The relative efficacy of momentum strategies in the South African equity market

by

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(200501761)

MINOR DISSERTATION

submitted in partial fulfilment of the requirements for the degree

MAGISTER COMMERCII

in

FINANCE

in the

FACULTY OF ECONOMIC AND FINANCIAL SCIENCES

at the

UNIVERSITY OF JOHANNESBURG

SUPERVISOR: Prof Ilsé Botha

DECEMBER 2015

Declaration of original work

I, **Chantal Marx**, declare that this minor dissertation is my own unaided work. Any assistance that I have received has been duly acknowledged in the dissertation. It is submitted in partial fulfilment of the requirements for the degree of Masters of Commerce at the University of Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

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Signature Date

Abstract

This study revisits the concept of momentum and explores the efficacy of different well-known momentum-based strategies in the South African equity market. The work expands on existing research by contrasting three well-known momentum strategies, namely the traditional approach (Jeegadeesh & Titman, 1993), the industry approach (Moskowitz & Grinblatt, 1999) and the 52-week-high strategy (George & Hwang, 2004) in terms of their performance to a passive (control) portfolio and one another as applied to the South African equity market. The results confirm that South African investors can expect excess returns from employing either the traditional momentum approach or the industry momentum approach (there is no significant difference in performance) but not the 52-week-high approach. This study could also contribute to the growing body of research on the efficiency of the South African market since the success of trading strategies supports the predictability of asset prices which may challenge weak form efficiency.

Acknowledgements

While the first few chapters of this minor dissertation were completed in a relatively short time, the transformation and analysis of such a significant volume of data as this topic required proved to be one of the most challenging experiences of my life. I learnt that frustration often led to mistakes and that a measured, considered tactic was the only way to climb a mountain (of data).

I wish to thank my supervisor, Professor Botha, for providing rapid, cogent feedback and having patience with me through my numerous data transformation disasters. I must also give my appreciation to the University of Johannesburg and the FirstRand Group for financing a significant portion of my studies. I would like to thank my husband for happily spending many weekends over the last two years on his own as a result of my dedication to this study. Finally, I would like to thank my parents, Drs. PP and C Gouws, for inspiring me to continue learning every day.

This minor dissertation is dedicated to my grandfather, Dr. CM de Villiers.

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Chapter 1: Introduction

1.1 Introduction

In 1922, renowned trader Jesse Livermore noted that asset prices 'are never too high to begin buying or too low to begin selling' (LeFevre, 1923). Share price momentum has been a topic of interest for many years, and recent share price movements in the South African market warranted a revisiting of the concept.

This study has been initiated to revisit the concept of momentum and explore the efficacy of different well-known momentum-based strategies in the local equity market. It also aims to provide a new perspective on momentum investing in the South African equity market through exploring momentum in the context of behavioural traits common to market participants. The study intends to expand on existing research by contrasting three well-known momentum strategies in terms of their performance to a passive (control) portfolio and one another in a South African setting. The results could also contribute to the growing body of research on the efficiency of the South African market since the success (or failure) of trading strategies supports either the predictability or unpredictability of asset prices, which may challenge or confirm weak form efficiency.

The results of this study may be of value to all market participants; however, traders and fund managers with flexible mandates are anticipated to benefit most. Tax concerns, size effects, and investment horizon constraints may prevent retail portfolio managers from employing momentum strategies; the behavioural context in which this study is conducted may assist managers in explaining the momentum phenomenon.

This chapter will begin by presenting the background to the study, offering some insight into the origins of momentum investing and identifying challenges to its existence. The problem statement and research questions are then discussed, after which the sample and methodology are reviewed. Finally, the limitations, delimitations, and significance of the research are explored. The concluding section

of this chapter will provide an overview of how the remainder of this dissertation is organised.

1.2 Background of the problem

The prediction of asset price movements has long been a popular focus area among researchers across the world. Accurate forecasting methods are of great importance to investors, policy makers, and other market participants when making investment decisions in their respective fields of interest. However, attempting to predict asset prices is futile if the Efficient Market Hypothesis holds; consequently, a great deal of research has been directed towards proving or disproving this theory.

An efficient market was first defined by Fama in 1965 and later more concisely described as 'a market in which prices always "fully reflect" available information (Fama, 1970). Fama (1970) concluded that stock market prices follow a random walk. The Random Walk Theory hypothesises that a given change in price is in no way influenced by past stock price movements and that price levels are therefore not predictable.

Finance is a social science, however, and the human element inherent to financial markets implicitly draws into question the main premises of the Efficient Market Hypothesis. First, the suggestion that stock returns follow a random walk has been widely disputed (George & Hwang, 2004; Smith, 2008; Appiah-Kusi & Menyah, 2003). Second, informational inefficiencies have been shown to exist in numerous markets (Jegadeesh & Titman, 1993; Chan, Jegadeesh & Lakonishok, 1996; Rastogi, Chaturvedula & Bang 2009; Hur, Pritamani & Sharma, 2010). The presence of informational inefficiencies can be related to the psychology and behaviour of individual investors, and cognitive errors and emotional biases have been shown to induce inefficiency in financial markets (Shiller, 2003).

Empirical studies on market efficiency present conflicting findings and there appears to be a clear distinction between findings in developed markets and emerging markets. It seems that studies of the latter more often than not result in the rejection of the Efficient Market Hypothesis. It follows that, over time, several studies have

confirmed the presence of weak form efficiency in stock markets in countries such as the United States (Jensen, 1978; Narayan, 2006), United Kingdom (Dimson & Marsh, 1999; Smith, 2012), and Japan (Abdulnasser, 2004; Ling, 2011). Across several emerging markets, Claessens, Dasgupta and Glen (1993), Achour, Harvey, Hopkins and Lang (1998) and Poshakwale (1996) could not confirm efficiency. Rockinger and Urga (2000) found evidence of efficiency in the Hungarian, Czech and Polish market, but a significant level of return predictability exists in Russia. Kim and Shamsuddin (2008) concluded that while the Taiwanese market is efficient in the weak-form, Indonesia, Malaysia and Philippines show no sign of market efficiency. Urrutia (1995) and Karemera, Ojah and Cole (1999) found evidence of efficiency in several emerging markets. In emerging markets, conflicting findings were for the most part found when methodological differences existed, notably in returns currency (US dollar or local currency) and sample periods.

As with other developing economies, conflicting views exist over whether or not the South African market is efficient. Some studies show that the South African market is of the weak form efficiency and that, therefore, stock price movements cannot be predicted (Magnusson & Wydick, 2002; Zhang, Wu, Chang & Lee, 2012), whereas others (Smith, 2008; Appiah-Kusi & Menyah, 2003), also with some methodological differences, disputed this notion.

Amid conflicting evidence of market efficiency, opponents of the Efficient Market Hypothesis identified several methodological shortcomings in traditional measures of efficiency itself. The most noteworthy of these deficiencies may be the gradual nature of information dispersion as well as the often overlooked effect of investor psychology on asymmetric responses to new information, and ultimately, asset prices (Bem, 1965; Moskowitz & Grinblatt, 1999; Hirshleifer, 2001; Mizrach & Weerts, 2009; Hur et al., 2010). These studies stood in direct contrast to Fama's (1965b) claim that, on average, prices will adjust to new information correctly.

Hong, Lim and Stein (2000) cited the lagged dispersion of information to investors as a possible reason for market inefficiency (Hong, et al., 2000). Slow dissemination of new information, and ultimately inefficiency, has been shown to be more prevalent in small, less liquid, stocks (Daniel, Hirshleifer & Subrahmanyam, 1998; Hong et al.,

2000; Chordia, Roll & Subrahmanyam, 2008) and, perhaps interrelated, shares and markets with low analyst coverage (Hong et al., 2000). In emerging markets, stocks are usually less liquid than their developed market counterparts (Lesmond, 2005), the companies are smaller (Bekaert, 1995), and analyst coverage is lower (Griffin, Kelly & Nardari, 2010). Furthermore, a relatively lower degree of transparency and voluntary disclosure (Chan & Hameed, 2006) may further slow information diffusion.

Apart from information diffusion inefficiencies, investor reaction to new information (once it is disseminated) may also be brought into question. According to Shiller (1999), the Efficient Market Hypothesis is based on the 'primitive' notion that individuals behave rationally and are able to accurately process all available information. It can be argued, however, that investor psychology and cogitative ability, or behavioural factors, play an important part in financial markets and the inefficiency thereof.

If the South African equity market is not efficient, it follows that trading strategies may be implemented profitably. When considering well known trading strategies, momentum, contrarian, and value strategies are often recalled. Amongst those searching for returns in excess of that of a pre-defined benchmark (alpha) in the South African equity market, recent market moves have brought into question the efficacy of deep value and contrarian investing. Sectors and stocks that have performed well over the last two years have continued to do so and areas of the market that have performed poorly have followed what seems to be a relatively persistent downward trajectory (Figure 1.1). Berger, Israel and Moskowitz (2009) define momentum as 'the tendency of investments to exhibit persistence in their relative performance'. These moves could therefore be indicative of the existence of momentum in the South African equity market.

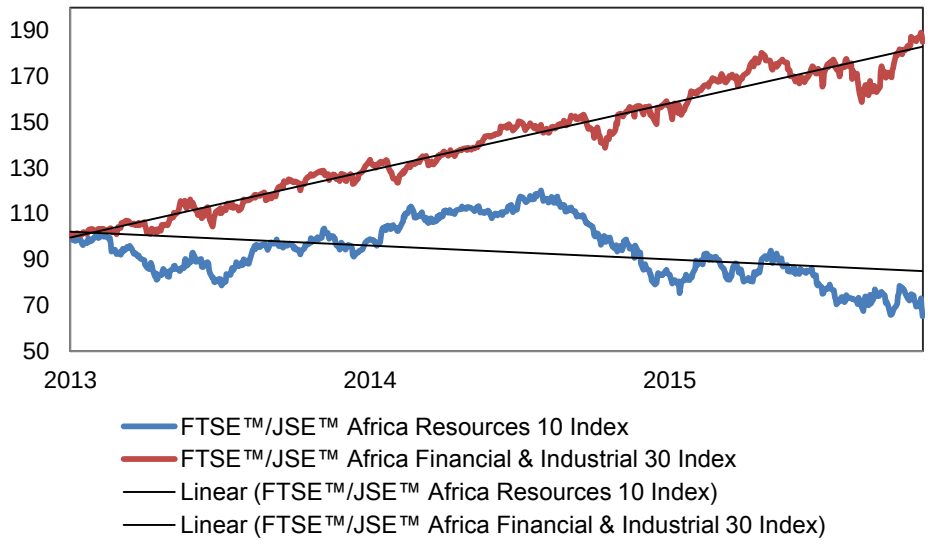

Figure 1.1: The FTSE™/JSE™ Africa Financial & Industrial 30 Index™ (Total Return) and the FTSE™/JSE™ Africa Resources 10 Index™ (Total Return) compared (rebased to 1 January 2013).

Source: I-net Bridge (2015)

Although the notion of momentum can be traced to trader Jesse Livermore circa 1922, the theory of momentum in stock price behaviour is rooted in the concept of relative strength as first introduced by Gartley (1945) and later popularised by Levy (1967). Momentum is slightly different to relative strength, however, since momentum refers to a share's strength relative to its own performance rather than the performance of the market as a whole. Momentum based investing gained widespread recognition following a study by Jegadeesh and Titman (1993) which showed that a returns-based momentum strategy (now known as the traditional approach) generates excess returns in the United States (US) in the short to medium term. Several popular auxiliary studies followed, including research by Chan et al. (1996) on investor reaction to new information, Moskowitz and Grinblatt (1999) on industry momentum effects, and George and Hwang (2004) on momentum effects based on the 52-week-high. As recent as last year, Varadi (2014) proposed a new strategy known as probabilistic momentum, which has not yet been academically tested (and also outside the scope of this study).

If momentum is indeed present in the South African equity market, the need arises to test whether a momentum-based strategy can generate superior returns relative to a passive strategy. Further to this, since there are several empirically researched strategies to choose from, it may be valuable to determine which would perform best

in the South African equity market. Taking Shiller's (1999) words to heart, it may also be worthwhile to explore the psychological drivers of inefficiency, and ultimately, how these behavioural biases allow for momentum trading strategies to generate significant excess returns. In turn, the success of certain momentum strategies could also provide insight into the behaviour of South African investors.

1.3 Problem statement & research questions

Besides the original test by Jeegadeesh and Titman (1993) on the 'traditional' momentum approach in the US equity market, several other researchers have successfully applied the same strategy to the same market (Gutierrez & Kelley, 2008; Chan et al., 1996; Jegadeesh & Titman, 2001; Lewellen, 2002), and a variety of different markets (Rouwenhorst, 1998; Rouwenhorst, 1999; Chui, Titman & Wei, 2000; Hon & Tonks, 2002; Kang, Liu & Ni, 2002; Griffin, Ji & Martin, 2005; Cheng & Wu, 2010). In South Africa, the traditional momentum approach has been tested against a passive (control) portfolio in several prior studies (Achour et al., 1998; Chan, Hameed & Tong, 2000; Fraser & Page, 2000; Van der Hart, Slagter & Van Dijk, 2003; Griffin et al., 2005; Sehgal & Jain, 2012), with mixed results.

After Moskowitz & Grinblatt (1999) popularised the industry momentum strategy, as applied to the US equity market, several authors found evidence of industry momentum in numerous markets (O'Neal, 2000; Swinkels, 2002; Giannikos & Ji, 2007). Specifically, in analysing the outcome in 38 countries including South Africa, Giannikos and Ji (2007) found that an industry momentum strategy earns significant profits globally. The 52-week-high momentum strategy proposed by George and Hwang (2004) has been confirmed to be applicable in the US by Sapp (2011) and in several other countries by Liu, Liu and Ma (2011) and Marshall and Cahan (2005). Gupta, Locke and Scrimgeour (2010) found that a 52-week-high 'winner' portfolio (top 30%) could not significantly outperform a 52-week-high 'loser' portfolio (bottom 30%) in the South African market. While the traditional momentum strategy has been extensively tested in the South African market, the 52-week-high and industry momentum strategies had not yet been exclusively tested against a passive (control) portfolio.

When considering the efficacy of the above-mentioned strategies on a relative basis, George and Hwang (2004) found that in the US, the 52-week-high strategy is a better predictor of future returns than the traditional approach. Marshall and Cahan (2005) came to a similar conclusion in Australia and further asserted that the 52-week-high strategy outperforms the industry momentum strategy. In contrast, Bornholt and Malin (2011) found that the traditional approach significantly outperforms the 52-week-high approach across 44 developed and emerging markets; and Gupta et al. (2010) found that the conventional momentum strategy tends to outperform both the 52-week-high strategy and the industry momentum strategy across 51 countries. All three strategies have not yet been tested simultaneously, and contrasted, in the South African equity market.

Additionally, from a theoretical standpoint, exploring possible explanations for the presence of momentum effects in local company shares may contribute to a better understanding of why momentum strategies outperform a random approach (if indeed they do so). The reciprocal can also be explored – what do trading strategy results uncover about South African investor behaviour?

The first research question addressed by this study is therefore which of the three momentum strategies tested outperform a passive (control) portfolio in the South African equity market. The second enquiry is into which momentum-based strategy performs best: the traditional approach, the 52-week-high approach, or the industry approach. These questions will be answered within an investor psychology framework, offering explanations of market movements based on behavioural finance theory.

1.4 Overview of sample and methodology

This study follows a quantitative explanatory approach employing several different analytical methods. The research is conducted as a pseudo-experiment whereby the passive strategy employed will act as a ‘control’ and the different momentum investment strategies employed as experiments. The study uses secondary monthly data of the top 100 shares by market capitalisation listed on the Johannesburg Stock Exchange (JSE) between May 1994 and May 2014. In total, seven portfolios are

constructed, six of which reflect the three momentum strategies ('winner' and 'loser' portfolios), with the seventh being the passive 'control' portfolio consisting of all top 100 shares.

The research methodology (considered in full in Chapter 3) has three distinct phases incorporating the sample set out in the preceding paragraphs.

Applying Student's t-test (for paired samples), the seven resultant portfolio performances are initially tested for significant differences to one another. In other words, differences will be assessed between 'winner' and 'loser' portfolios, between strategies, and against the passive (control) portfolio. Thereafter, the risk adjusted performances are analysed using the modified Sharpe ratio (Gregoriou & Gueyie, 2003). The modified Sharpe ratio incorporates modified Value-at-Risk (VaR) as its risk measure, as opposed to the standard deviation used to measure risk in the traditional Sharpe ratio. The modified VaR is a measure by which risk in non-normal distributions, such as returns distributions, can be more accurately assessed as it adjusts for skewness and kurtosis (Favre & Galeano, 2002)

Finally, Chow's test for structural breaks is performed to assess whether two financial crisis periods, namely the Asian currency crisis and the Great Recession, impacted on the behaviour of the momentum strategies tested.

Apart from explaining in more detail the sample and methodology employed, Chapter 3 will also explore how the validity and reliability of the results of the study are ensured.

1.5 Assumptions, limitations, and delimitations

An important limitation to this study is that the sample period was constrained to May 1994 onward, in order to account for a possible structural break on April 27th, 1994. Among several delimitations are limiting the sample to the Top 100 shares, leaving transaction costs out of the account, and ignoring liquidity impediments. These limitations and delimitations are discussed in full in Chapter 3. In terms of

assumptions made, the methodology presented in Chapter 3 is considered adequate to draw statistically sound and possibly generalizable conclusions from the results.

1.6 Significance of the research

This study will provide new perspective on momentum investing in the South African equity market. This study will expand on the current research by considering the 52-week-high strategy (George & Hwang, 2004) and the industry-based approach (Moskowitz & Grinblatt, 1999) in the South African equity market in isolation. The study also considers the comparative efficacy in the South African equity market of these two approaches, along with the traditional approach, by comparing the respective outcomes between strategies and comparing the outcomes to a passive (control) portfolio. Further, the results are presented within a behavioural finance framework; a synthesis of existing ideas in this regard is presented in the literature review portion of this minor dissertation.

The results of this study may be of value to all market participants; however, traders and fund managers with flexible mandates are anticipated to benefit most. Tax concerns, size effects, and investment horizon constraints may prevent retail portfolio managers from employing momentum strategies; the behavioural context in which this study is conducted may assist managers in explaining this market phenomenon.

1.7 Conclusion

Succeeding this introductory chapter, this minor dissertation will be organised as follows: the literature review will be presented in Chapter 2; Chapter 3 will present the research methodology employed in this study in depth; Chapter 4 will present and discuss the findings arising from the data analysis methods explored in Chapter 3 both in isolation and in the context of the literature presented in Chapter 2; the final chapter, Chapter 5**,** will summarise and discuss the main findings of this study and present policy implications and recommendations for further research.

In the next chapter, an extensive body of existing literature is reviewed in an attempt to address several distinct issues. The Efficient Market Hypothesis is explored since the ability to earn momentum profits will hinge on the stock market being inefficient. Thereafter, reasons for possible inefficiencies are addressed with the emphasis being on behavioural factors. The topic of momentum investing is then explored and it is asked whether momentum profits can be earned in equity markets. Finally, possible reasons for the potential success of momentum strategies are explored within a behavioural framework.

Chapter 2: Tracing the Efficient Market Hypothesis to Behavioural Explanations of Success in Momentum Trading: A Literature Review

2.1 Introduction

The existence of momentum effects in stock markets is based on the premise that the Efficient Market Hypothesis does not hold: if a price prediction strategy can be implemented profitably, it implies that stock prices have memory and do not follow a random walk as Fama suggested (1965b). The basis of this study's questioning of the Efficient Market Hypothesis is that individual investors tend to induce inefficiency into the market due to cognitive failures and behavioural heuristics (Shiller, 1999). It follows that a momentum strategy may be profitably employed in an inefficient market and that the success of such a strategy is rooted in how market participants behave and make decisions.

In this chapter, existing literature is reviewed so as to answer four key questions. Firstly, can an investment strategy be employed profitably in the stock market (i.e. is the stock market inefficient)? Secondly, if the efficiency of the market can be brought into question, is there a reason for this inefficiency? Thirdly, the topic of momentum investing is explored and it is asked whether momentum profits can be earned in the stock market. Finally, if momentum strategies can be successfully implemented, why do these opportunities exist?

The first section focuses on the first of these questions, sketching a background on the concept of predictability in the stock market. Theories and empirical findings on Random Walk Theory and the Efficient Market Hypothesis are reviewed.

The subject of behavioural finance is explored in the second section to explain, first, why the market may not be efficient and second, to formulate a basis for why momentum profits can be earned. Since a myriad of biases and heuristics exist in behavioural finance, this section will focus on behavioural occurrences that specifically drive momentum in the stock market.

In the third section of this literature review, different momentum strategies and the results thereof are explored in more depth so as to identify shortcomings in current literature, the reasons behind conducting the study at hand, and potential future research topics. In considering the scope of literature studied in the final part of this review, several momentum strategies other than those focused on in this study will be revisited on a case by case basis only.

The last section will attempt to formulate a cohesive theory on why momentum profits can be realised in the stock market. This section will draw on different findings and theories proposed on the topic from a behavioural finance perspective.

2.2 The Random Walk Theory and the Efficient Market Hypothesis

2.2.1 *Random Walk Theory*

The concept of a random walk is grounded in probability theory, and more specifically, the concept of Martingale sequences (Lo, 2008), which can be defined as a sequence of random variables for which the predicted future value is the same as its current value at the time of prediction (Wolpert, 2010). In reference to stock prices, Malkiel (2003:59) loosely defined a random walk as 'a price series where all subsequent price changes represent random departures from previous prices'. The Random Walk Theory of stock price behaviour therefore challenges the notion of 'dependence' between stock price movements and implies that trading strategies based on past price movement cannot deliver excess returns over a buy-and-hold strategy (Jensen & Benington, 1970).

Regnault (1863, cited in Jovanovic & Le Gall, 2001) was perhaps the first to put forth a random-walk-related theory on short-term price movements in the stock market. In analysing the stock market as a game of 'heads or tails' (increasing or decreasing) he found that 'at any moment, no advantage exists for one possibility or for the other'. A similar train of thought was later followed by Bachelier (1900), who proposed that, based on probability theory, the expected profit of a speculator is nil at the inception of a trade. Working (1934) later asserted that the distinctly random

changes observed in stock price movements warrant further investigation, and Kendall (1953) heeded this call through a series of empirical tests on serial correlation intrinsic to prices of British industrial stocks and cotton spot prices. Kendall (1953) noted that the time series appeared to be 'wandering'. Osborne (1959) confirmed and formalised Bachelier's (1900) findings by establishing that stock price changes follow the same distribution as particles in Brownian motion and that successive price changes are therefore independent of one another. Fama (1965a) empirically tested and found support for the assumptions of Random Walk Theory, namely that successive price changes are independent, and that the price changes conform to some distribution.

The Random Walk Theory is closely related to, and perhaps set the groundwork for, the Efficient Market Hypothesis (Malkiel, 2003). Apart from suggesting that price movements behave in a non-predictable way, the Random Walk Theory indirectly implies that asset prices respond to information in a certain way. As Van Horne and Parker (1967) noted, it infers that new information is assimilated in such a way that deviations about the intrinsic value of a share will also be random.

2.2.2 *The Efficient Market Hypothesis*

According to Sewell (2011), ideas reflecting the Efficient Market Hypothesis could be traced back to the 19th century, when Gibson (1889, cited in Sewell, 2011:2) asserted that once 'shares become publicly known in an open market, the value which they acquire may be regarded as the judgment of the best intelligence concerning them'. The definition and formulation of the Efficient Market Hypothesis, however, is credited to Fama (1965a, 1970). Fama (1965a) defined an efficient market as one in which investors behave in a 'rational' way and that all available information is fully reflected in an asset's price. It holds that if stock markets are indeed efficient, asset prices 'cannot be predicted in any meaningful way' (Fama, 1965a:34).

Prior to Fama (1965a), Cootner (1964) commented on a collection of papers published in his edited work *The Random Character of Stock Market Prices* echoing formal definitions of the Efficient Market Hypothesis. In an introduction to Random

Walk Theory, Cootner (1964) noted that traders cannot be expected to continually profit from the implementation of trading rules to past price data since this information is available to all market participants and consequently, all profitable opportunities will be eliminated. The theory underlying the Efficient Market Hypothesis was then highlighted by Samuelson (1965:41), who suggested that 'what can be perceived about the future must already be "discounted" in current price quotations'.

To fully appreciate the empirical evidence considered in Section 2.2.3, it is important to note that there are different types of market efficiency (Fama, 1970; Fama, 1991), namely weak form efficiency, semi-strong form efficiency, and strong form efficiency.

2.2.2.1 Weak form efficiency

Weak form efficiency implies that successive price changes are independent of one another (Fama, 1970). Weak form efficiency is therefore closely related to Random Walk Theory in that the confirmation of stock prices following a random walk in itself implies weak form efficiency (Worthington & Higgs, 2004). It is also a precursor for market efficiency as a whole since, by definition, equity prices in an efficient market will be unpredictable (or follow a random walk) since they fully incorporate all relevant information. Jones (2009) noted that weak form efficiency tests include statistical testing for independence, or showing that strategies implementing trading rules do not produce returns in excess of a buy-and-hold strategy after deducting trading costs (proving economic independence).

2.2.2.2 Semi-strong form efficiency

According to Fama (1970), semi-strong form efficiency indicates that current prices fully reflect all available public information. Once information is made public in a semi-strong form efficient market, investors will not be able to generate excess returns over a buy-and-hold strategy based on public information since its impact will already be reflected in the price (Moyer, McGuigan, Rao & Kretlow, 2011). Moyer et al. (2011) asserted that proof of semi-strong form efficiency implies that the market is also weak form efficient since information used to determine weak form efficiency

(mainly prices) is also publicly available. Tests for semi-strong form efficiency generally take the form of event studies considering the impact of firm-specific announcements like stock splits, earnings calls, rights offers, and so forth (Fama, 1970). As Fama (1970) said, the idea is that event studies considering different announcement 'types' will accumulate to form a body of evidence supporting semi-strong form efficiency.

2.2.2.3 *Strong form efficiency*

Finally, strong form efficiency implies that all available information (both public and non-public) is reflected in market prices of securities (Fama, 1970). In a strong form efficient market, therefore, no individual or group will be able to earn excess returns over a buy and hold strategy, whether or not they are insiders possessing special knowledge of the firm (Moyer et al., 2011). Tests for strong form efficiency include the analysis of mutual fund returns, whereby 'skilled' investors' returns are analysed (Fama, 1970); and tests for private information are conducted by considering insider trading patterns (Fama, 1991).

2.2.3 *Empirical studies on the Efficient Market Hypothesis*

Empirical studies present conflicting findings on market efficiency. There appears to be a clear distinction between findings in developed markets and emerging markets, with studies of the latter often resulting in the rejection of the Efficient Market Hypothesis.

Over time, several studies have confirmed the presence of weak form efficiency of stock markets in developed markets such as the United States (Jensen, 1978; Narayan, 2006), United Kingdom (Dimson & Marsh, 1999; Smith, 2012), and Japan (Abdulnasser, 2004; Ling, 2011). Evidence of efficiency in emerging markets was inconsistent and for the most part dissimilar due to methodological differences, most notably in the currency in which returns are measured (US dollar or local currency) and time period differences. In a study considering first-order autocorrelations in stock price returns of twenty large emerging economies, Claessens et al. (1993) found that all these markets display inefficiencies. Achour et al. (1998) proposed that

a stock selection strategy may result in excess returns in Mexico, Malaysia and South Africa, and Poshakwale (1996), testing for the day-of-the-week effect, showed that the Bombay Stock Exchange is not efficient. Rockinger and Urga (2000) found evidence of efficiency in the Hungarian, Czech and Polish market, and a significant level of return predictability in Russia. Kim and Shamsuddin (2008) concluded that while the Taiwanese market has been efficient in the weak form, Indonesia, Malaysia and Philippines show no sign of market efficiency. Urrutia (1995) asserted that the largest Latin American emerging markets (Argentina, Brazil, Chile, and Mexico) are weak form efficient; Karemera et al. (1999) drew the same conclusion for fifteen emerging markets.

In the South African context, specifically, several conflicting studies were also found. On the one hand, Zhang et al. (2012) found that the South African market is weak form efficient in local currency terms, and Smith and Dyakova (2013) found that in a study of eight African countries, South African stock market moves are amongst the least predictable. On the other hand, Appiah-Kusi and Menyah (2003) discovered that the South African market is not weak form efficient; Smith (2008) echoed this finding.

2.2.4 *Opposition to the Efficient Market Hypothesis*

Amid conflicting evidence of market efficiency, opponents of the Efficient Market Hypothesis identified several methodological shortcomings in traditional measures of efficiency itself. The most noteworthy of these deficiencies may be the gradual nature of information dispersion, different reactions to new information, the cost of obtaining information, and the often overlooked impact of investor psychology, responses to new information, and ultimately, asset prices (Bem, 1965; Grossman & Stiglitz, 1980; Moskowitz & Grinblatt, 1999; Hirshleifer, 2001; Mizrach & Weerts, 2009; Hur et al., 2010).

Hong et al. (2000) cited lagged dispersion of information to investors as a possible reason for market inefficiency. Slow dissemination of new information, and ultimately inefficiency, have been shown to be more prevalent in small, less liquid, stocks (Daniel et al., 1998; Hong et al., 2000; Chordia et al., 2008) and, perhaps

interrelated, shares and markets with low analyst coverage (Hong et al., 2000). In emerging markets, shares have been found to be less liquid than developed market counters (Lesmond, 2005), companies are smaller (Bekaert, 1995), and analyst coverage is lower (Griffin et al., 2010). Furthermore, a relatively lower degree of transparency and voluntary disclosure (Chan & Hameed, 2006) could further slow information diffusion.

Apart from information diffusion inefficiencies and the cost of obtaining information, investor reaction to new information (once disseminated) may also be brought into question. Dimson and Mussavian (1998) considered several tests of overreaction and under-reaction with a particular focus on return predictability. The tests cited confirmed both positive serial correlation and negative serial correlation in stock returns over differing time horizons. These citations, together with further literature on the phenomena of over -and under-reaction to new information, are explored in detail in the proceeding section.

Another important consideration is that all investors are not deemed equal when it comes to gaining and possessing information. Investment professionals are often believed to be more informed, not as a result of trading on non-public information, but rather due to their inclination to study publicly available data more closely (Bloomfield, Libby & Nelson, 1999). For example, Price (1998) found that institutional investors make greater use of alternative non-earnings information (either privately acquired, or obtained through the costly use of financial statements). Grossman and Stiglitz (1980) argued that because of the high cost associated with gaining information, prices could not fully reflect available information, since those who pay for that information (either through time or in monetary terms) would receive no compensation. Adding on to the above, being satisfied with receiving no compensation for their trouble would by definition imply irrationality amongst investors – dispelling a main premise of the Efficient Market Hypothesis (being that market participants are rational).

This finding was echoed by Lo (2008), who asserted that critique by psychologists and behavioural economists endure since they undermine the most basic assumption of the Efficient Market Hypothesis, that is, that human beings behave in

a rational way. According to Shiller (1999), this notion that human beings behave rationally and consequently are able to accurately process all available information is archaic. The author argued that investor psychology and cognitive ability play an important part in financial markets and the inefficiency thereof.

2.3 Theories of behavioural finance

Hirshleifer (2001) explained that behavioural finance, the study of investor psychology, could trace its roots to economic theory proposed by well-known economists such as Adam Smith, Irving Fisher, and John Maynard Keynes. Acccording to Ashraf, Camerer and Loewenstein's (2005), Smith pioneered concepts like overconfidence and loss aversion in his lesser known publication *The Theory of Moral Sentiments* (1759). Fisher (1930, cited in Thaler, 1997), through his theories on investor impatience and inter-temporal choice, perhaps laid the groundwork for behavioural finance concepts like prospect theory, the disposition effect and regret aversion. Keynes (1921, cited in Dow, 2008) expanded on the notion of overconfidence, especially by exploring how humans establish reasonable grounds for action.

Considering his earlier utterances, it may be considered ironic that Smith has been credited with introducing what would later be known as 'the economic man' – '…an alarmingly rational creature who invariably seeks his own interest, (and) who reacts with lightning speed to actual and anticipated changes in his real income and wealth…' (Grampp, 1948:315). Kregel (2007) noted that the theory of a rational economic man contributed to the formulation of the Efficient Market Hypothesis, which implies that all information required to make rational economic decisions in the market (which economic man would invariably make) is contained in prices determined in competitive markets. From an economic psychology perspective, Simon (1955:101) was among the first to formulate doubt on the concept of the perfectly rational economic man. He asserted that '…actual human rationality-striving can at best be an extremely crude and simplified approximation to the kind of global rationality implied…by game-theoretical models'. Simon also proposed a theory on 'limited rationality' later termed 'bounded rationality' (Klaes & Sent, 2005). Simon

(1987) best defined the concept of bounded rationality as taking into account the cognitive limitations of a decision maker when considering rational choice theory.

It was upon Simon's initial doubts that Tversky and Kahneman (1972, 1973, 1979) based their work to obtain a map of 'bounded rationality' through exploring the systematic biases present in the choices that people, previously assumed to be rational agents, make (Kahneman, 2003). In analysing human judgement and decision making, the authors found evidence of several heuristics, namely, representativeness (Kahneman & Tversky, 1972), availability bias (Tversky & Kahneman, 1973), and adjustments and anchoring (Kahneman & Tversky, 1973). Kahneman and Tversky (1979) also developed prospect theory. While Kahneman and Tversky had a significant influence on the emergence of behavioural finance research and literature, it was Slovic (cited in Shefrin, 2002) who pioneered formal studies on behavioural finance in his conduction of psychological studies of decision making behaviour exhibited by stockbrokers first (Slovic, 1969), and analysts and individual investors later (Slovic & Lichtenstein, 1971). Slovic and Lichtenstein (1971) focused on cognitive bias and noted that individuals exhibited bias to quantum of information, and extremity of information (individuals assign more weight to negative events). In reference to market participants, the authors also recalled evidence of conservatism in which new information is given little weight (under-reaction to new information), direct estimation methods, mental attachment to previously calculated probabilities, and 'recency' effects, amongst others. It is valuable to note that the work by Slovic (1969), and Slovic and Lichtenstein (1971) draw on characteristics of information disseminated in the market and the interpretation of said information, noted earlier as possible grounds for opposition to the Efficient Market Hypothesis.

In establishing a behavioural explanation for the occurrence of momentum in stock prices, several other theories of investor behaviour must be explored, namely overconfidence (Fischhoff, Slovic & Lichtenstein, 1977), mental accounting (Thaler, 1980), the disposition effect (Shefrin & Statman, 1985), regret aversion (Loomes & Sugden, 1982), and herding (Keynes, 1930). The specific biases made reference to in this study are summarised in Table 2.1.

Table 2.1: Summary of behavioural biases relevant to a study on momentum effects

Behavioural Bias	Description	Origin in Finance
Herding	According to Baddeley, Burke, Schultz & Tobler (2012) herding occurs when private information is highly influenced by public information over decisions made by the group. This is consistent with bounded rationality (Keynes 1930).	First proposed by Keynes (1930) in an observation of modern financial markets. Consistent with bounded rationality, Keynes proposed that in an uncertain world, it may be rational to assume that others are better informed.
'Recency' effects	Investors tend to give more weight to recently obtained information (Offerman & Sonnemans, 2004).	Slovic and Lichtenstein (1971) in psychological studies of decision making behaviour exhibited by analysts and individual investors.
Conservatism	New information is given little weight (Slovic & Lichtenstein, 1971). This is different from 'recency' in that new information is given little weight but recent information that has already been considered is given more weight.	Slovic and Lichtenstein (1971) in psychological studies of decision making behaviour exhibited by analysts and individual investors.
Overconfidence	According to Einhorn and Hogarth (1978), people exhibit great confidence in their often mistaken judgments. The effect is that greater weight is attached to information already known.	Fischhoff et al. (1977) across several different general knowledge questions with a monetary 'bet' attached to confidence of subjects in answers.
Representativeness	The erroneous prediction of future events based on past events considered as similar (Kahneman & Tversky, 1972). Closely linked to overconfidence and conservatism which may lead to overreaction to information already 'known', and an under-reaction to new information (Shiller, 1999).	Kahneman and Tversky (1972) in a psychological analysis of human judgement and decision making.
Availability Bias	Refers to the ease at which information relating to a situation is recalled (Tversky & Kahneman, 1973).	Kahneman and Tversky (1973) on the psychology of prediction. This ties in with representativeness (similar events may be easily recalled), the 'recency effect' (more recent events will be more easily recalled), and other findings by Slovic and Lichtenstein (1971).
Anchoring and Adjusting	Kahneman and Tversky (1973) describe an 'anchor' as a point of reference which may take the form of an initially calculated value or starting point around which further adjustments are made. The authors propose that adjustments are typically inefficient and biased towards the 'anchor' value. Investors will attach less weight to information that deviates from this starting point.	Kahneman and Tversky (1973) on the psychology of prediction. This initial starting point may be related to representativeness (the starting point is based on a past event), and availability bias (the starting point is easily recalled).
Prospect Theory	According to Tversky and Kahneman (1992), prospect theory holds that an individual's value function is 'concave for gains, convex for losses, and steeper for losses than for gains'. Simply put, the authors find that investors attach greater value to incremental losses than gains.	Kahneman and Tversky (1979) in a critique on the expected utility theory as a descriptive model for making risky decisions.
Mental Accounting	Individuals compartmentalise current and future assets into separate, non-transferable portions. Individuals assign different levels of importance (weight) to each group (Thaler, 1980).	Using prospect theory as a foundation, this descriptive model of consumer choice was established by Thaler (1980). Mental accounting may also be associated with representativeness, as well as direct estimation methods considered by Slovic and Lichtenstein (1971).
Disposition Effect	The tendency by investors to hold losing stocks too long and sell winning stocks too soon (Hur, et al., 2010).	Developed by Shefrin and Statman (1985) the disposition effect is based on prospect theory and mental accounting.
Regret Aversion	Regret aversion involves the consideration of opportunity costs inherent to decision making. Investors will avoid making firm decisions in fear of experiencing regret thereafter.	Loomes and Sugden (1982) developed the theory of regret aversion in an attempt to simplify prospect theory. Fear of regret was also mentioned by Thaler (1980) in his development of mental accounting theory. Regret aversions is therefore closely related to the disposition effect.

Source: Author's own representation

The behavioural finance theories discussed in Table 2.1 relate to how investors react to new information. Forming the theoretical basis of momentum trading strategies,

market participants have been found to exhibit asymmetric response behaviour, in other words over- or under-reaction to information (Hur et al., 2010).

2.3.1 *Behavioural theories and evidence on over-reaction*

One of the earliest observations on overreaction in markets was made by Keynes (1936, cited in De Bondt and Thaler, 1985), who noted that new information often has an 'excessive' and even 'absurd' influence on the market. Howe (1986) asserted that interest in market over-reaction (or exaggeration) can be traced to the seventeenth century 'Tulip Bubble', although modern theories of this market anomaly were pioneered by researchers like Smidt (1968), who considered exaggeration in response to so-called 'bubbles'.

Much of what has been written on over-reaction in the theoretical sense was based on some of the behavioural finance theories listed in Table 2.1. Herding, recency effects, representativeness, anchoring and adjusting, prospect theory, and mental accounting may all contribute to overreaction to new information by investors. Arrow (1982) first referred to the link between modern behavioural finance theory and over-reaction in noting that Kahneman and Tversky's (1972, 1973, 1979) work reflected the excessive reactions to information observed in securities and futures markets. De Bondt and Thaler (1985) first married the psychological theories on overreaction with market evidence of overreaction and found that monthly US stock returns data were consistent with what the authors referred to as the 'overreaction hypothesis'. Shiller (1987) found evidence of herding in the overreaction of investors during the October 1987 US stock market crash, and Offerman and Sonnemans (2004) later proposed that general overreaction may be caused by recency effects.

Empirical studies on market over-reaction were popularised by Shiller (1981), who was amongst the first to present evidence of overreaction in the stock market by considering the volatility of US stock prices in relation to new information. He found that volatility appeared far too high, five to thirteen times too high in fact, to be attributed solely to new information entering the market. Apart from De Bondt and Thaler's 1985 findings, Renshaw's (1984) presentation of evidence of 'panic-selling'

in the US stock market and Howe's (1986) findings that over-reaction to news is economically significant in US security prices are also widely referenced.

Amongst more recent studies, Dreman and Lufkin (2000) examined the subject of overreaction in the US stock market by considering five fundamental company criteria, namely, growth in earnings, growth in cash flow, growth in sales, return on equity (ROE), and profit margin. The authors found that relatively small changes in underlying fundamentals drive relatively large price movements, which supports the concept of psychological over-reaction by market participants. Lobe and Rieks (2010) found significant evidence of overreaction in the Frankfurt stock exchange, and Joseph and Mazouz (2010) found evidence of overreaction by investors in 39 different countries. Lansing (2012) showed that market agents overreact to information or shocks in US technology stocks specifically; finally, Brown, Wei and Wermers (2013) found that US mutual fund managers overreact to analyst recommendation changes.

2.3.2 *Behavioural theories and evidence on under-reaction*

The under-reaction phenomenon in equity markets is often linked to the concept of 'post earnings announcement drift'. Pioneered by Ball and Brown (1968), post earnings announcement drift is the persistent movement of a stock price in a specific direction for some time following a good (price moves up) or bad (price moves down) earnings release. The premise is that market participants initially under-react to earnings information, thereby generating only a gradual upward or downward price move. Barberis, Shleifer and Vishny (1998) and Ritter (2003) ascribed this phenomenon to conservatism bias – the tendency to underweight new information. Frazzini (2006) asserted that bad news travels slowly among stocks trading at capital losses (when facing a capital loss, investors avoid realising the loss) and good news travels slowly among stocks trading at capital gains (immediate selling prevents a stock price from rising). Frazzini's findings are consistent with regret aversion bias and prospect theory.

The existence of an under-reaction to earnings announcements was also found by Bernard and Thomas (1989) in US share prices between 1974 and 1986. The

authors concluded that the nature of information dissemination and assimilation may result in this under-reaction. Chan, Frankel and Kothari (2004) found evidence of under-reaction to one year accounting news in US equities between 1975 and 2000. Rendleman Jr, Jones and Latane (1982) considered earnings 'surprises' in the US between 1970 and 1980 and identified a lagged price response after the initial information release. Others explored under-reaction to other corporate news: for example, Shleifer (2000) found that after corporate announcements (which may include earnings, dividend initiations or misses, share repurchases, splits or equity offerings) stocks experience a significant initial price change followed by a slow drift in the same direction for some time, consistent with under-reaction. Ikenberry and Ramnath (2002) showed that market prices under-react in the event of stock splits in the US between 1988 and 1997. Finally, rather than looking at historical stock market prices, Kirchler (2009) designed an experiment consisting of the behaviour of ten traders over 24 periods. The author observed under-reaction of price changes to fundamental information in both bull and bear markets.

2.3.3 *Behavioural theories and evidence on the interaction of over-reaction and under-reaction combined*

As Ritter (2003) attested, the existence of well-established biases predicting and supporting both over-reaction and under-reaction in financial markets is one of the major criticisms levelled at behavioural finance. Challengers of behavioural finance assert that advocates of investor psychology as a theoretical basis for market inefficiency tend to employ these explanations ex post facto to 'fit' results. As Hirshliefer (2001) argued, however, patterns of mispricing are dynamic, and models of dynamics could explain inter-temporal patterns such as the interaction of under- and over-reaction due to liquidity differences, size differences, and information dissemination.

Daniel et al. (1998) proposed a theory to this effect based on investor overconfidence and biased self-attribution, which causes asymmetric shifts in confidence as investment outcomes change. The authors suggested that overconfidence results in excess volatility, long-term price reversals, and predictability based on public information, while biased self-attribution results in

momentum and post earnings announcement drift. Kaestner (2006) also found evidence of simultaneous over- and under-reaction, with under-reaction dominating short-term price movements and over-reaction, brought on by representativeness, being a long-term phenomenon.

Dreman and Lufkin (2000) proposed that over-reaction and under-reaction could be seen as part of the same process. The authors asserted that the outperformance (underperformance) of the best (worst) stocks could be explained by investor overreaction before purchasing (selling) the stock, resulting in the prices being driven higher (lower). The resultant correction (following rapid price appreciation or depreciation) would take much longer, indicative of a subsequent under-reaction. Lin and Rassenti (2008) built on this integrated approach and put forth a price inertia theory of under- and over-reaction. The authors proposed that as information arrives over time, prices slowly converge toward intrinsic value; thereafter, when news surprises give the same signs, prices continue to fall behind new intrinsic values, manifesting in under-reacting drifts. When news surprises change signs, prices again do not move quickly enough towards intrinsic values, resulting in a 'temporal pattern of overreacting reversals'.

2.4 Theory of momentum share price behaviour

Although the concept of momentum was first described circa 1922, rather simplistically, by Jesse Livermore, who noted that prices 'are never too high to begin buying or too low to begin selling' (LeFevre, 1923), the theory of momentum in stock price behaviour traces its roots to the concept of relative strength as first introduced by Gartley (1945) and later defined by Levy (1967) as the strength of past stock price movement. Levy asserted that abnormal profits could be earned by investing in stocks that exhibit price strength relative to the rest of the market. Although Jensen and Bennington (1970) put Levy's findings down to selection bias, several others found support for relative strength investing (Akemann & Keller, 1977; Bohan, 1981; Brush & Boles, 1983; Jacobs & Levy, 1988).

Momentum investing is different from relative strength investing in that it measures a share's strength relative to its own performance as opposed to the rest of the market.

Several distinct momentum trading strategies have been developed over the last 22 years, including the 'traditional approach' (Jegadeesh & Titman, 1993), earnings momentum (Chan et al., 1996), the industry approach (Moskowitz & Grinblatt, 1999), the 52-week-high strategy (George & Hwang, 2004), and a new strategy recently proposed by Varadi (2014) known as probabilistic momentum, which has not yet been academically tested.

2.4.1 *The traditional approach to momentum investing*

Jegadeesh and Titman (1993) developed what is now considered to be the conventional (or traditional) momentum strategy. The strategy is based on returns of individual stocks in which 'losers' over a specific time period are sold and 'winners' are bought. The authors found that the strategy generates significant positive returns in the US stock market over three- to twelve-month holding periods. The strategy was based on the concept of relative strength as introduced above.

Apart from Jegadeesh and Titman (1993), others have shown that investors can earn momentum profits (employing the traditional approach) in the US (Gutierrez & Kelley, 2008; Chan et al., 1996; Jegadeesh & Titman, 2001; Lewellen, 2002). Outside the US, Griffin et al. (2005) investigated momentum in 40 stock markets and found that momentum profits are economically significant around the world. Rouwenhorst (1998) found that momentum strategies are profitable over the medium term in 12 European markets, and Hon and Tonks (2002) observed that momentum profits could be earned in the UK over certain time periods. Rouwenhorst (1999) reported significant momentum profits in 20 emerging markets, while Chui, Titman and Wei (2000), Kang et al. (2002), and Cheng and Wu (2010) found evidence of medium term price persistence in Asian stock markets. Fraser and Page (2000) showed that momentum profits could be earned on the JSE.

2.4.2 *Earnings momentum and post earnings announcement drift*

Traditional momentum strategy proposes that it is possible to profit from price momentum, or momentum in stock returns. Earnings momentum and post earnings announcement drift are closely related to this concept in that proponents of earnings

momentum believe that earnings per se drive post-announcement drift (a price reaction), which allows price momentum strategies to be successful in the first place. The concept of earnings momentum can be traced to findings by Ball and Brown (1968) and Bernard and Thomas (1989) on post earnings announcement drift but was first found to be an independent, profitable momentum strategy (separate from price momentum) by Chan et al. (1996).

Earnings momentum strategies often employ standardised unexpected earnings (SUE) and analyst revisions as buy and sell signals. The rationale here is that earnings surprises or earnings expectation revisions will induce post earnings announcement drift – if the earnings surprise or expectation adjustment is positive, prices will slowly adjust upward, and vice versa.

Earnings momentum has been found to be profitable and perhaps even a precursor for price momentum in 16 European countries and in the US (Leippold & Lohre, 2008). Hong, Lee and Swaminathan (2003) observed that the strategy yields abnormal returns in several western countries and Hong Kong, but falls short in other Asian markets. The authors also highlighted that price momentum strategies are only profitable in countries where earnings momentum exists. Chordia and Shivakumar (2006) found that the predictive ability of price momentum is zero when accounting for earnings momentum, further supporting the above findings. Several reasons for the seeming interrelation of price and earnings momentum strategies were proposed by Hong et al. (2003). First, both price momentum and earnings momentum are manifestations of similar cognitive biases inherent to human market interactions; second, in both instances, momentum is associated with country-specific information dissemination issues (also behaviourally induced). Hirshleifer (2001), for example, noted that securities with the strongest price momentum effects also exhibit the strongest post earnings announcement drift (believed to be a manifestation of earnings momentum).

Based on these findings, earnings momentum is assumed to be incorporated in price momentum in this study; therefore, the strategy is not independently tested.

2.4.3 *Industry momentum*

Based on price momentum (and inadvertently earnings momentum), Moskowitz and Grinblatt (1999) presented evidence of the success of a price momentum strategy based on industry classification. The strategy involves the purchase (sale) of shares from industries that have outperformed (underperformed) in the past. The authors found that industry components contribute significantly to specific shares' return momentum – industry portfolios that have performed well in the past continue to perform well, and industry portfolios that have performed poorly in the past continue to perform poorly. Moskowitz and Grinblatt (1999) asserted that industry effects, rather than stock specific effects, drive price momentum. In this pioneering study, the strategy was found to be more profitable than conventional, individual stock momentum strategies in the US.

Several authors found evidence of industry momentum in numerous markets. O'Neal (2000) showed that the industry momentum strategy could be successfully employed when considering sector mutual funds in the US, and Swinkels (2002) showed that industry momentum is significant in the US and Europe, but not in Japan. Giannikos and Ji (2007) found that industry momentum earns significant profits in 38 countries globally including emerging markets in Latin America and Asia, and South Africa.

Although industry momentum has been characterised as a consequence of single stock price momentum (traditional approach) by some (Pan, Liano & Huang, 2004), the independence of these strategies has been well established (Giannikos & Ji, 2007; Chordia & Shivakumar, 2002). This study therefore considers the traditional approach and the industry approach independently.

2.4.4 *The 52-week-high strategy*

A different approach to measuring underlying momentum was developed by George and Hwang (2004). Known as the 52-week-high strategy, this approach reflects anchoring and adjusting bias and proposes a short-term trading strategy (six- to twelve-month holding period) based on price nearness to the 52-week-high. A share closer to its 52-week-high is expected to outperform a share further away from its 52-

week-high. The theory is based on the assertion that ‘a stock whose price is at or near its 52-week-high is a stock for which good news has recently arrived’ (George & Hwang, 2004: 2146). The authors found that this strategy outperforms a strategy based on past returns in the US (specifically the industry approach and the traditional approach).

Sapp (2011) asserted that the 52-week-high strategy is significant in predicting mutual fund returns in the US, while Liu et al. (2011) demonstrated that the strategy is robust in ten international stock markets across Europe and Asia and Marshall, and Cahan (2005) found that the 52-week-high strategy produces significant returns when employed in the Australian stock market.

2.4.5 *Probabilistic momentum*

New expansions on well-tested concepts are often discovered, and Varadi’s (2014) concept of probabilistic momentum is no different. Although rigorous empirical testing is currently lacking, it may be worthwhile to broadly outline this approach. The strategy employs relative probabilities to make better informed trades, thereby reducing the frequency of trading (and ultimately transaction costs) to provide a smoother profit trajectory. Since the strategy has not yet been the subject of academic research, it remains outside the scope of this study.

2.4.6 *Comparison of momentum strategies*

In comparing different momentum-based strategies, several conflicting findings are presented across different geographies and time-periods.

George and Hwang (2004) found that in the US, the 52-week-high strategy is a better predictor of future returns than the traditional approach between 1963 and 2001. Marshall and Cahan (2005) mirrored this finding in Australia between 1990 and 2003, and also found that the 52-week-high strategy outperforms the industry momentum strategy. From a broader standpoint, through analysing market indices of 44 countries between 1970 and 2009 in US dollar terms, Bornholt and Malin (2011) found that the traditional approach significantly outperforms the 52-week-high

approach in both developed and emerging markets, while Gupta et al. (2010) found that across 51 countries and over the 25 years prior to 2007, the conventional momentum strategy tends to outperform both the 52-week-high strategy and the industry momentum strategy.

The success of momentum-based methods have been explored in South Africa based, for the most part, on the past returns strategy popularised by Jegadeesh and Titman (Chan et al., 2000; Van der Hart et al., 2003; Griffin et al., 2005; Achour, et al., 1998, Sehgal & Jain, 2012). In South Africa, the performance of the 52-week-high strategy and the industry momentum strategy, and the comparison of the three strategies are still sparse and largely unexplored.

2.5 Theory on why momentum profits can be earned

While the existence of momentum (in certain instances at least) is difficult to refute, many conflicting theories on what its potential causes still exist. Much effort has been made to conform momentum to existing asset pricing models – all coming short of providing a sound explanation for this pricing phenomenon (Fong, Wong & Lean, 2005). Fong et al. (2005) listed several instances of this: for example, Jegadeesh and Titman (1993) and Cooper, Gutierrez and Hameed (2004) found that momentum is not caused by market risk, Fama and French's unconditional three-factor model cannot explain momentum (Fama & French, 1996; Grundy & Martin, 2001), and momentum appears to be generally unrelated to macro-economic factors (Cooper et al., 2004). Further to this, Jegadeesh and Titman (2001) found experimental design flaws in Conrad and Kaul's (1998) finding that the profitability of momentum strategies may stem from cross-sectional variations in mean returns rather than any predictable time-series variations in stock returns. After correcting for these flaws, Jegadeesh and Titman (2001) found that few (if any) of the profits earned in employing momentum strategies were due to the cross-sectional variation in mean returns.

In line with Jegadeesh and Titman (2001), and Hong and Stein (1999), Fong et al. (2003) concluded that models incorporating behavioural biases of investors may offer a more promising alternative to risk-based explanations of momentum.

In forming the behavioural-theoretical basis of momentum trading strategies, market participants have been found to exhibit asymmetric response behaviour, in other words over- or under-reaction to information (Hur et al., 2010). Hur et al. (2010) proposed two main schools of thought on how investor behaviour induces momentum effects. The first proposes that investors perpetually under-react to new information; the second, that investors tend to overreact to new information. A third explanation is also offered by others – that momentum effects are generated (and short term in nature) due to the interaction of over- and under-reaction to new information (Daniel et al., 1998; Hong & Stein, 1999; Jegadeesh & Titman, 1993; Appiah-Kusi & Menyah; 2003). Specific cogitative and emotional biases inherent to humans were offered as explanations for these occurrences in several studies.

On the subject of overreaction, Brown et al. (2008) found that institutional managers overreact to new information, which causes an overreaction in stock prices due to herding. De Bondt and Thaler (1985) found that stock market participants overreact to new information. The overreaction is attributed to 'recency' bias whereby new information is given greater weight than prior known information. Offerman and Sonnemans (2004) proposed that due these recency effects, investors overreact to positive and negative price moves, which results in them becoming too optimistic about winners and too pessimistic about losers.

In direct contrast to De Bondt and Thaler, Barberis et al. (1998) asserted that conservatism bias (and anchoring and adjusting) may lead to market participants' under-reacting to new information, as investor's underweight new information when adjusting their expectations. Grinblatt and Han (2005) and Abbes, Boujelbène and Bouri (2009) suggested that with 'winning' stocks, investors under-react to positive firm-specific news, while with 'losing' stocks, they under-react to negative firm-specific news as a result of the disposition effect.

When considering the interaction of these two phenomena, Jegadeesh and Titman (1993) suggested that investors may under-react to information relating to short-term prospects and overreact to information relating to the long-term prospects of a company. The authors emphasised the plausibility of this notion given that the

information available on a firm's short-term prospects (like earnings forecasts) differs from the more technical information used to gain insight into its long-term prospects (like historical financials). Daniel et al. (1998) proposed that an investor exhibits overconfidence in his or her own assessments of a company and that, subsequently, share prices exhibit overreaction to new public information that confirm prior beliefs (confirmation bias) and under-reaction to new public information that disproves past ideas. Finally, Hong and Stein (1999) proposed a unique unified theory of investor over- and under-reaction and how these relate to momentum in share returns. The authors suggested that investors under-react to new information in the short term due to the gradual nature in which information is diffused, where after momentum traders themselves overreact to new information (be it due to overconfidence, availability bias, or representativeness) thereby inducing momentum profits.

The theories discussed thus far all assume that purchase and sale choices are 'different sides of the same coin' (Barber & Odean, 2008). However, the drivers of momentum could be disjointed or completely different for 'losers' and 'winners'. Barber and Odean (2008) asserted that purchase decisions are often marred by behavioural bias since heuristics (rules of thumb) are incorporated to filter through the vast number of stocks available for purchase. The authors contended that in the absence of the opportunity to short (usually only readily available at an institutional level), investors only have a small subset of stocks to sell – those they already own.

2.5.1 *Buy-side effects*

On the buy side, it appears that investors initially under-react to new information due to a combination of slow dissemination of information to the broader market, and behavioural traits such as anchoring and adjusting, conservatism, regret aversion, or confirmation bias in the event that new information contradicts investors' initial perceptions. This provides momentum traders with an opportunity to enter the trade at 'under-reacted' levels. Thereafter, information disseminates to the broader market and investors overreact to new information (due to herding, 'recency' bias, representativeness, or overconfidence), pushing the price higher and allowing momentum traders to profit. As asserted by Hong and Stein (1999), momentum traders may even be the reason why the price of a 'winner' continues to rise (due to

trader herding). Barber and Odean (2008) also confirmed herding behaviour by market participants and showed that individual investors overreact to price information and tend to buy 'attention-grabbing' stocks which include counters that have exhibited high returns in the past. This also confirms Offerman and Sonnemans' (2004) 'recency' theory.

2.5.2 Sell-side effects

On the sell side, the initial under-reaction is also prevalent due to the gradual diffusion of information to the investing public. Under-reaction can also be attributed to the disposition effect, regret aversion, conservatism bias, or confirmation bias in the event that new information contradicts investors' initial perceptions. The under-reaction may also be due to the fact that the subset of stocks available for sale is relatively small for individual investors and short selling is, for the most part, confined to institutional trading (Barber & Odean, 2008). Overreaction follows again for the same reasons as on the buy side. The overreaction will be limited somewhat due to the disposition effect (Grinblatt & Han, 2005; Abbes et al., 2009), but will nevertheless allow momentum traders to profit after entering the trade following the initial under-reaction to new information.

2.6 Conclusion

This aim of this literature review was to provide context and background to the subject of momentum-based investing and to identify the gaps in the current literature upon which this study is based. Conflicting evidence was presented on market efficiency and several methodological shortcomings were identified. These included the gradual nature of information dispersion, different reactions to new information, the cost of obtaining information, as well as the overlooked effect of investor psychology on asymmetric responses to new information, and ultimately, asset prices. Based on theories of behavioural finance, a background to the over-reaction and under-reaction phenomena in financial markets was provided as a foundation for discussions on why momentum profits can be earned.

Specific momentum strategies were then discussed and the need to explore the relative performance of these strategies in the South African equity market was highlighted. The most widely researched strategies were identified as the 'traditional approach', the 52-week-high approach and the industry approach. Amongst them, only the traditional approach had previously been tested in isolation in the South African equity market. Scope exists, therefore, to test these three strategies simultaneously so as to ascertain whether the application of a momentum based strategy in South Africa can yield excess profits and to determine which of the three strategies performs best. In testing whether excess profits can be earned in the South African equity market, this study will also indirectly test for weak form efficiency since trading strategies based on past price movements should not yield excess returns in a weak form efficient market.

Finally, the literature was consulted on possible reasons why momentum profits can be earned. While claims of market risk factors, mean reversion and macro-economic influences have been widely refuted, several authors, including Jegadeesh and Titman (2001), Hong and Stein (1999), and Fong et al. (2003) concluded that models incorporating behavioural biases of investors may offer a more promising alternative to risk-based explanations of momentum.

Chapter 3: Research Methodology

3.1 Introduction

This study incorporates three distinct momentum investing strategies that were previously tested and compared in equity markets (both developed and developing country equity markets). The JSE is a well-developed emerging market stock exchange, and it is assumed that these strategies could be applied in this market. The three momentum strategies are implemented on the same sample and the results compared with one another as well as with a passive (control) portfolio. The momentum strategies are replicated from foundation studies by Jeegadeesh and Titman (1993), Moskowitz and Grinblatt (1999), and George and Hwang (2004) and therefore deemed appropriate for purposes of comparison.

Jegadeesh and Titman (1993) developed what is now known as the traditional momentum strategy, George and Hwang (2004) proposed the 52-week-high strategy, and Moskowitz and Grinblatt (1999) proposed that an industry-based momentum strategy can be successfully implemented. The strategies to establish the three momentum portfolios are summarised in the sample design section of this Research Methodology chapter. The passive (control) portfolio is a passive (control) portfolio consisting of the top 100 stocks (by market capitalisation) listed on the main board of the JSE.

Until now, the industry-based and 52-week-high strategies had not yet been exclusively tested in the South African market. Apart from this, a comparative study considering all three approaches had also not yet been attempted in South Africa. A point of contention may be the omission of the earnings momentum strategy. Based on prior findings highlighted in Chapter 2 of this study, earnings momentum is assumed to be incorporated in price momentum in this study; consequently, the strategy is not independently tested.

The chapter considers the broader research design, after which the sample design and methodology are discussed. The measurement characteristics are then reviewed and, finally, the study limitations and delimitations are considered in depth.

3.2 Research design

Due to the numerical nature of data employed in this empirical study, it follows a quantitative explanatory approach employing several distinct data analysis techniques. As explained by Saunders, Lewis and Thornhill (2012), the object of explanatory research is to garner a causal relationship between variables. In this case, an attempt is made to assert whether momentum strategies yield returns in excess of a random portfolio. This part of the strategy emulates a pseudo-experiment whereby a passive strategy approach acts as the 'control' and the different investment strategies employed are the experiments. An experiment or pseudo-experiment is especially valuable when undertaking practical research (Lipsey & Hurley, 1990) since it simulates a real-life scenario. This allows the researcher to draw stronger conclusions than otherwise possible (Jackson, 2012). In terms of drawbacks, Stangor (2011) and Jackson (2012) assert that, due to the non-random assignment to groups (experiment and control), the pseudo-experiment may have several threats to internal validity. In other words, the results may be open to alternative explanations or flaws. In this particular study, therefore, exhibited momentum effects may have been anomalous. However, by conducting a longitudinal study over the very long term (20 years), the results may be validated as more than a statistical fluke (Stangor, 2011).

3.3 Sample design

The study incorporates monthly data from May 1994 to May 2014. The time period was chosen since South Africa experienced a significant structural change following its first democratic election on April 27th 1994. When considering a data set, it is of vital importance to correctly analyse data from the point of a structural shift so as to not distort results (Bekaert & Harvey, 2002).

Secondary stock market price data are sourced from the JSE. The sample incorporated the top 100 shares by market capitalisation at the beginning of each month. Existing listings as well as shares that were delisted for whatever reasons are included so as to eliminate the potential of survivorship bias from the result. Taking survivorship bias into account is important for constructing an experiment in two key ways. Firstly, samples spoilt by survivorship bias could intensify the appearance of return predictability, and secondly, comparability to the control (the benchmark) may be compromised since it will not present with survivorship issues (Brown, Goetzmann, Ibbotson & Ross, 1992).

Seven distinct portfolios are constructed, six of which reflect the three momentum-based strategies, with the seventh being a 'control' portfolio consisting of all top 100 stocks. Two portfolios are constructed, rebalanced, altered, and maintained for each momentum strategy as proposed by George and Hwang (2004). These portfolios are labelled as the 'loser' portfolios and the 'winner' portfolios. The portfolio construction strategies are summarised in Table 3.1:

Table 3.1: Portfolio Construction

Portfolio	Short Name	Construction
Traditional Approach 'winner'	TW	The winner portfolio was an equally weighted portfolio of 30% of stocks with the highest past 6-month return. Each month, a new portfolio was formed based on past 6-month returns. The position was held for six months.
Traditional Approach 'loser'	TL	The loser portfolio was an equally weighted portfolio of 30% of stocks with the lowest past 6-month return. Each month, a new portfolio was formed based on past 6-month returns. The position was held for six months.
Industry Approach 'winner'	IW	The winner portfolio was an equally weighted portfolio of the top 30% of stocks ranked by the value-weighted industry return (GICS sector classification). Each month, a new portfolio was formed based on past 6-month returns. The position was held for six months.
Industry Approach 'loser'	IL	The loser portfolio was an equally weighted portfolio of the bottom 30% of stocks ranked by the value-weighted industry return (GICS sector classification). Each month, a new portfolio was formed based on past 6-month returns. The position was held for six months.
52-Week Approach 'winner'	52W	The winner portfolio was an equally weighted portfolio of the 30% of stocks with the highest ratio of current price to 52-week-high. Each month, a new portfolio was formed based on past 6-month returns. The position was held for six months.
52-Week Approach 'loser'	52L	The loser portfolio was an equally weighted portfolio of the 30% of stocks with the lowest ratio of current price to 52-week-high. Each month, a new portfolio was formed based on past 6-month returns. The position was held for six months.
Top 100 portfolio	Control	Top 100 shares. Equal weighted, held for six months.

Source: Author's own representation

The portfolio returns are measured on a monthly basis and recorded. Overall, there are 236 sample monthly returns in each resultant time series.

3.4 Methodology

The methodology has three distinct phases. First, the resultant portfolio performances are tested for significant differences to one another. Second, the risk adjusted performances are analysed. Finally, Chow's test for structural breaks is performed in order to garner insight into whether financial crisis affected the behaviour of the strategies.

3.4.1 *Testing for significant differences in performance*

Student's t-test (for paired samples) is applied to each portfolio relative to one another and the random portfolio, since Student's t-test has often been used to test for differences between two means. A paired comparisons test is used since the portfolios can be termed as dependent, meaning that they have something in common (DeFusco, McLeavey, Pinto & Runkle, 2007). DeFusco et al. (2007) state that a pairwise comparison is suitable for the comparison of investment strategies. The specific strategies can then also be contrasted for efficacy.

The distinct null and alternative hypothesis in the case of a comparison to the random portfolio can be written as:

$$H0: u_{di} = u_{d0}; Ha: u_{di} \neq u_{d0}$$

where u_{di} is the mean of the strategy portfolio i and u_{d0} is the mean of the random portfolio.

The distinct null and alternative hypothesis in the case of a comparison between strategy portfolios $(i - j)$ is:

$$H0: u_{di} = u_{dj}; Ha: u_{di} \neq u_{dj} \text{ or } H0: u_{di} = u_{dj}; Ha: u_{di} \neq u_{dj}$$

where u_{di} is the mean of the strategy portfolio i and u_{dj} is the mean of the strategy portfolio j.

The t-statistic is calculated as:

$$t = \frac{d - u_{d0}}{s_d}$$

where d is the sample mean difference and s_d is the standard error of the mean difference.

3.4.2 *Risk adjusted performance comparison*

After the pure returns of the portfolios are tested, the risk-adjusted returns of the portfolios are contrasted. The modified Sharpe ratio (Gregoriou & Gueyie, 2003) is employed as the risk-adjusted returns measure. The modified Sharpe ratio incorporates modified VaR as its risk measure, as opposed to the standard deviation, which is considered as a measure of risk in the traditional Sharpe measure.

$$Modified\ Sharpe = \frac{R_{pi} - R_f}{modified\ VaR}$$

where R_{pi} is the return on portfolio i and R_f is the return on a risk-free portfolio. In this case, the South African 10-year generic government bond yield is used.

The modified VaR was first proposed by Favre and Galeano (2002), who employed a Cornish-Fisher expansion to traditional VaR. The authors argued that, by adjusting for skewness and kurtosis, returns that follow a non-normal distribution can be more accurately assessed.

$$Modified\ VaR = \left\{R_{pi} + \left[z_c + \frac{1}{6}(z_c^2 - 1)S + \frac{1}{24}(z_c^3 - 3z_c)EK - \frac{1}{36}(2z_c^3 - 5z_c)S^2\right]\sigma\right\}$$

where z_c is the critical value on a normal distribution; S is skewness; EK is excess kurtosis; and σ is the standard deviation of portfolio returns.

3.4.3 *Chow's test for structural breaks*

Structural breaks are hypothesised for two significant financial crisis periods, namely the Asian currency crisis and the Great Recession. F-statistics are calculated to garner whether the three tested strategies (TL, 52L, and IL) behave differently relative to the Top 100 before and after the Asian currency crisis, and before and after the most recent financial crisis (the Great Recession). The F-statistics are calculated as follows:

$$F = \frac{RSS_c - [\frac{RSS_1 + RSS_2}{k}]}{[(RSS_1 + RSS_2)/(n - 2k)]}$$

Where RSS_c is the regression sum of squares for the combined model; RSS_1 is the regression sum of squares for the first model (pre-crisis); and RSS_2 is the regression sum of squares for the second model (post-crisis). The F statistic is analysed with K and $N - 2K$ degrees of freedom. K is the number of models employed and N the total number of observations.

3.5 Measurement characteristics

3.5.1 *Validity*

Validity is concerned with the extent to which a measure can be shown to measure what it actually intends to measure (Cramer & Howitt, 2004). The study is tested for internal and external validity. Internal validity refers to whether the momentum strategies employed result in a different outcome to that seen in the passive (control) portfolio, and whether there is sufficient evidence to support the claim. External validity refers to whether the results can be generalised to include the entire

population, specifically the South African top 100 listed equities by market capitalisation across all time frames.

Due to the objective nature of the data used to conduct the study and the careful methodology followed to obtain the results, the study's sole threat to internal validity is the non-random assignment to the pseudo-experimental groups (Stangor, 2011; Jackson, 2012).

In other words, the exhibited momentum effects may only be anomalous. However, by conducting a longitudinal study over the very long term (20 years), the results may be validated as more than a statistical fluke (Stangor, 2011).

External validity is ensured through the careful construction of the research design (Ondercin, 2004), although certain threats to external validity are very difficult to eliminate entirely: specifically, that the sample set may exhibit a non-representative response (Norris, 2005). The best strategy identified in this study may not always be the best, and the strategies may not be successfully employed when considering smaller, less liquid, counters or a subset of the sample stocks used in the study. Exhaustive documenting of the research methodology employed, however, can allow the test to be replicated successfully (albeit with perhaps a different outcome) and external validity will be maintained.

3.5.2 *Reliability*

Reliability refers to the extent to which the experiment or test can consistently produce the same outcome: in other words, if the same results will be achieved if the experiment is replicated (Robinson, 2008). Bryman and Bell (2011) highlighted three factors to take into consideration when measuring reliability, namely, stability, internal reliability, and inter-observer consistency.

This study is fully repeatable and therefore stable, and the same results will be found by others if conducted over the same period of time across the same sample. Historical financial data obtained from a reputable source will not change over time.

The statistical methods used in the analysis are clearly laid out and inter-observer consistency is therefore possible.

For the same reasons highlighted above, internal reliability will be established when considering a test-retest measurement technique. While not a necessary condition for internal validity in this particular experiment, split-half reliability will be measured so as to garner an idea of the consistency of the results of the pseudo-experiment over time. The sample is divided into two ten-year periods, 1994 to 2004 and 2004 to 2014, over which the experiment is conducted. Apart from the analysis being conducted and the results compared on both sample sets, the resultant time series of each distinct strategy are compared. This comparison will be affected by taking the correlation coefficients of the corresponding strategies. The split-half correlation coefficient r_{SH} can be calculated as follows:

$$r_{SH} = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum xy)^2]}}$$

where n is the number of pairs of returns, x is the first half of outcomes, and y is the second half of outcomes.

According to Furr (2010), the split-half estimate, a form of the Spearman-Brown prophecy formula, is then taken.

$$Split - half\ estimate = \frac{2r_{SH}}{1 + r_{SH}}$$

where r_{SH} is the split-half correlation coefficient. The reliability score will range between zero and one. The more reliable the experiment, the closer to one the resultant score will be.

3.6 Limitations and delimitations

According to Rudestam and Newton (2014), limitations refer to restrictions in the study over which one has no control, while delimitations are deliberately imposed limitations on the research design.

3.6.1 *Limitations*

The sampling period is limited to post-April 1994 so as to account for a possible structural break that took place on April 27th, 1994 as highlighted in the sampling design section.

3.6.2 *Delimitations*

The study limits the sample of shares used to the top 100 shares by market capitalisation traded on the JSE. Monthly returns data are used since the reference studies used employed the same measurement period.

A second delimitation revolves around transaction costs. This study does take into account the transaction costs inherent to trading in the momentum portfolios. Transaction costs in emerging markets have trended downward in the past (Domowitz, Glen & Madhavan, 2000); incorporating historically high costs in the portfolio would have resulted in a downward bias to the momentum portfolios constructed relative to those tested in other markets. If trading costs are expected to continue to decline in this market, the after-cost result would be significantly different going forward. Finally, the study does not take into account liquidity and the resultant impact of delayed trading. First, the sample delimitation to the top 100 shares by market capitalisation should mitigate this impact somewhat. Second, the studies upon which the research was based also did not take into account the possibility of trading delays.

3.7 Conclusion

The chapter considered the broader research design, the sample design and the methodology employed in this study. The measurement characteristics were reviewed and the limitations and delimitations were considered.

The study follows a quantitative explanatory approach employing several distinct data analysis techniques incorporating secondary monthly data of the top 100 JSE-listed shares by market capitalisation from May 1994 to May 2014. Seven portfolios are constructed, six of which reflect the three momentum-based strategies, with the seventh being a 'control' portfolio. In terms of data analysis methodology, the resultant portfolio performances are tested for significant differences to one another using Student's t-test (for paired samples), the risk-adjusted performances as measured by the modified Sharpe ratio are analysed, and Chow's test is performed to test for structural breaks in the dataset.

Chapter 4: Results & Discussion

4.1 Introduction

This chapter begins by discussing the findings stemming from the implementation of the data analysis methods discussed in Chapter 3. The results of the trading strategies are presented, after which the significance of any documented outperformance against the passive (control) portfolio and other trading strategies is explored. This was done on both a return-only and a risk-adjusted returns basis. The results are discussed within the context of earlier findings and the literature explored in Chapter 2. Finally, the reliability, validity, limitations, and delimitations of the study are presented and argued.

4.2 Empirical findings

To judge from the arithmetic average performances of the 'winner' and 'loser' portfolios in each strategy as well as the passive (control) portfolio, it seemed as if the traditional approach 'winner' portfolio (TW) outperformed both the other momentum portfolios as well as the passive (control) portfolio. The initial findings are summarised in Table 4.1:

Table 4.1: Arithmetic Mean Six Month Performance Summarised

Portfolio	Short Name	Average Six Month Performance
Traditional Approach 'winner'	TW	11.02%
Traditional Approach 'loser'	TL	5.37%
Industry Approach 'winner'	IW	10.71%
Industry Approach 'loser'	IL	5.94%
52-Week Approach 'winner'	52W	8.71%
52-Week Approach 'loser'	52L	8.54%
Top 100 portfolio	Control	8.45%

Source: Author's own calculation

All the 'winner' portfolios performed better than the 'control' portfolio, the 'winner' portfolios outperformed all the 'loser' portfolios, and the control outperformed all the loser portfolios but one (52L). The significance of these out-performances (or underperformances) was brought into question; Table 4.1 and Figure 4.1 show that the industry approach 'winner' portfolio (IW) underperformed TW by just 0.31% per

six-month period. Further to this, the 52-week approach 'winner' (52W) outperformed the control by only 0.26% and outperformed its own 'loser' portfolio (52L) by just 17 basis points. Figure 4.2 shows that the 52L portfolio, in fact, outperformed both the control and the 52W portfolio up to December 2013. The need to test the differences in performances between the strategies was identified and Student's t-test was applied to do so.

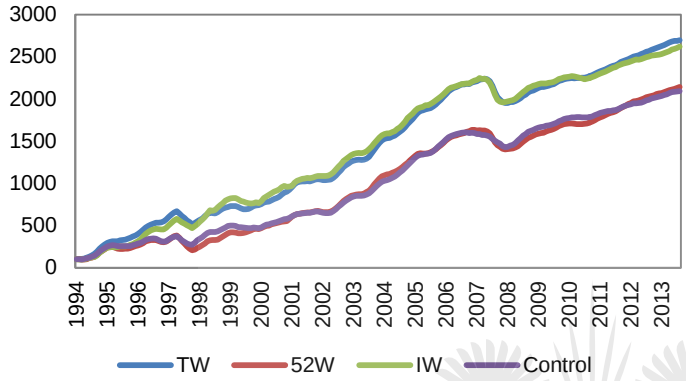

Figure 4.1: 'Winner' portfolio performances compared to passive (control) portfolio

Source: Bloomberg, Author's own calculations

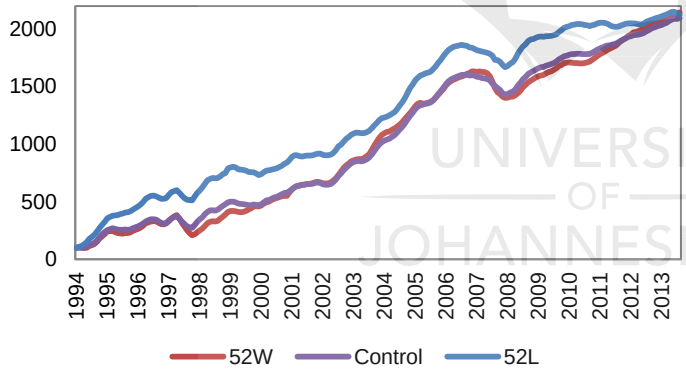

Figure 4.2: 52W and 52L portfolio performances compared to passive (control) portfolio

Source: Bloomberg, Author's own calculations

4.2.1 *Testing for significant differences in performance*

Student's t-test (for paired samples) was applied to each portfolio relative to one another and the passive (control) portfolio in order to establish whether performance differences were significant. The results are summarised in Table 4.2.

Table 4.2: Significance of difference between respective portfolio performances

Tested Portfolios	Arithmetic Mean Difference	p-value from Student's t-Test for Paired Samples	Difference significant at 5%?
TW and Control	2.58%	0.000	Yes
52W and Control	0.26%	0.521	No
IW and Control	2.26%	0.000	Yes
TL and Control	-3.08%	2.393	Yes
52L and Control	0.09%	0.827	No
IL and Control	-2.51%	0.000	Yes
TW and TL	5.66%	0.000	Yes
52W and 52L	0.17%	0.799	No
IW and IL	4.77%	0.000	Yes
TW and 52W	2.32%	0.000	Yes
TW and IW	0.31%	0.475	No
52W and IW	-2.01%	0.000	Yes

Source: Author's own calculations

Both the TW and IW portfolios were found to significantly outperform the passive (control) portfolio. TL and IL were found to significantly underperform the passive (control) portfolio. Neither 52W nor 52L were found to provide returns significantly different to the passive (control) portfolio: in other words, 52W was not found to significantly outperform and 52L was not found to significantly underperform the control. The outperformance of 52W relative to 52L was found to be insignificant. TW was found to outperform TL and IW was found to outperform IL by significant margins. Between the different strategies, it was found that TW and IW performed significantly better than 52W but that the strategies did not perform significantly different to one another.

4.2.2 *Risk adjusted performance comparison*

After the significance of the difference in returns was tested, the risk-adjusted returns of the portfolios were contrasted. The modified Sharpe ratio was employed as the risk-adjusted returns measure. The modified Sharpe ratio uses modified value-at-risk (VaR) as a risk measure as opposed to standard deviation. Modified VaR takes into account skewness and kurtosis, thereby assessing better the impact of these metrics on actual risk. The results are summarised in Table 4.3:

Table 4.3: Selected Portfolio Risk Metrics and Modified Sharpe

Portfolio	Average Six Month Return	Standard Deviation	Sharpe Ratio	Skewness	Kurtosis	Modified VaR	Modified Sharpe Ratio
TW	11.0%	15.4%	0.45	-1.7	6.6	0.04	0.27
52W	8.7%	13.6%	0.34	-1.4	4.1	0.07	0.19
IW	10.7%	16.0%	0.42	-1.6	6.3	0.06	0.24
TL	5.4%	13.7%	0.09	-0.5	3.8	0.14	0.05
52L	8.5%	14.0%	0.32	0.0	0.1	0.14	0.14
IL	5.9%	14.5%	0.13	-1.1	4.3	0.12	0.08
Control	8.5%	11.9%	0.37	-0.4	0.5	0.10	0.16

Source: Author's own calculations

Most of the portfolios, including the control, projected negative skewness. This means that the distributions have long left tails and that the portfolios exhibited few extreme losses and frequent small gains. The exception here was 52L, which was symmetrical. While all the other portfolios also exhibited excess kurtosis (kurtosis greater than 3) and were therefore leptokurtic, the 52L portfolio and passive (control) portfolio were close to normal. TW and IW had the highest levels of excess kurtosis, which means that the variance in the portfolios was caused by a few extreme deviations as opposed to smaller deviations.

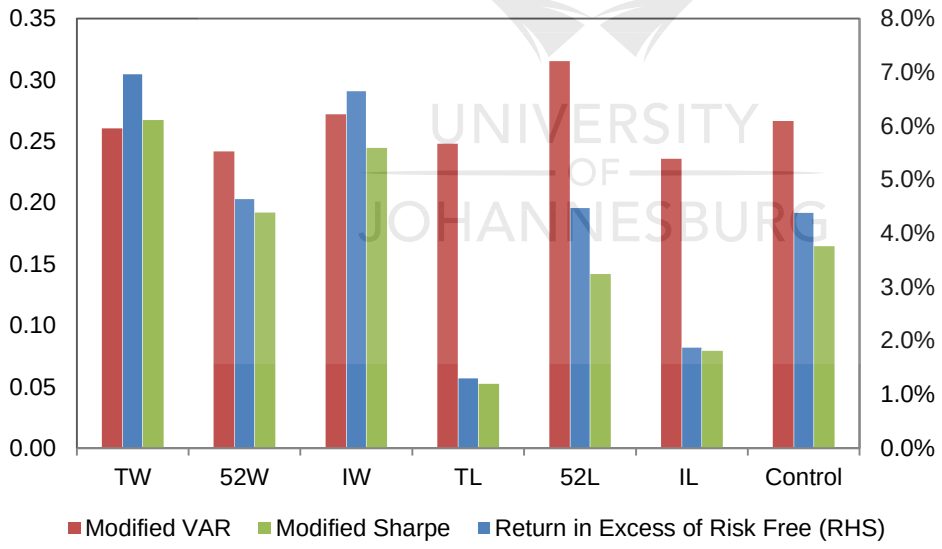

Figure 4.3: Risk and return profiles compared

Source: Author's own calculations

From Figure 4.3, it can be seen that 52L had the largest modified VaR because of the symmetrical distribution of the portfolio's returns. Negative skewness, which was observed in the other portfolios, will result in a reduced probability of large losses which, in turn, had a positive impact on modified VaR (it decreased). The modified

VaR for TW and IW was similar to the market portfolio, although the decomposition of the modified VaR showed that this result came about for different reasons. More pronounced negative skewness (as with 52L) and higher returns had a positive impact on TW and IW's modified VaR, while the high levels of excess kurtosis increased the risk of large losses. For the passive (control) portfolio, low excess kurtosis assisted the metric, while a lower return and less negative skewness resulted in a higher modified VaR number.

From the modified Sharpe ratio, it was clear that TW and IW outperformed the other portfolios on a risk-adjusted basis. TL and IL performed worst on a risk-adjusted basis, for the most part due to the lower absolute returns exhibited by these portfolios. Overall, the modified Sharpe ratio confirmed the results of the absolute return analysis. While a significant difference could not be established between TW and IW in the absolute returns analysis, the modified Sharpe ratio identified TW as the best performing portfolio (on a risk-adjusted basis) over the sample period.

4.2.3 *Other findings*

Structural breaks were hypothesised for two significant financial crisis periods, namely the Asian currency crisis (Break 1) and the Great Recession (Break 2). Chow's test for structural breaks was employed and F-statistics were calculated to garner whether the three tested strategies (TL, 52L, and IL) behaved differently relative to the passive (control) portfolio before and after the Asian currency crisis, and before and after the most recent financial crisis. Table 4.4 summarises the result of the aforementioned tests:

Table 4.4: Results – Chow's test for structural breaks

	TW	52W	IW
Break 1 F-statistic	1.2140	3.1282	0.0863
p-value	*0.6930*	*0.9722*	*0.0326*
Break 2 F-statistic	6.3224	0.5542	5.7551
p-value	*0.9995*	*0.3538*	*0.9990*

Source: Author's own calculations

The null hypothesis for Chow's test is that there is no structural break: in other words, the strategies do not behave differently. From the table above it can be

concluded that there were no structural breaks in the behaviour of the TW or 52W portfolios relative to the passive (control) portfolio (p-value > 0.05). While the Great Recession seemed to have had no impact on the behaviour of IW, the Asian currency crisis did indicate a structural break in the data.

4.3 Discussion

The findings of this study may be placed into context in light of prior studies conducted and against the behavioural finance background sketched in Chapter 2. The empirical findings from the individual strategies are discussed first, after which prior comparative findings are explored. The section concludes with possible implications for behavioural science and weak form efficiency in South Africa.

4.3.1 *Empirical findings*

4.3.1.1 *Traditional momentum strategy*

In line with findings by Griffin et al. (2005), Fraser and Page (2000), Achour et al. (1998), and Sehgal and Jain (2012), this study found that the traditional approach outperformed the passive (control) portfolio (and significantly so) in the South African equity market. The study by Griffin et al. (2005) was concluded ten years prior to the end of this study's sample period; the Fraser and Page (2000) result was generated considering returns between 1973 and 1997; Achour et al. (1998) looked only at the five year period following 1993; while Sehgal and Jain's (2012) sample period stretched between January 1993 and February 2008. This study therefore not only confirms their findings but also shows that the traditional momentum approach delivers alpha for a sample period extending to 2014.

In South Africa, the findings of this study contrasted with those of Van der Hart et al. (2003), who could not identify a significant difference in performance of traditional momentum portfolios relative to the market portfolio between 1995 and 2005. The number of shares included in momentum portfolios in the last mentioned study was on average much larger (~65) than the portfolio size employed in this study (~30). The same was true for the differences in findings to Achour et al. (1998), where the

average portfolio size was 63. In this case, the momentum periods (one month and one year) were also different to the period employed in this study (six months).

Besides confirming findings from the traditional approach foundation study conducted in the US (Jeegadeesh & Titman, 1993), the results were also in line with prior findings by Gutierrez and Kelley (2008), Chan et al. (1996), Jegadeesh and Titman (2001), and Lewellen (2002) in the US. Relative to findings from other countries and regions, the findings confirmed evidence presented by Griffin et al. (2005) for 40 stock markets across the world; Hon and Tonks (2002) in the UK; Rouwenhorst (1998, 1999) for 12 European markets and 20 emerging markets; and Chui et al. (2000), Kang et al. (2002), and Cheng and Wu (2010) in Asian stock markets.

4.3.1.2 *52-week-high momentum strategy*

For the 52-week-high approach, the results confirmed findings by Gupta et al. (2010) that a 52-week-high 'winner' portfolio does not significantly outperform a 52-week-high 'loser' strategy in the South African market. The Gupta et al. (2010) study was conducted on returns between January 1975 and July 2007. This study therefore not only confirms their findings but also shows that the 52-week-high approach is ineffective (winner does not significantly outperform loser) for a period extending to 2014.

The findings of this study were in contradiction with the findings presented in the foundation study conducted by George and Hwang (2004) as well as Sapp (2011) in the US. The results were also different to Liu et al.'s (2011) conclusions from ten international stock markets across Europe and Asia and Marshall and Cahan's (2005) findings in Australia.

4.3.1.3 *Industry momentum strategy*

With regard to the efficacy of an industry momentum strategy in isolation, this study confirmed prior findings by Giannikos and Ji (2007). The strategy yielded profits significantly higher than the passive (control) portfolio in South Africa. This study

again extended the sample period, as the Giannikos and Ji (2007) study extended only to 2000.

When considering findings from other countries and regions, the findings in this study accord with Moskowitz and Grinblatt (1999), O'Neal (2000), and Swinkels' (2002) results out of the US, as well as Swinkels (2002) in Europe and Giannikos and Ji (2007) in 38 countries globally.

4.3.1.4 *Between momentum strategy differences*

This study found that in the South African equity market, between 1994 and 2004, the traditional momentum strategy and the industry momentum strategy significantly outperformed the 52-week-high strategy. This was in line with findings by Bornholt and Malin (2011), who found that the traditional approach significantly outperformed the 52-week-high approach in 44 countries between 1970 and 2009, and partially in-line with Gupta et al. (2010). While this study confirmed the authors' finding that the traditional approach tends to outperform the 52-week-high strategy (the study was conducted across 51 countries and over the 25 years prior to 2007), the results could not confirm Gupta et al.'s (2010) second finding – that the traditional approach tends to outperform both the 52-week-high strategy and the industry momentum strategy. In this study it was found that the traditional momentum strategy does not significantly outperform the industry momentum strategy.

While the study could therefore confirm the generalisation of Jegadeesh and Titman's (1993) findings to the South African market, it could not make a similar confirmation of either George and Hwang's (2004) findings or Moskowitz and Grinblatt's (1999). For Jegadeesh and Titman (1993), the traditional momentum approach did significantly outperform the passive (control) portfolio. For George and Hwang (2004), the 52-week-high approach could not outperform the traditional approach or the passive (control) portfolio. For Moskowitz and Grinblatt (1999), while the industry momentum approach proved superior to the 52-week-high approach and delivered excess returns over the passive (control) portfolio, it did not perform significantly different to the traditional momentum approach.

The findings presented in this study were in line with the broad study conducted across 44 markets by Bornholt and Malin (2011). The authors found that between 1970 and 2009, the traditional approach significantly outperformed the 52-week-high approach in both developed and emerging markets. It was also consistent with results presented by Gupta et al. (2010), who found that, across 51 countries and between 1982 and 2007, the conventional momentum strategy outperformed both the 52-week-high strategy and the industry momentum strategy, although this study could not confirm the latter proposition on an absolute returns basis.

In light of the fact that the performance of the industry momentum strategy could not be found different to that of the traditional approach, one may consider revisiting Pan et al's (2004) findings that industry momentum is simply a consequence of single stock price momentum (traditional momentum).

4.3.2 *Behavioural explanations*

This study showed that momentum profits in excess of a random (control) portfolio could indeed be earned in the South African equity market but only by employing the traditional approach and the industry momentum approach. The results showed that the 52-week-high approach was not only less effective than the other two proposed methods, but that it was also unable to outperform the random passive (control) portfolio.

Since the traditional momentum approach was found to deliver returns in excess of a random portfolio in the South African equity market, it follows that certain behavioural biases inherent to the theory of momentum may ring true from a South African investor perspective. These include herding, 'recency' bias, the disposition effect, overconfidence, self-attribution bias, confirmation bias, availability bias, conservatism bias, and representativeness.

The equal success of the industry momentum trading strategy in the South African equity market provides proof that herding, overconfidence, and self-attribution bias and the rest may also translate to an industry level in this market. Explanations of the success of the 52-week-high strategy are often attributed to Barber and Odean's

(2008) account of bounded rationality. Its relevance to the 52-week-high momentum approach was confirmed for the US market by Huddart, Lang and Yetman (2009). Bounded rationality suggests that there are cognitive (and temporal) limits to the amount of information human beings can process (Barber & Odean, 2008). Market participants will try to limit the universe of investable shares by limiting choices in some generic way. Huddart et al. (2009) suggest that one such way would be focussing on attention-grabbing shares, for example, shares which recently breached their 52-week highs or lows. This effect, the authors argue, would be more pronounced on the buy side among smaller (retail) investors because of the limited information at their disposal. This may be why the 52-week-high strategy may have proved ineffective in the South African context; it has very recently been acknowledged that the South African market is predominantly institutionally owned (*Finweek*, 2015).

Another conclusion that can be drawn from the failure of the 52-week-high strategy in South Africa is a unique take on the 'anchoring and adjusting' behavioural bias. The 52-week-high may not be viewed as an appropriate 'anchor' by investors – perhaps because of a more pronounced conservatism bias and less weight being given to readily available information (availability bias).

4.3.3 *Implications for the Efficient Market Hypothesis*

By testing the efficacy of trading strategies based on historical price movement, this study indirectly tested for weak form efficiency in the South African market. Weak form efficiency implies that successive price changes are independent of one another (Fama, 1970). It is also a precursor for market efficiency as a whole since, by definition, equity prices in an efficient market will be unpredictable (or follow a random walk) since they fully incorporate all relevant information.

To establish weak form efficiency, Jones (2009) asserted that besides statistically testing for independence, it is possible to show that strategies implementing trading rules do not produce returns in excess of a buy-and-hold strategy after deducting trading costs (proving economic independence). Although trading costs were not considered in this study, since it was found that the traditional momentum approach

as well as the industry momentum approach generated statistically significant excess returns over a twenty-year period, there are further grounds for reconsidering the efficiency of the South African equity market.

4.4 Validity, reliability, and limitations

4.4.1 *Validity*

Internal validity was ensured through the nature of the data used, carefully following the stated methodology, and conducting a longitudinal study over the very long term. Although it is very difficult to remove all threats to external validity, careful construction of the research design would have been eliminated most threats to external validity.

4.4.2 *Reliability*

As explained in Chapter 3, reliability refers to the extent to which the experiment or test can consistently produce the same outcome (Robinson, 2008). The study considers stability, internal reliability, and inter-observer consistency when discussing the reliability of the experiment.

It was previously established that due to the data sourcing methods used and the discussion of statistical methods presented, the study is fully repeatable and therefore stable, and inter-observer consistency is possible. Split-half reliability was measured to confirm internal reliability. The split-half reliability score ranges between zero and one – the closer to one, the more reliable the experiment.

TL (0.60), 52W (0.63), and IW (0.46) exhibited split half reliability in excess of that of the passive (control) portfolio (0.40).

4.4.3 *Limitations and delimitations*

The only limitation was that the sampling period was limited to post-April 1994 so as to account for a possible structural break that took place on April 27th, 1994. There

were several delimitations, however, including that the sample was limited to the top 100 JSE-listed shares, transaction costs were not taken into account, and liquidity was not factored in. These limitations and delimitations were discussed in full in Chapter 3.

4.5 Conclusion

This chapter began by discussing the results of the data analysis portion of the study. On a returns-only basis, it seemed as if the traditional approach winner portfolio (TW) outperformed both the other momentum portfolios as well as the passive (control) portfolio. All the 'winner' portfolios performed better than the 'control' portfolio, the 'winner' portfolios outperformed all the 'loser' portfolios, and the control outperformed all the loser portfolios but one (52L). Employing Student's t-test (for paired samples), it was found that the 52-week-high portfolios did not significantly outperform the passive (control) portfolio and 52W did not significantly outperform 52WL. Conversely, both the TW and IW portfolios significantly outperformed their respective 'loser' portfolios as well as the passive (control) portfolio, but not each other. This implies that a South African investor could expect excess returns from employing either the traditional momentum approach or the industry momentum approach but not the 52-week-high approach. This result was confirmed by the results of the risk-adjusted comparison as well. Evidence of a structural break or change in the behaviour of the industry momentum approach following the Asian currency crisis was found. No evidence of structural breaks was found for either the tradition momentum approach or the 52-week-high approach.

The findings were discussed in the context of prior research conducted on these momentum strategies, specifically in South Africa. The fact that the traditional approach outperformed the passive (control) portfolio confirmed prior findings by Griffin et al. (2005), Fraser and Page (2000), Archour et al. (1998), and Sehgal and Jain (2012). The findings of this study were in contrast to Van der Hart et al. (2003). For the 52-week-high approach, the results confirmed findings by Gupta et al. (2010) – that the 52-week-high winner portfolio could not outperform a passive (control) portfolio. The study also confirmed prior findings by Giannikos and Ji (2007) that the industry momentum approach yields excess profits in South Africa.

Since this study is the first to contrast the three methods in the South African market, the results of the comparison were specifically contrasted to other international markets. The finding that traditional momentum strategy and the industry momentum strategy significantly outperformed the 52-week-high strategy was in line with findings by Bornholt and Malin (2011), who found that the traditional approach significantly outperformed the 52-week-high approach in 44 countries between 1970 and 2009, and partially in line with Gupta et al. (2010). The latter found that the traditional approach tends to outperform both the 52-week-high strategy and the industry momentum strategy.

Also, from a foundation study perspective, while the study could confirm the generalisation of Jegadeesh and Titman's (1993) findings to the South African market, it could not make a similar confirmation of either George and Hwang's (2004) findings or Moskowitz and Grinblatt's (1999).

The failure of the 52-week-high strategy in the South African equity market dispelled the notion of bounded rationality locally (perhaps because of ownership patterns) as well as the appropriateness of 52-week highs and lows as pricing 'anchors'. However, since the traditional and industry momentum approaches were both found to deliver returns in excess of a random portfolio in the South African equity market, it followed that certain behavioural biases inherent to the theory of momentum may ring true from a South African investor perspective both in individual shares and in industries. These included herding, 'recency' bias, the disposition effect, overconfidence, self-attribution bias, confirmation bias, availability bias, conservatism bias, and representativeness.

Finally, and perhaps following on from the finding on behavioural biases, it was also concluded that, since the traditional momentum approach as well as the industry momentum approach generated statistically significant excess returns over a twenty-year period, the efficient market hypothesis could not hold, and the South African market could not be categorised as efficient or weak form efficient.

Chapter 5: Conclusions & Recommendations

5.1 Introduction

Momentum-based investment strategies were popularised by Jegadeesh and Titman (1993), who showed that a returns-based momentum strategy (the traditional approach) generated excess returns in the United States in the short to medium term. This not only gave rise to the attempted replication of the study in other markets but also resulted in the emergence of other well-known and widely tested momentum strategies, in particular Moskowitz and Grinblatt's (1999) industry momentum strategy and George and Hwang's (2004) 52-week-high strategy.

While several momentum-based strategies had been employed in the South African context prior to this study, neither the 52-week-high nor the industry momentum strategies had been tested in the South African equity market in isolation. The three foundation strategies mentioned above had also not been contrasted to one another or to a random or passive (control) portfolio. The aim of this study was to expand on the current literature by filling these gaps, as well as exploring and synthesising behavioural explanations often cited for the existence of momentum in equity markets. Behavioural explanations were hypothesised on the basis that markets, including the South African equity market, are inefficient because of human cogitative shortcomings.

Chapter 1 of this minor dissertation introduced the concepts of efficient markets, behavioural science, and momentum, and posed the research questions. The literature review in Chapter 2 explored existing findings within the momentum investing sphere by examining prior conclusions on efficient markets, behavioural science, and momentum, and marrying these findings. Chapter 3 involved an in-depth exploration of the research methodology employed in answering the research questions. Chapter 4 began by discussing the findings arising from the data analysis methods discussed in Chapter 3. The results were then discoursed within the context of earlier findings and the literature explored in Chapter 2.

This chapter will summarise and discuss the main findings of this study and present policy implications and recommendations for further research.

5.2 Discussion of research findings

The initial findings presented in Chapter 4 implied that a South African investor could expect excess returns from employing either the traditional momentum approach or the industry momentum approach (with no significant difference in performance) but not the 52-week-high approach. The above result was confirmed by the results of the risk-adjusted comparison, the only difference being that TW was established as the best performing portfolio (on a risk adjusted basis) over IW, which was the second-best performing portfolio.

Further to the above, while the study could confirm the generalisation of Jegadeesh and Titman's (1993) findings to the South African market, it could not make a similar confirmation of either George and Hwang's (2004) findings or Moskowitz and Grinblatt's (1999). For Jegadeesh and Titman (1993), the traditional momentum approach did significantly outperform the passive (control) portfolio. For George and Hwang (2004), the 52W did not outperform TW or the passive (control) portfolio. For Moskowitz and Grinblatt (1999), while IW outperformed 52W and the passive (control) portfolio, it did not yield returns significantly different from TW.

In light of the fact that the performance of the industry momentum strategy could not be confirmed as different to that of the traditional approach, one may consider revisiting Pan et al.'s (2004) findings that industry momentum is simply a consequence of single stock price momentum (traditional momentum). A further issue with the industry momentum strategy was also identified, as Chow's test for structural breaks identified a change in the behaviour of the strategy following the Asian currency crisis. This means that the strategy cannot be reliably employed through an entire market cycle.

The literature review of this study assisted in synthesising the divergent theories on why momentum profits could be earned. It provided a foundation upon which behavioural biases could be tested in the context of momentum within the South

African market. In other words, the success or failure of certain momentum strategies in the South African equity market supports the existence or absence of these biases in that environment.

The failure of the 52-week-high strategy in the South African equity market challenged the notion of bounded rationality locally (perhaps because of ownership patterns) as well as the appropriateness of 52-week highs and lows as pricing 'anchors'. However, since the traditional and industry momentum approaches were both found to deliver returns in excess of a passive (control) portfolio in the South African equity market, it follows that certain behavioural biases inherent to the theory of momentum may ring true from a South African investor perspective both in individual stocks and in industries. These included herding, 'recency' bias, the disposition effect, overconfidence, self-attribution bias, confirmation bias, availability bias, conservatism bias, and representativeness.

By testing the efficacy of trading strategies based on historical price movement, this study indirectly explored weak form efficiency in the South African market (successive price changes are independent) and provided a precursor for market efficiency as a whole (an efficient market is unpredictable). While this study could not confirm or dispel market efficiency in its current form, it did provide further grounds for reconsidering efficiency in the South African equity market.

This study was initiated in order to provide a new perspective on momentum investing in the South African equity market. The work expanded on existing research by considering the 52-week-high and the industry-based approaches relative to a passive (control) portfolio in the South African market. The study also considered the comparative efficacy of these two approaches, along with the traditional approach, in the South African equity market. The results also contributed to the growing body of research on the efficiency of the South African market. By proving that momentum profits can be earned in this market, it may follow that the South African equity market may not exhibit weak form efficiency. Finally, the literature review portion of this study synthesised the divergent theories on how behavioural biases inherent to market participants can result on momentum effects. This could provide other researchers with more clarity on the matter going forward.

5.3 Implications and recommendations for future research

The results showed that both the traditional momentum and industry momentum approaches considering six-month intervals over a twenty period could be successfully implemented in the South African market. Traders and fund managers can therefore adjust their respective trading strategies to consider the potential impact of momentum on asset price performances. The study also identified behavioural factors as a possible source of momentum and inefficiency in the equity market. It is therefore important that market participants remain mindful of their cognitive shortcomings when making investment decisions and, in turn, realise that there are benefits to be had in light of the behavioural biases of other investors.

The results of this study also raised several questions which could be explored through future research efforts. First, the notion and occurrence of bounded rationality could be further explored within the South African context. Second, the finding that momentum profits can be earned in South Africa may have implications for the efficient market hypothesis. Third, the evidence of a structural break in the industry momentum returns profile following the Asian crisis could be further explored in terms of the possible reasons behind it and actual industry momentum tilts. Finally, and perhaps most pressingly, in light of the fact that industry momentum strategy performance could not be found different to that of the traditional approach, one may consider revisiting Pan et al's (2004) findings that industry momentum is simply a consequence of single stock price momentum (traditional momentum), specifically applied to the South African equity market.

The results of this study may be of value to all market participants; however, traders and fund managers with flexible mandates will benefit most from the research. Tax concerns, size effects, and investment horizon constraints may prevent retail portfolio managers from employing a momentum-based strategy, although the behavioural factors offered as explanation for momentum profits may assist managers in explaining market movements.

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