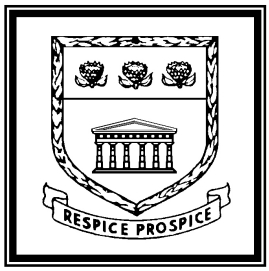

University of the Western Cape

FACULTY OF NATURAL SCIENCES

Department of Mathematics and Applied Mathematics

Test of the Overreaction Hypothesis in the South African Stock Market

A Research Project presented to the Department of Mathematics of Applied Mathematics in the Faculty of Natural Science at the University of the Western Cape

In partial fulfillment of the requirements for the degree of Master of Science (M.Sc) in Computational Finance

By

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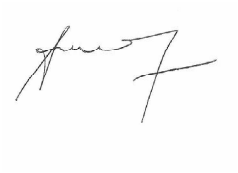
Co-supervisor: Professor Danelle Kotze

Declaration

I, Jose Kumu Itaka, hereby, declare Overreaction Hypothesis in the South African stock market is my original work, that it has not been or being partially or entirely submitted at any other institution for degree purposes and all sources I have used have been indicated and acknowledged by complete references.

Jose Kumu Itaka



Dedication

This research project is heartily dedicated to my daughters, Josianne Itaka, Benedicte Itaka and Esther Itaka, hoping that they will one day realise that education is a weapon against ignorance and poverty and a key to unlock the doors to success.

Acknowledgement

Thanks to God Almighty for giving me health and strength to complete this Research Project. Only due to His blessing I could complete this work.

There are no words to express my gratitude and thanks to My Beloved parents, Family members for always standing by me. Their existence and love have been very supportive to me. I owe a debt of gratitude to my uncles Domai Adrien and Pero Gerard for encouraging me to pursue this degree and inspiring me to follow my dreams.

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Finally, I would like to express my gratitude to all those who have contributed in one way or another and helped me to complete this work: lecturers, colleagues, friends and others.
Thank you to all.

Abstracts

This research undertakes to investigate both long-term and short-term investor overreaction on the JSE Limited (JSE) over the period from 1 January 2002 to 31 December 2009. The period covers the restructuring and reform of the JSE in the early 2000s to the end of global financial market crisis in late 2008/2009, which can be regarded as a complete economic cycle. The performances of the winner and loser portfolios are evaluated by assessing their cumulative abnormal returns (CAR) over a 24-month holding period. The test results show no evidence of mean reversion for winner and loser portfolios formed based on prior returns of 12 months or less. However, test results show evidence of significant mean reversion for the winner and loser portfolios constructed based on their prior 24 months and 36 months returns.

In addition, the study reveals that the mean reversion is more significant for longer-formation-period portfolios as well as for longer holding periods. The examination of the cumulative loser-winner spreads obtained from the contrarian portfolios based on the constituents' prior 24 month and 36 month returns indicates that the contrarian returns increase for portfolios formed between 2004 and 2006, and declines thereafter towards the end of the examination period. The deterioration of contrarian returns coincides with the subprime mortgage crisis in 2007 and the subsequent global financial crisis in 2008. This evidence suggests that the degree of mean reversion on the JSE is positively correlated to the South African business cycle.

Keywords: random walk, efficient market hypothesis (EMH), overreaction hypothesis, mean reversion, contrarian, momentum, market timing.

JEL Classification: G11, G12, G14, G15.

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Chapter 1

Introduction

1.1 Background

In its weak-form, the Efficient Market Hypothesis (EMH) states that all historical information relating to an asset should be reflected in the market price of the asset, and hence no investor could earn abnormal returns by making use of historical price information. The violation of this tenet has been demonstrated through a succession of studies by DeBondt and Thaler (1985, 1987). The study results of DeBondt and Thaler (1985, 1987) demonstrate that stocks that systematically underperform the market in a specific period will outperform in the following periods and vice versa in the market correction. The phenomenon finds its origin in psychological application of the overreaction hypothesis which implies that investors overreact in the occurrence of dramatic events, in such manner that new pessimistic events drag the stock prices under their long-term intrinsic values while new optimistic events drive the stock prices over their long-term intrinsic values. Once investors notice mispricing of stocks, they seek to profit from these opportunities through their trading activities, which bring stock prices back to their long-term intrinsic values. This process is known as mean reversion. Mayost (2012) describes mean reversion as a negative correlation between market fluctuations in one period and succeeding periods that results from the investor overreaction phenomenon.

The presence of mean reversion is seen as an opportunity for investors to predict future fluctuations in stock prices based on their prior performance in order to earn abnormal returns by implementing the contrarian strategy. This investment style counteracts the prevalent market movements by purchasing stocks that are performing badly and selling them when they are performing well.

Since the contrarian strategy is a gamble on stocks that have recently performed poorly, it is seen as a reverse relative strength strategy according to Hsieh and Hodnett (2011). The fact that market belief varies according to various phases of the business cycle, the abnormal returns generated through the reverse relative strength strategy would be cyclic. Thus, investor overreaction and the ensuing mean reversion of the prior winner and loser portfolios could be cyclical in nature.

1.2 Objectives

Inspired by the findings of DeBondt and Thaler (1985, 1987) on the New York Stock Exchange (NYSE) and the follow-up studies conducted on the Johannesburg Stock Exchange (now the JSE Limited) by Page and Way (1992) and Hsieh and Hodnett (2011), this research undertakes to investigate both long-term and short-term investor overreaction using monthly stock returns from the JSE throughout the period from January 2002 to December 2009. This study attempts to determine the degree of investor overreaction on the JSE, and undertakes to investigate the specific timing of mean reversion that might exist with reference to the various stages in the South African economic cycle.

1.3 Structure

The subsequent parts of this research are structured as follows. Chapter 2 discusses relevant theories relating to this research, which include the Random Walk Theory of Regnault (1863), the Efficient Market Hypothesis (EMH) of Fama (1965, 1970), Capital Asset Pricing Model (CAPM) of Sharpe (1964), Prospect Theory of Kahneman and Tversky (1979, 1992) and Overreaction Hypothesis of DeBondt and Thaler (1985; 1987). Chapter 3 presents an overview of prior literature on overreaction hypothesis in international and South African stock markets. The review explores the empirical evidence of investor overreaction as well as alternative explanations suggested by various researchers. Chapter 4 describes the process of data collection, the sample, the methodology used as well as the motivation behind the methodology employed. Chapter 5 presents and interprets the post-formation results of the winner and loser portfolios over short-term and long-term formation periods while Chapter 6 undertakes to investigate the specific timing of mean reversion for portfolios constructed under different formation periods with reference to the various stages in the South African economic cycle. Chapter 7 presents summary and conclusion on findings.

1.4 Contribution

The examination of the overreaction hypothesis on the JSE using the cumulative abnormal return (CAR) approach has previously been employed by Page and Way (1992) and Hsieh and Hodnett (2011). However, this research seeks to expand on the literature related to the predictability of stock prices on the JSE. The main contribution of this research is bi-faceted; the employed data as well as methodology. With regard to the examination period, none of the studies (Page and Way, 1992) and Hsieh and Hodnett, 2011) conduct their tests over the

period from 1 January 2002 to 31 December 2009. The examination period covers the restructuring and reform of the JSE Ltd to the end of global financial market crisis in 2008, which can be regarded as a complete economic cycle.

From a methodological viewpoint, the CARs of the portfolios used in Page and Way (1992) and Hsieh and Kathleen (2011) were computed on a quarterly basis rather than on a monthly basis as demonstrated in this research. Moreover, the studies conducted by Page and Way (1992) and Hsieh and Kathleen (2011) focus primarily on the performances over long holding periods instead of exploring the cyclicality of momentum or contrarian returns over both short-term and long-term holding periods. Momentum investment strategies are usually short-term based and may often generate significant returns if applied properly. However, momentum investment strategies require significant control since trades have to be closed out at the first indication of weakness. This study undertakes to determine the appropriate timing on average that momentum or contrarian investors should apply to optimise the performance of their portfolios.

Chapter 2

Theoretical Overview

2.1 Introduction

This chapter discusses relevant theories underpinning the research. The Random Walk Hypothesis that argues against the presence of serial correlation between successive prices of assets is discussed in Section 2.2. The Efficient Market Hypothesis (EMH) that provides the framework of all finance literature is presented in Section 2.3. Section 2.4 discusses the tenant of the Capital Asset Pricing Model (CAPM) as well as its challenges. Section 2.5 presents the Behavioural Finance as an alternative hypothesis to the EMH. Section 2.6 discusses the Overreaction Hypothesis in support of the Behavioural Finance.

2.2 Random Walk Hypothesis

Prior empirical research shows that the efficiency of the market was initially examined by the means of statistical simulations of price behaviours based on the Random Walk Hypothesis pioneered by Jules Regnault in 1863. The Random Walk Hypothesis stipulates that the current asset price is uncorrelated to prior asset prices. This implies that asset price fluctuations have no memory, and hence predictions of future prices based on historical price patterns are impossible.

The Random Walk Hypothesis assumes that, the present market price is seen as the finest intrinsic value, which is estimated on the basis of all available information. The intrinsic value is derived from the fundamental analysis of the firm's expected future earnings potential. In the occurrence of new event, investors should review the firm's expected future earnings on the

basis of the event's impact on the firm's future earnings. Therefore, the fluctuations in the stock market prices are subject to the availability of new information. These fluctuations, nonetheless, reflect changes in the estimated intrinsic values and are uncorrelated to historical price patterns.

The Random Walk Hypothesis also assumes that the assimilation of new information by the market is done in such a fashion to ensure that any variation related to intrinsic value should be random. Should stock market price variations be remotely systematic or correlated, market participants will exploit riskless profitable opportunities from these predictable stock price movements. Thus, any generated profit from non-random variations related to intrinsic value would be eliminated through these actions. The validity of the theory was thereafter tested and proved by Louis Bachelier in 1900, in his PhD thesis, after its exploration as the theory of speculation. Later the theory was integrated in the Efficient Market Hypothesis (EMH) by Fama (1965, 1970).

2.3 Efficient Market Hypothesis (EMH)

Fama (1965) supports the prior efforts of Regnault (1863) by confirming the fact that stock market prices vary randomly and are inconsistent. The Random Walk Hypothesis paved the path to the introduction of the Efficient Market Hypothesis (EMH). An efficient market is identified as a market where security prices are publicly available and reflect all available information accurately and promptly. Thus, no investors can consistently achieve abnormal returns on a risk-adjusted basis. The EMH assumes the impossibility of predicting the market, since market efficiency induces current stock prices to constantly integrate and reveal publicly available information.

The EMH asserts that assets are always traded at their intrinsic values in an efficient market, which prevents investors from making abnormal returns resulting from either buying undervalued assets or selling overvalued assets. In addition, Fama (1965) suggests that, since numerous studies have been reporting evidence in favour of the Random Walk Hypothesis, any attempt at predicting future price movements through fundamental or technical analysis would be fruitless.

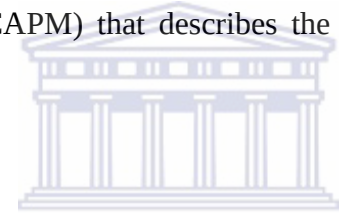
In a follow up paper, Fama (1970) extends and refines his preceding theory to formally distinguish three different levels of market efficiency and differentiates them by their respective abilities to, and speeds at which stock markets process information and publicly reflect this information in stock prices. The three forms of EMH are weak, semi-strong, and strong.

The weak-form EMH states that all historical price patterns and trading volume relating to its stock are reflected in its prices. This implies that no trader should generate abnormal returns by making use of historical price and volume information. Stock market prices show evidence of no consecutive dependence and there is no replica to stock price patterns. Therefore, technical analysis would not be able to consistently generate abnormal returns. However, certain types of fundamental analysis may possibly generate abnormal returns.

The semi-strong form EMH stipulates that, if a market is efficient of a semi-strong form, all publicly available information is reflected in stock prices. This implies that stock prices adjust promptly to reflect new information introduced in the market. The semi-strong form EMH encompasses the weak-form EMH. Since the hypothesis assumes that all publicly available information is reflected in stock prices and traders can only buy stocks after these new

information is published, no trader can generate abnormal returns by trading new but publicly available information.

The strong form EMH states that, all the information (public and private) is reflected in stock prices. This is not only a combination of both weak form and semi-strong form of EMH but also an extension because it includes private information that previous forms did not. Since all information is reflected in stock prices, no investors would gain more than the risk-adjusted return even if the private information is revealed to them. This effectively eliminates any potential profits from insider trading. The EMH have become the theoretical framework that underpins empirical hypothesis and literature in all areas of finance and investment. The Capital Asset Pricing Model (CAPM) that describes the risk-return relationship of assets, securities or portfolios.



2.4 Capital Asset Pricing Model (CAPM)

The CAPM stems from the Modern Portfolio Theory (MPT) of Markowitz (1952), who sets out to construct an efficient frontier of risky assets in an attempt to develop an optimal risky portfolio known as the market portfolio through the concept of diversification. The basic tenet of the theory is that investors are expected utility maximisers who seek to maximise their returns for a specific level of risk or minimise the risk for a specific level of return. This is commonly known as the mean-variance efficiency of an investor's portfolio. The efficient frontier encapsulates a portfolio of sub-optimal risky assets and seeks to determine the best combination of those risky assets at each level of risk. The Separation Theorem of Tobin (1958) introduces the risk-free asset into the feasible set of investments and suggests that investors can allocate their capital between any portfolio on the efficient frontier of risky assets and the risk-free asset depending on their levels of risk aversion. The market portfolio, known

as the optimal risky portfolio on the efficient frontier of risky portfolios is derived in the capital allocation process based on the Separation Theorem.

Based on the concept of the market portfolio and efficient diversification postulated by the MPT, Sharpe (1964) introduces the capital asset pricing model (CAPM) that estimates the risk-adjusted return of an asset or portfolio based on its exposure to the risk inherent in the market portfolio. The CAPM shows that the risk premium on an asset is subject to the asset's exposure to the market risk, while the asset's risk varies according to the covariance of its returns with the market portfolio. The risk premium is determined by the systematic risk of the portfolio, which is what matters to investors. This is because total risk comprises systematic risk that is not diversifiable and specific risk that is unsystematic and diversifiable. Due to the fact that unsystematic risk is uncorrelated with the broad market returns and is specific to a particular asset or industry, it can be reduced through diversification. On the other hand, the systematic risk is of macroeconomic origin such as economic growth, crises, movements of interest rates, geopolitical uncertainties, etc. These kinds of risk factors cannot be reduced by diversification and hence investors have to be compensated for it.

The degree of systematic risk of an asset is measured by the beta coefficient of the CAPM as follows:

$$\beta = Cov\,(R_i, R_m) \,/\, {\sigma_m}^2 \quad (2.1)$$

Where:

$Cov\,(R_i, R_m)$: the covariance between the asset *i*'s return and market return; and

${\sigma_m}^2$: the variance of the return on the market portfolio.

Based on the CAPM, the expected return of any an asset in equilibrium state will be the summation of the risk-free rate and the asset's risk premium, which is the market risk -premium multiplied by the asset's beta coefficient (quantity of risk).

$$E(R) = rf + \beta[E(R_m - rf)] \quad (2.2)$$

Where:

rf: the risk-free rate; and

$\beta[E(R_m - rf]$: the risk premium on the asset.

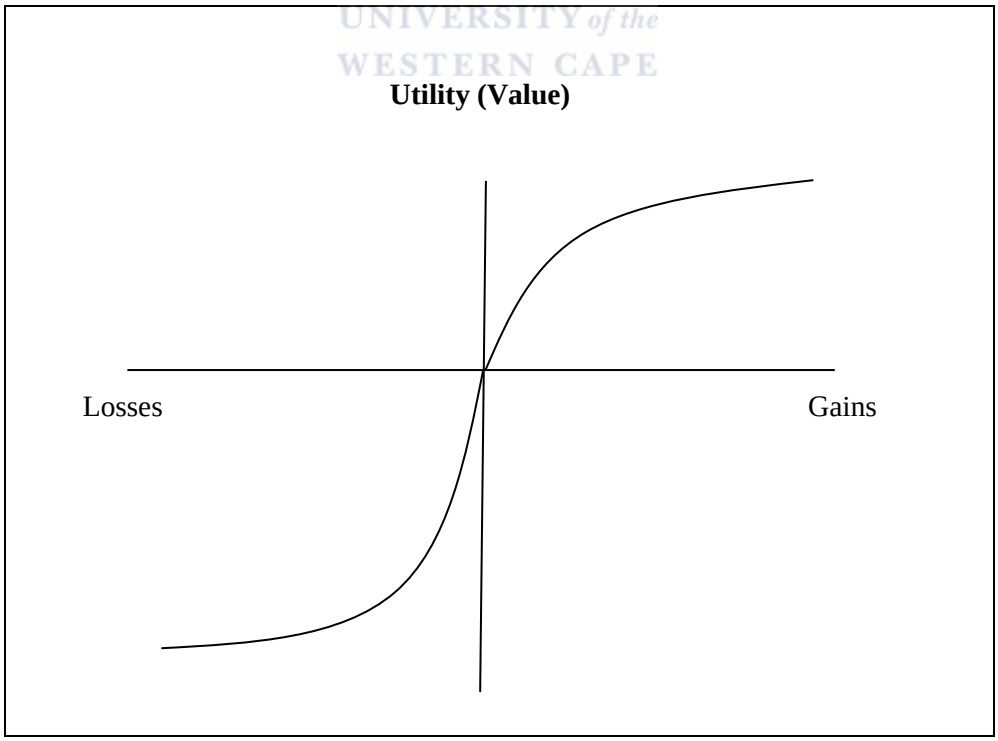
The expected return of an asset depicted in Equation 2.2 is the fair return an asset should earn in an efficient market in the notion of the CAPM. In an efficient market, asset returns should not deviate from the expected returns indicated in Equation 2.2. Thus, tests of the validity of the CAPM implicitly are tests of the EMH. This is known as tests of the joint hypothesis.

2.5 Behavioural Finance

Known as an application of psychology in financial markets, Behavioural Finance provides insight to how the behaviours of financial market players affect the functioning of stock markets and asset price movements in an attempt to provide an understanding of possible anomalies in the capital market. For quite some time the field was explored by economists and psychologists such as, Darity and Goldsmith (1996) who publishes the influence of psychology in economics and Slovic (1972) who examines the investment process from a behavioural point of view. However, Behavioural Finance was not recognised as a discipline until the late 1980s when researchers started discovering inconsistencies in the view that market returns were determined by the CAPM and the EMH. Such inconsistencies are viewed as anomalies by the proponents of Behavioural Finance. The concept of Behavioural Finance begins with the introduction of prospect theory by Kahneman and Tversky (1979).

Prospect theory relates to the behavioural decision making process of investors under conditions of uncertainty. It explains how individuals choose between alternative probabilities related to risk, when the probabilities of results are predicted. The theory was initiated in 1979 and extended later in 1992 by Kahneman and Tversky as the most accurate psychological explanation of decision making, in contrast to the Expected Utility Theory. Prospects theory assumes that the decisions made by individuals are based on the potential gains and losses assessed through heuristic methods. The model seems to be explicative, since it attempts to model individuals' choices rather than their decisions. Also, the authors demonstrate that, investors' risk aversion increases at a declining rate in the positive utility region while decreasing at increasing rate in the negative utility region. This concept is known as loss aversion as illustrated by Figure 2.1.

Figure 2.1: The asymmetric value function of Prospect theory



In addition to examining the implication of uncertainty and gain-loss risk predisposition in making investment decisions, Lopes (1987), describes hope and fear as factors that investors use to evaluate alternatives

The psychology of investing by Shefrin (2000) classifies the psychological factors into three categories based on heuristic-driven bias, frame dependence and inefficient markets. Heuristic-driven bias refers to a process in which investors make decisions based on trial and error to develop rules of thumb that are potentially biased, such as an attempt to predict an asset's future performance based on its previous performance. This behaviour is in contradiction to the Random Walk Theory.

Frame dependence refers to investor's tendency to look at a situation in a different way depending on the way that situation is presented. Based on illogical emotion, frame dependence attempts to clarify why investors are often making irrational decisions. For example, when presented with a situation in which a product is being offered at price of R10 and a situation in which the similar product is commonly priced at R15 while on sale for R10, many purchasers would consider this latter as a better value although in both situations they are being requested to afford the same amount for the same product.

Inefficient market refers to market price deviations from their intrinsic values due to heuristic-driven bias and framing effects, which contradicts the EMH. While heuristic-driven bias and frame dependence are known as forms of biases, inefficient market is a consequence of those biases, which introduces market anomalies that allow riskless arbitrage.

The most important anomalies that influence investor behaviour according to Shefrin (2000) include, conservatism, aversion to ambiguity and disposition effect. Conservatism refers to the

fact that most investors are hesitant to exploit the new information. Aversion to ambiguity expresses an attitude of preference for familiar risks over the unfamiliar risks. Disposition effect refers to the investor's predisposition of selling assets that experiences increases in values, while holding those that experiences decreases in value for too long.

In addition, overconfidence may lead investors to set their expectations too high and overstate both their problem-solving aptitude and ability to analyse complex situations. Lichtenstein, Fischhoff and Philips (1982), in their psychological analysis, show that people have a tendency of overestimating their knowledge and this is obvious in most professional domains. The authors suggest that investors are more confident of the adequacy of information that they possess than it is in reality. Weinstein (1980) and Kunda (1987) also argue that investors have a tendency of being unrealistically optimistic and expect the occurrence of positive events rather than their peers. Daniel, Hirshleifer, and Subrahmanyam (1998) describe the investors as overconfident when they are seeing themselves in better position of estimating the value of an asset rather than considering its fair values. Shefrin (2000) shows that, overconfidence leads to the excess of trading volume as they are selling more than what is required. Daniel et al. (1998) claim that the investors' overreaction phenomenon is caused by their overconfidence taken in conjunction with the changes in confidence from self- attribution bias, while Shiller (1997) maintains that the cognitive bias related to the representative heuristic adds to the explanation of the overreaction effect.

2.6 Overreaction Hypothesis

DeBondt and Thaler (1985, 1987) describe investor overreaction as a situation where investors violate Bayes rule by making their decisions based on stocks' prior performance rather than their long-term fundamentals, which results in the systematic overshooting of asset prices. In

the presence of investor overreaction, past winning stocks are oversubscribed while past losing stocks are oversold. Such phenomenon is expected to reverse in the long-term when market corrections occur. The Overreaction Hypothesis was initially examined by DeBondt and Thaler (1985, 1987) on the New York Stock Exchange (NYSE) over the period from 1926 to 1982. Their results provide evidence of investor overreaction on the NYSE. Consequently, this gives investors opportunities to earn abnormal return in long-term period by purchasing prior losers while selling prior winners. Arguments stem from Prospect Theory and the Overreaction Hypothesis challenge the theoretical foundation of the EMH and investor rationality. According to Shleifer (2000), irrational investors' behaviour may find its explanations through the above behavioural arguments.

2.7 Conclusion

Based on the Random Walk Hypothesis, stock market prices vary randomly and are inconsistent with prior movements. If the current stock price is uncorrelated to prior stock price movements, no prediction of future stock market prices based on the historical price patterns is possible. Although the Random Walk Hypothesis was originally discovered by Jules Regnault in 1863, the theory was further explored and validated by Fama (1965), who introduced the Efficient Market Hypothesis (EMH). The author defines an efficient market as a market where asset prices reflect all the available information accurately and promptly. Thus, no investors can consistently achieve abnormal returns on a risk-adjusted basis. Based on a set of assumptions, Capital Asset Pricing Model (CAPM) of Sharp (1964) provides accurate prediction regarding the relationship between the risk of an asset and its expected return when the market is in equilibrium. However, the findings of subsequent research have cast doubt on the proclamations of both EMH and CAPM. The problems with MPT as a concept are exacerbated by the introduction of Prospect Theory by Kahneman and Tversky (1979) and the

Overreaction Hypothesis of DeBondt and Thaler (1985, 1987). Prospect Theory relates to the behavioural decision making process of investors under conditions of uncertainty and attempts to provide psychological explanations in the decision making process of an investor. On the other hand, the Overreaction Hypothesis provides grounds for abnormal returns during mean reversion in the presence of investor overreaction in the market.

Chapter 3

Literature Review

3.1 Introduction

This Chapter presents an overview of prior literature on overreaction hypothesis in international and South African stock markets. The review explores the empirical evidence of investor overreaction and the subsequent mean reversion as well as alternative explanations suggested by various researchers. Section 3.2 presents the proposition of the Overreaction Hypothesis by DeBondt and Thaler (1985, 1987) and alternative explanations such as; time varying risk, size effect, microstructure effect, and the January effect. Section 3.3 discusses significant international literature. Section 3.4 presents results from South African studies. Section 3.5 concludes the chapter

3.2 Overreaction Hypothesis

Efficient Market Hypothesis (EMH) assumes that all relevant information related to an asset should be reflected in the price of that asset. Therefore, no investment strategies based on information that is publicly available may lead to abnormal returns. However, empirical studies on Overreaction Hypothesis challenge the EMH in its weak form in that stock market mean reversion is somehow predictable.

This behaviour normally occurs owing to market traders, who generally overreact to exceedingly dramatic events so that unexpectedly negative news drag stock prices below their respective intrinsic values, while unexpectedly positive news pushes up the stock prices above

their respective intrinsic values. After a period, investors become conscious of their mistakes and adjust their actions during market corrections. This consequently, would lead to the variation in the stock prices in the opposite direction of their prior performance. Hence, this gives the possibility of earning abnormal returns by applying a contrarian investment strategy, which consists of buying prior loser stocks while selling prior winner stocks.

In their foremost research, DeBondt and Thaler (1985) examine the predictability of stock returns by analysing market overreaction on the New York Stock Exchange (NYSE) over the period from January 1926 to December 1982. Using the average cumulative abnormal returns (ACAR) approach, their findings reveal that the prior loser portfolios outperform their counterpart winner portfolios by approximately 25% per annum on average, over the subsequent 36-months of their portfolio formation. The abnormal returns accumulated have an inverse relationship to the perceived state of the portfolio. More so, when loser portfolios accumulate positive abnormal returns, winner portfolios accumulate negative abnormal returns and vice-versa. The longer the formation periods the more significant is the mean reversion in the holding period. Moreover, the mean reversion for the loser portfolios appears to be more significant compared to their counterpart winner portfolios.

DeBondt and Thaler (1987), in their revised article, re-examine the effectiveness of the overreaction hypothesis, with the same attributes used in DeBondt and Thaler (1985), but this time with much focus on the influences of market risk, firm size as well as seasonality in the test results. Their findings provide assurance to their prior results and suggest that the mean reversion of prior winners and losers could not be explained by market risk and the size effect. Once again, the authors find negative autocorrelation of returns for portfolios with long formation periods; particularly in January. However, the excess returns for winners in January

are negatively correlated with those of prior winners in December. DeBondt and Thaler (1987) suggest that a possible interpretation of the phenomenon of overreaction would be an incorrect perception of future cash flows in extreme situations, characterised by sporadic fluctuations in the stock market.

The studies conducted by DeBondt and Thaler (1985, 1987) have given rise to an on-going debate on stock market overreaction in subsequent years. Some researchers support the overreaction hypothesis while others, though admitting the existence of the phenomenon, provide alternative explanations for its occurrence.

3.2.1 Time varying risk

Time varying risk refers to the contingency of risk on significant fluctuations, with stocks displaying periods of high and low risk in different periods. In a study conducted by Chan (1988) on NYSE over the period from 1932 to 1985 reveals that winner and loser portfolios undergo significant variations in market values throughout the formation period. The author suggests that stocks with negative abnormal returns will amplify their betas and therefore boost their expected returns. The beta of loser portfolios rises over a subsequent period of negative abnormal returns while the beta of the winner counterparts declines over a period of positive abnormal returns. After taking into account the time-varying beta coefficients of the winner and loser portfolios, the abnormal return of the contrarian investment strategy becomes insignificant. His findings provide support to the risk variation explanation.

From a slightly different angle, Ball and Kothari (1989) use an alternative method to examine the serial correlation in relative returns on NYSE over the period from 1926 to 1986. Their results report negative autocorrelation in returns owing to changes in relative risks.

The authors suggest a new argument for the negative autocorrelation, taking into account variations in leverage. While leverage is a decreasing function of prior stock returns, beta coefficient is an increasing function of leverage. Therefore, a series of negative abnormal returns will increase with leverage. This, in turn, amplifies the beta coefficient of the firm, which leads to greater expected returns. Their study finds significant variations in the beta coefficients between the formation and the examination periods, which suggests that time varying risk is a strong explanatory variable in terms of mean reversion in stock returns.

Jones (1993), on the other hand, supports the argument that evidence of investor overreaction could be due to market swings and suggests that the beta coefficients of the winner portfolios tend to be relatively higher in upward markets and vice versa. He argues that U.S. stock return patterns and contrarian profits are consistent with time-varying expected returns.

3.2.2 Size effect

Other researchers have dismissed the explanatory discussion on overreaction evidence as presented by DeBondt and Thaler (1985) and report evidence in favour of the size effects. Size effects refer to the tendency of small firms (firms with small market cap) to outperform the large firms (firms with large market cap) over the long-term period. Zarowin (1989) examines the Overreaction Hypothesis on the NYSE over the period from 1971 to 1981. Zarowin (1989) reports evidence of mean reversion on the NYSE, but argues that these results are attributed to size effects since the loser portfolios are comprised of mostly smaller caps. Chopra, Lakonishok and Ritter (1992) examine the abnormal returns on NYSE over the period from 1926 to 1981. The authors argue that firm size, past returns and beta coefficients are inter-correlated factors in assessing portfolio returns. After running a multiple regression analysis on the three factors, the results reveal significant mean reversion of the winner and

loser portfolios after size and beta coefficients are accounted for. In addition, the extent of the mean reversion seems to be more significant for small caps relative to large caps. They attribute their result to the predominance of individual investors who are more predisposed to investor overreactions.

While employing an alternative approach to forming control portfolios, Albert and Henderson (1995) remonstrate against Zarowin (1989, 1990)'s results by examining firm size, overreaction, and return reversals on NYSE over the period from 1963 to 1989. They argue that the size matching approach implemented by Zarowin (1990) is biased in the way the firms are ranked, On the contrary to the firm size explanation, their findings indicate that in the case where large caps underperform small caps in a particular formation period, the outperformance should have occurred in the subsequent examination period. However, small caps should outperform large caps in the examination period in the case where size effect is seen as the only determinant of examination period returns, in spite of formation period performance.

3.2.3 Microstructure effect

Microstructure is defined as the trading mechanisms employed for financial securities. It describes the process and after math of trading assets under standardised conditions. Because of the difficulty of setting accurate bid-ask prices, transactions sometimes occur at a bargained price between the bid-ask spread. Bid-ask errors give rise to significant spurious risks in the stock returns. Thus, some studies refer to it as the main source of the apparent stock market mean reversion. For example, Conrad and Kaul (1993) criticise the overreaction evidence of DeBondt and Thaler (1985) and suggest evidence in favour of bid-ask effect. Conrad and Kaul (1993) investigate the long-term performance of contrarian strategies on NYSE over the period from 1926 to 1988. Their results reveal that, the returns generated through long-term contrarian

strategies employed by DeBondt and Thaler (1985) are upwardly biased since their choice of stocks was biased towards low-priced loser stocks. Conrad and Kaul (1993) highlight the fact that the bid-ask spread in loser stocks is wide and prone to non-trading, as their returns are extremely sensitive to microstructure and liquidity effects. Furthermore, they criticise the empirical process on the basis that the accumulation was based on one particular period returns over extended periods. The authors argue that, the accumulation process is not only hoarding the real returns, but also includes the increasing bias in one particular period returns, which was caused by measurement errors.

Moreover, the authors suggest the use of buy and hold (BHR) performance measure rather than the cumulative abnormal returns (CAR) in measuring the performance of winner and loser portfolios. They demonstrate that by using buy and hold performance measure, all non-January stock returns that are generated through long-term contrarian strategy will be eradicated. Overall, the authors dismissed the evidence of the long-term overreaction observed by DeBondt and Thaler (1985) study, since the abnormal returns accumulated in prior long run contrarian strategies are deemed to be a mixture of both a biased performance measure and January effect, this is not related to past performance.

Loughram and Ritter (1996) challenge Conrad and Kaul (1993) by rebuffing their claim that the DeBondt and Thaler results were affected by the use of cumulating single period returns. After running various tests, their results reveal slight differences over the examination period returns when both CARs and BHRs methods are applied. Loughram and Ritter (1996) argue the fact that the BHRs method provides more precision and accuracy at the portfolio selection stage but, thereafter, both CARs and BHR methods will result in similar process outcomes.

3.3 International evidence

The overreaction phenomenon discussed thus far focus on the U.S. stock market. However, research results from international markets should shed more light on the validity of this phenomenon and its degree of pervasiveness across world markets. Alonso and Rubio (1990) investigate the Overreaction Hypothesis on the Spanish stock market over the period from 1967 to1984. They report evidence of mean reversion on the Spanish stock market over the examination period. Similar to the study conducted by DeBondt and Thaler (1985, 1987), the effect becomes more pronounce when formation and examination period are extended.

On the contrary, Forner and Marhuenda (2000) examine the profitability of contrarian strategies on the Spanish stock market over the period from January 1963 to December 1997. Their study does not find evidence of investor overreaction on the Spanish stock market throughout the examination period. These findings are inconsistent with those reported by Alonso and Rubio (1990). The inconsistencies between findings could be attributed to different methodologies employed over different sample periods explored in the two studies. Forner and Marhuenda (2000) use only the non-overlapping examination periods, while Alonso and Rubio (1990) use both non-overlapping examination and formation periods.

Campbell and Limmack (1997) investigate the overreaction phenomenon in the U.K. stock market over the period from 1979 to 1990. Although they find the persistence in performance for both winner and loser portfolios over the subsequent 12 months of portfolio formation, stock market mean reversion is observed 24 to 60 month after portfolio formation. On the other hand, Andrikopoulos, Arief and Pagas (2011) investigate the time varying nature of the overreaction effect in the U.K. stock market throughout the period from July 1987 to March 2004. Their findings report a feeble existence of the overreaction effect over the examination period. The authors indicate that the overreaction effect vanishes when the size effect is

controlled for and any unexplained abnormal return is possibly due to various phases of the market, which makes it difficult to exploit.

From an Asian perspective, Ahmad and Hussain (2001) examine the Overreaction Hypothesis on Kuala Lumpur Stock Exchange (KLSE) over the period from 1986 to 1996. Their findings report evidence of investor overreaction in KLSE, as well as the occurrence of mean reversion for both winner and loser portfolios over the subsequent 36 months of their formation. Test results also show that when formation period is adjusted for, the size effect provides insignificant explanation for test period CARs. Even in the case where firm size is adjusted for, formation period CARs contain explanatory power for examination period CARs. Norli, Annua, Taufiq and Sazali (2011) also examine the overreaction phenomenon on the Malaysian stock market, using Syariah compliant stock data provided by Bursa Malaysia stock market over the period from 1988 to 2009. Their results confirm the evidence of the overreaction effects in Bursa Malaysia stock market. Moreover, the authors show that mean reversion is likely to be strong throughout the sub-period before the 1997 Asian financial turmoil and worldwide 2008 Crisis. Thereafter, the overreaction effects seem to be reduced. A possible explanation for this shift is the altering of investment strategies by investors as a result of new information birthed from the crisis. Their study, however, does not control for size and was more or less of a seasonal study of overreaction as opposed to that of Ahmad and Hussain (2001).

Otchere and Chan (2003) test the short-term overreaction hypothesis on the Hong Kong stock market over the period from 1996 to 1998. The test period includes both pre and post Asian financial turmoil periods. Their findings report the evidence of investor overreaction in the Hong Kong stock market, most especially for firms with large market cap during the period

preceding Asian financial turmoil period. The reversal returns seems to be more significant for the winner portfolios than for the loser portfolios. However, the examination of bid-offer spread shows impossibility of gaining from the investment contrarian strategy. The extent of overreaction seems to decline throughout the financial turmoil period due to a decline of trading noise.

Wu (2010) examines investor overreaction in the Chinese stock market using daily returns over the period from 12 December 1990 to 31 December 2001. After running a rolling-regression parameter model estimating both mean reversion and momentum strategies, the results reveal evidence of a significant mean reversion within an average half-life slightly shorter than one year. Abnormal returns for the contrarian strategy are discovered, while the implementation of the momentum strategy does not generate any abnormal return. These results confirm the evidence of investor overreaction in the Chinese stock market over the examination period.

Khatua and Pradhan (2014) examine the overreaction on National Stock Exchange (NSE) of India using quarterly earnings announcement data for 50 firms over the period from October 2005 to November 2010. Their results support that the change in the abnormal returns is subject to the level of market volatility. They also show that the positive ACARs around an event are due to high volatility periods and are more significant for firms with small market-cap. In addition, events are examined by the degree of information content of that news. Events are therefore sorted as good, bad and no news, and this categorisation is subject to the degree of change from actual and expected returns. A 2.5 % excess of actual returns on expected returns is considered good news, while a 2.5 % deficit of actual return against the expected return is considered bad news. Anything in-between the 2.5 % excess and 2.5 % deficit is considered no news or noise. The results indicate that even though most of the events

turned out to be no news or noise, investors tend to overreact to bad news than to good news. This evidence confirms the existence of asymmetric information in the stock market.

Ibrahim (2011) undertakes a cross-country study on the Association Southeast Asian Nations (ASEAN) markets. He investigates mean reversion behaviour across the Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam stock markets over the period from August 2000 to May 2010. After running autoregressive exponential GARCH-in mean model, the results report evidence of investor overreaction with a strong asymmetrical mean reversion throughout the market crash in the Indonesian market in 2008. The Vietnamese market shows evidence of a strong momentum in stock returns related to the market crash period. However, no such evidence was observed in either Singapore or Thailand market. In addition, the effect of leverage is reported in each of ASEAN markets, excluding Vietnam market. The author attributes the above-mentioned differences to different stages of market development, degree of efficiency or volatility.

Rouwenhorst (1998) conducts study on overreaction hypothesis in Europe over the period from 1980 to 1995 using a sample of 2,190 stocks from 12 different European countries. The results indicate that the extended worldwide stock markets display a continuance of medium-term return; in which case, medium term is defined as 1 year. This shows how worldwide portfolio diversification that purchase prior medium-term winners and sell their corresponding losers are well-performed, in terms of returns, compared to other portfolios. In addition, his study results indicate the negative correlation between the continuance of the return and the firm size, and the correlation between the European and U.S. momentum returns. This correlation may lead to momentum strategy gains since both European and U.S. momentum returns are exposed to similar factors.

Hsieh and Hodnett (2012) analyse the timing of stock market mean reversion related to worldwide economic cycles using the abnormal returns calculated through the CAPM and the Fama and French (1993) 3-factor model throughout the period from 1999 to 2009. Their results reveal the existence of a specific timing of mean reversion for worldwide markets. The timing of mean reversion seems to be consistent with the variation of market participants' behaviour and future prospects during the worldwide economic cycle. The authors show that the extent of the mean reversion is more pronounced in turmoil period when market participants are terrified while less pronounced when market participants are excessively confident. Consequently, trading on prior long-term losers is resilient throughout financial market crisis periods.

3.4 South African Evidence

With regards to the South African stock market, Page and Way (1992) examine the Overreaction Hypothesis on the Johannesburg Stock Exchange (now the JSE Limited) throughout the period from 1974 to 1989. Their results report evidence of investor on the JSE over the examination period. For portfolios with 24-month and 36-month formation periods, loser portfolios outperform their winner counterparts by 10% and 20% respectively in terms of their 36 months holding period. Furthermore, asymmetrical mean reversions for both loser and winner portfolios were detected just as in DeBondt and Thaler (1985, 1987). Their results confirm the violation of the EMH in its weak form on the JSE throughout the examination period. Nevertheless, Page and Way (1992) assert that the January effect documented in the U.S. studies does not affect tests conducted on the JSE, consequent to the fact that the majority of the stocks on the JSE are held by institutional investors and firms that have no restriction in choosing the calendar month for closing their financial years.

In order to avoid seasonality bias encountered from DeBondt and Thaler (1985, 1987) and Page and Way (1992), Muller (1999) examines the investor overreaction on the JSE using the top 200 stocks by market cap for the period from 1 January 1985 to 28 February 1998. A set of market returns is generated through simulation of each combination of starting date, formation period and holding period. The size of portfolios is initially restricted to either 30 or 60 stocks, while the maximum period of formation and holding for winner and loser portfolios is computed through simulation of each combination of formation and holding period from 60 to 1,400 days. Muller (1999)'s results reveal the evidence of investor overreaction on the JSE in that loser portfolios are seen to accumulating positive abnormal returns within extended holding periods while their winner counterparts accrued negative abnormal returns within extended holding periods. In addition, an asymmetrical mean reversion is observed for both the winner and loser portfolios.

Hsieh and Hodnett (2011) examine the investor overreaction and the consecutive mean reversion on the JSE over the period from 1988 to 2009. Their findings report the existence of a saturation point up until which both prior winners and losers maintain their momentum. Once the saturation point is reached the mean reversion occurs. The mean reversion seems to be more pronounced in the prior winner and loser portfolios with an extended formation period. Hsieh and Hodnett (2011) also analyse the statistical interrelation between the abnormal returns of the winner and loser portfolios, and reveal the existence of an inverse relationship between winner and loser portfolios. The winner and loser portfolios accumulate abnormal returns in opposite direction. Furthermore, they argue that mean reversion is more likely to take place when investors are less convinced about the outlook of the economy.

3.5 Conclusion

The RWH and the EMH assert that stock prices vary randomly and are inconsistent. Conversely, much evidence has demonstrated the possibility of predicting future stock performance based on their prior performance. This reveals the existence of investor overreaction in the stock market. DeBondt and Thaler (1985) referred to it as “overreaction effect”. The Overreaction Hypothesis describes how investors allow their emotions to influence their objectivity by attempting to predict price patterns based on recent price movements; a practice that violates the RWH and the EMH. Since its observation, the overreaction effect has been reviewed recurrently by different researchers across the world.

This chapter reviews significant prior literature and gives a perception of current researchers in the relevant area. So far, research related to overreaction effect is essentially from the following standpoints; the longer the formation period, the stronger the degree of mean reversion. In addition, the degree of mean reversal is stronger for the loser portfolios compared to their winner counterparts. It is also observed that, the mean reversal become more significant during and after the financial crisis periods. This could be attributes to the extreme volatility that changes investor behaviour.

Chapter 4

Research Methodology

4.1 Introduction

This chapter focuses on the methodological considerations for the study. It investigates the implications of the Overreaction Hypothesis on the JSE from 1 January 2002 to 31 December 2009. The period covers the restructuring and reform of the JSE Limited to the end of the global financial market crisis in 2008, which is a complete economic cycle. Section 4.1 describes the sources as well as the process of selecting the research sample. This is followed by Section 4.2 that describes the research procedure. Section 4.3 describes the process of constructing portfolios as well as the process of testing the significance of the investor overreaction on the JSE. Finally, Section 4.4 describes the process of testing the timing of mean reversals.

Empirical research on the financial markets supports that most investors have a tendency to overreact to unforeseen, salient, and recent information, which consequently leads to the subsequent mean reversion in the stock market. This research investigates the existence of investor overreaction as well as the timing of mean reversion on the JSE over the complete economic cycle from 1 January 2002 through 31 December 2009.

4.2 Data

The dataset comprises monthly total returns, which include both capital gains and dividend yield of 166 constituents of the FTSE/JSE All Share Index provided by DataStream International over the complete economic cycle from the 1 January 1999 to 31 December 2009 as of 1 January 2012. Potential research biases in this data include data-snooping bias, survivorship bias and look-ahead bias.

Data-snooping bias arises as a result of the repeated dataset for model building, with an objective to obtaining desirable or speculated results. For instance, using similar historical data of a particular prior research to conduct another research may lead the latter research to pry on the findings of the earlier research. Consequently, the research analysis and conclusions are expected to be similar to prior literature. Notably, the examination of the Overreaction Hypothesis on the JSE using the cumulative residual return approach has previously been employed by Page and Way (1992) and Hsieh and Kathleen (2011). However, none of their research made use of total monthly return data over the period from 1 January 2002 up to 31 December 2009 as used in the current research. This has reduced the risk of prying on other prior research, therefore mitigating data snooping bias.

On the other hand, Survivorship bias is known as a formal error of including only the survivors in the stock market in the research sample. Focusing only on existing and operational stocks in the market at the close of the sample period might possibly lead to untrue conclusions due to omitted failures, such as the exclusion of delisted stocks from the financial performance analysis. Owing to the fact that large firms are less inclined to be delisted, this research follows the studies conducted by Page and Way (1992) and Muller (1999) to restrict the sample by considering only the largest 100 stocks according to their market values in each month to mitigate the survivorship bias in the sample.

In addition, Page and Way (1992) argue that the residual returns of larger firms would presumably be slightly smaller and it sets a high standard to test the Overreaction Hypothesis. In general, stocks with smaller market capitalisation introduce significant noise level in the test results. This is due to their potential low liquidity and high volatility of returns. For this reason, it is necessary to rank stocks from uppermost to lowermost according to their respective market values. This is done so as to avoid the inclusion of stocks that are illiquid into the research sample.

The look-ahead bias occurs when a research assumes the availability of necessary information while they are not. This is unlikely to be the case in this research given that dataset employed is generated by stock prices and dividends yield from FTSE/JSE All Share Index constituents. While closing prices are declared on daily basis, declaration and payment of dividends are made without delay.

4.3 Methodology

The broad market index employed in this research is represented by an equally-weighted portfolio with monthly-rebalanced records of the sample set. Hsu (2006) supports the use of an equally-weighted broad market index rather than the use of a cap-weighted index by arguing that cap-weighted indices are mean-variance inefficient in the presence of investor overreaction as it has a tendency to overweigh overvalued stocks and underweight undervalued stocks. Total monthly returns inclusive of capital gain and dividend yield are computed for each stock over the examination period. The total monthly return of stock *i* in period *t* is computed by using Equation 4.1:

$$R_{i,t} = \left(\frac{TRI_{i,t}}{TRI_{i,t-1}} - 1 \right) \quad (4.1)$$

Where:

$TRI_{i,t}$ is the total return index of stock *i* in month *t*; and

$TRI_{i,t-1}$ is the total return index of stock *I* in month *t-1*.

The equally-weighted monthly market return for month *t*, ($RM\ (EW)_t$) is computed by dividing the sum of total monthly returns for the top 100 sample stocks by 100 as expressed by the following equation:

$$R_M\ (EW)_t\ = \sum_{i=1}^{n=100} R_{i,t}\ /\ 100 \quad (4.2)$$

The use of monthly returns is adopted to avert the influence of biases due to asynchronous, irregular trading, bid-ask manifestation, as well as the returns gained on daily and weekly basis, which usually swerve from normality (Brown and Warner, 1980).

At the beginning of each month over the period from 1 January 2002 through 1 January 2008, winner and loser portfolios of 40 stocks are formed based on the prior 1-month, 3-month, 6-month, 12-month, 24-month and 36-month returns of the sample stocks. The top 40 stocks in terms of their prior returns are assigned to the winner portfolio, whereas the bottom 40 stocks are assigned to the loser portfolio. The prior *K*-month returns for stock *i* at the start of month *t*, ($MOM\ (K)_{i,\ t-1}$)is computed using the following equation:

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

Following the above procedure, 73 winner and 73 loser portfolios are formed, with the last winner and loser portfolios formed on 1 January 2008.

4.4 Performance Evaluation

The performances of the winner and loser portfolios formed in Section 4.2 are compared and contrasted to that of the market proxy over a 24-month holding period.

The details of the pre-formation periods and the corresponding post-formation periods are demonstrated in Table 4.1.

Table 4.1 Pre- and Post-Formation Periods

Winner/Loser Portfolio	**Formation Date**	**Post-Formation Evaluation Period**
1	01/01/2002	01/01/2002 ~ 31/12/2004
2	01/02/2002	01/02/2002 ~ 31/01/2005
3	01/03/2002	01/03/2002 ~ 28/02/2005
•	•	•
•	•	•
•	•	•
72	01/12/2007	01/12/2007 ~ 30/11/2009
73	01/01/2008	01/01/2008 ~ 31/12/2009

To calculate the post-formation cumulative returns for the winner and loser portfolios, the cumulative returns of the portfolio constituents since portfolio formation are first calculated.

Given a time-series monthly returns for stock *i*, the *T*-month cumulative return for period *t = 1, 2…T* is computed using the following equation:

$$CR(T)_i = \prod_{t=1}^{T}(1 + R_{i,t}) - 1 \qquad (4.4)$$

Where, *T* represents the length of the holding period from 1month up to 24monthsas the holding period. Thus, the *T*-month post-formation return for winner/loser portfolio of 40 stocks formed at the beginning of month *t* is computed using the following equation:

$$CR(T)_{W/L_t} = \sum_{i=1}^{n=40} CR(T)_i \ / 40 \qquad (4.5)$$

Similarly, the *T*-month cumulative market return $CR_M(T)$ for the top 100 stocks is computedusing Equation(4.6):

$$CR_M\ (T) = \sum_{i=1}^{n=100} CR(T)_i \ / 100 \qquad (4.6)$$

Once the *T*-month post-formation returns for each of the winner/loser portfolios and the cumulative market return for the top 100 stocks are calculated, it becomes easier to assess the winner and loser portfolio performance generated in each month. According to Page and Way (1992), the performance of the market may be assessed through different fundamental approaches such as mean-adjusted returns, market-adjusted returns and risk-adjusted returns.

The risk-adjusted returns approach assesses the performance of an investment by determining its returns for a specific level of risk. It provides the possibility to establish the difference between high and low risk investments. Most common risk-adjusted return measures are Jensen's alpha, Treynor measure and the Sharpe ratio. In the other hand, the mean-adjusted return approach assesses the performance of an investment by indicating the deviation of the current returns from the mean returns for a particular period. It is also known as least squares means, and may be computed by applying the multiple regression equation. The market-adjusted returns approach, on the other hand, assesses the performance of an

investment by providing its residual returns for a particular period. The residual returns are calculated as the difference between the market return and the portfolio return.

DeBondt and Thaler (1985) explore the market-adjusted returns, market residual approach, and residual returns computed using the Capital Asset Pricing Model (CAPM). Despite using various types of residuals, their findings indicate uniformity of results and no impact on the fundamentals of their conclusions has been identified using different evaluation methods. Based on the above conclusion regarding the various approaches, this research adopts the original market-adjusted returns approach by DeBondt and Thaler (1985) to calculate the cumulative abnormal returns (*CAR*) for the winner/loser portfolio over *T*-month holding period using the following equation:

$$CAR(T)_{W/L} = CR(T)_{W/L} - CR_M(T) \tag{4.7}$$

After the *T*-month *CARs* for each of the winner/loser portfolio formed at the beginning of each of the 73 months are computed from t = 1, 2, 3… to *T*. The average *T*-month cumulative abnormal returns for the winner/loser portfolio ($ACAR(T)_{W/L}$) is computed using Equation 4.8:

$$ACAR(T)_{W/L} = \sum_{n=1}^{N=73} CAR(T)_n^{W/L} \; / \; 73 \tag{4.8}$$

Where;

$CAR(T)_n^{W/L}$ is the *T*-month *CAR* for the n^{th} winner/loser portfolio; and n = 1 … 73.

The procedure is repeated to compute the *ACARs* for all winner and loser portfolios formed based on the prior 1-month, 3-month, 6-month, 12-month, 24-month and 36-month sample stock returns for each month in the 24-month holding period. By analysing the *ACARs* of both winner and loser portfolios, the relative post-formation performance of the various winner and loser portfolios can be established over the examination period.

The evidence of investor overreaction and the subsequent mean reversion on the JSE is established if the *ACARs* for the loser portfolio is positive (that is,$ACAR(T)_L > 0$), while that of its counterpart winner is negative (that is, $ACAR(T)_W < 0$).

After the significance of mean reversion is established on the JSE, this paper undertakes to investigate whether there exists specific timing of mean reversion on the JSE over the examination period by observing the relative strength of mean reversion between the various winner and loser portfolios formed over the examination period.

The relative strength between the winner and loser portfolios can be evaluated by examining the difference between the *CARs* between the winner and the loser portfolios formed in each of the 73 portfolio formation dates using Equation 4.9:

$$DCAR(T) = CAR(T)_L - CAR(T)_W \quad (4.9)$$

Where:

DCAR (T) is the spread between the loser-winner *CARs* over the *T*-month holding period. It provides an indication of the strength of mean reversion after *T* months holding period; and

T takes on values of 12, 24 or 36.

The *CARs* of 12-month, 24-month and 36-month post formation periods will be examined in this research based on Equation 4.9.

4.5 Conclusion

This chapter focuses on the methodological considerations for the study. It investigates the implications of the Overreaction Hypothesis on the JSE from 1 January 2002 to 31 December 2009. The period covers the restructuring and reform of the JSE Ltd to the end of global financial market crisis in 2008, which is a complete economic cycle. The methodology applied in this research is similar to that applied by DeBondt and Thaler (1985). The performances of the winner and loser portfolios are evaluated through their respective cumulative abnormal returns, *CARs* on a monthly basis. The evidence of investor overreaction as well as the ensuing mean reversion on the JSE is established if the average cumulative abnormal returns, *ACARs* for the loser portfolio are positive, while that of its counterpart winner is negative. The specific timing of mean reversion on the JSE over the examination period is investigated by examining the cumulative spreads between the various winner and loser portfolios formed over the examination period. This can be achieved by comparing the difference between the average cumulative abnormal returns, *DACARs* for the otherwise identical winner and loser portfolios formed in each of the 73 portfolio formation dates.

Chapter 5

Performance of Winner and Loser Portfolios

5.1 Introduction

This chapter presents the empirical test results of the Overreaction Hypothesis on the JSE over the complete economic cycle from 1 January 2002 to 31 December 2009. Section 5.2 presents the post-formation performance of the winner and loser portfolios constructed over short- and long-term formation periods. The portfolios constructed based on prior 1-, 3- and 6-month prior returns of sample stocks are defined as short-formation portfolios, while the portfolios constructed based on prior 12-, 24- and 36-month prior sample stock returns are classified as long-formation portfolios. Section 5.3 draws comparisons between the performances of the winner and loser portfolios with various lengths of formation periods. Section 5.4 concludes the chapter.

5.2 Post-Formation Performance

As mentioned in Chapter 4, the post-formation performances of the various winner and loser portfolios are evaluated by their respective averaged cumulative abnormal returns (*ACARs*) over 24-month holding period subsequent to their formation dates.

5.2.1 Short-term momentum

The post-formation *ACARs* for the winner and loser portfolios with short-formation periods are shown in Figure 5.1. The *ACARs* for the Winner 1, Winner 3 and Winner 6 portfolios are labeled with black stipples, while the *ACARs* of their corresponding Loser1, Loser 3 and Loser 6 portfolios are labeled with blank stipples.

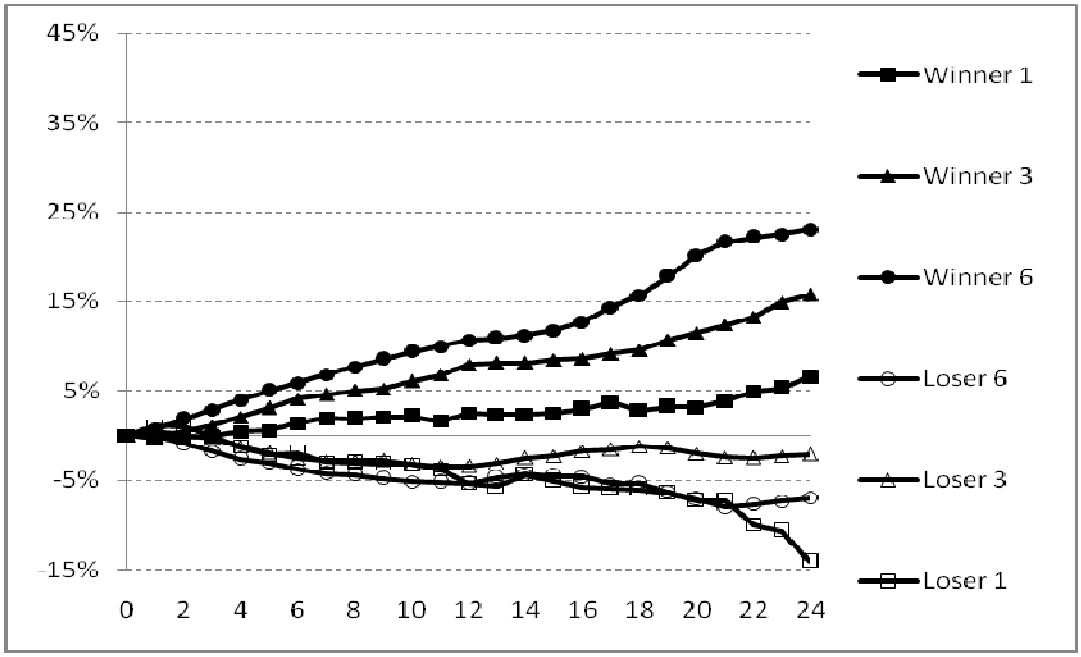


Figure 5.1Average Cumulative Abnormal Returns for Short-Formation Portfolios

As shown in Figure 5.1, the Loser 6 portfolios underperform the market proxy by 6.96%, while the Winner 6 portfolios outperformed the market proxy by 23.05% on average, 24months after formation. The Loser 6 portfolios accumulate negative abnormal returns while the Winner 6 portfolios accumulate positive abnormal returns over the 24-month holding periods. Similarly, the Loser 3 portfolios underperform the market proxy by 2.11%, while the counterpart Winner 3 portfolios outperform the market proxy by 15.74% on average, 24months after formation. While the Loser 3 portfolios accumulate negative abnormal returns over the 24 months holding periods, their counterpart Winner 3 portfolios accumulate positive abnormal returns 24 months after formation.

With regard to the performances of the portfolios constructed from prior 1 month sample stock returns, the Loser 1 portfolios underperform the market proxy by approximately 14.05%, while their counterpart Winner 1 portfolios outperform the market proxy by 6.55% on average over the 24-month holding period. Thus, the Loser 1 portfolios accumulate negative abnormal

returns while the Winner 1 portfolios accumulate positive abnormal returns 24 months after formation.

In summary, the short-term winner portfolios outperform their loser counterparts based on the analysis of their 24-month *ACARs*. The *ACAR* for the Winner 6 portfolios are much greater than those of the Winner 3 and Winner 1 portfolios. In the same vein the *ACAR* for the Winner 3 portfolios are much greater than those of the Winner 1 portfolios. In terms of the short-term loser performance, the *ACAR* for the Loser 3 portfolios is the most significant compare to those of the Loser 6 and Loser 1 portfolios.

The above analysis reveals the short-term momentum effect for the winner and loser portfolios. In addition, the performance persistence is more significant for the short-term winner portfolios compared to their loser counterparts.

5.2.2 Long-term reversal

The post-formation *ACARs* for the winner and loser portfolios with long-formation periods are shown in Figure 5.2.The *ACARs* for the Winner 12, Winner 24 and Winner 36 portfolios are labeled with black stipples, while the *ACARs* of their corresponding Loser12, Loser 24 and Loser 36 portfolios are labeled with blank stipples.

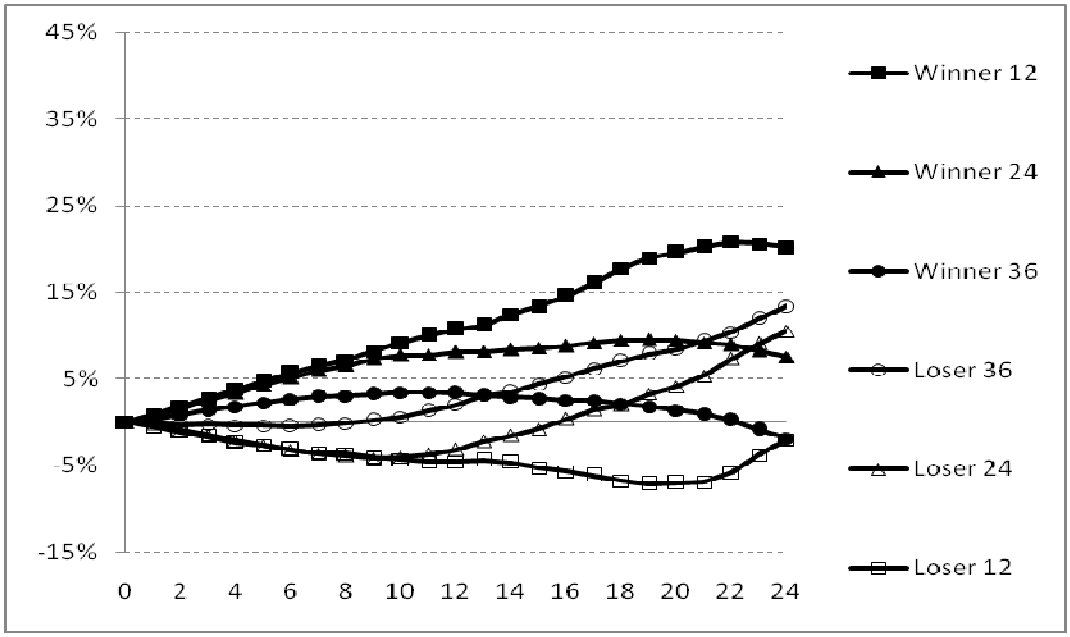


Figure 5.2Average Cumulative Abnormal Returns for Long-Formation Portfolios

As presented in Figure 5.2, the Loser 36 portfolios outperform the market proxy by 13.36%, while the Winner 36 portfolios underperform the market proxy by 1.85%, on average, 24 months after their formation. The Loser 36 portfolios accumulate positive abnormal returns, while their counterpart Winner 36 portfolios accumulate negative abnormal returns 24 months after their formation. On average, the reversals for the Loser 36 portfolios occur 9 months after their formation, while the performances of the Winner 36 portfolios reverse approximately 13 months after their formation. Similarly, the Loser 24 portfolios outperform the market proxy by 10.54%, while their counterpart Winner 24 portfolios underperform the market proxy by 7.53%, on average, 24 months after their formation. More specifically, the performances of the Loser 24 portfolios and their winner counterparts reverse, on average, approximately 8 months and 10 months after portfolio formations respectively.

On the other hand, the persistence of prior returns is evident in the post-formation *ACARs* for the Loser 12 and Winner 12 portfolios. The Loser 12 portfolios underperform the market

proxy by 1.98%, while the Winner 12 portfolios outperform the market proxy by 20.18%, on average, 24 months after their formation. The Winner 12 portfolios accumulate positive abnormal returns and lose their momentum approximately 22 months after their formation. On the other hand, the Loser 12 portfolios accumulate negative abnormal returns until approximately 20 months after their formation. It is noted that the momentum effect for the Winner 12 and Loser 12 portfolios is much greater than that for the portfolios constructed based on the prior 6-month, 3-month and 1-month returns of sample stocks.

5.3 Analysis of Average Cumulative Abnormal Returns

Table 5.1 compares and contrasts the *ACARs* of the winner and loser portfolios over 1-, 3-, 6-, 12- and 24-month holding periods since portfolio formation. The difference between *ACARs* of the comparable winner and loser portfolios is expressed as loser-minus-winner *ACARs*.

Table 5.1 Analyse of Average Cumulative Abnormal Returns

Formation Period	**Portfolio**	**Holding Period *ACARs***				
		1 month	3 months	6 months	12 months	24 months
36-month	Loser	0.06%	0.27%	0.45%	2.03%	13.36%
	Winner	0.38%	1.40%	2.65%	3.34%	1.85%
	Loser-winner	-0.32%	-1.67%	-2.20%	-1.31%	11.51%
24-month	Loser	-0.16%	-1.47%	-3.24%	-3.16%	10.54%
	Winner	0.67%	2.49%	5.14%	8.13%	7.53%
	Loser-winner	0.83%	-3.96%	-8.38%	-11.29%	3.01%
12-month	Loser	-0.54%	1.69%	-3.20%	-0.46%	-1.98%
	Winner	0.83%	2.73%	5.66%	10.74%	20.18%
	Loser-winner	-1.37%	-4.42%	-8.86%	11.19%	-22.16%
6-month	Loser	-0.10%	-1.77%	-2.54%	-3.48%	-6.96%
	Winner	0.69%	2.90%	4.09%	0.79%	23.06%
	Loser-winner	-0.79%	-4.67%	-6.63%	-4.27%	-30.02%
3-month	Loser	0.45%	-0.31%	-0.24%	-3.48%	2.11%
	Winner	-0.15%	11.12%	4.09%	0.79%	15.75%
	Loser-winner	0.59%	-1.43%	-6.63%	-4.27%	-17.86%
1-month	Loser	1.14%	-0.13%	-0.19%	-5.32%	-14.05%
	Winner	-0.36%	-0.10%	1.42%	2.46%	6.55%
	Loser-winner	1.51%	-0.03%	-1.61%	-7.78%	-20.60%

Despite the fact that temporary reversal within the first month of holding is documented for portfolios with 1-month and 3-month formation periods, strong momentum effect is documented for short-formation portfolios with 12-month or shorter formation periods.. The difference in *ACARs* between the Loser 1, Loser 3, Loser 6 and Loser 12 portfolios and their winner counterparts are -20.60%, -17.86%, -30.02% and -22.16% respectively.

On the other hand, although portfolios with 24-month and 36-month formation periods exhibit mean reversion 24-month after their formation (3.01% and 11.51% respectively), the loser portfolios are not expected to outperform their winner counterparts within the first 12-month holding period as the loser-minus-winner *ACARs* remain negative within the first 12-month holding period.

5.4 Conclusion

This chapter presents the empirical test results of the Overreaction Hypothesis on the JSE. In examining the *ACARs* for the winner and loser portfolios with 12-month or shorter formation periods, the result reveal significant momentum effect as the loser portfolios continue to accumulate negative abnormal returns, while their winner counterparts continue to accumulate positive abnormal returns after 24 months of their formation. Thus, it appears that there is no evidence of mean reversion on the JSE for short-formation winner and loser portfolios.

On the other hand, mean reversion was observed for the loser and winner portfolios constructed based on their prior 24-month and 36-month returns. The mean reversion for portfolios with 36-month formation period appear to be more significant compared to those formed based on their prior 24 months returns. In addition, the degrees of mean reversion for

the loser portfolios are more significant compared to their winner counterparts. These findings are consistent with the international evidences provided by DeBondt and Thaler (1985, 1987) on the NYSE; Alonso and Rubio (1990) on the Spanish equity market; Campbell and Limmack, (1997) in the U.K. market and Ahmad and Hussain (2001) on KLSE. These findings are also consistent with the local evidence provided by Page and Way (1992), Muller (1999) and Hsieh and Hodnett (2011) that indicate the evidence of the long-term investor overreaction on the JSE.

Chapter 6

Timing of Mean Reversion

6.1 Introduction

The evidence of mean reversion for portfolios with 24- and 36-month formation periods; and the presence of momentum effect for portfolios with 1-, 3-, 6- and 12-month formation periods are documented in the prior chapter. This chapter undertakes to investigate whether there exists a specific timing of mean reversion for these portfolios. The loser-winner spreads are computed for the comparable loser and winner portfolios throughout the examination period. The cumulative loser-winner spreads over 12- and 24-month holding periods are subsequently analysed in Section 6.2. The economic rationale for the specific timings of mean reversion indicated by the signs and magnitudes of the cumulative post-formation loser-winner spreads are discussed, with references to the various stages in the South African economic cycle in Section 6.3.

6.2 Timing of mean reversion

The 12-month cumulative loser-winner spreads for portfolios constructed under 1-, 3- and 6-month formation periods are demonstrated in respective order in Chart (a), Chart, (b) and Chart (c) of Figure 6.1. On the other hand, cumulative loser-winner spreads for portfolios constructed under 12-, 24- and 36-month formation periods are demonstrated in Chart (d), Chart (e) and Chart (f) of Figure 6.1 respectively. Similarly, the 24-month cumulative loser-winner spreads are presented in Figure 6.2. Positive cumulative spreads indicate the existence of mean reversion. On the contrary, when the winner portfolios outperform the loser portfolios, negative cumulative spreads are expected in the post formation periods.

When positive cumulative spreads are observed, the contrarian strategy is profitable for the holding period while negative cumulative spreads indicate that the momentum strategy is profitable. Although momentum effects are present in short-formation portfolios, as discussed in Chapter 5, the examination of the cumulative post-formation spreads in Figure 6.1 and Figure 6.2 reveal that the timing of such effect is inconsistent for these portfolios throughout the examination period. For the longer-formation portfolios; that is, portfolios constructed based on the 12-, 24-, and 36-month formation periods, the momentum effect is observed before 2005 with negative cumulative loser-winner spreads, which indicates that the portfolios formed under the momentum strategy are mostly profitable during this period. However, the existence of mean reversion indicated by the positive cumulative loser-winner spreads is evident for these portfolios after 2005.

When the results of the 12-month holding period (Figure 6.1) are compared to those of the 24-month holding period (Figure 6.2), the mean reversion is more pronounced for longer-formation portfolios as well as for longer holding periods. When contrarian strategies are developed under 24-month and 36-month formation periods, the 24-month cumulative loser-winner spreads increase between 2004 and 2006 with contrarian returns decrease thereafter toward the end of examination period.

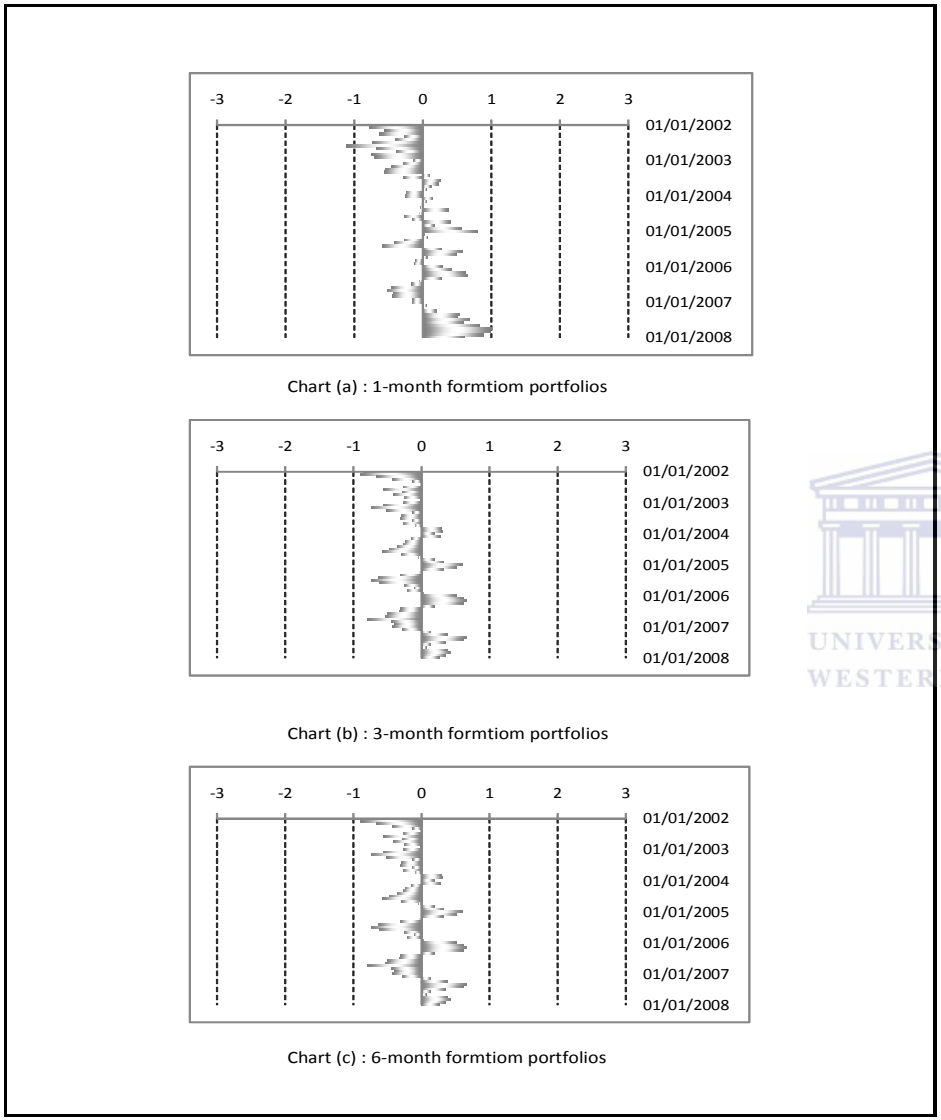


Figure 6.1 12-Months Cumulative Loser-Winner Spreads

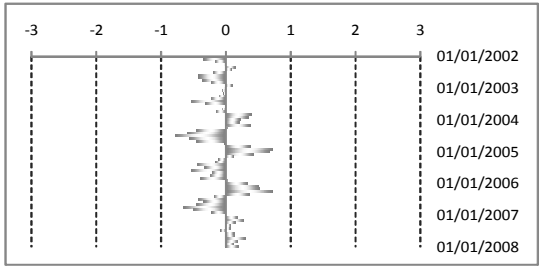


Chart (a) : 1-month formtiom portfolios

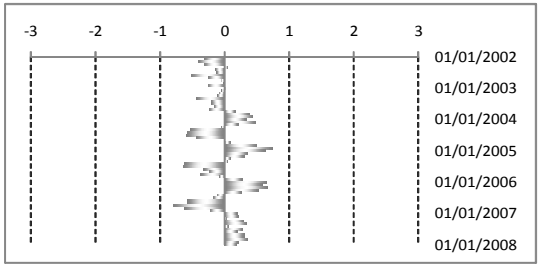


Chart (b) : 3-month formtiom portfolios

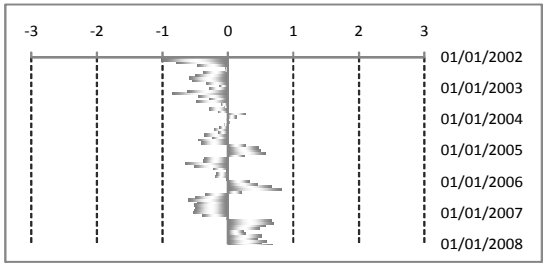


Chart (c) : 6-month formtiom portfolios

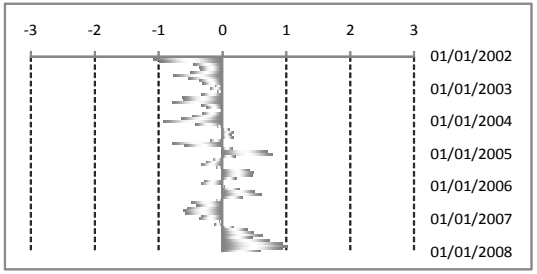


Chart (a) : 12-month formtiom portfolios

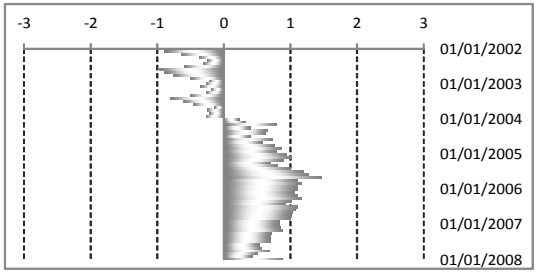


Chart (a) : 24-month formtiom portfolios

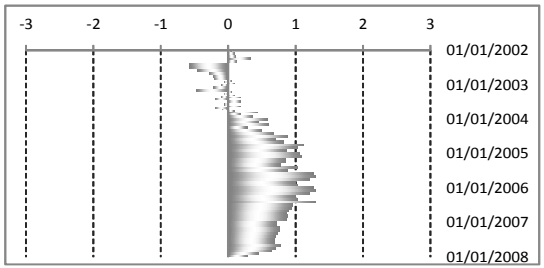


Chart (a) : 36-month formtiom portfolios

Figure 6.1 24-Months Cumulative Loser-Winner Spreads

Table 6.1 provides the summary for the number of positive cumulative loser-winner spreads. When the portfolios are held for 12-months since formation, the number of negative cumulative spreads outweighs the number of positive cumulative spreads (30:43). This result is also observed when portfolios are held for 24-month since formation, with the exception of portfolios with 24-month and 36-month formation periods. More specifically, 24-month and 36-month formation portfolios exhibit a significant number of positive cumulative loser-winner spreads compared to the negative cumulative loser-winner spreads when the portfolios are held for 24 months after formation. Out of 73 portfolios formed under 36-month formation periods, 58 portfolios generate positive cumulative loser-winner spreads after 24-month holding period. This implies that both longer formation period and holding period are required for investors to earn significant contrarian returns under the assumptions of the Overreaction Hypothesis.

Table 6.1 The Analysis of Cumulative Loser-Winner Spreads

Cumulative Spread	1-month		3-month		6-month		12-month		24-month		36-month	
	+	-	+	-	+	-	+	-	+	-	+	-
12-month	31	42	32	41	32	41	30	43	27	46	22	51
24-month	34	39	31	42	33	40	30	43	46	27	58	15

6.3 Timing of Mean Reversion and Economic Cycle

According to the annual economic report of the South African Reserve Bank (SARB), the world economy experienced a stifled expansion in the first half of 2002, following a slight growth rate recorded in 2001. Great resilience has been observed in aggregate demand domestically, which lead to a considerable expansion of consumption expenditure and fixed

capital formation for both the private and public sectors in 2002. The global economy remains unstable in 2003 due to the war in Iraq and the eruption of the epidemical Severe Acute Respiratory Syndrome (SARS), which ravaged Asian-Pacific region and parts of North America. The slowing demand in the Eurozone has also affected the domestic production capacity. During this period, negative cumulative loser-winner spreads are observed for longer formation portfolios in Chart (e) and Chart (f) of Figure 6.1 and Figure 6.2 respectively.

The worldwide economy experienced strong expansion within the last quarter of 2003 and financial expansion was maintained in 2004 and 2005. Domestically, low interest rates have catalysed growth, through the facilitation of fiscal policies as well as the higher international prices for exported commodities, which effectively boosted business and consumer confidence. During this period, strong mean reversion patterns are observed for longer formation portfolios. These patterns are stronger for portfolios held for 24-month period in Figure 6.2 compared to portfolios held for 12-month as indicated in Figure 6.1. The 24-month cumulative loser-winner spreads for longer formation portfolios in Figure 6.2 remain positive but begin to weaken after 2006. Although real growth recovered its momentum in the first half of 2006 as the manufacturing sector began to recover, the aggregate Real Gross Domestic Expenditure (GDE) and the Real Final Consumption Expenditure by households dropped significantly since 2007 due to tightening up of economic activities caused by subprime mortgage crisis.

The overall analysis reveals that stock market mean reversion seems to be stronger during the upswing of the South African economic cycle and the contrarian return deteriorates when the

economy is slowing down. Thus, the mean reversion on the JSE seems to be positively correlated to the South African economic cycle.

6.4 Conclusion

This chapter undertakes to investigate the specific timing of mean reversion for portfolios constructed under different formation periods. Study results reveal that no specific timing is identified for the loser and winner portfolios constructed with formation periods of 12 months or under. Although significant momentum effect is observed for the short-formation portfolios on average over the examination period in the previous test, the actual timing of such effect seems to be uncorrelated to the South African economic cycle. On the other hand, for portfolios with longer formation periods, negative cumulative loser-winner spreads are observed before 2004, which indicates that the portfolios formed under the momentum strategy are mostly profitable during this period. The contrarian returns represented by the positive cumulative loser-winner spreads increase between 2004 and 2006 for the longer formation portfolios, which coincides with the strong bull market on the JSE. The contrarian returns deteriorate since the subprime mortgage crisis in 2007 into the subsequent global financial crisis in 2008/2009. This evidence suggests that the degree of mean reversion on the JSE is positively correlated to the South African business cycle.

Chapter 7

Conclusion

The main objective of this research is to examine the existence of the overreaction phenomenon and the subsequent mean reversion on the JSE over the examination period from 1 January 2002 to 31 December 2009. The research also attempts to identify the specific timing of mean reversion in relation to the phases in the South African economic cycle in the South African stock market over the examination period. The results observed from this research generally agree with those observed in both international and local literature. This chapter attempts to sum up the main arguments discussed and the findings discovered in this research. Section 7.2 presents and discusses the major highlights of the results observed in this research, while Section 7.3 discusses the implications of these results with regard to other empirical literature. Section 7.4 concludes with recommendations for further research.

In examining the average cumulative abnormal returns of the winner and loser portfolios with formation periods of 12 months or under, the results reveal significant momentum effect as the loser portfolios accumulate negative abnormal returns, while their winner counterparts deliver positive abnormal returns after 24 months of their formation. Thus, it appears that there is no evidence of mean reversion on the JSE for short-term winner and loser portfolios. These findings are consistent with those also observed by Campbell and Limmack (1997) in the U.K. market in which they show that both loser and winner portfolios maintain their current performance over the subsequent 12 months of their formation.

On the contrary, significant mean reversion is observed for the winner and loser portfolios constructed based on their prior 24-months and 36-month returns. The mean reversion for portfolios with 36-month formation period appear to be more significant compared to those formed based on their prior 24 months returns. In addition, the degrees of mean reversion for the loser portfolios are more significant compared to their winner counterparts. These findings are consistent with international evidences provided by DeBondt and Thaler (1985, 1987) on the NYSE; Alonso and Rubio (1990) on the Spanish equity market; Campbell and Limmack, (1997) on the U.K. market and Ahmad and Hussain (2001) in the Malaysian market who argue the evidences of the mean reversion as a consequence of the investor overreaction when the tests are based on long-term formation periods. These findings are also consistent with the local evidence provided by Page and Way (1992), Muller (1999) and Hsieh and Hodnett (2011) who provide evidence of the long-term contrarian effect on the JSE.

When examining the prior 12- and 24-month cumulative loser-winner spread in the post-formation periods, no specific timing is identified for the short-term winner and loser portfolios. Although significant momentum effect is observed for the short-formation portfolios, the actual timing of such effect appears to be uncorrelated to the South African economic cycle. On the other hand, negative cumulative loser-winner spreads are observed before 2004for portfolios with longer formation periods, which indicates that the portfolios formed under the momentum strategy are mostly profitable during this period. The contrarian returns represented by the positive cumulative loser-winner spreads increase between 2004 and 2006 for the longer formation portfolios, which coincides with the strong bull market on the JSE. The contrarian returns deteriorate since the subprime mortgage crisis in 2007 into

the subsequent global financial crisis in 2008/2009. This evidence suggests that the degree of mean reversion on the JSE is positively correlated to the South African business cycle.

The findings of this research violate the weak form efficient market hypothesis, which asserts that investors cannot time the market based on prior stock performance. However, the results show evidence of short-term momentum effect and the long-term mean reversion for the winner and loser portfolios. Although the specific timing for the short-term momentum effect on the JSE is not identified, the degree of mean reversion is observed to be positively correlated with the South African economic cycle. The area demands further research includes how to predict the turning point of the economic cycle based on the degree of mean reversion and implement strategies to exploit the timing of mean reversion

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