one day holding period. For the entire period, the gainers portfolio provided larger upside and downside potential compared to the losers portfolio. The maximum value was only about one-fifth larger than that of the losers portfolio (30.12% versus 24.99%) but the maximum loss was nearly double (-21.38% versus -11.99%). The weekly average portfolio returns for gainers was about one third smaller than that of losers (4.37% compared with 6.50%). Both portfolios experienced their largest weekly gains and losses during the crisis period. The results suggest that there was high upside potential for a contrarian strategy when using either portfolio even after trading costs, but this was mainly beneficial during the crisis period.

Table 30: Weekly Portfolio Returns Summary for Five Day Holding Periods

Returns	Whole period (2000-2015)		Pre-crisis period (2000- 2007)		Intra-Crisis period (2008-2009)		Post-Crisis period (2010-2015)	
	Gainers	Losers	Gainers	Losers	Gainers	Losers	Gainers	Losers
Minimum	-0.21384	-0.11989	-0.08554	-0.04795	-0.21384	-0.11989	-0.07057	-0.03956
Maximum	0.301224	0.249872	0.120489	0.099949	0.301224	0.249872	0.099404	0.082458
Mean	0.043691	0.064993	0.017477	0.025997	0.069906	0.103988	0.014418	0.021448

6.2.1.3 Monthly Data

Monthly portfolio returns were calculated for the one day and five day holding periods as seen in Table 31 below. From July 2000 to June 2015, the losers portfolio provided larger upside and downside potential compared to the gainers portfolio. This is seen by the maximum gain which was considerably larger than that of the gainers portfolio (23.10% versus 13.67%) and a maximum loss which was three times larger (-20.36% versus -6.83%). The losers monthly mean return of 1.37% was however nearly half of the gainers portfolio (2.67%). These values show that although the losers offered potential higher gains (and losses as well), on average the gainers portfolio offered a better average. The most extreme portfolio losses were experienced by both portfolios during the post-crisis period, which was also the case for portfolio gains. This is unusual given that there was strong market recovery for the most part of the post-crisis period. Trading on these assumptions was only highly beneficial when the market was in any case bullish, which suggests limited use when monthly returns are considered. Again, if trading costs can be held to 1% or below, these results indicate a potentially profitable trading strategy based on short-term overreaction may be possible.

Table 31: Monthly Portfolio Returns Summary for One Day Holding Periods

Returns	Whole period (2000-2015)		Pre-crisis period (2000-2007)		Intra-Crisis period (2008-2009)		Post-Crisis period (2010-2015)	
	Gainers	Losers	Gainers	Losers	Gainers	Losers	Gainers	Losers
Minimum	-0.06833	-0.20356	-0.02733	-0.08143	-0.03416	-0.10178	-0.06833	-0.20356
Maximum	0.13669	0.230957	0.054675	0.092383	0.08431	0.12171	0.13669	0.230957
Mean	0.02666	0.013697	0.010663	0.005479	0.02932	0.015067	0.008797	0.00452

Considering the larger period (2000 to 2015) and a five day holding period, the gainers portfolio proved the better option as it provided greater upside and lower downside potential compared to the losers portfolio for a five day holding period. The largest monthly gain was one-fourth higher than that of the losers portfolio (19%), and a maximum loss of 14.9% as opposed to 18.26%. The monthly mean return of 5.6% was also relatively higher than the 3.69% of the losers portfolio (0.056%). These trends were consistent for all three sub-periods when considered separately as well. The most extreme portfolio losses were experienced by both portfolios during the pre-crisis period, while the largest portfolio gains were obtained post-crisis. An explanation for the former is unclear, however, the latter may be explained by the increasingly bullish market post-crisis.

Table 32: Monthly Portfolio Returns Summary for Five Day Holding Periods

Returns	Whole period (2000-2015)		Pre-crisis period (2000-2007)		Intra-Crisis period (2008-2009)		Post-Crisis period (2010-2015)	
	Gainers	Losers	Gainers	Losers	Gainers	Losers	Gainers	Losers
Minimum	-0.149	-0.18264	-0.149	-0.18264	-0.0894	-0.10959	-0.04917	-0.06027
Maximum	0.261024	0.190018	0.104409	0.076007	0.182717	0.133013	0.261024	0.190018
Mean	0.056011	0.003688	0.022405	0.001475	0.084017	0.005532	0.018484	0.001217

6.2.1.4 Annual Data

The previous subsections covered relatively short returns periods (daily, weekly and monthly). This section focuses on returns over a year, and provides results which can be benchmarked with South African inflation. Annual portfolio returns were calculated for the one day holding period and the aggregated statistics are shown in Table 33 below. For the whole sample period, the losers portfolio provided larger upside and smaller downside potential compared to the

gainers portfolio. This is illustrated by a gainers maximum value of 64.86% versus 44.02%, and a minimum value of -7.99% versus -18%. The gainers annual mean return of 21.86% was also more than three times that of the losers portfolio (6.2%). The losers average returns for the entire period was also nearly three times larger than inflation and hence offered substantial real returns compared to the gainers which was on par with inflation. The most extreme portfolio losses were experienced by both portfolios during the intra-crisis period, which was also the case for portfolio gains, suggesting that exercising these strategies offered large upside and downside in the crisis period specifically.

Table 33: Annual Portfolio Returns Summary for One Day Holding Periods

Returns	Whole period (2000-2015)		Pre-crisis period (2000-2007)		Intra-Crisis period (2008-2009)		Post-Crisis period (2010-2015)	
	Gainers	Losers	Gainers	Losers	Gainers	Losers	Gainers	Losers
Minimum	-0.18004	-0.07991	-0.07202	-0.03197	-0.18004	-0.07991	-0.05941	-0.02637
Maximum	0.44024	0.6486	0.176097	0.25944	0.44024	0.6486	0.14528	0.214038
Mean	0.06199	0.218614	0.024795	0.087446	0.06564	0.231513	0.020456	0.072143

Table 34 below provides summary statistics for annual portfolio returns when calculated for a five day holding period. For the whole sample period, the gainers portfolio provided larger upside and downside potential compared to the losers portfolio. The largest annual gain and loss for the losers were 18.12% and -6.21% respectively, compared with the gainers with 27.19% and -15.32%. These trends were also consistent for all three sub-periods that were separately considered. The annual mean returns are quite similar at 5.94% for the gainers, and 4.95% for the losers. The average returns for the entire period were in the target inflation band suggesting these strategies were not ideal in providing real returns (and even more so if transaction costs are considered).

Table 34: Annual Portfolio Returns Summary for Five Day Holding Periods

Returns	Whole period (2000-2015)		Pre-crisis period (2000- 2007)		Intra-Crisis period (2008-2009)		Post-Crisis period (2010-2015)	
	Gainers	Losers	Gainers	Losers	Gainers	Losers	Gainers	Losers
Minimum	-0.15317	-0.06214	-0.06127	-0.02486	-0.07658	-0.03107	-0.15317	-0.06214
Maximum	0.27192	0.18121	0.10877	0.07248	0.27192	0.18121	0.27192	0.18121
Mean	0.059375	0.049531	0.02375	0.023812	0.065313	0.065484	0.019594	0.019645

6.2.2 Hypothesis 4: An economically significant reversals trading strategy exists

Hypothesis 4 states that a trading strategy on the JSE that is based on share return reversals will provide excess returns, effectively meaning it is economically significant and could be the basis for a profitable trading strategy. This is an important aspect of this project as it investigates the practical applications which would transfer the findings from the domain of theoretical conjecture to real world use. The Sharpe ratio was used for the entire period, as well as the different sub-periods divided into pre-, intra- and post-crisis. This provides a consistency check for the economic significance across the periods, especially in the context of an atypical period such as the Global Financial Crisis. In addition to the performance evaluation based on a simple comparison of benchmarked returns using the Sharpe ratio, a t-test based on unequal variances was performed for the portfolios to test Hypothesis 4 through the difference in sample means. This provides a more robust statistical method for differentiating the economic significance of the portfolio strategies. For any significant result of excess profits, the final step to confirm the validity would be the deduction of the typical buy and sell round trip transaction cost.

6.2.2.1 One Day Holding Period Performance

Considering the mean portfolio Sharpe ratios for a one day holding period over all the sub-periods, the losers portfolio provides positive benchmark adjusted returns per unit of volatility for the overall period and all the sub-periods as well. The gainers portfolio performs similarly with the exception of the post-crisis period. This suggests that on a relative risk scale on average there were excess returns available if either portfolio strategy was used in nearly all the periods. When comparing the maximum and minimum Sharpe ratios for the overall period, losers have a larger absolute minimum than maximum (-0.26 versus 0.25) while gainers have a 50% larger maximum than minimum (0.31 versus -0.21). These extremes suggest that either portfolio offers performance premiums. However, there is added risk without added return for the losers when compared to the gainers.

Table 35: Annual Sharpe Ratio Summary for One Day Holding Periods

Sharpe Ratio	Whole period (2000-2015)		Pre-crisis period (2000-2007)		Intra-Crisis period (2008-2009)		Post-Crisis period (2010-2015)	
	Gainers	Losers	Gainers	Losers	Gainers	Losers	Gainers	Losers
Minimum	-0.20983	-0.26172	-0.07134	-0.07851	-0.17053	-0.26172	-0.20983	-0.02808
Maximum	0.312793	0.249608	0.131778	0.055413	0.312793	0.192198	0.206232	0.249608
Mean	0.116889	0.218343	0.02431	0.111866	0.18922	0.124019	-0.56904	0.270745

Two Sample t-test

The t test required for the analysis here is a modified version referred to as Welch's t test, which is used when the two samples cannot be assumed to have equivalent variances and these variances are unknown. These tests are performed one sided and two sided here, separately for the gainer and loser portfolios.

The null and alternative hypotheses for the one sided and two sided tests are as follows:

Test 1: two sided

$$H_0: \mu_{PORTFOLIO} = \mu_{ALSI}$$

$$H_1: \mu_{PORTFOLIO} \neq \mu_{ALSI}$$

Reject the null hypothesis if: t statistic > critical value of t

Test 2: one sided

$$H_0: \mu_{PORTFOLIO} = \mu_{ALSI}$$

$$H_1: \mu_{PORTFOLIO} > \mu_{ALSI}$$

Reject the null hypothesis if: t statistic > critical value of t or (-)t < (-) critical value

The statistics are calculated as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s_{\bar{X}_1 - \bar{X}_2}} \tag{6.1}$$

Where:

$$s_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} \tag{6.2}$$

\bar{X}_1 is the Mean Portfolio Return

\bar{X}_2 is the Mean ALSI Return

s_1^2 is the Portfolio Return Sample Variance

s_2^2 is the ALSI Return Sample Variance

n_1 is the number of observations of Portfolio Return

n_2 is the number of observations of ALSI Return

Tables 36 and 37 below summarises the t-test results for Tests 1 and 2 for the gainer and loser portfolios, based on a one day holding period. As seen in the table below, none of the tests yielded evidence to support either a significant difference in mean returns or a higher return for the portfolios relative to the ALSI at the 10% significance level. This contrasts with the results from the analysis of the Sharpe ratios, questioning the reliability of these portfolios in providing sustainable excess returns. The deduction of transaction costs is rendered unnecessary due to the absence of a statistically significant excess returns.

Table 36: Test 1 and 2 results for a one day holding period

	Gainers	Losers
Test 1	t=0.512<1.96 – Do not Reject Null	t=1.29<1.96 – Do not Reject Null
Test 2	t=0.512<1.64 – Do not Reject Null	t=1.29<1.64 – Do not Reject Null

Table 37: t test for gainers portfolio and ALSI (1 day)

	Portfolio Return	ALSI Return
Mean	0.000562	0.001103
Variance	0.00174	0.000229
Observations	1765	1765
Hypothesized Mean Difference	0	
Degrees of freedom	2220	
Significance level	10%	
t Stat	0.51191	
P(T<=t) one-sided test	0.304382	
t Critical one-sided test	1.64554	
P(T<=t) two-sided test	0.608764	
t Critical two-sided test	1.961033	

Table 38: t test for losers portfolio and ALSI (1 day)

	Portfolio Return	ALSI Return
Mean	0.001668	0.000441
Variance	0.001692	0.000202
Observations	2097	2097
Hypothesized Mean Difference	0	
Degrees of freedom	2590	
Significance level	10%	
t Stat	1.291075	
P(T<=t) one-sided test	0.098396	
t Critical one-sided test	1.645442	
P(T<=t) two-sided test	0.196793	
t Critical two-sided test	1.96088	

6.2.2.2 Five Day Holding Period Performance

The analysis based on the five day holding period provides some different results in general. Considering the mean Sharpe ratio for the five day holding period over the entire period, the losers portfolio provides a value ten-fold that of the gainers portfolio. In addition, the maximum is about 60% larger than the gainers portfolio while the minimum is also more

extreme. Of interest is the periods in which the minimums and maximums occur, being the intra-crisis and post-crisis periods respectively. The incidence of these extremes in these periods suggest that for more than a day's holding period, the reversals strategy takes on high risk and does not perform at all during financial turmoil. In periods of market recovery, it seems that there are very large returns available, relative to risk, but this may very much be due to low risk as opposed to high absolute returns. The analysis of the Sharpe ratio on its own provides little clarity on the reliability of the reversals strategy for excess returns.

Table 39: Annual Sharpe Ratio Summary for Five Day Holding Periods

Sharpe Ratio	Whole period (2000-2015)		Pre-crisis period (2000-2007)		Intra-Crisis period (2008-2009)		Post-Crisis period (2010-2015)	
	Gainers	Losers	Gainers	Losers	Gainers	Losers	Gainers	Losers
Minimum	-0.34691	-0.50718	-0.10407	-0.15215	-0.34691	-0.50718	-0.03722	-0.05441
Maximum	0.499873	0.767081	0.110972	0.170292	0.384902	0.590652	0.499873	0.767081
Mean	0.030781	0.34368	0.01577	0.176081	0.017483	0.19521	0.038168	0.426163

Two sample t-test

The same t tests as the previous section were conducted for the portfolios, but in this case using a five day holding period. Table 40 below summarises the results for Tests 1 and 2 for the gainer and loser portfolios. As seen in the table below, none of the tests yielded evidence to support either a significant difference in mean returns or a higher return for the gainers portfolio relative to the ALSI at the 10% significance level. The losers portfolio did provide weakly significant evidence for the null hypotheses for both tests. This provides some clarity as to the usefulness of the losers portfolio for a five day holding period which corroborates some of the findings from the Sharpe ratio. Tables 40 and 41 below summarise the test outputs as well.

Table 40: Test 1 and 2 results for a one day holding period

	Gainers	Losers
Test 1	t=1.321<1.96 – Do not Reject Null	t=-1.873<-1.96 –Reject Null
Test 2	t=1.321<1.64 – Do not Reject Null	t=-1.873<-1.64 –Reject Null

Table 41: t test for gainers portfolio and ALSI (5 Days)

	Portfolio Return	ALSI Return
Mean	0.11797	0.17151
Variance	0.00475	0.000346
Observations	398	398
Hypothesized Mean Difference	0	
Degrees of freedom	435	
Significance level	10%	
t Stat	1.321	
P(T<=t) one-sided test	0.105672	
t Critical one-sided test	1.64554	
P(T<=t) two-sided test	0.35911	
t Critical two-sided test	1.961033	

Table 42: t test for losers portfolio and ALSI (5 days)

	Portfolio Return	ALSI Return
Mean	0.05151	0.1109
Variance	0.00324	0.000272
Observations	398	398
Hypothesized Mean Difference	0	
Degrees of freedom	435	
Significance level	10%	
t Stat	-1.87291	
P(T<=t) one-sided test	0.10981	
t Critical one-sided test	1.64554	
P(T<=t) two-sided test	0.04632	
t Critical two-sided test	1.961033	

6.3 Conclusion

In order to test the practical and economic significance of this studies' findings for return reversals, a trading strategy was tested to provide portfolio returns which could be compared with the ALSI market benchmark. Section 6.2 presented the results for one day and five day holding periods. For the whole sample period, the losers (at $\pm 5\%$ and $\pm 10\%$) portfolio provided larger upside and downside potential compared to the gainers portfolio on a daily basis. On a weekly basis, there were better returns for gainers in times of crises due to the larger reversals in a crisis period, and better returns for losers in a period of market recovery when considering the gains rolled over for a week. On a month long horizon, the most extreme portfolio losses were experienced by both portfolios during the post-crisis period, which was also the case for portfolio gains. This is unusual given that there was strong market recovery for most of the post-crisis period. The annual data suggested that the gainers portfolio provided larger upside and downside potential compared to the losers portfolio.

To provide robust results for Hypothesis 4 (an economically significant reversals trading strategy exists), risk and benchmark adjusted returns were calculated using the Sharpe ratio. For a one day holding period over all the sub-periods, the losers portfolio provided positive returns per unit of volatility for the overall period and all the sub-periods as well. The gainers portfolio performed similarly with the exception of the post-crisis period. The analysis based on the five day holding period provided some different results. Considering the mean Sharpe ratio for the five day holding period over the entire period, the losers portfolio provides a value ten-fold that of the gainers portfolio. In addition, the maximum is about 60% larger than the gainers portfolio while the minimum is also more extreme. The outperformance of these portfolios relative to the ALSI did not receive statistical support based on t-tests. For both one day and five day holding periods, there was no statistical significance for the difference of mean returns between either the gainers portfolio and ALSI or the losers portfolio and ALSI. Due to this, Hypothesis 4 was rejected and there was no further investigation based on the deduction of transaction costs.

Chapter 7: Limitations and Suggestions for Further Research

7.1 The Joint Hypothesis Problem

The joint hypothesis problem is based on the challenge presented in adequately testing market efficiency given that an additional concurrent hypothesis is required on some model for prices. This model itself would present a framework on how prices occur efficiently to begin with and then the actual observed prices can be tested to determine whether efficiency holds. In practice, this approach would usually fail and lend support to the hypothesis that markets are inefficient. This is often due to an incomplete model which has omitted some important factors which are assumed to have a rational basis. There is often no need to explain what these factors might be, but their existence is assumed, or it cannot be proved that they do not exist. This in essence creates a circular logic pathway which undermines the conclusions in relation to market efficiency.

7.2 Limited Economic Significance

An important aspect of any theoretical result is the ability to extend it to the future and use it for some practical and realistic application. In this context, this is the question of whether a statistically significant result has economic significance in the financial market. Not only is a market application important but the horizon over which it can yield results is also a key matter. Much investigation of the Overreaction hypothesis has been coupled with a search for portfolio allocation strategies to earn excess profits. Notably, these have all been in the long term, which is outside the scope of this project. This project sought to fill a gap in the investigation of short term strategies based on overreaction and add to the international work on this phenomenon. There were mixed results for the economic significance of the contrarian strategy employed on this dissertation. Relative performance metrics based on the Sharpe ratio suggested positive returns but statistical tests found no significant difference between the portfolio returns and the ALSI which was the market benchmark. This limits the support for opportunities to utilise the reversals consistently.

7.3 The study does not investigate Behavioural Aspects

Market participants may react rationally or irrationally when transacting in asset markets. The study of the psychological aspects which drive and direct certain responses is part of behavioural studies, which are far removed from the scope of this study. An investigation of such factors in the short term would require consideration of many psychological aspects, which are peripheral to the objectives of this study and to avoid over complication such an endeavour was avoided. The inability to investigate these effects, although due to practical and methodological limitations, does render this study incomplete when viewed as investor focused research.

7.4 Non-Event attribution and specification

This research project focused on a pure returns assessment of share overreaction based on total return index values. These returns were not distinguished based on firm specific events such as dividends, share options, buy backs or other potentially value adjusting events although an attempt was made to mitigate this issue through use of the total return index which would incorporate dividend and other return contributions. This is based on such events being reflected similarly for all shares, which may not be a realistic assumption. In addition, these events impact substantially on trading strategies as the share price can move significantly on any given day due to announcements related to these.

7.5 Price impact on the reliability of the trading strategy

An additional limitation is the effect that price movements might have on the reliability of the trading strategy derived from the results of investigating extreme short term price overreaction. The issue is whether the individual investor would be able to trade at the previous closing price, which is highly unlikely on any given day. However this effect is less likely to affect the reliability of trading strategies based on longer horizon historical performance when compared to the short horizon used in this study.

7.6 Non-attribution to rational structural uncertainty

When considering the market anomalies highlighted in this study, there is an implicit assumption of an 'irrational' view. However, there is an alternative 'rational' view which posits that these anomalies are a manifestation of risks and abnormal returns as expected due to the assumed inherent risks. Share specific and market risks were for the most part proxied by the use of returns volatility and the SAVI but other structural risks were not incorporated. Brav and Heaton (2002) directly compared these two competing assumptions and found that although they have opposing views, their mathematical and predictive similarities render them hard to distinguish from each other. In addition, these authors found that even if the anomalies occur due to irrationality, their disappearance may require some form rational learning such as the ability of investors to reject competing rational explanations for observed market price patterns (Brav and Heaton, 2002). Further investigation on this would perhaps add value in research on the independence or interaction of these alternative views.

7.7 Suggestions for further research

This section builds on the limitations of this study to provide different extensions and alternatives to the research in this dissertation. There were consistently significant evidence of reversals, however there were no excess profits available for traders based on a contrarian strategy. An implication of this is that an additional filter may be required to identify true candidate shares for such a strategy. More research with a focus on sectoral or industry based trading strategies would be useful as there may be a case to focus on overreaction in certain sectors such as resources and minerals.

Another area to explore further is the investigation of overreaction based on behavioural aspects. This would involve the development of statistical metrics that are able to adequately function as financial proxies for investor actions based on behavioural tendencies which may lead to overreaction.

The final suggestion for further investigation is to track price movements specifically related to company announcements and news. This would involve recording all the formal announcements from the company as well as other general news which may impact prices and tagging these to large price shifts that occur within a trading day. This is difficult to execute in practice for even a moderate number of companies over a small horizon given that there may be multiple announcements for all the companies in addition to opinions and other influential news that may not even originate from the company itself. As investors select and act on any information in a complex and often unpredictable manner, any combination of information and personal bias may lead to price movements. This analysis would have to be combined with a behavioural study to adequately provide any meaningful conclusions.

Chapter 8: Conclusion

Chapter 2 provided a theoretical overview and literature study for the overreaction hypothesis. Section 2.2 contained three key theories, the Overreaction, Efficient Market and Uncertain Information hypotheses. The efficient market hypothesis (EMH) states that a market in which all publicly available information is reflected in the market prices of assets is efficient. If overreaction exists in the JSE, then it comes up against the conventional theory of market efficiency, especially weak form efficiency (De Bondt & Thaler, 1985). The uncertain information hypothesis (UIH) asserts that the abnormal returns following both positive and negative price movements or events should remain positive for some time (Ketcher & Jordan, 1994). Behavioural finance was also covered as an area which provided another dimension of analysis to overreaction.

Section 2.3 discussed bid-ask bounce, January, value and size effects, as well as transaction costs and time varying risk premiums in relation to overreaction. Section 2.4 focused on prior research conducted over the short term internationally, highlighting the differing evidence gathered over different time periods and geographies. Section 2.5 presented evidence from work on overreaction and reversals in South Africa, and was followed by studies on general returns modelling in South Africa. Section 2.6 discussed the common methodologies used in all the studies of short term overreaction, namely event studies, variance modelling and regressions.

Chapter 3 consisted of an overview of the data collection process, sample and methodology. The required data will be sourced from Thomson Reuters Datastream International as well as Bloomberg and McGregor Bureau of Financial Analysis. Then the key issues of share liquidity and survivorship bias were considered with measures to circumvent these. A summary of the screening criteria that was used in refining the sample followed this. Furthermore, the sample was analysed for trends of interest in developing hypotheses 3 and 4.

Chapter 4 expanded on hypothesis development and the methodology. Based on a combination of analysis of prior literature and exploratory data analysis, some areas of specific research were developed as testable hypotheses to address the key research questions. Hypothesis 1 was that short term share return reversals exist on the JSE. Hypothesis 2 held that there were difference in the magnitude of upward and downward return reversals. Hypothesis 3 was that reversals are altered in times of Financial Turmoil. Last of all, hypothesis 4 stated that a profitable reversals trading strategy exists. A discussion of South Africans returns research informed the choice and validated some of the key variables used in the empirical models. Four model specifications were finalised based on the work of Lobe and Rieks (2011). A selection of exploratory and diagnostic checks were performed on the raw data and it was concluded that none of the regression assumptions were not violated.

The prior research of Chapters 2, 3 and 4 is applied was to the dataset with the results and analysis provided in Chapter 5. This chapter presented the results and key findings from the statistical analysis of the data. Section 5.2 considered the evidence from each of regression models and explained the results in terms of the regression variables that measured the various effects. The reversal, average return, size and P/E variables are significant over the one day and five day holding periods and were a useful suite of factors whereas the book-to-market and volatility variables were trivial in explaining short term overreaction. This section also compared the findings from prior literature, and found some matches with the prevailing evidence from other markets, for instance Lobe and Rieks (2011) and Choudhary and Sethi (2014).

Robustness checks were then used in Section 5.3 to check for the reliability of the results using coefficient persistence checks. For Models 1 to 4 the coefficients for return reversals and average return proved to be consistent and robust irrespective of the different cut-offs. Average return was always the largest coefficient. Book-to-market ratio and the volatility measures had the most limited significance and also happened to have the smallest coefficients. Size and P/E were significant for smaller cut-offs and had small magnitudes in

general. In conclusion, the reversal, average return, size and P/E variables are significant over one day and five day holding periods, whereas the book-to-market and volatility variables were trivial in explaining short term overreaction. Section 5.4 positioned the results in relation to Research Hypotheses 1 to 3 in providing conclusions to these based on the results and found that there was strong support for the first two hypothesis but mixed evidence for hypothesis 3. The key contribution of this work has been to validate the existence of share price overreaction for very short horizons on the JSE. Common effects such as the size and value effects have also gained support and may yield trading strategies as well.

Chapter 6 covered the practical and economic significance of this studies' findings for return reversals, a trading strategy was used on past data as a comparative measure by testing it relative to the ALSI market benchmark. Section 6.2 elaborated on the methodology with respect to portfolio selection, allocation and return measurement. Section 6.3 presented the results for one day and five day holding periods and contextualized the results respect to Hypothesis 4. The losers portfolio provided larger upside and downside potential compared to the gainers portfolio on a daily basis. On a weekly basis, there were better returns for gainers in times of crises due to the larger reversals in a crisis period, and better returns for losers in a period of market recovery when considering the gains rolled over for a week. On a month long horizon, the most extreme portfolio losses were experienced by both portfolios during the post-crisis period, which was also the case for portfolio gains.

Based on Sharpe ratios the portfolios outperformed the ALSI but this did not receive statistical support based on t-tests. For both one day and five day holding periods, there was no statistical significance for the difference of mean returns between either the gainers portfolio and ALSI or the losers portfolio and ALSI. Due to this, Hypothesis 4 was rejected and there was no further investigation based on the deduction of transaction costs. Further work on analysing this phenomenon in different sectors may yield more focused strategies that are able to capture abnormal returns better than a market wide selection.

Chapter 7 highlighted six limitations that constrained the level of research and suggested different extensions on the scope of the work in this research project. The first limitation was the joint hypothesis problem which implies a circular argument when testing market efficiency which hindered the potential for the findings to be applied in a meaningful way in testing market efficiency. The second limitation was limited economic significance due to no statistical support for a contrarian trading strategy as a means to outperform the market. Another key limitation is a lack of means to directly investigate behavioural aspects in the scope of this work, which leaves a large area of analysis untapped. The fourth limitation was the inability to identify or account for every single event or news item which may trigger overreaction thus rendering the testing environment poorly controlled for with respect to these factors. The next limitation was the price impact on the reliability of trading strategy outcomes and the final limitation was a lack of specific investigation on the 'rational' view of anomalies. The suggestions for further research involved focusing the investigation of overreaction to specific business sectors and incorporating behavioural aspects as well as announcements into the scope of research.

References

Akhigbe, A., Gosnell, T., and Harikumar, T. 1998. *“Winners and Losers on NYSE: A Re-Examination Using Daily Closing Bid-Ask Spreads.”* Journal of Financial Research, 21, 53–64.

Atkins, A.B., and E.A. Dyl. 1990. *“Return reversals, Bid-Ask Spreads, and Market Efficiency”*. Journal of Financial and Quantitative Analysis, 25, 535–547.

Appiah-Kusi J and Menyah K. 2003. *“Return predictability in African stock markets”*. Review of Financial Economics, 12 (3): 247-270.

Basiewicz, P. and Auret, C. (2010). *“Feasibility of the Fama and French three factor model in explaining returns on the JSE”*. Investment Analysts Journal, 71(1): 13-25.

Ball, R., Kothari, S.P. and Shanken, J. 1995. *“Problems in measuring portfolio performance: An allocation to contrarian investment strategies”*. Journal of Financial Economics, 38(1), 307–343.

Bowman, R.G. and Iverson, D. 1998. *“Short-run overreaction in the New Zealand stock market.”* Pacific-Basin Finance Journal, 6, 475–491.

Brav, A. and Heaton, J. B. 2012. *“Competing Theories of Financial Anomalies”*. The Review of Financial Studies, Special 2002, Vol. 15, No.2, 575-606.

Bremer, M. and Sweeney, R. J. 1991. *“The Reversal of Large Stock-Price Decreases.”* The Journal of Finance, Vol. 46, No. 2 Jun., 747-754.

Bremer, M., Hiraki, T., and Sweeney, R. J. 1997. *"Predictable patterns after large stock price changes on the Tokyo stock exchange."* Journal of Financial and Quantitative Analysis, 32, 345–365.

Brown, K. C., Harlow, W. V., and Tinic, S. M. 1988. *"Risk aversion, uncertain information, and market efficiency."* Journal of Financial Economics, 22, 355–385.

Campbell, K. and Linmack, R. 1997. *"Long term overreaction in UK stock market and size adjustments."* Applied Financial Economics, 75, 537–548.

Chan, K.C. 1988. *"On the contrarian investment strategy."* Journal of Business, 612, 147–163.

Chopra, N., Lakonishok, J. and Ritter, J.R. 1992. *"Measuring abnormal performance: Do stocks overreact?"* Journal of Financial Economics, 312, 235–268.

Choudhary, K. and Sethi, N. 2014. *"A Study of Overreaction Hypothesis in the Indian Equity Market."* Asia-Pacific Journal of Management Research and Innovation, 104, 355–366.

Conrad, J. and Kaul, G. 1993. *"Long term market overreaction or biases in computed returns?"* The Journal of Finance, 481, 39–63.

Conrad, J. S., Hameed, A. and Niden, C. 1994. *"Volume and Autocovariances in Short-Horizon Individual Security Returns."* Journal of Finance, 49, 1305-1329.

Cox, D. R. and Peterson, D. R. 1994. *"Stock Returns following Large One-Day Declines: Evidence on Short-Term Reversals and Longer-Term Performance."* The Journal of Finance Vol. XLIX, no. 1.

Da, Z., Liu, Q., and Schaumberg, E. 2014. "A Closer Look at the Short-Term Return Reversal.". Management Science Vol. 60, No. 3, 658–674.

De Bondt, W. F. M. and Thaler, R. 1985. "Does the Stock Market Overreact?". The American Finance Association, 1985.

De Bondt, W. F. M. 1989. "Stock Return reversals and Overreaction to News Events: A Survey of Theory and Evidence.". NATO ASI Series Volume 54, 1989, 57-84.

Dissanaike, G. 1999. "Long-term stock return reversals in the UK: Evidence from Regression Tests.". The British Accounting Review Volume 31, Issue 4, December 1999, 373–385.

Fama, E. F. 1970. "Efficient Capital Markets: A Review of Theory and Empirical Work." Journal of Finance. 25:2.

Frisch, T., Kolaric, S. and Schiereck, D. 2014. "Returns on Large Stock Price Declines and Increases In The South African Stock Market: A Note On Market Efficiency.". International Business and Economics Research Journal – May/June 2014 Volume 13, Number 3.

Gilson, R.J. and Kraakman, R.H. 2003. "The Mechanisms of Market Efficiency Twenty Years On: The Hindsight Bias". Harvard Law School John M. Olin Center for Law, Economics and Business Discussion Paper Series. Paper 446.

Global Competitiveness Report 2014-2015. World Economic Forum.

Hoffman, A. J. 2012. "Stock return anomalies: Evidence from the Johannesburg Stock Exchange". Investment Analysts Journal, 75.

Hong, H. and Stein, J. C. 1999. *"A Unified Theory of Underreaction, Momentum Trading, and Overreaction in Asset Markets"*.

Huang, Y. 1998. *"Stock Price Reaction to Daily Limit Moves: Evidence from The Taiwan Stock Exchange"*. Journal of Business Finance and Accounting, 253.

Hsieh, H. H. and Hodnett, K. 2011. *"Tests of the overreaction hypothesis and the timing of mean reversals on the JSE Securities Exchange (JSE): The case of South Africa"*. Journal of Applied Finance & Banking, vol.1, no.1, 2011, 107-130

Itaka, J. K. 2015. *"Test of the Overreaction Hypothesis in the South African Stock Market"*. Department of Mathematics and Applied Mathematics, Faculty of Natural Sciences, University of the Western Cape.

Jefferis K and Smith G. 2005. *"The changing efficiency of African Stock Markets"*. South African Journal of Economics, 73(1): 269-271.

Ji, L., R. Nisbett, and Y. Su. *"Culture, Change and Prediction"*. Psychological Science, 12, 2001, 450–456.

Kahneman, D., and Tversky, A. 1982. *"Intuitive Prediction: Biases and Corrective Procedures"*. Defense Advanced Research Projects Agency.

Ketcher, D. N., and Jordan, B. D. 1994. *"Short-term return reversals following major price innovations: Additional evidence on market overreaction"*. Journal of Economics and Business.

Kudryavtsey, A. 2012. *"Short-Term Stock Return reversals May Be Reversed"*. International Journal of Economic Sciences and Applied Research, 129-146.

Lasfer, M. A., Melnik, A., and Thomas, D. C. 2003. *“Short-term reaction of stock markets in stressful circumstances”*. Journal of Banking and Finance. Volume 27, Issue 10, October 2003, 1959–1977.

Lobe, S. and Rieks, J. 2011. *“Short-term market overreaction on the Frankfurt stock exchange”*. The Quarterly Review of Economics and Finance, 51, 113–123.

Locke, S. and Gupta, K. 2009. *“Applicability of contrarian strategy in the Bombay stock exchange”*. Journal of Emerging Market Finance, 8(2): 165-189.

Ma, Y., Tang, A. P., and Hasan, T. 2005. *“The Stock Price Overreaction Effect: Evidence on Nasdaq Stocks”*. Journal of Business and Economics, Vol. 44, No. ¾, Summer - Autumn, 113-127.

Maher, D. and Parikh, A. 2011. *“Short-term under/overreaction, anticipation or uncertainty avoidance? Evidence from India”*. International Financial Markets, Institute and Money, 21, 560– 584.

Mankiw, N. G. 2011. *“Principles of Economics”*. 6th edition. Mason, OH: South-Western Cengage Learning, 686.

Muller, C. 1999. *“Investor Overreaction on the Johannesburg Stock Exchange”*. Investment Analysts Journal, 49, 5-17.

Muller, C. and Ward, M. 2013. *“Style-based effects on the Johannesburg Stock Exchange: A graphical time-series approach”*. Investment Analysts Journal, 42(77).

Otchere, I and Chan, J. 2003. *“Short-term overreaction in the Hong Kong stock market: can a contrarian trading strategy beat the market?”* The Journal of Behavioural Finance.

Page, M. J. and Way, C. V. 1993. *“Stock Market Over-reaction: The South African Evidence”*. Investment Analysts Journal, 35-49.

Park, J., 1995. *“A Market Microstructure Explanation for Predictable Variations in Stock Returns following Large Price Changes”*. Journal of Financial and Quantitative Analysis, 241-256.

Simpson, M. W., Guidici, E., and Emery, J. T. 2011. *“One-month Individual Stock Return Reversals and Industry Return Momentum”*.

Sohail, A. and Javid, A.Y. 2014. *“The Global Financial Crisis and Investors’ Behaviour: Evidence from the Karachi Stock Exchange”*. Pakistan Institute of Development Economics Islamabad.

Strugnell, S., Gilbert, E. and Kruger, R. 2011. *“Beta, size and value effects on the JSE, 1994 – 2007”*. Investment Analysts Journal, 74:1-17

Van Rensburg, P. and Robertson, M. 2003. *“Size, price-to-earnings and beta on the JSE Securities Exchange”*. Investment Analysts Journal, 32:58, 7-16

Zarowin, P. 1989. *“Short-run market overreaction size and seasonality effects”*. The Journal of Portfolio Management Spring 1989, Vol. 15, No. 3: 26-29.

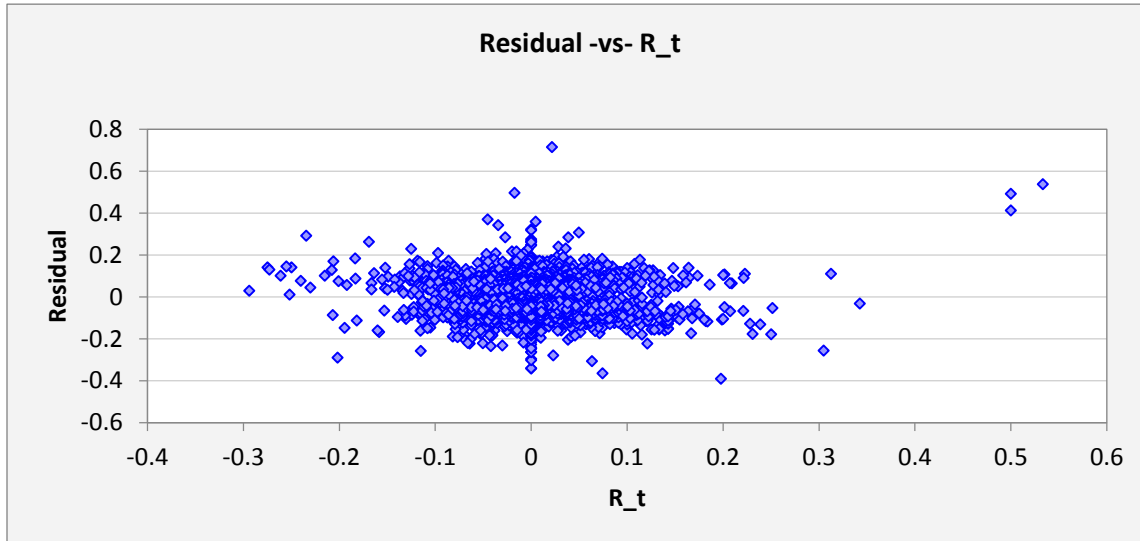
Appendices

Appendix A: Residuals Versus Independent Variable Plots

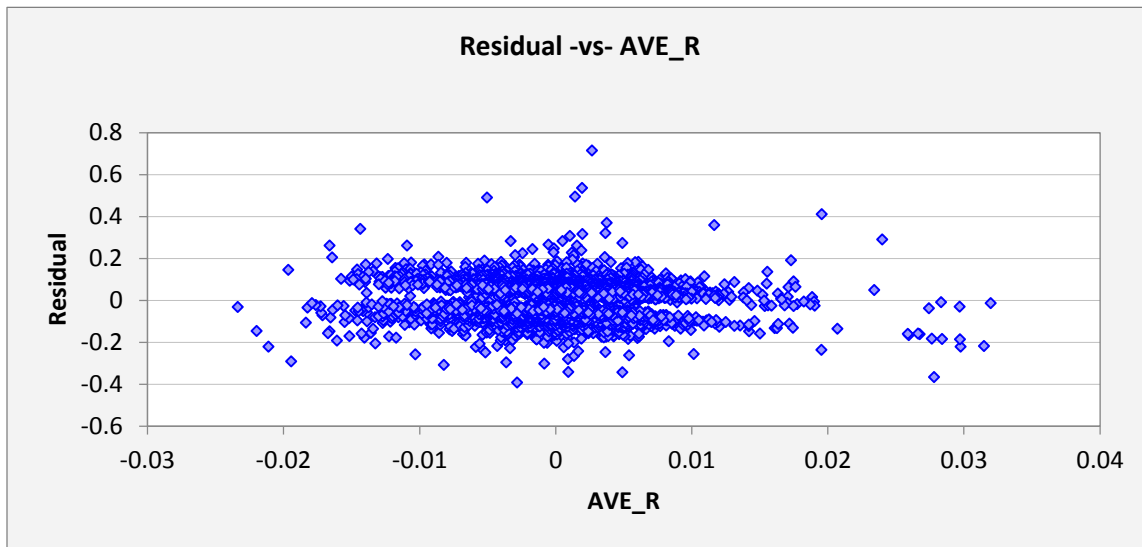
The diagnostic check for non-linearity is a collection of regression error values (residuals) plotted against the different independent variables. A systematic pattern in these plots indicates some non-linearity.

The figures below represent residual versus plots and there are no systematic patterns discernible lending support to the notion that there are no issues with linearity when performing the regressions.

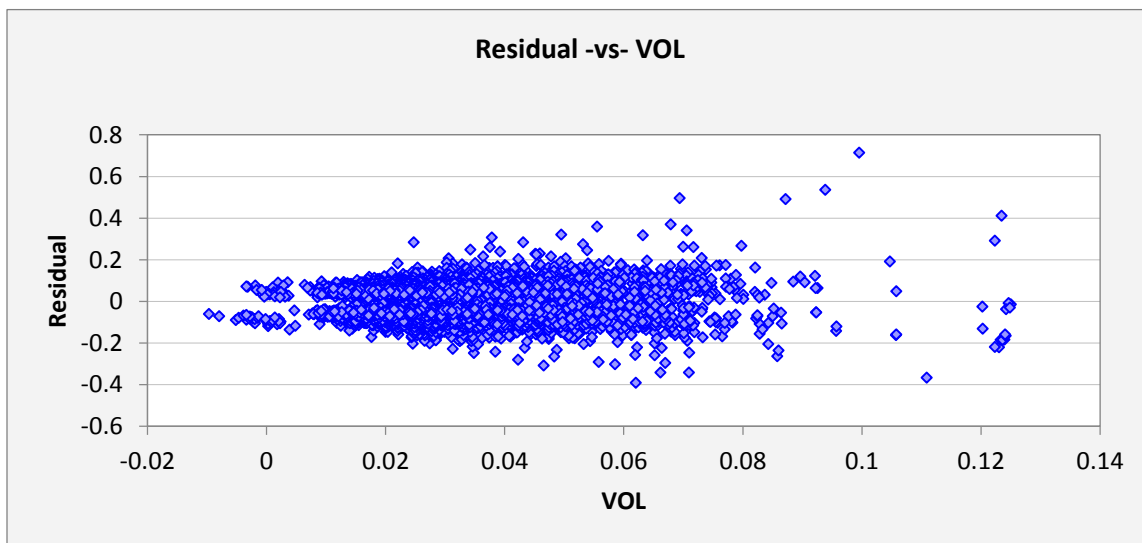
Appendix A1: Residuals versus ($R_{i,t}$)



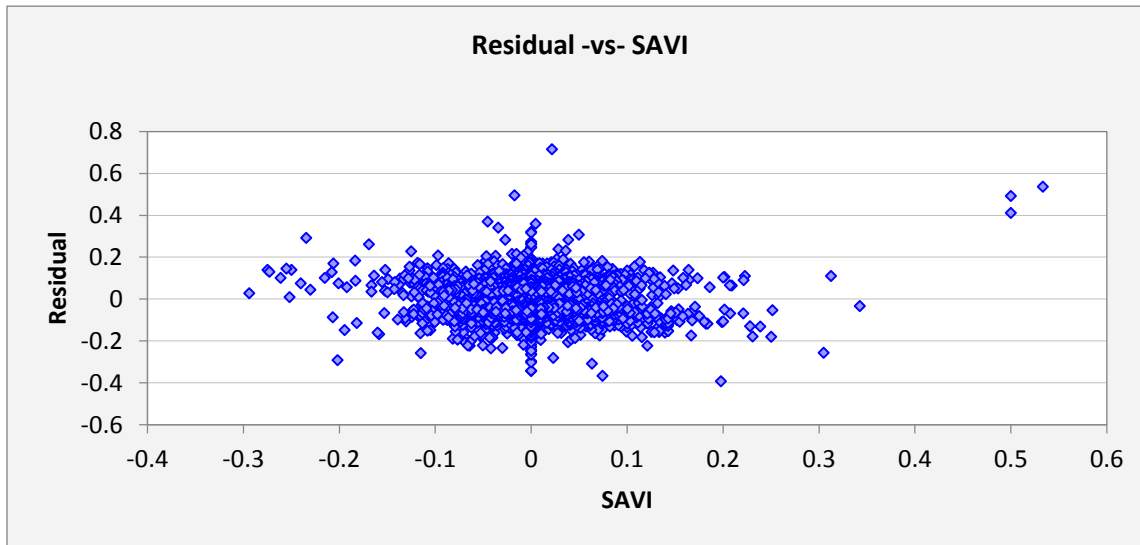
Appendix A2: Residuals versus ($AR_{i,t}$)



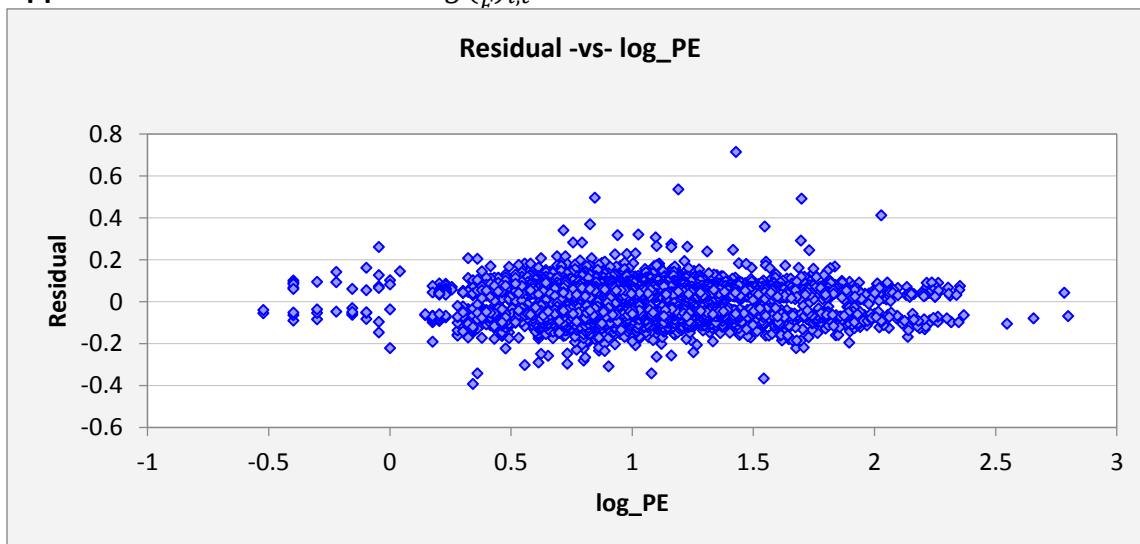
Appendix A3: Residuals versus ($V_{i,t}$)



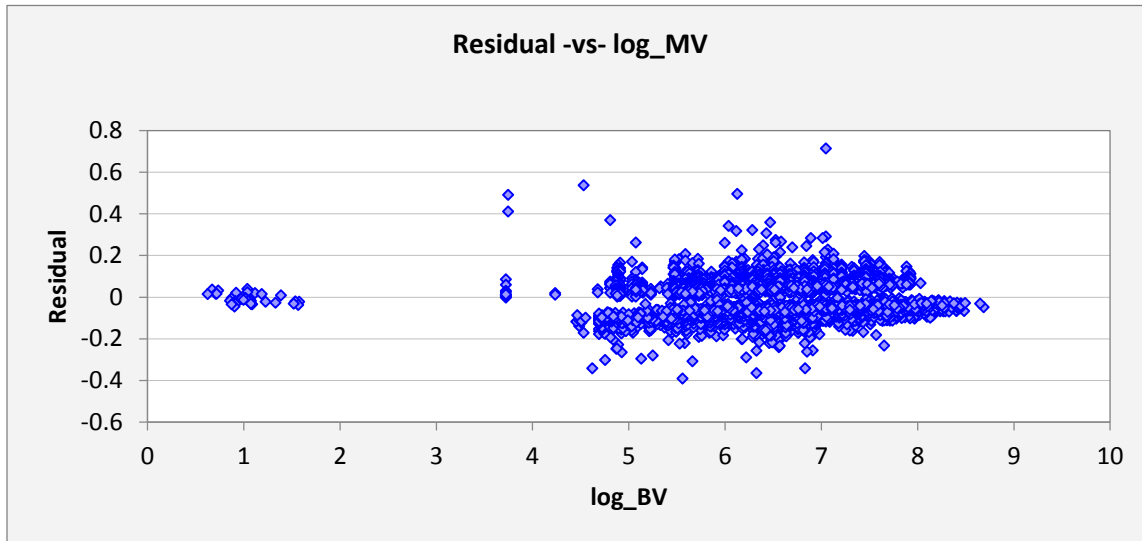
Appendix A4: Residuals versus ($SAVI_t$)



Appendix A5: Residuals versus $\log(\frac{P}{E})_{i,t}$



Appendix A6: Residuals versus $\log(MV_{i,t})$



Appendix A7: Residuals versus $\log(BTM_{i,t})$

