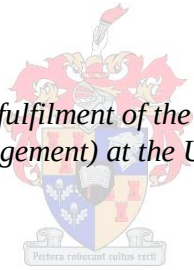
Investigating Momentum on the Johannesburg Stock Exchange

by
Hendrik Andries Snyman



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Declaration

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Abstract

"To invest successfully over a lifetime does not require a stratospheric IQ, unusual business insight, or inside information. What's needed is a sound intellectual framework for making decisions and the ability to keep emotions from corroding that framework." Warren E Buffet[2]

Applying the Industrial Engineering systems approach, this dissertation utilised the theories and propositions of previous studies to argue (model) the cause of financial herd behaviour and the subsequent momentum effect. From this, a hypothesis was postulated to test:

- whether momentum is a common attribute amongst top performing shares,
- whether technical analysis indicators can better identify the phenomenon, and
- whether the return from these shares would justify momentum as a viable investment strategy.

A unique experiment derived from previous academic studies was adapted to explore the degree of the momentum phenomenon. This was done by ranking shares according to both technical analysis as well as pure price performance momentum criteria.

Returns were translated as a rank in relation to the market as a whole, thereby minimising any effects that different market periods could have on a momentum return relationship. The degree of the relationship was evaluated by applying the alternative Spearman Rank Order Correlation Co-efficient in conjunction with a permutation test to determine the statistical significance of any trends.

The viability of the phenomenon as an investment strategy was gauged by comparing annualised average returns against both the market capitalisation weighted JSE All Share Index as well as against an un-weighted representation of the market.

The results revealed a seemingly unambiguous co-dependence between momentum and return with statistically significant trends being ever present. Applying the maximum taxes and trading costs revealed that the highest ranked momentum shares did indeed outperform both market benchmarks from the period of January 1990 to August 2009, suggesting the validity of the philosophy as an investment strategy.

[2] Preface to the 4th Edition of Benjamin Graham's *The Intelligent Investor* (1986).

The outcome of the study in part rejected the null hypothesis, as technical indicators were unable to identify future top performing shares better, with price performance momentum measures delivering the superior returns.

Future studies may include optimising the various technical indicators towards the JSE rather than using generic settings. Other interesting topics could include combining momentum with other investment strategies to investigate synergy and further pinpointing the source of the phenomenon. Over the past number of years, tighter controls and monitoring of investments has resulted in the documentation of the individual number of shareholders who are buying and selling shares. Utilising this data over the next number of years, an experiment could attempt to relate the number of individual investors trading in a particular share to herd behaviour and the subsequent momentum effect.

Opsomming

Die verhandeling, binne die bedryfsingenieursstelsels benadering, gebruik teorieë en voorstelle van vorige studies om die gevolge van finansiële gedrag en die gevolglike momentum effek te bespreek. Uit die analise is ‘n voorstel saamgestel om die volgende te toets:

- Is momentum ‘n algemene verskynsel by aandele wat goed presteer, en
- kan tegniese analitiese indikatore die verskynsel beter verklaar, en
- dui die opbrengs van die aandele daarop dat momentum ‘n bruikbare beleggingsstrategie is.

‘n Unieke eksperiment uit vorige studies is aangepas om die aard van die momentum verskynsel te ondersoek. Dit was gedoen deur aandele volgens beide tegniese analise asook suiwer prestasie momentum kriteria te klassifiseer.

Opbrengste is met die hele mark in konteks geplaas om sodoende enige impak van verskillende mark tye op die momentum opbrengs verhouding te elimineer. Die verband is opgestel deur die alternatiewe “Spearman Rank Order Correlation koëffisiënt” saam met permutasie toetse te gebruik om die statistiese belangrikheid van enige neigings uit te wys.

Die geldigheid van die verskynsel as ‘n beleggingsstrategie is gemeet deur jaarlikse gemiddelde opbrengste teen beide die markkapitalisasie geweeg teen die JSE Alle Aandele Indeks sowel as ‘n ongeweegde verteenwoordiging van die mark te bepaal.

Die resultate dui op ‘n interafhanklikheid tussen momentum en opbrengste met statistiese neigings altyd teenwoordig. Deur die maksimum belasting en verhandelingskoste toe te pas wys dit dat die hoogste momentum uitgewyste aandele die markriglyne uitpresteer het van Januarie 1990 tot Augustus 2009 wat die geldigheid van die benadering as ‘n beleggingsstrategie bevestig.

Die studie verwerp die nul hipotese gedeeltelik in die sin dat dit nie toekomstige top presterende aandele kan uitwys nie, maar aan die ander kant gee prysprestasie momentum meting wel buitegewone opbrengs.

Toekomstige studies mag die optimisering van verskeie tegniese indikatore van die JSE insluit, ‘n kombinasie van momentum met ander beleggingsstrategieë gebruik, en verder die bron van die verskynsel vas pen. Oor die afgelope aantal jare het beter beheer en die monitoring van beleggings die dokumentasie van individuele aandeelhouers moontlik gemaak. Hieride data sou kon gebruik

word as ‘n toets om die korrelasie tussendie aantal aandeelhouers wat ‘n spesifieke aandeel verhandel en tropgedrag te bepaal en om dit te gebruik om die momentum effek beter te verklaar.

Acknowledgements

This dissertation is dedicated to all those people who provided moral and financial support along with particular insight into the weird and wonderful world that is investing.

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Table of Contents

List of Figures

List of Tables

Chapter 1 - Introduction and Overview

1.1 Introduction

Since the historical issue of the first publicly traded shares by the Dutch East India Company in 1602, investors, self-proclaimed financial gurus and ordinary citizens alike have employed a vast array of strategies in an attempt to outwit the financial market.

In 1970, so-called modern finance and regulated markets witnessed the inception of the Efficient Market Hypothesis by renowned financial theorist Prof. Eugene Fama (Fama, 1970). His study proclaimed that one could never consistently beat the market, as rational investors quickly absorbed new information to displace any mispricing or 'inefficiencies' within the market.

With advances in the field of psychology and in our understanding of how the brain processes decision variables, the application of psychology to financial decisions gave birth to the field of financial behaviour. In opposition to the Efficient Market Hypothesis, financial behavioural theorists believe that the masses settle the market price and that they, as such, are human and imperfect in nature.

Where single shares often outperform the market, proposers of the Efficient Market Hypothesis argue that there is no common trait between these shares and thus no strategy to identify them consistently.

This dissertation aims to explore the phenomenon of herd behavior proposed by behavioral theorists and to ascertain whether the subsequent momentum effect can be exploited by technical analysis to identify consistently the outperforming shares, those shares which produce greater returns than the market average, on the Johannesburg Stock Exchange (JSE).

1.2 Hypothesis

The study proposes to examine whether the stock exchange acts as a meta-system, in other words, as a single entity defined by the sum of its parts. Simply put, it investigates whether individual investors investing in stocks have a net effect and, if so, whether this effect is a recurring one, and whether it can be harnessed to create a profit.

Where previous studies have attempted to identify and/or exploit this phenomenon by pure price performance measures, this dissertation will propose that the price trends can be better identified through technical analysis indicators and that momentum is a consistent common trait amongst the top performing shares on the JSE.

The study will focus on the principles of both statistical and economic significance, i.e. by asking whether the investment strategy holds true both statistically and when taking into account the economics of investing, including the costs of trading and taxes.

Null Hypothesis

> ***H_0**: The phenomenon of herd behaviour establishes price momentum on the JSE, which can be better identified through technical analysis indicators to pinpoint the future top performing shares on the JSE . This price pattern can be exploited as an investment strategy to outperform the market as a whole.*

Evidence that would disprove such a theory and relate to the alternate hypothesis includes a low correlation between momentum and top performing shares, as well as the absence of significant excess returns.

Alternate Hypothesis

The alternate hypothesis supports the Efficient Market hypothesis viewpoint of the market and of price trends.

> ***H_1**: There are no statistically significant price patterns on the JS,E and price fluctuations occur too quickly to be harnessed. The implications of trading costs and taxes void an active trading strategy utilizing the momentum philosophy.*

1.3 Importance of the Study

Even though this research field or topic is not new by any means, this dissertation does take a different approach. Whereas previous studies have gauged the performance and statistical significance of a momentum strategy by means of capital gains, this study notes the overwhelming difference between returns in different market periods, and thus, instead, compares shares according to their performance, translated as a performance rank. Therefore, the study should reveal with greater statistical clarity whether momentum shares continually perform amongst the best shares within a given period and thus attain a top rank within the share universe.

The dissertation also applies previous academic thinking from international studies to the local JSE by gauging price momentum through both pure price performance measures as well as technical analysis indicators. Should these momentum measures provide consistent and significant positive results, it would disprove the strong form of the Efficient Market Hypothesis on the JSE.

1.4 Research Problems

Given the scope and time constraint of the study, technical indicators and their individual settings were limited to those favoured by institutions and internationally published authors. Therefore, the study's results are guided by broad technical analysis rationalisations with limited optimisation towards the JSE.

1.5 Dissertation Outline

The Institute of Industrial Engineers[3] define Industrial Engineering (IE) as follows:

"Industrial Engineering is concerned with the design, improvement and installation of integrated systems of people, materials, equipment and energy. It draws upon specialised knowledge and skills in the mathematical, physical and social sciences together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from such systems."

[3] http://www.iienet2.org/Details.aspx?id=282

The Industrial Engineering systems approach depicted in Figure 1 comprises two distinct stages. The initial stage comprises investigating a system, identifying the factors that affect the system (modelling the system) and defining performance measurements. The later stages entail studying the results of the measurement exercise and altering the system for the better. The exercise is continuously repeated in order to formulate an optimal scenario.

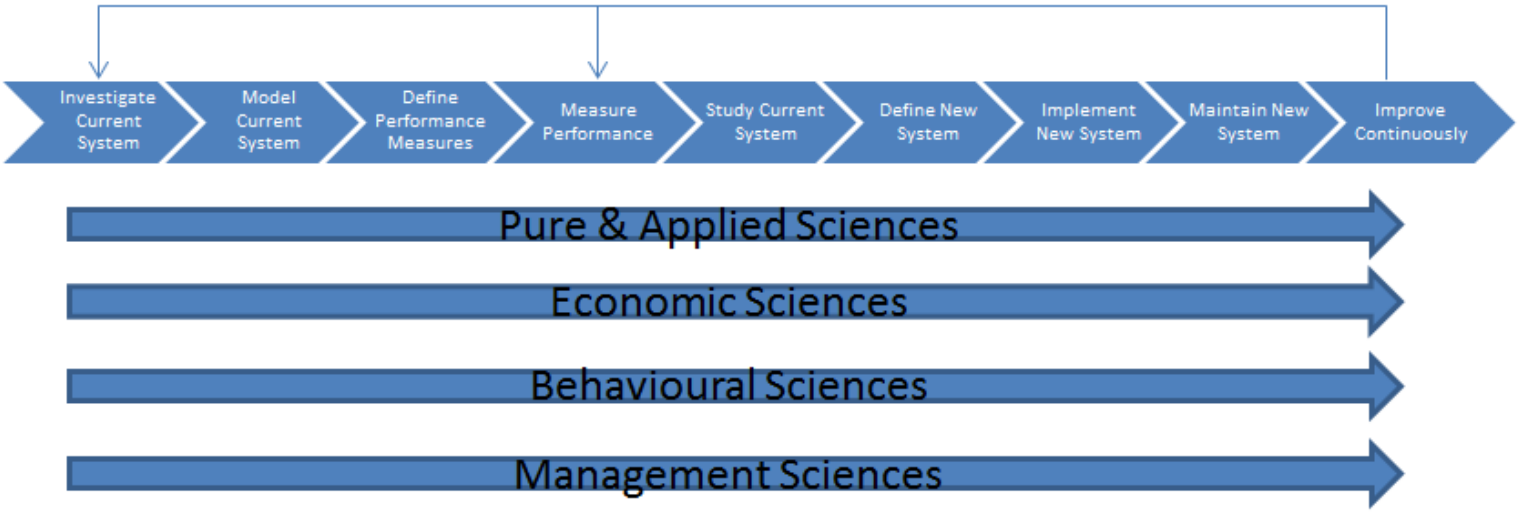

Figure 1 - Industrial Engineering Systems Approach

Industrial Engineers are equipped with various tools during the course of their studies to understand the concepts of pure and applied sciences, economics, as well as behavioural and management sciences. These tools allow them to understand the various concepts of most systems.

Traditionally, the Industrial Engineering systems approach has been applied to the manufacturing process by utilising the discipline to define a process or system, identifying critical measurement points and observing the results with the ultimate goal of optimising the process.

In this dissertation, the discipline will be applied to the investment process, specifically by focusing on technical analysis and the strategy of momentum investing.

Investigating the system:

Chapter 2 of the dissertation will investigate various philosophies about the stock market and the investment strategies, which have stemmed from the respective beliefs.

Modelling the System:

Chapter 3 draws upon previous studies to model the stock price cycle as proposed by financial behavioural theorists.

Chapter 4 introduces the various technical analysis indicators, which have evolved from the initial method of gauging momentum through pure price performance measures.

Define Performance Criteria:

Chapter 5 defines the methodology to measure the statistical significance of the momentum phenomenon as well as to take into account issues of trading costs and taxes.

The final chapter will discuss the results obtained from the study as well as its implications. Given the average annualised returns, the dissertation will discuss the validity of the momentum philosophy as a sole investment strategy or as part of a filtering system to identify good investments.

1.6 Summary

As the previous section has sought to explain, this dissertation will explore the efficiency of the JSE and the phenomenon of the so-called 'momentum effect'. The study will argue that the stock exchange is indeed driven by individuals whose actions and decisions establish the market price. These individuals do not make decision as some theories may argue and are subject to various market driven factors.

By reviewing previous academic studies and theories on behavioural finance, the dissertation will attempt to explain so-called 'herd behaviour' and the subsequent momentum effect of such behaviour on price fluctuations.

Chapter 2 – Investment Concepts and Beliefs

2.1 Introduction

No single concept within the investment community has attracted as much scrutiny as the Efficient Market Hypothesis. First published in 1970 by Prof. Eugene Fama from the University of Chicago's Business School, the hypothesis states that at any point in time all available information on a particular share and/or market is already taken into account to establish the market price of the particular asset (Fama, 1970). Consequently, the hypothesis suggests that it is impossible for the common investor to outperform the market consistently by using information that is already available to everyone. The hypothesis assumes that:

- Investors have rational expectations.
- On average, the investment community as a whole is correct.
- Should new information become available, investors adjust their expectations appropriately.

The theory promotes three forms of efficiency, from a strong to a weak reaction. Figure 2 below illustrates the three different market reactions to the entry of new information, which affects the underlying value of the share.

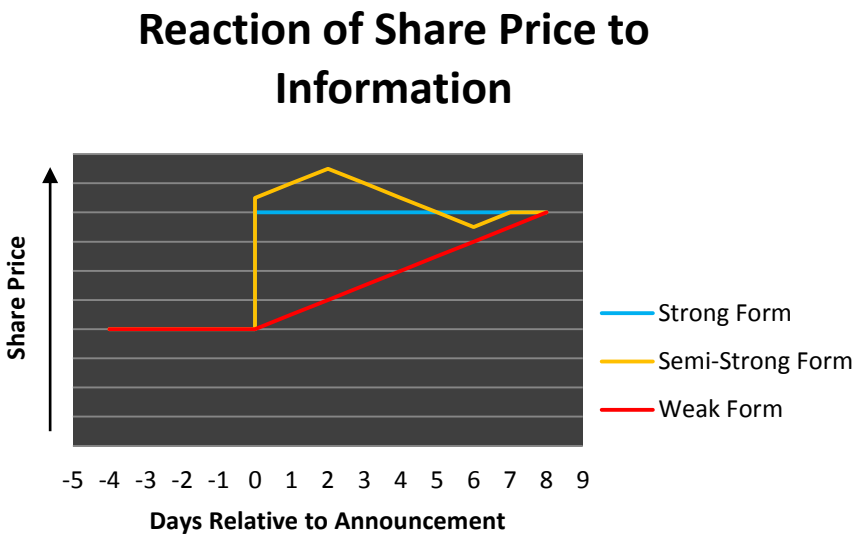

Figure 2 - Efficient Market Hypothesis Depiction - Source: Journal of Finance, Vol 25 (2), 1970, pg 385

According to Figure 2 above, when new information becomes available, the market reacts in three different ways, which affects the underlying value of the share:

> Weak form: Future price movements are unexpected and therefore random, as investors exploit different avenues to gain available information on particular assets. This is often the case where the market is in its infancy and not regulated, and where information is slow to move through the financial system.
>
> Semi-strong form: Information is readily available and prices adjust rapidly and appropriately. An indication of a semi-strong market is a constant upward or downward adjustment after new information has been made available, with an initial price change. This would suggest that investors have a biased view and that they display some inefficiency.
>
> Strong form: Share prices immediately adjust to reflect all relevant public and private knowledge. Thus, it would be impossible for investors to gain excess returns.

Since its inception, the Efficient Market Hypothesis has received astounding criticism from both empirical and theoretical studies. If the efficient market theory is true, then mispricing is a phenomenon rarely identified, which is a fact disputed by works from economists such as Daniel Kahneman, Amos Tversky, Richard Thaler and Paul Slovic. Believing investors and subsequently the market to be irrational and open to various psychological biases, the reasoning of these economists led to strategies that avoid high-value stocks and focus on undervalued and/or growth shares.

Presented in Figure 3 is the result of a study conducted by Robert Schiller (2001), author of *Irrational Exuberance*. The study compared price-to-earnings ratios, compiled as an average over the previous ten years, in relation to subsequent 20-year annualised returns. The figure shows the trend that undervalued shares (low P:E ratios) can produce superior returns compared to high value shares (high P:E ratios).

This, along with various other and more recent studies, at the very least contradicts the strong form of the Efficient Market Hypothesis. With all this evidence pointing to ‘holes’ within the efficient market theory, one thing remains certain, namely, that it is extremely difficult to outperform the market consistently over the long term.

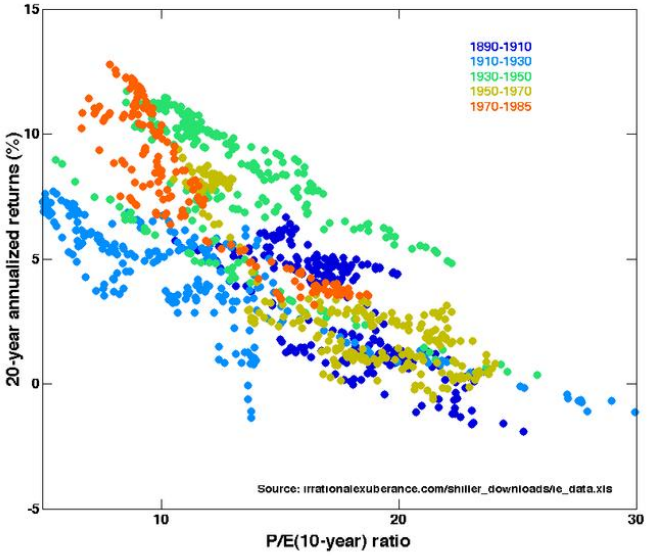

Figure 3 - PE Ratio vs Annualised Returns - Source: R. Shiller *Irrational Exuberance*, 2001, pg 11

With the allure of large profits and rags to riches stories exploited by the media, the financial centres continue to draw droves of people who want to stake their claim. Given Warren Buffet's investment record, he has been epitomised as the smartest investor of his time with a following resembling that of a religious cult making a yearly pilgrimage to his company's annual general meeting in Omaha, Nebraska. Warren Buffet has beaten the American S&P 500 market for 20 out of the past 24 years from 1980 to 2003, with an average out-performance of 12.24% making luck an unlikely reason for his success (Schroeder, 2008). Warren himself is not entirely convinced by the legitimacy of the hypothesis, and instead prides himself on recognising value where others have sighted doom.

An investor's investment philosophy is largely based on his or her personal belief in the legitimacy of the Efficient Market Hypotheis. Where fundamental and value investors believe in long-term investment to realise a profit, traders and technical analysts believe that the market dictates the asset price and that it, as such, is its own best predictor. In the remainder of this chapter, the relevant investment philosophies are presented according to their respective proposers and their belief in the efficiency of the stock market.

2.2 Investing Philosophies

Since the inception of the first open market, buyers and sellers of goods and services have adopted specific strategies to ensure that they ultimately attain the greatest profit. This section aims to highlight some of the most prominent investment philosophies on the stock exchange.

2.2.1 Fundamental Investing

Fundamental investing is presented below as described by the writings of Frank Reilly & Keith Brown(2006), Zvi Bodie, Alex Kane & Alan Marcus (2004) and Thomsett (1998). Their textbooks are prescribed by various international academic institutions and are used as the cornerstone of their respective investment courses.

Fundamental investing is an investment philosophy whereby an investor reviews an organisation's past performance by analysing the company's financial statements and current market conditions to identify discrepancies between the perceived future intrinsic value and the market value of the company. By exploiting these discrepancies, investors hope to generate a profit.

Typically, fundamental investors use the three-step top-down approach based on the belief that a stock's returns are influenced by its surroundings, in other words, the state of the economy, market and industry, as depicted in Figure 4. The process follows a logical and realistic path, governed by steadfast rules. Starting with the global community, the strategy identifies growing and fast developing economies before focusing on a specific market and finally narrowing down the focus to a specific stock.

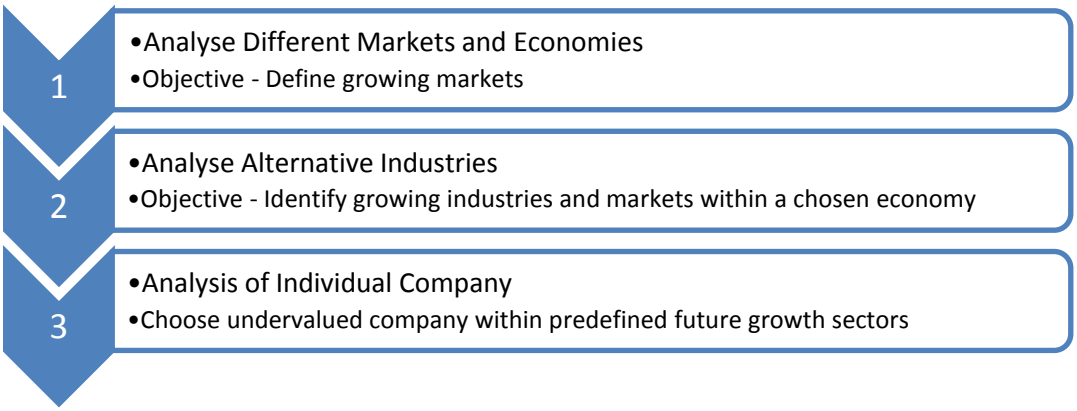

Figure 4 – Three-Step Top-Down Approach

The purpose of financial statement analysis is to measure an organisation's performance in the critical areas of business against those of competitors within the market. Fundamental investors hold the view that financial statement analysis provides investors with insight into the operations of a business and that it makes it possible to assess whether the organisation promises to grow in future, thus providing the investor with a good return on their investment.

The following equations, combined with information gleaned from a company's financial statements, are the most basic methods of estimating the supposed real value of a share:

$$g = b \times ROE$$

Where: g = Growth

b = Plough Back Ratio (proportion of return reinvested)

ROE = Return on Equity

In the case of constant growth, the value of a share can be estimated by:

$$E(r) = \frac{D_1}{P_0} + g$$

Where: E(r) = Expected return

D_1 = Expected next dividend

P_0 = Current share price

Fundamental investors have a long-term view and believe in buying shares of undervalued companies in hope that the market will realise the true value of the company. The subsequent rectification of the market price will result in the original investor realising a profit.

2.2.2 Value Investing

The value investing philosophy is unanimously believed to be the brainchild of Benjamin Graham (1986), a widely respected individual during his lifetime and mentor to the great financial gurus, such as Warren Buffet.

Value investors are concerned with identifying fairly valued shares of companies that show promise. These companies produce products or provide a service, which the investor considers valuable to society and which will continue to be so in the future. Value investors place great emphasis on the company's brand and its ability to innovate new products and services continually.

Value investors are firm believers of the 'buy and hold' strategy, committing themselves for a substantial investment period. They tend to buy the shares of a good company at a reasonable or deflated price and hope to reap the benefits from dividends rather than from organic growth prospects of the brand or company. The believed master of value investing, Warren Buffet, describes this investment philosophy as finding an outstanding company at a sensible price.

2.2.3 Random Walk

Followers of the random walk theory are also strong believers in the Efficient Market Hypotheis, and often cite arguments by Burton Malkiel in *A Random Walk Down Wall Street* (1973). Followers of this investment philosophy believe that share prices typically display signs of random walk and that an ordinary investor who does not have access to superior financial research, financial power or business relationships, would thus be unable to outperform the market consistently.

Burton emphasises that both the media and investors focus on statistical outliers who have been lucky, while ignoring the large population of investors who are unsuccessful in their endeavours to outperform the market. Burton consequently suggests that investors may as well adopt a proportional portfolio, which more accurately reflects the market.

2.2.4 Trading

In terms of the definition by the CFA institute (2008), traders are short-term investors who try to exploit short-lived market movements to achieve a profit. Trading positions are held for a short and limited time and are therefore dependant on immediate market movements and forecasts. Traders make use of technical analysis, which is discussed in the next chapter, combined with short-term news and information, as it spreads throughout the financial world.

Trading is an intensely active investment strategy and is therefore employed by investment professionals, which also means that it has specific tax implications. These will be discussed later (see Section 5.2).

2.2.5 Technical Analysis

Reilly & Brown (2006), Bodie, Kane & Marcus (2004) and Thomsett (1998) in their writings describe technical analysis as a method of investment where the investor does not analyse the company itself but rather reviews the past price movements and volume of trading of stocks in order to derive a future trading pattern and recognise an investment opportunity.

Technical analysts use data from the market itself, based on the belief that the market is its own best predictor. Such investors aim to buy and hold a share until contrary patterns are identified, with periods ranging from a few months to years. There have been many developments in technical analysis, with most analysts believing in their own settings and indicators.

Several assumptions, summarised in Reilly & Brown's *Investment Analysis and Portolio Management* (2006), lead to this view of price movements:

1) The market value of any good or service depends solely on supply and demand.
2) The market is governed by many rational and irrational factors, including economic variables, opinions, moods and trends. The market automatically updates the weight that all of these factors have on the market price.
3) Disregarding minor fluctuations, the prices for individual shares and the market follow trends for certain lengths of time.
4) Trends change in reaction to supply and demand relationships.

Dow Theory

Charles H. Dow was the founder and editor of the *Wall Street Journal* and after his death in 1902, the Dow Theory was collectively presented by William Hamilton (1922), Robert Rhea (1932) and George Schaefer (1960) as a compilation of his editorials. Dow suggested three types of price movements, comparing these to the flow of water:

1) Major trends that are like tides in the ocean;
2) Intermediate trends that resemble waves;
3) Short run movements that represent ripples.

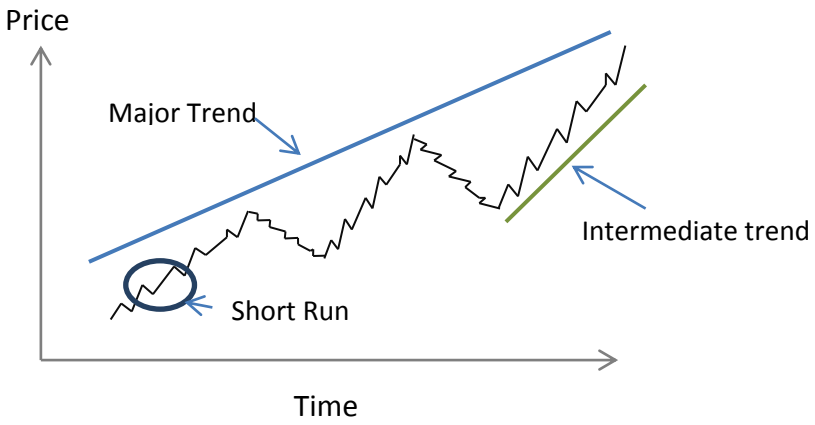

Figure 5 - Dow Trend Theory

Dow's philosophy attempts to identify major trends, while realising that there will be price movements in the opposite direction due to investors deciding to take profits, as depicted above.

The fundamental principle of this theory, as depicted in Figure 6, defines:

- Upward trends as higher peaks followed by higher troughs;
- Downward trends as lower troughs followed by lower peaks.

Should these conditions not be met, the share is said to be trading in a flat channel.

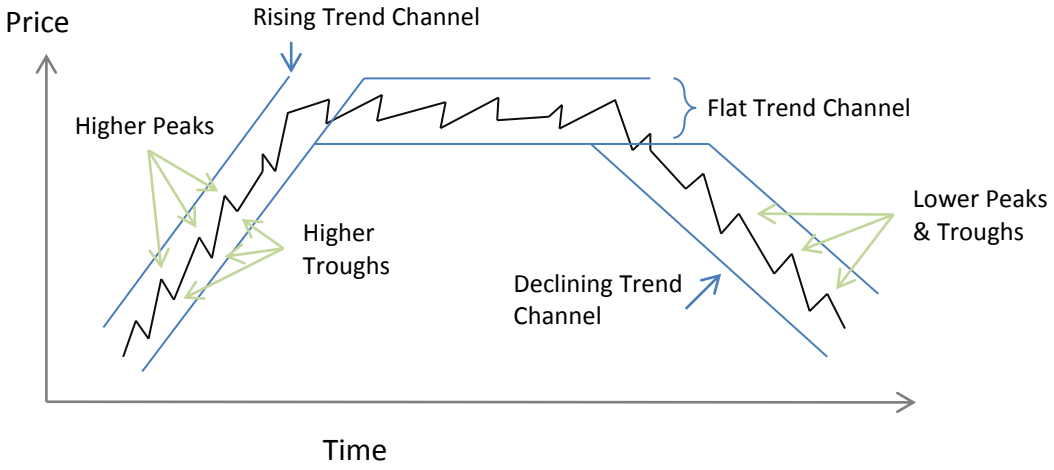

Figure 6 - Stock Price Trends

Technical analysts believe that information enters the market over time and not all at once, thus leading to the trend observed in stock prices depicted below. Technical analysts look for the beginning of a trend from an equilibrium value to a new equilibrium value, but they do not attempt to predict this new value.

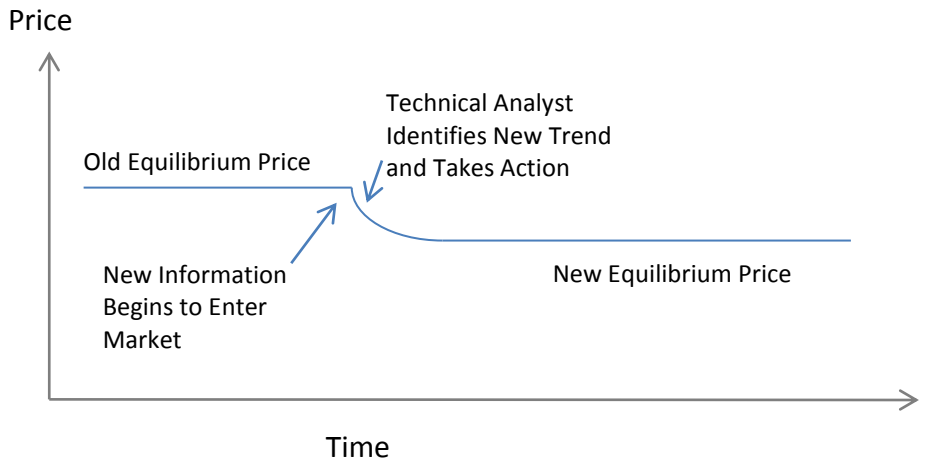

Figure 7 - Technical Analysis View of Price Adjustments

The equilibrium value or share price at any point in time is a function of the basic economic principle of supply and demand. Steven Achelis in his book, *Technical Analysis from A to Z* (2006), depicts the phenomenon in Figure 8 below.

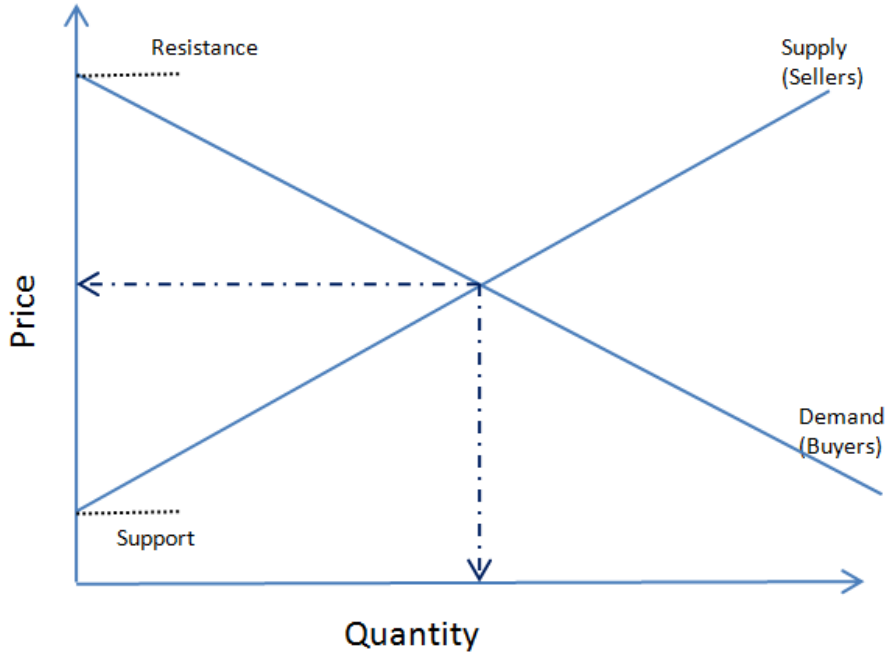

Figure 8 - Supply and Demand – Source: Achelis, *Technical Analysis from A to Z*, 2006, pg 12

The principle is easy to understand. As the share price increases, more people are willing to sell. The price will never drop below the support level, as no one is willing to sell at or below this price. As the share price decreases, more investors are willing to buy at the particular price. When the supply line intersects the demand line, equilibrium is reached and investors are willing to trade. The angles of these two lines are constantly shifting to create new support, resistance and intercept points.

2.3 Summary

Each investor on the stock exchange acts and makes decisions according to their own beliefs as to the efficiency of the stock exchange and the role and effect of individual investors. All of the investment philosophies mentioned in this chapter are grounded in logic and rationality, and all have created successful investors in their own right, but that does not mean that they will necessarily suit every type of investor.

The following chapter will focus on the concept of behavioural finance and the phenomenon of momentum.

Chapter 3 –Momentum

3.1 Defining Momentum

Before one can start to examine whether price patterns exist on the JSE, a clear definition of momentum has to be established.

> *"Momentum is a persistent price trend within a discernable channel, which somehow defies random movement"* Steven B Achelis, *Technical Analysis from A to Z*, 2006, pg 195

Therefore, momentum can be defined as the existence of persistence in price movements over time. Consequently, if the price of a share increases over the periods [t-k,t-k+1],..,[t-1,t] (where k is a positive integer), it is expected to follow this trend and to increase over the period [t,t+1]. The definition can be extended to state that, if a share outperforms other shares (or a benchmark portfolio) over the period [t-k,t-k+1],..,[t-1,t], then the share should continue to outperform its peers or benchmark over the period [t,t+1].

If neither momentum nor mean reversion existed, then:

$$E[r_t | r_{t-1}, r_{t-2}, \dots] = E[r] \; \forall \; t$$

Where r_t is the return in time *t* for an individual share.

Therefore the non-existence of momentum implies that the expected return in any period, given the returns in prior periods, is the mean return of the share, and that this is independent of the return series $r_{t-1}, r_{t-2}, \dots, r_1$.

Momentum implies that the returns in any period are dependent on the returns in the previous period, and that the returns in a period can be predicted by the returns in a prior period. Further to establish the statistical validity of such a persistent price trend, there should be a positive correlation between the returns in $r_{t-1}, r_{t-2}, \dots$ and those returns expected in r_t.

3.2 Explanations for Momentum

Behavioural finance theories have been postulated to bridge the gap between theories based on rational investors and contrary price fluctuations.

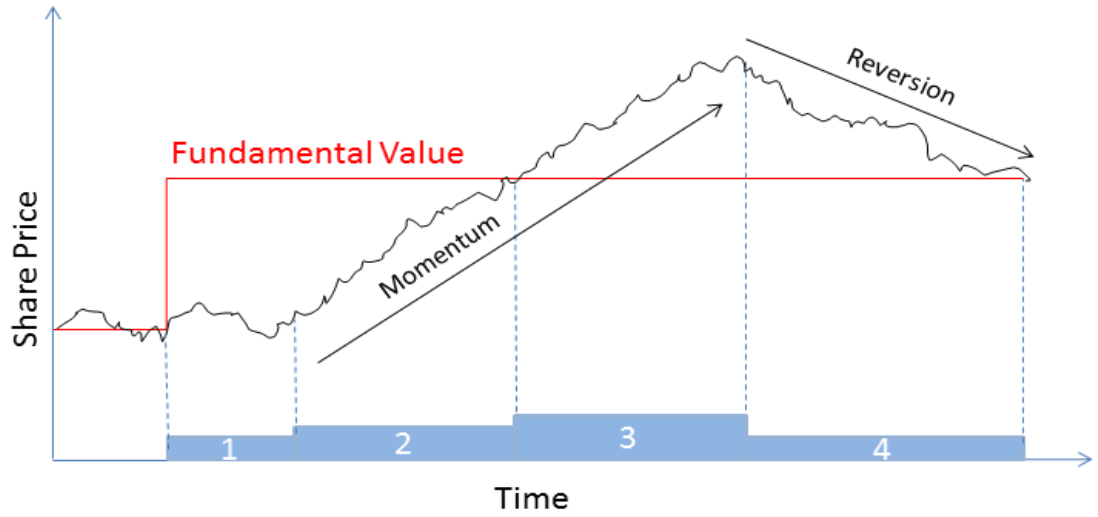

Figure 9 - Perceived Price Trend

The stock price trend observed above is a graphical representation of the explanations for momentum and mean reversion, as encapsulated by Hong & Stein (1997), using DeBondt and Thaler' s (1987) model, "The Three Stages of Price Reaction" .

The red line illustrates the supposed fundamental value of the share price with the shift at the beginning of point 1 initiated by an announcement that fundamentally increased the value of the underlying stock. Such announcements include earnings announcements, stock issues and repurchases, dividend initiations and omissions and analyst recommendations. An overview of such announcements is provided by Bernard (1992).

Stage 1: Under-Reaction

The market does not seem to discount new information quickly, with the share price continuing along an undefined trend, as noted by Chan, Jegadeesh and Lakonishok (1996).

Stage 2: Adjustment

The period of adjustment observes a migration towards the new true fundamental value, as the information is gradually absorbed by the public (Hong & Stein, 1997).

Stage 3: Over-Reaction

The period of adjustment initiates momentum, with returns exhibiting an unconditional positive serial correlation to previous returns for short horizons of 6 to 12 months (Jegadeesh and Titman, 1993).

The phenomenon of momentum causes the share price to extend past the fundamental value. This idea was presented by DeBondt and Thaler (1985), who found that stock returns are inversely correlated at long horizons, i.e. shares who experienced high (low) returns over any given five--year period tend to deliver low (high) returns over the subsequent five-year period.

Stage 4: Reversion

Over longer periods, shares experience a correction towards the fundamental value (Hong & Stein, 1997).

The price trend and evidence presented therefore suggests that momentum is a short-term anomaly, lasting between 6 to 12 months, with mean reversion occurring over longer periods.

Given this price trend, some theories have been formulated to explain the psychological biases that affect an investor and cause these anomalies.

Behavioural theorists consistently put forward the concept of herd behaviour to justify such price trends. Herd behaviour can be defined as the tendency of individuals to mimic the actions of a larger group, whether rational or irrational (Thaler, 1993). The rationale behind herd behaviour has two main drivers, namely:

- Social pressure – wanting to be part of the group
- Common rationale – assuming that such a large group cannot be wrong

This phenomenon is present throughout the stock exchange, where individual investors are subject to news and fads and adjust their portfolios accordingly.

3.3 Janus Factor

The winner of the Charles H Dow Award, Gary Anderson, tried to explain overreaction and subsequent mean reversion by proposing the so-called Janus Factor in 2003 (Anderson, 2003). Janus was the early Roman god of gates and portals, and he was represented by two opposing faces, suggesting the two-sided nature of everything.

Anderson modelled the stock market as a system of capital flows under the influence of traders and their two-sided 'Janus-like' behaviour. He proclaimed that, during certain market periods, a positive feedback loop exists, i.e. a movement in one direction prompts more of the same movement in the same direction.

Figure 10 - Positive Feedback – Source: JSE, 2003 - 2010

Anderson further explained that the market as a whole could be modelled as a negative feedback loop, depicted below. This is evident when investors wish to realise a profit, by selling their assets. This net aggregate of selling triggers the selling of more shares. At a certain point, investors realise that shares are oversold and thus embark on bargain hunting, which triggers more buying, thus leading to a subsequent price rise.

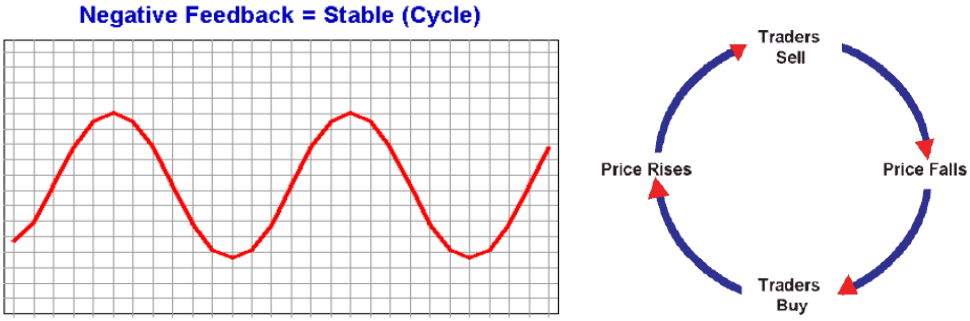

Figure 11 - Negative Feedback Loop – Source: Anderson, *The Janus Factor*, 2003, pg 3

Consequently, during periods of positive feedback, rising share prices trigger more buying of outperforming shares, whereas declining share prices encourage the sale of underperforming shares. During the subsequent negative feedback period, overbought shares are sold to make a profit, while oversold shares are bought at a discount, as they are perceived as bargains, thus reverting the population to the mean or market aggregate.

Anderson proposed that this phenomenon could be displayed graphically by plotting the returns of specific shares against the returns of the market. Using REMGRO as an example in the following figure, during so-called positive feedback periods, a share moves away from the market aggregate, only to revert during a correction.

As viewed below left, from 2000 Remgro (blue) outperformed the JSE All Share Index (ALSI) (white). Below right, the same was illustrated by movement '1' with the share's return (y-axis) plotted against the market's return (x-axis), with the share as a single plot moving away from the basic equity line (BEL), a line that represents equal performance for both the share and market. In late 2007, the share reverted to the market during a negative feedback period, as illustrated by shift 2 below right.

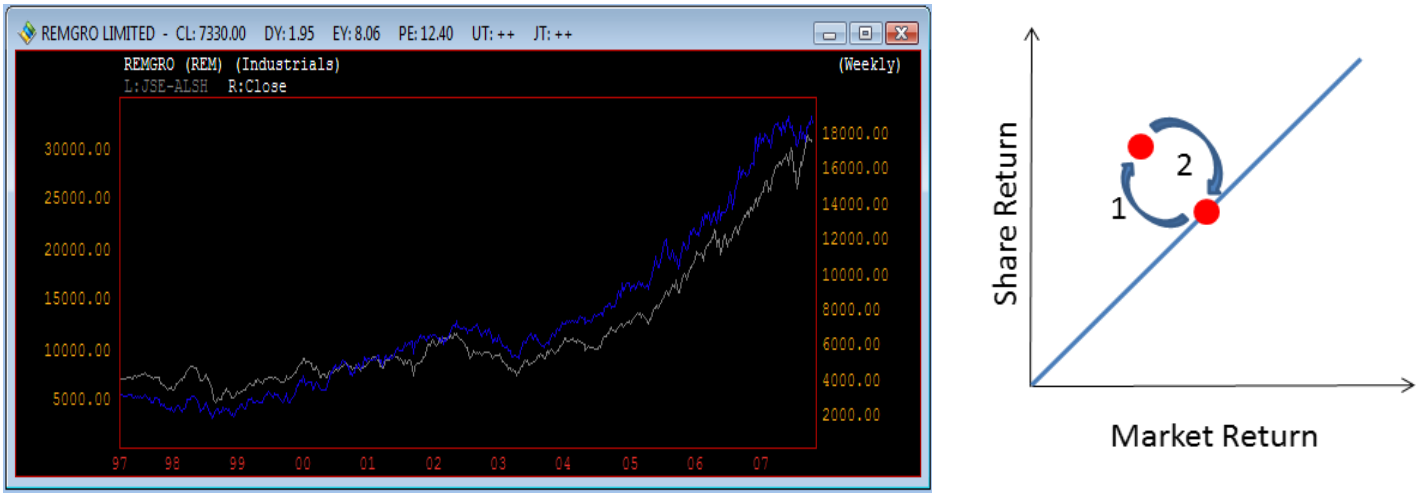

Figure 12 - Remgro as an example of positive and negative feedback loops - Source JSE, 1997 - 2008

The market as a whole displays similar traits, with shares moving away from the aggregate line during bull runs, as rising shares are bought and declining shares are sold. This is illustrated by the spread in Figure 13, below left. During market corrections, the shares return to the market mean, depicted by the return to the market line in Figure 13, below right.

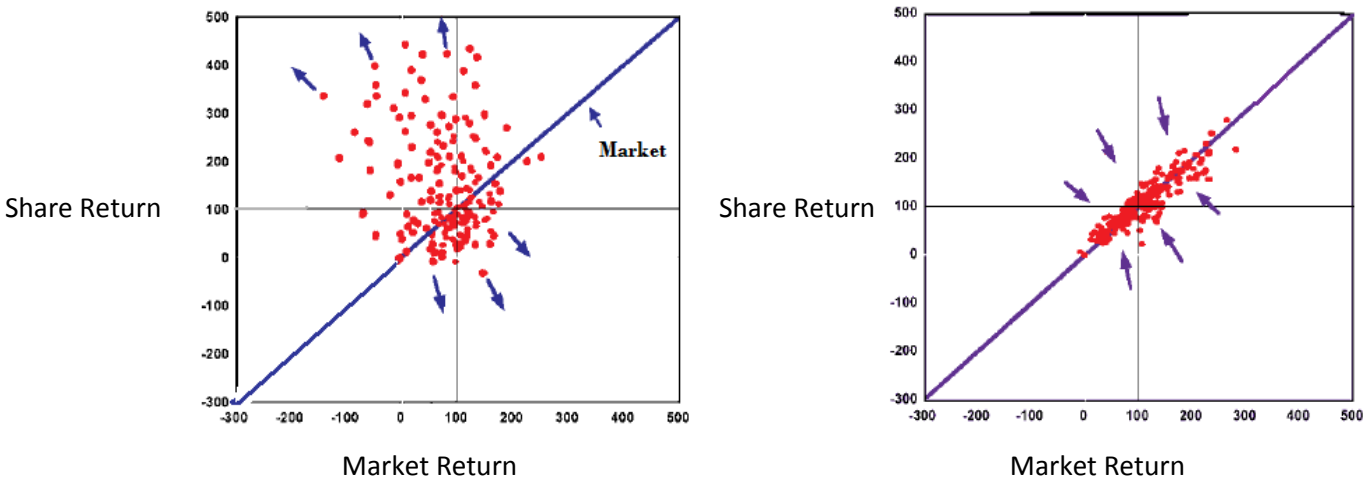

Figure 13 – Momentum & Mean reversion – Courtesy: Andersen, *The Janus Factor*, 2003, pg 7

This dissertation will accept both the viewpoint presented in Section 3.2 as well as Anderson's theory, presented in section 3.3 with regard to the behaviour of the stock exchange, while attempting to investigate the dissertation hypothesis accordingly.

3.4 Existence of Momentum

In reality, the phenomenon of momentum and reversion to the mean are two sides of the same coin. As proposed by Anderson (2003), positive feedback loops are evident in the short term, with increasing shares prices prompting more buying and supporting price momentum. Thereafter, these shares will become overbought and sold, explaining reversion.

Richard Driehaus, a Chicago money manager, was one of the first investors to apply a momentum investment strategy publicly; he was often quoted as saying, "Far more money is made by buying high and selling at even higher prices" (Schwager, 1992: pg 224). The strategy depends upon an investor identifying which share prices are increasing and, moreover, which are doing so at a substantial rate.

The phenomenon of momentum was first identified by Scholes and Williams (1977), when their method of using ordinary least squares was used to speculate over future market returns, i.e. the returns of the previous periods will explain the returns of the current period, a concept that is aptly named momentum.

A seemingly contradictory theory presented by De Bondt and Thaler (1985) argued that previous losers would outperform previous winners, as they became winners. In reality, the only difference between the two theories is the period of test of return, as presented in Section 3.2.1, which explained that momentum is experienced over 6 to 12 months with reversion occurring over even longer periods.

A large proportion of the investment community believes that mean reversion is caused by over-reaction, as the share price oscillates from one extreme to another. As stated by Hong and Stein (1997: pg 4), "Every existence of under-reaction sows the seeds for over-reaction". Thus, it would seem that short-term over-reaction leads to medium-term momentum, and that mean-reversion occurs over longer periods. The question therefore arises as to what causes these phenomena.

3.4.1 Momentum on the US Market

The phenomenon of momentum and the psychological tendencies behind it was first explicitly proposed on the US stock exchange by Jagadeesh & Titman (1993). Their study set out to explain why mutual funds, which enjoyed abnormally high returns[4], showed a strong tendency to purchase shares that performed favourably over the previous months. Their curiosity was initiated by a study conducted by Lo & MacKinley (1988), who had found positive serial correlation between previous return and future returns on a weekly and monthly basis.

Lo & MacKinley (1988) proposed that shares should be weighted according to their past performance, gauged against that of the market. Positive weights were assigned to a winner portfolio, whereas negative weights (short selling) were assigned to the loser portfolio. Their strategy used the entire market instead of a subset, as used by Jegadeesh & Titman (1993). As displayed in Figure 14 the entire share universe was divided into two subsets with those who outperformed being bought and those who underperformed being sold.

[4] Abnormally high returns are defined as returns greater than the relevant index in which the share is listed.

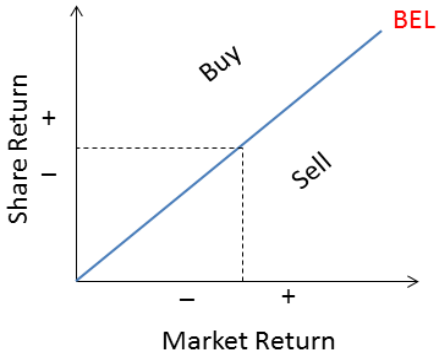

Figure 14 - Lo & MacKinley (1988) Methodology Depiction – Own Depiction

In their initial study, Jegadeesh & Titman(1993) reviewed the returns of shares over the previous one, two, three and four quarters, along with holding periods of one, two, three and four quarters. This equates to a total of 16 different portfolios.

Each month, the share universe was ranked according to the returns of their prior periods, and grouped into ten deciles. The shares were equally weighted within these deciles, with the top portfolio being the winner portfolio and the bottom being assigned as the loser portfolio. At the beginning of each month, the strategy was to sell the loser portfolio and buy the winner portfolio. Portfolios were equally weighted according to value[5] and held for K months, according to the different holding period strategies. Graphically, the process can be displayed as below in Figure 15.

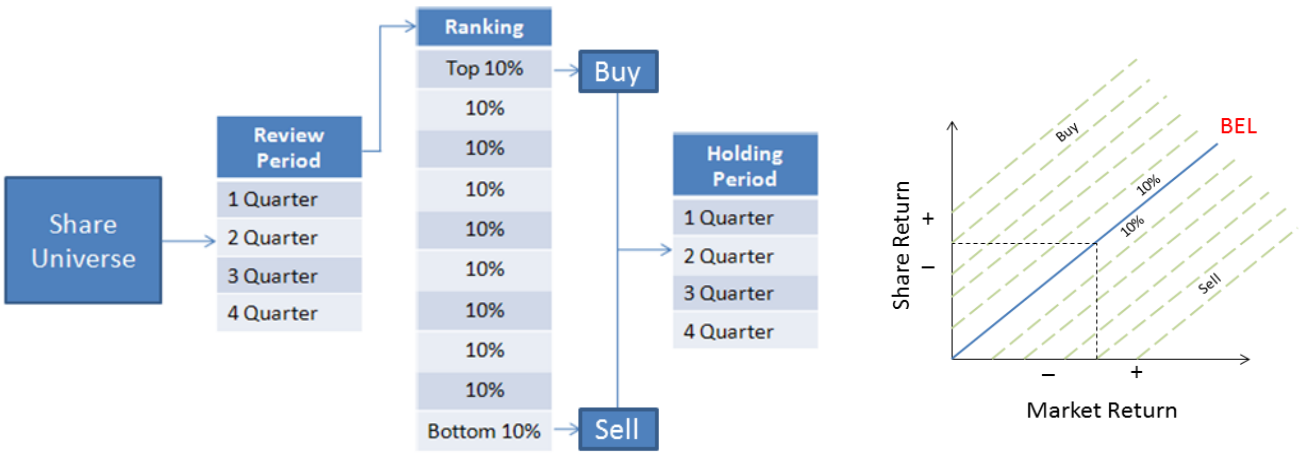

Figure 15 - Jegadeesh & Titman Methodology Depiction – Source: Own Depiction

[5] Each share is assigned a certain percentage of money, i.e. R100 gives 100 R1 shares or 10 R10 shares.

According to their findings, momentum did exist: the best results were obtained from shares whose performance had been evaluated over the past 12 months and using a 3-month holding period along with the construction of zero cost[6] portfolios. This concept contradicted the paradigm of the time, namely, that only contrarian investment strategies could generate abnormal returns, defined as returns greater than the relevant exchange index.

Chan et al (1996) raised some concerns over the findings, arguing that the lack of explanation for the superior returns would suggest that momentum would not hold true for out-of-sample testing. Chan et al subsequently conducted their own out-of-sample test; however, as it overlapped the time frame used by Jegadeesh & Titman (1993), it meant that the test was not completely valid.

Other changes in their methodology included using a different ranking system than Jegadeesh & Titman (1993). Chan et al (1996), for instance, used 3 different rankings systems:

1) Standardised Unexpected Earnings (SUE)
2) Cumulative Abnormal Stock Return (ABSR)
3) Measure of earnings based on changes in analysts' forecasts of expected earnings (REV6)

By ranking the shares according to announcements of earnings news, Chan et al (1996) could explain the phenomenon of momentum as the market under-reacting to firm-specific information.

Jegadeesh & Titman (2001) replied to Chan et al's (1996) study by conducting their own out-of-sample test, using their methodology for the period 1990 – 1998. Reaffirming their previous findings, their strategy continued to provide the same returns as had been obtained in their 1993 study, thus challenging Chan et al's (1996) critique that their study would not hold for an out-of-sample test.

Conrad & Kaul (1998) conducted their own study, testing 120 different trading strategies, including momentum investing. They boldly defied the Efficient Market Hypotheis by stating that, regardless of whether a momentum or a contrarian strategy was used, the success of the strategy was based on the time-series behaviour of a share's price. Conrad & Kaul (1998) therefore provided further evidence that momentum strategies were likely to generate abnormal profits.

In 2002, Jegadeesh & Titman found further evidence to support their theory of momentum by applying Lo & MacKinley's (1988) strategy to their decile method of reviewing returns over six

[6] Zero cost portfolio refers to a method of constructing a portfolio where a dollar amount of shares is bought and the same dollar amount of shares is sold (shorted) to incur zero cost to the trader.

months and holding shares for a further six months, which they referred to as the "weighted relative strength strategy" or "WRRS".

The WRSS approach is based on buying and selling shares in proportion to their prior returns.

The weighting of share *i* at time t is:

$$w_{i,t} = \frac{1}{N(r_{i,t-1} - \bar{r}_{i,t-1})}$$

where *N* is the number of shares in the sample, $r_{i,t-1}$ is the return of the share *i* in the period *t-1*, and $\bar{r}_{i,t-1}$ is the mean return of all shares in period *t-1*.

The methodologies presented above have their respective advantages and disadvantages. With the decile portfolio, the share universe is not always divisible by 10. The decile portfolio is a strategy that can be implemented, unlike the theoretical strategy by Lo & MacKinley (1988), which proposes covering the entire market in a particular position – this is impossible to implement in practice, however, given the amount of money required to hold the shares.

Given the evidence in support of the momentum phenomenon on the US stock exchanges, the question remained whether the phenomenon existed in other stock exchanges and whether the strategy would produce similar results.

3.4.2 Momentum outside the US

In Great Britain studies were conducted on the London Stock Exchange by Liu et al (1999). They conducted their study over the period from 1977 – 1998, using the similar relative strength ranking as that of Jegadeesh & Titman (1993) and later that of Conrad & Kaul (1998), with a different portfolio weighting model. Weekly data intervals were used along with Wednesday share prices to minimise the Monday[7], holiday and End-of-Month effects[8].

All the strategies, except the '3-month formation – 3-month holding period' were successful. Both the one-week gap and no-gap strategies produced positive and statistically significant returns, with the best results being obtained from the '12-month review period and 3-month holding period' strategy.

[7] The Monday Effect theory states that on Mondays the prevailing previous trend will continue, i.e. if the share price was rising on Friday, it will continue to do so on the following Monday.
[8] Fridays and days before holidays often see a decline in share prices due to profit taking.

Given these results, it was proven that momentum did not only occur on the US market but that it was also prevalent on the London Stock Exchange.

Chan et al (2000) analysed the momentum phenomenon by reviewing 23 international stock markets for the period between 1980 and 1995. The study followed the methodology of Conrad & Kaul (1998) for 1, 2, 4, 12, and 26-week holding periods. The results matched those of the previous studies, proving that positive and statistically significant returns could be achieved in both developed and emerging markets. An exception surfaced in South Africa, however, where 1- and 2-week holding period strategies were positive yet insignificant, whereas with negative returns from the 12- and 26-week holding period strategies were significant.

In 2002, two mutually exclusive studies caused controversy over the momentum effect within the Asian markets. Hameed & Kusnandi (2002) completed their study of 6 Asian markets,[9] using monthly share prices with overlapping portfolios, the same methodology used by Jegadeesh & Titman (1993). The study revealed positive yet statistically insignificant returns, forcing Hameed & Kusnandi to conclude that there was no strong evidence of the phenomenon within the markets. Their explanation suggested that regulatory changes within the markets had affected their study. In the same year, Kang et al (2002) provided findings from their own study on the Chinese market with statistically significant returns in favour of the momentum effect.

With multiple studies across the world it would seem that the phenomenon was not only limited to the US.

3.4.3 Momentum on the JSE

Only a few studies concerning momentum have been conducted on the JSE by noteworthy scholars, namely Fraser & Page (2000), Van Rensburg (2001) and Van Rensburg & Robertson (2003). In addition, a Master's degree was completed by Louis Boshoff at the University of Stellenbosch in 2008 to determine the size and effect of the phenomenon.

Fraser & Page (2000) conducted a study of momentum and value based strategies on the industrial sector companies listed on the JSE. Their analysis was based on the methods used by Jegadeesh & Titman (1993), albeit with notable differences. The study was conducted over the period of January 1973 to October 1997 with 5 equally weighted quintile portfolios rather than the decile portfolios used by Jegadeesh & Titman. Another notable difference was the formation of the portfolio over

[9] Hong Kong, Malaysia, Singapore, South Korea, Taiwan and Thailand.

one month, and a holding period of one month. Fraser & Page (2000) concluded that the phenomenon of momentum did exist on the JSE and that it could be a profitable trading strategy.

Van Rensburg (2001) conducted a broader based study on the factors that could explain the return of the industrial sector. Using dividend adjusted share returns similar to Jegadeesh & Titman (1993), momentum portfolios were constructed for the period from February 1983 to March 1999. Once again, the portfolios were differently constructed, using three equally weighted portfolios instead of decile portfolios. The portfolios were tested for different formation and holding periods with 3, 6 and 12-month strategies being the most profitable. Van Rensburg concluded that the 12-month strategy was the most profitable and that it was evident that momentum did exist within the industrial sector.

Van Rensburg & Robertson (2003) broadened their analysis even further by conducting a cross-sectional study of the JSE over the period from July 1990 to June 2000. The same strategy was followed with different formation and holding periods, but the results were statistically insignificant.

The Master's thesis submitted by Louis Boshoff (2008) studied the specific phenomenon of momentum on the JSE from December 1979 to October 2007. Constructing zero cost portfolios similar to Lo & Mckinley (1988) and adjusting for liquidity as done by Chan et al (2000), Boshoff found that the 12-month holding period strategy was the most profitable. Contrary to the findings of Van Rensburg and Robertson (2003), Boshoff concluded that momentum did exist on the JSE but that it was not as significant as on the US and United Kingdom stock exchanges.

One could therefore conclude that, although momentum was present on the JSE, the period over which the studies were conducted did have a significant effect on the results, illustrated by the range of results obtained from the different studies.

3.5 Existence of Mean Reversion

3.5.1 Mean Reversion on International Markets

In Eugene Fama's (1970) early work announcing the theory of the random walk, he was criticised for his use of the small data set. Summers (1986) concluded that at least 6000 data sets were required to prove a standard test of random walk, thus nullifying Fama's earlier use of only 1700 data sets. Summers & Poterba (1988) went on to show strong evidence of positive autocorrelation over short time periods, proving that previous trends continued in the short run, with negative autocorrelation over longer time period, i.e. trends reversing over the long run.

De Bondt & Thaler's (1985) paper glamorised the idea of mean reversion by constructing winner and loser portfolios based on previous five-year returns, adjusted for firm size and risk. They presented evidence of mean reversion over longer holding periods for the portfolios on the US stock exchange from 1926 to 1982. In explaining their findings, they linked it to the psychological biases and decision-making behaviour of investors, thus coining the term "behavioural finance".

Paul Zarowin (1989) suggested that mean reversion could be explained in the form of the 'loser firm phenomenon'. His explanation was that a firm's return was linked to its size. A different explanation was that smaller firms carried greater risk, therefore justifying the abnormally high returns.

Chopra et al (1992) supported De Bondt & Thaler's (1985) conclusions by presenting evidence of mean reversion, even when they compensated by firm size and risk. Their findings also suggest that over-reaction was more severe for smaller firms than it was for larger ones.

In a more recent study, Bauman et al (1999) found evidence of over-reaction in 20 developed stock exchanges. A study on the Hong Kong stock exchange by Otchere & Chan (2003) found that over-reaction was evident and more pronounced for previous winners than for previous losers. Chiao & Hueng (2005) concluded their study on the New York and Japanese stock exchanges and found that over-reaction was still present, even when adjustments had been made for book-to-market and firm size.

3.5.2 Mean Reversion on the JSE

As is the case with the momentum studies, there is a lack of material on over-reaction and subsequent mean reversion on the JSE. However, three noteworthy studies have been conducted with significant results.

The initial study was conducted by Plaistowe & Knight (1986), and it compared weekly returns of winner and loser portfolios for one year after the formation of 35 shares. The study ran from 1973 to 1980, ranking shares according to their market-to-book value, and placing premium shares in the winner portfolio and discount shares in the loser portfolio. They concluded that the winner portfolio recorded significant losses but that the contrary was not as evident for the loser portfolio.

Page & Way (1992) used similar methodology to De Bondt & Thaler (1985) to construct winner and loser portfolios from ranking shares according to their cumulative historical returns. Overlapping and non-overlapping sets of portfolios were constructed for the period from 1974 to 1989. Page & Way concluded that there was significant evidence of investor over-reaction on the JSE, with loser portfolios outperforming the winner portfolios on average by a massive 15%.

These studies did not compensate for survivorship bias,[10] i.e. they only traded shares that were still in existence in 1980. This bias meant that the studies were flawed and that they were thus inadmissible as evidence of the phenomenon.

A revised study by Firer et al (2006) that compensated for survivor bias, investigated the existence of over-reaction on the JSE from the period from October 1983 to December 2005. Shares were ranked according to their Price-to-Earnings ratio, constructing equally weighted portfolios, using a similar methodology as that used by De Bondt & Thaler (1985).

They provided statistically significant results that coincided with those of De Bondt & Thaler (1985), showing clear evidence of reversion to the mean after over-reaction, as the loser portfolio outperformed the winner portfolio.

3.6 Summary

As can be deduced from the above discussion, the concepts of momentum and mean reversion are not new. However, the question arises as to whether taking a single periodic view of price performance has affected the outcome of previous studies and whether samples that are representative of the underlying continuous trend are not a better characterization of the price trend and ultimately the momentum phenomenon.

The following chapter will focus on the technical analysis indicators, which have been specifically designed to represent the underlying momentum price trend and the rationale behind them.

[10] Survivorship bias is the tendency for failed or delisted companies to be excluded from studies. These companies could have had a significant impact on such a study, questioning the integrity of the study.

Chapter 4 - Technical Analysis

The most basic definition of technical analysis is the study of share prices, with charts being the primary tool.

Technical analysts have devised literally thousands of indicators based on price movements and investor sentiment, each with their own rationale, review periods and individual settings. This study will focus on the indicators designed to exploit the phenomenon of momentum. These technical indicators have one thing in common, namely, they try to identify an upward trend in share prices.

Accepting the proposition of 'Janus-like' behaviour, these technical indicators attempt to identify shares that are moving from the right hand side of the Basic Equity Line (BEL), index, to the left hand side as presented below.

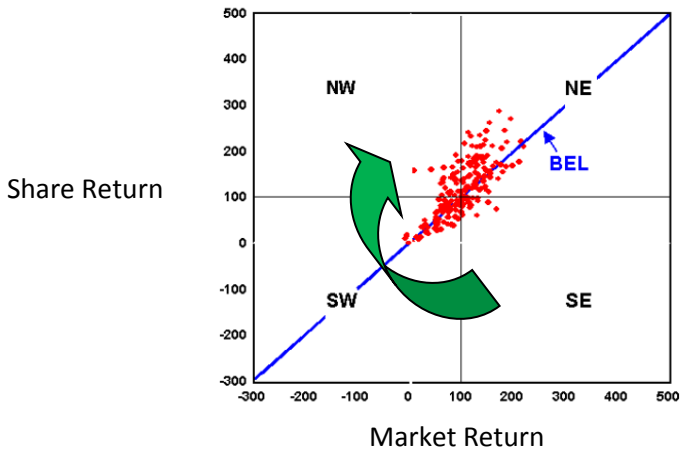

Figure 15 - Equity Performance vs Benchmark Index – Source: G. Anderson - Janus Factors, pg 6

The very first method of establishing momentum is through reviewing price performance over a previous period, as discussed in the methodologies proposed in Chapter 3. Therefore, shares that generated the greatest return over the previous period, have the greatest momentum.

One argument is that this form of gauging momentum is subject to identifying shares that are overvalued and are thus ready for a correction. Figure 16 illustrates how two different shares have the same momentum according to the price performance measure, although they have very different and distinct trends. Share B is in a downward trend towards the end of the review period, whilst share A is still increasing. Technical analysis indicators attempt to identify the underlying trend and thus to identify shares, which are still rising and which will continue to do so.

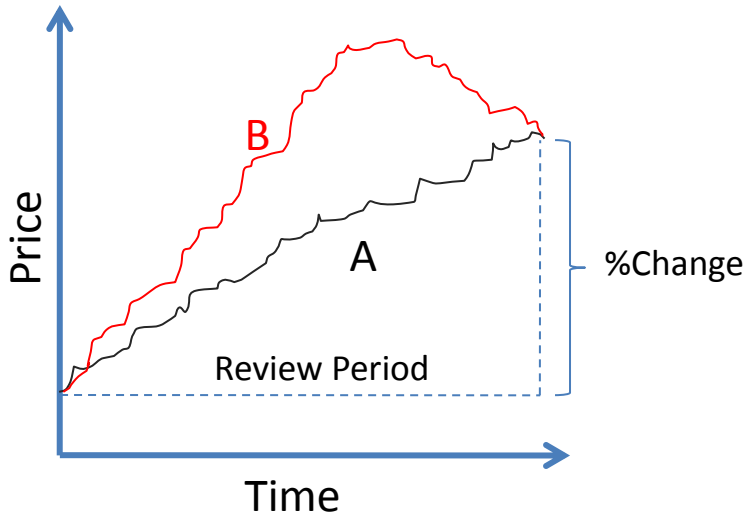

Figure 16 - Momentum Measures – own depiction

4.1 Moving Average Converging Diverging Indicator

4.1.1 Moving Averages

In an effort to diminish the effect of noise on price fluctuations or technical indicators, analysts combine indicators with a smoothing technique that utilises moving averages, thereby allowing the analyst to identify underlying trends more clearly.

Moving averages have long since been used to identify trends. A moving average is constructed by adding the current fluctuation to an average of previous fluctuations and thereby computing the new average.

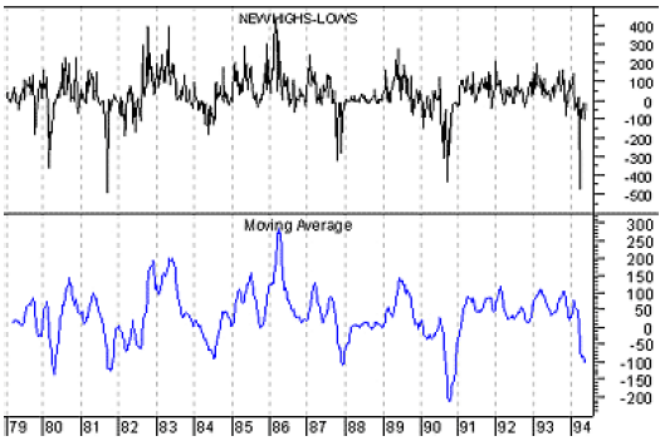

Figure 17 - Moving Average – Source: Achelis, A-Z Technical Analysis, 2006, pg 20

Figure 17 above illustrates how short-term price fluctuations (top) are absorbed by the group average to create a smoother price line (below).

After each period, when the new fluctuation has been added, the oldest fluctuation is no longer taken into account.

$$Moving\ Average_t = \frac{A_t + A_{t-1} + \ldots + A_{t-n+1}}{n}$$

Where *n* equals the period over which the moving average will be taken.

There are different types of moving averages, each with their own purpose:

Simple Moving Average – The fluctuations of each period are given equal weight

Exponential Moving Average – More recent fluctuations are given greater weight

The greater the period over which the average is taken, the less volatility there is in the moving average, as illustrated in Figure 18 below. Comparing the black share price against the red 7-week moving average and 21-day orange moving average, it is evident that the short-term moving average is much more susceptible to fluctuations than the longer term moving average.

Figure 18 - Simple Moving Averages – Source: Own Depiction

Technical analysts interpret the indicator by evaluating whether the share price is above or below the moving average. In the figure above the share price was compared against a single moving

average, where a buy (sell) signal would be indicated by the share price (black) moving above (below) the short-term 7 day moving average (red).

To remove false signals, as illustrated by the blue shaded region in the figure above, a further moving average was added, with the new buy (sell) signal being indicated by the short-term red moving average moving above (below) the long-term yellow moving average.

4.1.2 Moving Average Converging Diverging Indicator

The brainchild of Gerald Appel (2005), the Moving Average Converging Diverging (MACD) indicator has been successfully used by many money managers, and it features on almost every technical trading program. The indicator attempts to identify a trend through exploiting the relationship between two different moving averages.

Mathematically, MACD is calculated as:

$$MACD = Short\ term\ \ exponential\ moving\ average \\ - Long\ term\ exponential\ moving\ average$$

The basic concepts include:

- In rising markets, the short-term moving average will rise more quickly than the long-term moving average, thus resulting in the difference being positive and increasing
- In decreasing markets, the short-term moving average will fall faster than the long-term moving average, thus resulting in a decreasing trend in the indicator
- During price cycles, the short- and long-term moving averages will converge and diverge, aptly described by the name 'moving average converging-diverging'
- The closer the two moving average periods are to one another, the more sensitive the indicator is to price movements

Figure 19 - MACD Illustration – Source: Achelis, A-Z Technical Analysis, 2006, pg 21

Figure 19 above illustrates the MACD indicator (top) and the share price with superimposed 12- and 26-day simple moving averages (bottom). The indicator would signal a buy (sell) signal when the short-term moving average moves above (below) the long-term moving average, and the MACD indicator becomes positive (negative).

In order to compare the MACD values of individual shares directly, one would have to normalise the indicator. This can be done by modifying the MACD equation to the following:

$$MACD = \frac{Short\ term\ \ exponential\ moving\ average - Long\ term\ exponential\ moving\ average}{Long\ term\ exponential\ moving\ average}$$

4.2 Rate of Change

Popularised by Appel & Hitschler (1973) in their book *Stock Market Trading Systems*, this normalised indicator makes it possible to compare the momentum of different shares with different prices directly with each other.

Momentum is quantified by calculating the rate of change of price movements, i.e. the rate at which the price changes, mathematically stated:

$$Rate\ of\ Change = \frac{Price_t - Price_{t-n}}{Price_{t-n}} \times 100$$

Therefore, the price 'now' is compared to the price '*n*' periods ago. Stock technicians believe that share prices move in a cyclical manner, as depicted in Figure 20 below. The Rate of Change (ROC) indicator oscillates between extremes, with movement away from these extremes indicating a buy or sell signal.

As indicated in the figure below, the ROC indicator (top) is shown against the share price of Walgreen (bottom). Within the ROC indicator, subjective overbought and oversold lines were drawn to depict the historically extreme levels. As depicted, a buy (sell) signal is initiated by movement away from the lower (upper) extreme to higher (lower) ROC values.

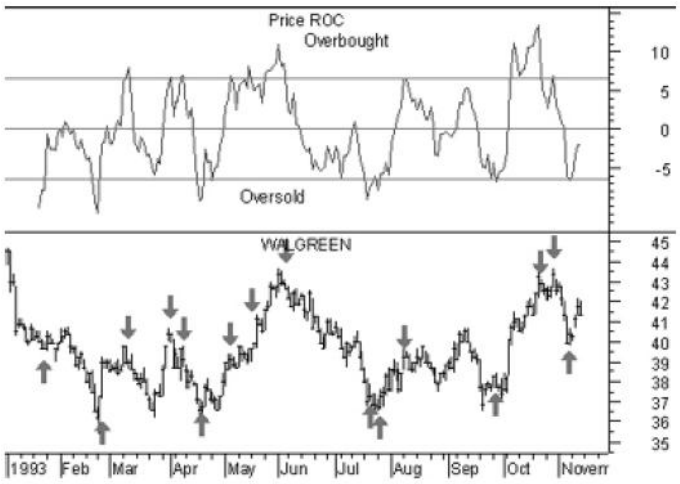

Figure 20 - ROC indicator – Source: Achelis, A-Z Technical Analysis, 2006, pg 126

4.3 Relative Strength Momentum

Stan Weinstein, an avid user of the relative strength concept, describes how this measures an asset's performance against that of a benchmark and how it is used to determine which shares in a sector or which sector in a market is performing the best (Weinstein, 1992, Page 75).

> *"My studies have consistently shown that two equally bullish charts will perform far differently if one is from a bullish sector while the other breakout is in a bearish group. The favourable chart in the bullish group will often quickly advance 50 to 75 percent while the equally bullish chart in a bearish group may struggle to a 5 to 10 percent gain".*

Illustrated in Figure 21 below is the performance of IBM, gauged against an index benchmark (below left), depicting the movement of the share price in relation to the index, as proposed by the Janus theory (below right).

The underlying principle of the Relative Strength Indicator is to identify shares that are performing better than the benchmark (Figure 21: top left) and that subsequently are experiencing a shift t towards the upper left sector of the graph below right, according to the Janus factor covered in Section 3.2.2.

In Figure 21 below, the out-performance of IBM above the index is indicated by the share price rising above the index, top left. This performance, which is greater than the index, caused a shift indicated below right, reflected by a rise in the relative strength indicator (bottom left) illustrated by '1' in both graphs in figure 21. The weak performance of IBM that followed, resulted in a reversal, with the share performance reverting to the market mean (below left) and the Relative Strength Indicator decreasing, which corresponded to '2' in both graphs.

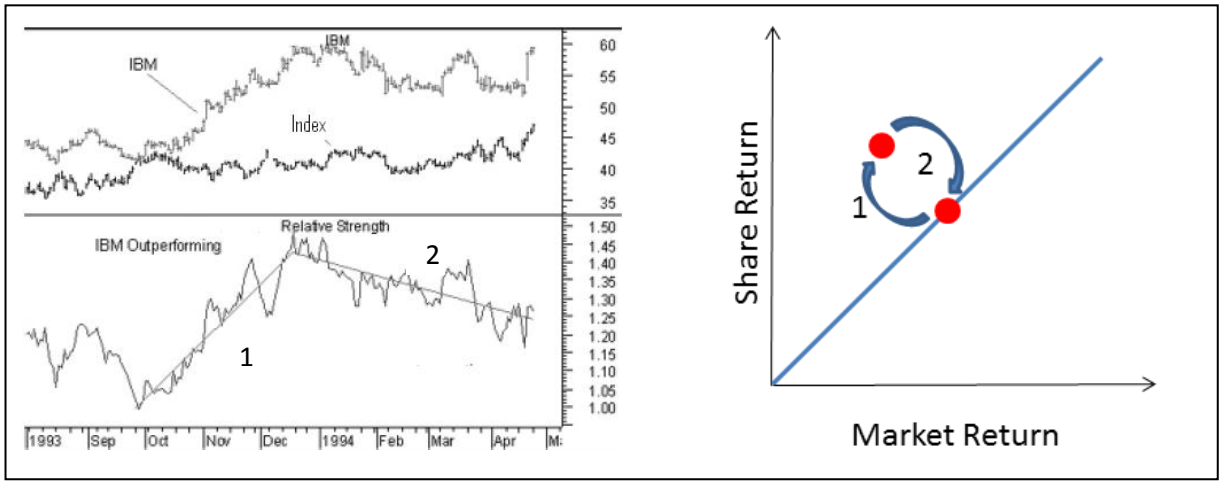

Figure 21 - Relative Strength - Source A-Z Technical Analysis, Achelis (2006), pg 130

Mathematically stated:

$$Relative\ Strength = \%\ Change\ asset\ Price - \%\ Change\ in\ Benchmark$$

By combining the concepts of relative strength and momentum through the utilisation of the Rate of Change concept, technical analysts hope to achieve higher returns more consistently. The rationale behind the concept is that the relative strength component can be used to identify shares that are outperforming the market, whilst the momentum component can be used to identify shares that have the ability to continue to do so (Metastock, 2008).

The indicator can be calculated as follows:

1) Calculate the relative strength of the particular share against that of the index
2) Smooth the relative strength by taking a moving average
3) Calculate the Rate of Change of the moving average series

In Figure 22 below, the share price of Mr Price is compared against that of the JSE ALSI (top). The blue line is the weekly range of Mr Price's share price, whereas the red line is the performance of the JSE ALSI.

The bottom window depicts the relative strength of Mr Price (red line graph) and subsequent ROC calculation of the moving average of the relative strength (blue bar graph). Technical analysts interpret the RSMOM (ROC of Relative Strength) indicator as a buy (sell) signal if RSMOM is positive (negative) and increasing (decreasing).

Figure 22 - RSMOM illustration - Source Own Depiction

4.4 Summary

Whereas previous academic studies used price measures to define shares as either previous winners or losers, this periodic sampling may have inadvertently affected the singular view of the share's performance.

The technical indicators discussed in this chapter are designed to allow a direct comparison between different shares, as well as to represent the underlying trend in the share's price, even when sampled periodically.

The following chapter will discuss the methodology that has been designed to test whether the technical indicators provide a better representation of momentum and whether momentum is a consistent attribute amongst top performing shares.

Chapter 5 – Methodology

5.1 Introduction

From the previous chapter, it is evident that the technical definitions of the concept of momentum differ from those of previous studies. This chapter discusses the design of the experiment ultimately to explore and compare the results of the separate momentum definitions and previous studies. The methodology described below is designed to identify three principles, namely:

- whether momentum is a common attribute amongst top performing shares
- whether technical analysis better identifies the phenomenon than price performance momentum measures
- whether the return from these shares would justify the momentum concept as a viable investment strategy.

5.2 Design of Experiment

5.2.1 Methodology

The methodology proposed in this study utilises the rationale of Jegadeesh & Titman (1993), whereby the share universe was divided into groups of deciles.

The methodology is illustrated as a flow diagram in Figure 23. This diagram indicates that the share's momentum will be translated into a rank. Given the time and scope of the study, the different settings for each of the technical momentum ranking methods will be obtained from the prospective proposers of each method, as tabulated below.

Ranking Method	Proposer	Settings
MACD	Gerald Appel	45 week long-term exponential moving average with a 15 week short-term exponential moving average
RsMom	Stan Weinstein	40 week exponential moving average of the share's relative strength against the JSE ALSI, with a 15 week ROC review period
ROC	Fred Hitschler	8 week price comparison

Table 1 - Technical Indicator Settings

Also indicated in the flow diagram below is the fact that, within the traditional price performance ranking method, several review periods will be tested, including 3, 6, 9, and 12 months.

Price performance will be gauged in terms of the capital gains yield over the holding period. Given the following formula, returns were calculated by:

$$r_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}}$$

Where:

r_{it} = return obtained over the period t

P_{it}= Price of the share at the end of the holding period

P_{it-1}= Price of the share upon purchase

The share's performance will be evaluated 1, 2, 3, 4, 6 and 12 months after momentum ranking, with returns also being translated into a rank. The performance will be utilised to evaluate the return of the various ranking methods, with the return rank being employed to evaluate whether momentum is a common attribute amongst top performing shares.

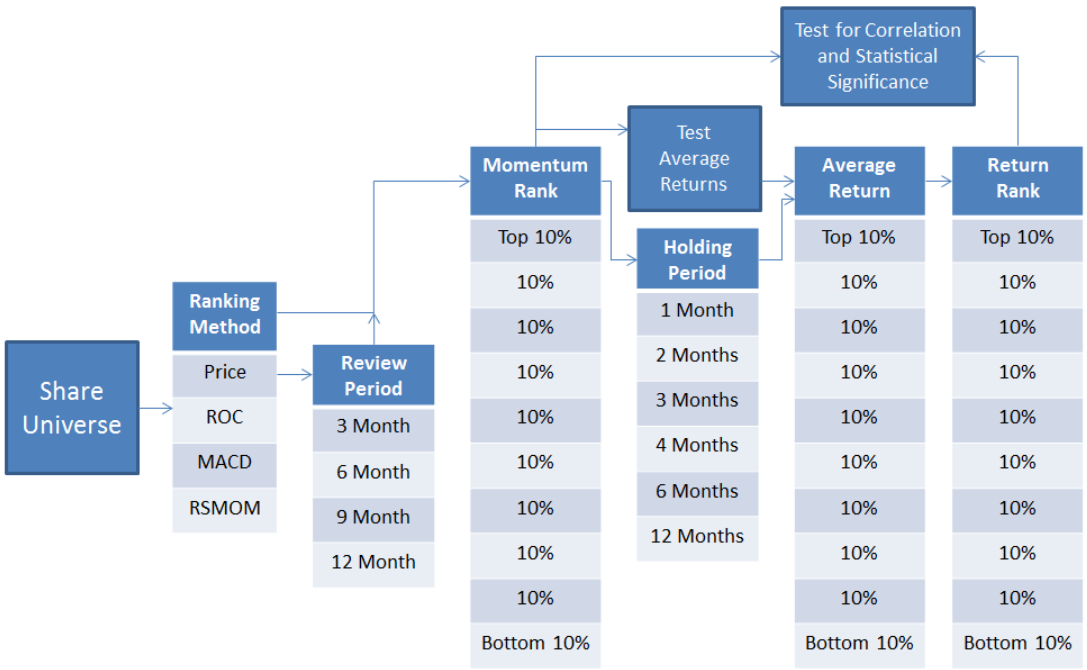

Figure 23 - Methodology Flow Diagram

Ranking returns into deciles allow the study to remove the impact of market variance from the results. During certain market periods, for instance, the index will return 15% in one year, with the top performing shares delivering somewhat above this, whereas in other periods, the market will return 5%, with the top performing shares deliver perhaps 10% to 15% the same as the index in a previous period. Evaluating the correlation between single values of momentum and these single values of return will deliver scattered and questionable results. Therefore, by gauging the performance of these shares against that of the market, by categorising returns into deciles, the study is able to evaluate the dependence of return on momentum, i.e. whether momentum is a common attribute amongst top performing shares.

The portfolios will be tested with overlapping quarterly intervals from January 1990 to August 2009, removing the possibility of timing being the source of the results.

Given this methodology, results that would support the momentum hypothesis would be a high statistical correlation between a high momentum rank and a high return rank; in other words, momentum shares would have the best performance. Secondly, by reviewing the average returns of the shares, it will be investigated whether high momentum ranked shares would provide returns greater than those of the benchmark, i.e. the JSE ALSI, even if taxes and trading costs are included.

A proxy for dividends in the form of dividend yield was not included in calculating the returns over the specified period. The concept of dividend yield assumes that dividends are continuously earned by the investor and it was thus omitted, given the hypothesis of this study, namely that 'Price momentum and subsequent capital gains are the source of favourable returns'.

As a result, dividend yield as a proxy for dividends was not included to calculate the rank or return of the respective shares. The rationale behind this was the following:

- The inclusion of dividends would impose technical difficulties due to a lack of data.
- Dividends do not support the experiment that 'price momentum' is a common trait amongst shares that can be compared in an empirical study.
- The fact that not all the shares on the JSE pay a regular dividend would prevent the uniform comparison of shares.
- All investment philosophies argue that perceived future dividends are discounted into the share price and that they have thus already had an impact on the study (Dividend Discount Model, Bodie et al, 2004).
- The inclusion of dividends would not negatively affect returns, as they only present further returns.

5.2.3. Data

The historical share data was obtained from Sharenet. The data included those shares listed on the JSE Securities Exchange from April 1985 updated to account correctly for share splits, unbundling and delisting. Delisted shares were included and considered for their listed period to remove the survivorship bias identified by Gilbert and Strugnell (2008). The data consisted of daily, weekly and monthly share prices and their respective high, low and closing levels.

5.2.3 Testing Program

The program Ariel™ was used to rank the shares according to the respective ranking methods. The Ariel program in reality is an open source version of MetaStock. The reasons for using this program include:

- The program allows the user to import share data from various stock exchanges, and it allows the historic representation and exploration of delisted shares.
- The program allows the user to edit the source code quickly and efficiently to suit the test being conducted.
- The program functions well with Microsoft Excel, allowing the user to code the methodology in Visual Basic, the programming language that is common to both programs.

Whereas previous studies used VBA or SQL based programming to execute their methodology, programming from the base routes leave much room for programming disparities, which could cause anomalies within the results. To ensure the integrity of the results obtained, the methodology in this program was vetted by doing paper traces for each ranking method, review and holding period.

5.2.4 Taxes & Trading Costs

Active trading does have its consequences in that, with each transaction, trading costs and taxes apply. These costs may erode any excess returns, thereby voiding any strategy that proposes active trading rather than holding an index balanced portfolio.

Trading costs are a fee that brokerage firms retain for trading on behalf of investors. Currently this fee equals 0.7% of the amount traded upon purchase and sale (Standard Bank Online Trading).

Investors who are against the use of the momentum strategy mention taxes as a major obstacle when employing such an active trading strategy. These critics suggest that abnormal returns are negated by the fact that share returns are taxed at income tax rates rather than capital gains tax rates.

Capital gains tax is calculated by adding 25% of the net capital gain to the individual's taxable income for the assessment year. Applying income tax to share return, however, the entire net capital gain would be added to an individual's taxable income. The tax rates for the year 2010/2011 are provided below.

Taxable Income (R)	Rate of Tax (R)
0 - 140,000	18% of taxable income
140,001 - 221,000	25,200 + 25% of taxable income above 140,000
221,001 - 305,000	45,450 + 30% of taxable income above 221,000
305,001 - 431,000	70,650 + 35% of taxable income above 305,000
431,001 - 552,000	114,750 + 38% of taxable income above 431,000
552,001 and above	160,730 + 40% of taxable income above 552,000

Table 2 - Applicable Tax Rates - Source SARS

The most important factor in determining the tax rate is the intention at the time the share was bought (Elandsheuwel Farming (EDMS) Bpk vs SBI 1978 (1) SA 101 (A) 39 SATC 163). Should an investor be able to prove that shares were purchased as an investment and not for short-term gain to form part of the individual's income, capital gains tax would be applicable and not income tax. Scale and frequency of transactions play a major role in determining the applicable tax rate but are not conclusive (CIR vs Nussbaum Supra).

Upon interviewing a tax representative from the South African Revenue Services, the subject still seems to remain in limbo. As a standard rule, any share kept for longer than three years is viewed as a capital asset and not taxed at income tax rates.

However, the concept of being able to deduct various expenses as part of 'the cost of doing business' is one not favourably considered by SARS, and they would much rather apply capital gains tax, unless active trading is exorbitant. As a rule of thumb, SARS would apply capital gains tax as long as an investor's portfolio is not turned over more than once, i.e. the number of positions taken per year divided by the number of shares held is not more than one. This principle was re-iterated by Tom de Lange, an active investor on the JSE, who provided tax submissions as verification of this principle.

In this dissertation, trading costs will be applied appropriately with returns of the deciles being gauged in respect to income tax within the 40% taxable income bracket, given the short-term nature of the phenomenon and uncertainty surrounding the principles of tax.

Momentum would pass as a viable investment philosophy, should neither trading costs nor income tax implications erode abnormally high profits.

5.4 Statistical Evaluation

Given that the experiment wishes to determine whether momentum is a common attribute amongst top performing shares, the results have to verify statistically whether there is dependence between momentum and return and whether such dependence is statistically significant. The statistical evaluation was conducted at the Centre for Statistical Consultation at the University of Stellenbosch under the guidance of Prof. D G Nel.

With both the momentum and the subsequent return being functions of a rank, and being grouped into deciles, the Spearman Rank correlation co-efficient was identified as the appropriate statistical measure for measuring the extent to which the variables were co-dependent (G Ferguson, 1989).

Table 3 below illustrates the process whereby the individual values of momentum and return are categorised into a corresponding rank.

Share	Momentum Rank	Momentum Decile	Return	Return Rank	Return Decile
Abi	80	7	28%	92	10
Absa	67	5	20%	83	9
Adcorp	32	4	6%	13	3
.....	.....	.....			
Voltex	71	6	8%	24	3
Wes-areas	17	2	-4%	9	2
Whtwater	28	4	12%	32	4

Table 3 - Rank Formulation

The Spearman correlation co-efficient was mathematically stated by:

$$r_s = \frac{6\sum d_{i^2}}{n(n^2-1)}$$

Where:

$d_i = x_i - y_i$ the difference between the momentum rank and the return rank for a particular share

n = the number of shares

The value of r_s quantifies the degree to which return rank is related to momentum, whether the return rank increases or decreases as the momentum rank increases. The value of r_s ranges from 1 to -1, where 1 signifies a perfect positive correlation and -1 a perfect negative correlation.

To test whether the relationship is merely one of chance, the correlation has to be tested for statistical significance. This is done by using software created for statistical evaluation, called Statistica™, and utilised by the Centre for Statistical Consultation at the University of Stellenbosch, due to its ease of use and the large sample sizes.

The software utilises a permutation test to gauge the statistical significance of Rank Spearman Correlations, a theory that evolved from the works of Fisher (1935) and Pitman (1937). Also called the randomization or re-randomization test, the statistical significance is determined by rearranging the labels on the observed data points. If the labels are interchangeable at the null hypothesis, H_0, which is that the two data sets have identical probability distributions. The advantage of this method is that it does not pre-assume a distribution to which the results have to fit.

The test is summarised in Figure 24 below for two sets of observations (blue and green). First, the difference in means between the two samples is calculated by using $\overline{x_A}$ - $\overline{x_B}$ (below left); this is the observed value of the test statistic, T(obs). Then the observations of the two groups are pooled (below middle). Next, the differences in sample means are calculated by using ($\overline{x_{Ai}}$ - $\overline{x_{Bi}}$), and recorded for every possible way of dividing the pooled observations into two groups of size n_a and n_b (below right). The resulting set of calculated differences is the exact distribution of possible differences under the null hypothesis. The one sided p-value of the test is calculated as the proportion of sampled permutations, where the difference in means was greater than or equal to the original T(obs).

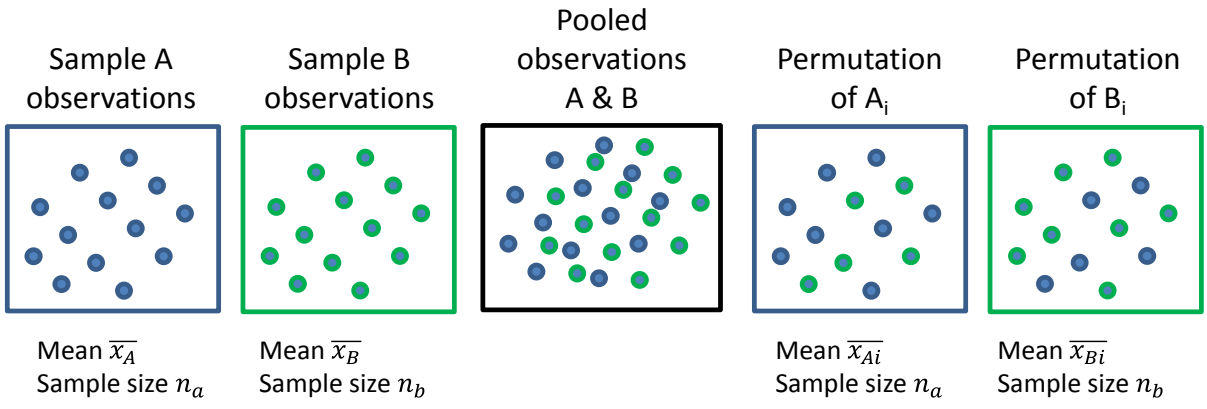

Figure 24 - Depiction of a Permutation Test – Own Depiction

The method described and depicted above was conducted by the Statistica™ software for every ranking method in relation to a respective return rank in order to determine whether the two groups had similar distributions (H_0).

The field of statistics proposes two types of errors with set error rates, which are considered acceptable within the field (see Figure 25 below).

		True state	
		H_0 true	H_A true
Decision based on sample statistic	Accept H_0	Correct decision: H_0 true and H_0 not rejected	Type II error or β
	Reject H_0	Type I error or α	Correct decision: H_0 false and H_0 rejected

Figure 25 - Statistical Error -Boslaugh & Watters (2008) - *Statistics in a Nutshell – pg 143*

The table above defines the two error types as:

Type I: The null hypothesis was true but was rejected

Type II: The null hypothesis was false but was accepted

For the purposes of this study, the relevant acceptance level for type I and II errors was 0.05, meaning that there was a 5% chance of wrongfully accepting or rejecting the null hypothesis. Therefore, if the p value was greater than 0.05, the null hypothesis, viz. that momentum ranks and return ranks are co-dependant and have similar distributions, would be rejected.

5.5 Economic Results

The return of the various ranking methods and holding periods was annualised and compared to a buy and hold strategy of the market for the same holding period from January 1990 to August 2009. The market comparatives included the JSE ALSI, a weighted representation of market participants, and the average return of an un-weighted portfolio that was representative of the entire market.

The JSE ALSI is a composite of all the shares listed on the JSE and weighted according to market capitalisation. The average annualised return of the JSE ALSI for the various holding periods are depicted in Figure 26. Figure 27 depicts the average annualised return of an un-weighted composite of all the shares according to the respective holding periods.

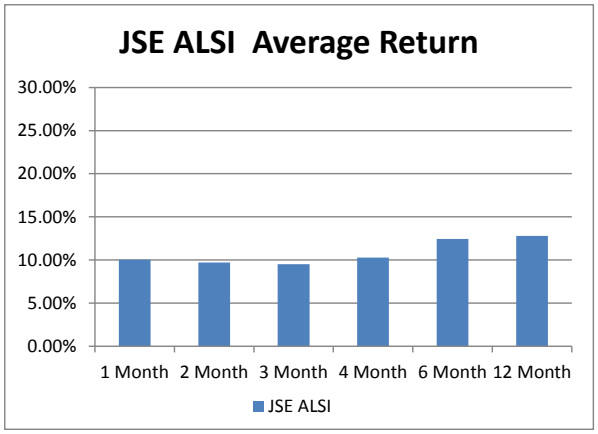

Figure 26 - JSE ALSI - Average Annualised Returns

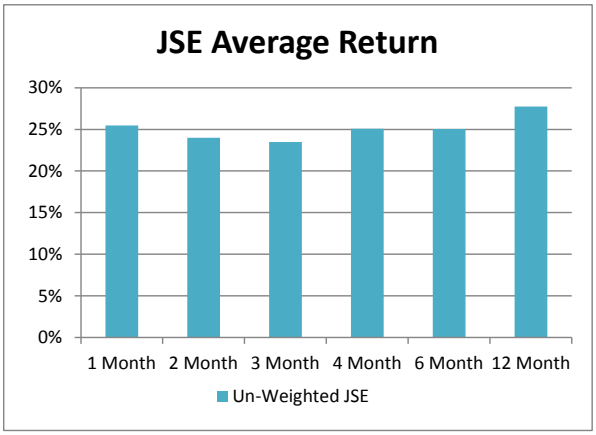

Figure 27 - Un-Weighted Average Annualised Returns

The figures above demonstrate that the JSE ALSI is heavily weighted towards companies who produce lower than the average share price gains in comparison to the average of the entire market.

5.5 Summary

Given the wide array of academic studies in the field of behavioural finance, it is of cardinal importance that the experiment does not commit the same errors as its predecessors have done. The data, the number of shares analysed and the data points were thus chosen to re-enforce the validity of the statistical results.

Given the quantitative nature of the experiment, opting to choose the original settings as prescribed by the respective proposers has confirmed the stability and legitimacy of the hypothesis, viz. that a momentum strategy can yield positive results without needing to adjust for local markets and share price cycles.

Chapter 6 – Results

The results examined the following issues in accordance with the initial hypothesis, as formulated in Section 1.2:

- whether momentum is a common attribute amongst top performing shares
- whether technical analysis is better able to identify the phenomenon than price performance momentum measures
- whether the return from these shares would justify momentum as a viable investment strategy.

6.1 Review of Statistical Results

As discussed in Section 5.3, correlation is a measure of co-dependence between the momentum rank and the return rank. The higher the correlation, the greater the degree of co-dependence; therefore, a value of one would signify a perfect positive correlation, whereas a value of -1 would indicate a perfect negative correlation.

The p-value enumerates the level of statistical significance. The lower the p- value, the less the chance of wrongfully accepting or rejecting the null hypothesis, namely, that momentum rank and return rank have similar distributions. For the purposes of this study, a maximum p-value of 0.05 is acceptable, therefore the study allows a 5% chance of wrongfully accepting or rejecting the null hypothesis.

Table 4 illustrates the statistical results for the respective ranking methods (left) compared to the holding periods (right), as described by the methodology. The results tabulate the values of correlation and statistical significance.

The colour gradient applied to the correlation values displays higher correlation values with progressively darker shades of green, with lower values fading towards lighter colours, and the lowest values being displayed in red.

Correlation and Statistical Significance								
Ranking Method			Holding Period					
			1 Month	2 Month	3 Month	4 Month	6 Month	12 Month
Price Performance Review Period	12 Month	Corr	0.02535775	0.09762351	0.13239142	0.12265101	0.16801587	0.1485712
		P-value	0.02599502	<0.01	<0.01	<0.01	<0.01	<0.01
	9 Month	Corr	0.01940237	0.08023338	0.10845208	0.11248693	0.1655183	0.15784433
		P-value	0.08850838	<0.01	<0.01	<0.01	<0.01	<0.01
	6 Month	Corr	0.00229389	0.07976178	0.10857185	0.10716522	0.15285623	0.16651274
		P-value	0.84041729	<0.01	<0.01	<0.01	<0.01	<0.01
	3 Month	Corr	-0.030644	0.02366136	0.05234836	0.05371506	0.0977817	0.12676206
		P-value	<0.01	0.03777311	<0.01	<0.01	<0.01	<0.01
RsMom		Corr	0.0368799	0.0902084	0.11479817	0.11066463	0.1482654	0.14989621
		P-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ROC		Corr	-0.0493031	0.00656071	0.03147626	0.03595846	0.0717674	0.09313878
		P-value	<0.01	0.49568489	<0.01	<0.01	<0.01	<0.01
MACD		Corr	0.02882336	0.08461649	0.11160021	0.10834743	0.14829733	0.14981135
		P-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Table 4 - Statistical Results

Reviewing the results in table 4, the following observations can be made:

1) There is a definite relationship between momentum and future expected returns. This is evident from the statistically significant positive correlations between the momentum ranks and return ranks.
2) The price performance ranking method with a 3-month review period and a one-month holding period, along with the ROC technical indicator and respective one-month holding period, had statistically significant inverse correlations.
3) The price performance ranking method with a 3-month review period and a two-month holding period, along with the ROC technical indicator and respective two-month holding period, had statistically insignificant positive correlations.
4) The correlation between momentum rank and return rank remains significant and increases with longer holding periods.
5) Price performance momentum ranking methods have a higher correlation than do the technical analysis ranking methods.
6) The price performance ranking method, with a three-month review period, along with the Rate of Change (ROC) technical indicator, has the lowest correlations.
7) The highest correlation co-efficient is obtained from a 6-month price performance momentum measure and a 12-month holding period.

From these observations, the following deductions can be made: Momentum is statistically proven, given the seemingly unambiguous correlation between momentum rank and return rank for almost all of the momentum ranking methods and review periods. Therefore, momentum is a common attribute amongst top performing shares over a period of one to twelve months.

However, the null hypothesis can be rejected in part. Where momentum has been proven to correlate with returns for the periods of one to twelve months, the correlation was greater for price performance momentum measures than technical indicators. Therefore, technical analysis is not a better predictor of future returns, which had been postulated in the initial hypothesis.

A counter argument can be made, namely, that the technical analysis indicators were not optimised for South African shares, and that this therefore leaves some room for improvement.

6.2 Review of Economic Results

Given the various arguments surrounding income tax and capital gains tax and the difficulty of defining this for the average investor, the maximum income tax of 40% was applied along with a 0.07% brokerage charge for every purchase and sale.

Slippage, namely, the difference an investor can expect between the spot price of the share and the average cost per share to fill the order, was not taken into account to calculate share returns. Slippage would be much lower for highly liquid shares, and it would be very difficult to apply in this experiment. The consequence of not including slippage in the experiment would be slightly overstated returns; however, slippage was also not included in calculating the average market returns over the same period, making the adjustment unanimous across the board.

The returns for the various ranking methods per decile were annualised and compared (see tables 5 and 6) against the average annualised returns of the JSE ALSI and an un-weighted representation of the market for each respective holding period. The column on the left denotes the ranking method and decile, whereas the columns on the right signify the relevant holding periods.

The tables presented are conditionally formatted, with red signifying returns below the JSE ALSI, orange representing returns greater than the JSE ALSI but less than the un-weighted average return of the market, and finally green illustrating those deciles that outperformed the un-weighted market average.

		Holding Period Average Return					
		1 Month	2 Month	3 Month	4 Month	6 Month	12 Month
JSE ALSI		10.02%	9.70%	9.51%	10.28%	12.43%	12.78%
JSE Unweighted		25.47%	24.00%	23.48%	25.07%	25.04%	27.73%
Price Performance 12 Month Review Period	Decile 1	18.88%	12.20%	9.53%	15.09%	15.37%	18.29%
	Decile 2	20.42%	10.60%	7.52%	7.85%	8.65%	10.38%
	Decile 3	8.60%	10.12%	9.30%	9.57%	8.16%	11.78%
	Decile 4	13.95%	10.10%	8.85%	10.09%	10.07%	11.03%
	Decile 5	11.66%	11.12%	9.72%	10.82%	11.00%	11.06%
	Decile 6	9.23%	12.55%	11.37%	11.23%	10.32%	11.65%
	Decile 7	11.14%	17.28%	15.82%	15.48%	13.97%	14.30%
	Decile 8	10.76%	13.61%	13.48%	13.85%	15.87%	16.42%
	Decile 9	16.76%	24.02%	21.24%	19.32%	20.56%	19.76%
	Decile 10	26.88%	34.13%	30.58%	32.98%	32.05%	36.99%
Price Performance 9 Month Review Period	Decile 1	19.47%	11.23%	9.86%	14.04%	13.33%	14.75%
	Decile 2	15.94%	11.19%	7.62%	8.47%	7.94%	9.68%
	Decile 3	18.71%	13.80%	10.96%	10.79%	8.71%	11.25%
	Decile 4	10.32%	10.39%	11.15%	11.05%	9.19%	12.28%
	Decile 5	13.37%	14.41%	11.70%	12.35%	14.07%	13.37%
	Decile 6	7.14%	10.74%	10.20%	11.56%	12.69%	13.44%
	Decile 7	9.27%	12.67%	11.89%	11.82%	11.98%	12.70%
	Decile 8	14.75%	17.07%	15.57%	16.26%	17.37%	17.17%
	Decile 9	13.90%	19.38%	18.56%	16.54%	18.64%	19.08%
	Decile 10	25.58%	34.70%	29.81%	33.39%	32.19%	38.09%
Price Performance 6 Month Review Period	Decile 1	20.98%	12.26%	9.92%	13.46%	13.51%	12.60%
	Decile 2	12.72%	9.11%	6.38%	8.71%	8.38%	9.74%
	Decile 3	13.81%	11.48%	11.32%	11.11%	10.06%	12.04%
	Decile 4	16.24%	11.37%	10.42%	11.21%	11.81%	13.93%
	Decile 5	14.10%	12.33%	10.13%	11.08%	9.75%	11.38%
	Decile 6	17.79%	16.51%	15.02%	14.87%	14.65%	14.11%
	Decile 7	11.83%	13.11%	13.09%	12.74%	12.68%	13.77%
	Decile 8	9.04%	12.79%	10.89%	10.61%	13.49%	13.99%
	Decile 9	14.74%	23.37%	21.25%	20.82%	21.34%	21.74%
	Decile 10	17.66%	33.42%	29.11%	31.86%	30.65%	38.70%
Price Performance 3 Month Review Period	Decile 1	18.11%	16.25%	9.11%	12.34%	11.23%	13.48%
	Decile 2	16.72%	13.16%	10.37%	11.07%	10.20%	10.40%
	Decile 3	18.90%	12.21%	10.83%	11.31%	10.88%	12.53%
	Decile 4	15.87%	16.72%	14.56%	15.41%	14.29%	12.33%
	Decile 5	16.01%	15.81%	17.22%	17.15%	16.61%	14.99%
	Decile 6	13.41%	14.61%	13.31%	13.63%	13.51%	18.41%
	Decile 7	13.61%	13.88%	12.49%	13.10%	13.73%	15.26%
	Decile 8	10.24%	12.37%	11.36%	11.18%	11.98%	13.72%
	Decile 9	10.50%	16.14%	15.06%	14.96%	17.99%	19.38%
	Decile 10	15.55%	24.43%	23.26%	26.39%	26.11%	31.81%

Table 5 - Return vs Ranking Method and Decile

		Holding Period Average Return					
		1 Month	2 Month	3 Month	4 Month	6 Month	12 Month
JSE ALSI		10.02%	9.70%	9.51%	10.28%	12.43%	12.78%
JSE Unweighted		25.47%	24.00%	23.48%	25.07%	25.04%	27.73%
RsMom	Decile 1	15.62%	11.30%	10.27%	11.77%	12.24%	14.06%
	Decile 2	14.25%	9.29%	8.29%	9.27%	8.36%	11.55%
	Decile 3	14.75%	10.96%	8.78%	8.71%	9.31%	11.42%
	Decile 4	10.83%	8.08%	7.10%	6.45%	7.80%	9.12%
	Decile 5	14.00%	12.65%	11.78%	10.52%	10.58%	10.39%
	Decile 6	10.93%	11.87%	10.23%	10.01%	10.99%	11.88%
	Decile 7	9.25%	9.86%	9.04%	7.70%	11.36%	12.01%
	Decile 8	12.57%	14.99%	14.42%	13.00%	16.27%	18.49%
	Decile 9	16.86%	20.81%	19.03%	16.98%	18.09%	18.45%
	Decile 10	23.72%	32.99%	30.83%	28.23%	29.76%	35.16%
ROC	Decile 1	20.19%	12.58%	9.87%	10.05%	9.75%	12.35%
	Decile 2	19.13%	12.67%	10.63%	9.57%	9.55%	9.47%
	Decile 3	19.41%	16.05%	13.41%	12.90%	14.79%	15.69%
	Decile 4	18.25%	15.60%	13.32%	12.62%	13.24%	15.61%
	Decile 5	16.70%	13.71%	11.38%	11.62%	12.98%	13.13%
	Decile 6	10.03%	9.62%	10.96%	9.85%	12.95%	14.16%
	Decile 7	10.98%	14.80%	12.51%	12.25%	12.97%	13.50%
	Decile 8	8.87%	12.96%	13.47%	11.37%	12.34%	15.37%
	Decile 9	7.28%	13.14%	13.59%	12.30%	14.12%	16.30%
	Decile 10	11.87%	21.95%	20.96%	20.43%	22.42%	27.33%
MACD	Decile 1	18.36%	14.21%	12.20%	13.87%	13.64%	15.16%
	Decile 2	13.63%	8.94%	8.12%	8.20%	8.70%	12.03%
	Decile 3	14.86%	9.28%	7.01%	7.59%	6.86%	9.68%
	Decile 4	12.31%	8.93%	8.78%	7.41%	8.91%	9.98%
	Decile 5	11.74%	11.47%	9.30%	9.02%	10.48%	10.12%
	Decile 6	10.43%	10.06%	10.15%	9.55%	10.65%	10.93%
	Decile 7	8.54%	11.79%	10.68%	9.09%	12.19%	12.76%
	Decile 8	15.87%	17.00%	16.09%	14.61%	15.90%	17.90%
	Decile 9	14.99%	17.96%	16.48%	15.06%	17.75%	18.50%
	Decile 10	21.98%	32.97%	30.84%	28.12%	29.55%	35.35%

Table 6 - Return vs Ranking Method and Decile

From tables 5 and 6 above, the following observations are evident:

- The 8th, 9th and 10th decile for each ranking method almost unanimously outperformed the JSE ALSI.
- The 10th decile for the various ranking methods and holding periods, except for the ROC technical indicator, is the only decile to outperform the un-weighted average return of the JSE.

- The 12, 9 and 6-month price performance ranking methods posted higher returns than their technical indicators counterparts.
- The top decile provided significantly higher average annualised returns than the 2nd highest decile for the various ranking methods and holding periods.
- The best performance was obtained from the 6-month price performance ranking method in conjunction with a 12-month holding period, returning an average annual return of 38.7% over the review period.

The observations that can be made from tables 5 and 6 re-affirm the statistical results, namely, that momentum is a common attribute amongst top performing shares for the period of one to twelve months. Rejecting the null hypothesis in part, price performance momentum measures delivered superior average annualised returns, when compared to technical analysis indicators.

A proposed explanation for the significant difference in average return between the two highest momentum deciles is that these shares receive a considerable amount of attention. Given the theory of financial herd behaviour, as proposed by Thaler (1993), the more attention a share or company receives, the greater its following becomes, which only perpetuates the cycle. Media, both airtime and newspapers, as well as the investment fraternity with their limited portfolio sizes, tend to concentrate on the top performers, a group that is easily made up of 10% of the number of shares on the JSE, i.e. one decile. Therefore the top decile enjoys an overwhelming amount of attention, which accelerates the phenomenon of herd behaviour and the subsequent momentum effect.

The final part of the hypothesis, namely that momentum can be applied as a viable investment strategy to obtain abnormally high returns, cannot be rejected. This is because, even though the maximum allowable tax had been applied, the top decile almost unanimously still outperformed the higher un-weighted market index for various holding periods. The top decile of the 12, 9 and 6-month price performance ranking method with a corresponding 12-month holding period performed the best, outperforming the un-weighted market index by 9.26 %, 10.36% and 10.96% respectively.

6.3 Summary

From the results, it is evident that momentum is a common attribute amongst top performing shares, given the positive statistically significant correlation between momentum rank and return rank. The null hypothesis is rejected in part, with the 12, 9 and 6-month price performing ranking methods attaining the highest correlation. Therefore, it was found that the technical indicators

evaluated are not better predictors of future returns price performance momentum measures, as stated in the null hypothesis.

However, the returns obtained with the highest decile revealed that momentum can be applied as a viable investment strategy to attain abnormally high returns as per the null hypothesis. This was evident from the fact that for the various ranking methods, excluding ROC, the top decile unambiguously outperformed the un-weighted market index for numerous holding period strategies.

Chapter 7 – Conclusion and Recommendations

7.1 Main Findings

"It is dangerous to apply to the future inductive arguments based on past experience, unless one can distinguish the broad reasons why past experience was what it was."

Maynard Keynes, 1925, pg 7

In the past two decades, a large volume of empirical work has been conducted in an attempt to identify and exploit price patterns on stock exchanges across the globe. It is becoming increasingly accepted that there are shortcomings in the Efficient Market Hypothesis due to its inability to explain these empirical price patterns. In order to account for these price patterns, new theories would have to acknowledge the existence of financial behaviour and the seemingly irrational decisions made by the investment fraternity.

The results support the views of behavioural theorists, in particular De Bondt & Thaler' s (1987) model, as set out in *The Three Stages of Price Reaction*. The findings in part reject the null hypothesis, as technical indicators were not able to identify top performing shares any better, but they validate the conclusions that:

- Momentum is a common attribute amongst top performing shares.
- Price performance momentum measures can best identify future top performing shares.
- Even with the inclusion of taxes and trading costs, the use of momentum is a viable investment strategy.

These findings are in line with those of Fisher & Page (2000) and Van Rensburg (2001 & 2003) with regard to momentum on the JSE. This study was thus able to illustrate the stability of the theory by translating return as a rank and applying the Spearman Rank Order Correlation Co-efficient, which revealed a seemingly unambiguous co-dependence between return and momentum.

The average annualised returns of the top decile of a momentum strategy applying a nine and six-month price performance comparison, in conjunction with a 12-month holding period, gives the investor the best chance to outperform the market.

Future empirical studies should relate returns to an un-weighted average return representation of the market and the generally accepted market cap weighted JSE ALSI. The ALSI is biased towards

large underperforming companies, giving an investor a similarly biased picture of the possible returns.

Having established evidence of the momentum effect on various international equities markets as well as on the JSE, the phenomenon seems to have been evident in one form or another since the inception of the modern stock exchange. With the global community attaining an ever-increasing disposable income, more and more individuals will start to invest their money on global stock exchanges. These investors with limited financial experience will make the same decisions as their predecessors and as proposed by financial theorists, and this should result in similar price trends as witnessed up to date.

All of these arguments and results translate into the fact that investors should remain vigilant of the phenomenon and the excellent rewards it can provide. There is no reason why investing should be considered as a binary system that forces the investor to choose one philosophy over another. The concept of price patterns can be combined with other investment philosophies and tools to create synergy to benefit the investor further.

7.2 Further Studies

During the course of this dissertation various appealing unanswered questions were exhumed volunteering themselves as prime subjects for future studies. These include the possible optimisation of the technical indicators proposed as well as utilising an un-weighted representation of the market as the benchmark within the RsMom indicator calculation.

Over the past number of years tighter controls and monitoring of investments has resulted in the documentation of the individual number of shareholders who are buying and selling shares. Utilising this data over the next number of years an experiment could attempt to relate the number of individual investors trading in a particular share to herd behaviour and the subsequent momentum effect.

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