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Analysing the efficiency of the Johannesburg Stock Exchange using the Magic Formula

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A thesis submitted to the Faculty of Commerce, Law and Management, Wits Business School at the University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Management in the field of Finance & Investment.

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Abstract

This study examined the efficiency of South African markets, namely the Johannesburg Stock Exchange (JSE) through the use of a value investing strategy called the “magic formula”, which was created by Joel Greenblatt and published in his 2006 book “the little book that beats the market”.

This study back tested the magic formula on the JSE from 2000 to 2016. It ranked stocks according to the magic formula methodology, using earnings yield and return on capital to derive portfolios.

The portfolios were then compared against the JSE All Share Index (the market). The magic formula showed evidence of outperformance of the market over the period, even when accounting for risk. The magic formula was compared against other portfolios derived from value investing ratios, namely ROA, ROE and EY. The ROA portfolio produced the best risk-adjusted results, but all value investing portfolios outperformed the market providing evidence against efficient markets.

List of Tables

Table 3.1: Magic Formula Results 26

Table 4.1: Portfolio Construction 37

Table 5.1: Key statistics of Portfolio A versus the Market 44

Table 5.2: Key statistics of Portfolio B versus the Market 46

Table 5.3: Key statistics of Portfolio A versus Portfolio B 48

Table: 5.4 Key Statistics for the Magic Formula and Various Market Indexes 65

Table 5.5: Key statistics for the alternative portfolios, Portfolio B and the market 53

Table A: Portfolio A Results versus the Market 63

Table B: Portfolio B Results versus the Market 64

Table C: Alternative investment strategies 66

List of Figures

Figure 4.1: Market capitalization percentage of JSE listed shares 32

Figure 4.2: Purchase and sale representation 38

Figure 5.1: Graphical representation of Portfolio A versus the Market 42

Figure 5.2: Cumulative returns Portfolio A versus the Market 44

Figure 5.3: Graphical representation of Portfolio B versus the Market 45

Figure 5.4: Cumulative returns Portfolio A versus the Market 47

Figure 5.5: Graphical representation of all annualized returns 49

Figure 5.6: Cumulative returns for Portfolio A, B, and the various indexes 51

Figure 5.7: Graphical representation of all annualized returns 52

Figure 5.8: Cumulative returns for alternative portfolios, Portfolio B and the market 54

List of Acronyms and Abbreviations

B/M	Book-to-Market
C/P	Cash Flow-to-Price
D/P	Dividend-to-Price
D_t	Dividend at time t
EBIT	Earnings Before Interest and Tax
EMH	Efficient Market Hypothesis
EY	Earnings Yield
JSE	Johannesburg Stock Exchange
N	Number of periods
NCAV	Net Current Asset Value
NYSE	New York Stock Exchange
P/E	Price/Earnings
P_t	Stock Price at time t
P_{t-1}	Stock price at time t_{-1}
R	Annual Return
ROA	Return on Assets
ROC	Return on Capital
ROE	Return on Equity
$\overline{R}_{\text{market}}$	Annualized Return of the market
$\overline{R}_{\text{portfolio}}$	Annualized Return of the portfolio
$R_{\text{risk-free}}$	Risk-free rate
S&P 500	Standard and Poor's 500 index
SG	Share Group
UK	United Kingdom
US	United States
VAR_{market}	Variance of the market
$VAR_{\text{portfolio}}$	Variance of the portfolio

Table of Contents

Abstract.....ii

List of Tables.....iii

List of Figures.....iii

List of Acronyms and Abbreviations.....iv

Table of Contents.....v

CHAPTER 1 INTRODUCTION.....1

CHAPTER 2 LITERATURE REVIEW.....5

2.1 Efficient Market Hypothesis.....5

2.2 Misconceptions surrounding the EMH.....7

2.3 Behavioural Finance and Contradictions of the EMH.....9

2.3.1 Low Price to Earnings (P/E) Ratio.....10

2.3.2 Book-to-Market (B/M) ratio.....12

2.3.3 Dividend-to-price (D/P) ratio.....12

2.3.4 Turn-of-the-Year Effect/January Effect:.....13

2.3.5 Size effect.....15

2.3.6 Weekend Effect:.....15

2.3.7 Momentum and Contrarian Strategies/Effects.....17

2.4 Value investing as investment strategy.....19

2.5 Conclusion.....22

CHAPTER 3 GREENBLATT'S MAGIC FORMULA.....23

3.1 Introduction.....23

3.2 The Magic Formula.....23

3.3 Greenblatt's ranking system.....25

3.4 Results.....26

3.5 Greenblatt versus the EMH.....28

3.5.1 Mispricing of risk.....28

3.5.2 The size effect.....28

3.5.3 Looking ahead bias.....29

3.5.4 Survivorship bias.....29

3.5.5 Data mining.....29

CHAPTER 4 RESEARCH METHODOLOGY.....31

4.1 Introduction.....31

4.2 Data Collection and Processing.....31

4.3 Avoiding Statistical Bias 34
4.4 Methods: 35
4.5 Calculating Returns 39
4.6 Accounting for Risk 40
CHAPTER 5 FINDINGS 42
5.1 Introduction: 42
5.2 Portfolio A and Portfolio B performance versus the Market 42
5.3 Portfolio A versus Portfolio B 47
5.4 The Magic Formula (Portfolio A and B) versus various other Market Indexes 49
5.5 The Magic Formula versus alternative value investing portfolios 52
CHAPTER 6 CONCLUSION 55
6.1 Conclusion 55
6.2 Further Research 56
References 57
Appendix 1: 63
Appendix 2: 64
Appendix 3: 65
Appendix 4: 66

CHAPTER 1
INTRODUCTION

1. Introduction

The goal of any investment is to earn a return and save for future spending; in other words, forgo current consumption in the hopes of greater future consumption. Many investors strongly believe they can systematically beat the market and earn superior returns through exploiting market inefficiencies and optimal stock selection strategies (Coval, Hirshleifer & Shumway, 2005). But can you systematically beat the market? This has been a long and frequently debated question amongst practitioners and academics alike (Persson & Selander, 2009).

The Efficient Market Hypothesis (EMH) which sprang to popularity in the 1970s suggests and provides evidence that you cannot beat the market for a prolonged period (Degutis & Novickyte, 2014). A simple summation for this is that, all information is already fully reflected in stock prices and thus unless you had insider information or take greater risks you would not be able to beat the market. While the EMH is widely accepted investors such as, Warren Buffet and Peter Lynch have outperformed the market for decades now. Warren Buffet has delivered returns of 155 times that of the S&P 500 over a period of 52 years (Frankel, 2017). Peter Lynch, also outperformed the S&P500 in all but two years from 1977 to 1990, averaging annual returns of 29% versus the S&P500 return of 8.35% (Frankel, 2010). The fact that so many investment houses and stock brokers exist, that individuals and institutions a like continue to try earn superior returns suggest that the EMH does not satisfy all.

Many different investment strategies have been developed over the years such as, value investing, growth investing, contrarian investing and momentum investing to mention a few.

These strategies all believe that they can identify anomalies of the EMH and take advantage of the inefficiencies they create in markets. This thesis has a strong focus on investing strategies and specifically Joel Greenblatt's Magic Formula, outlined in his book called: The little book that beat the market.

Studies by Njanike (2010) and Mabhunu (2004) state that the JSE is an efficient market and abides by the notions of the EMH. If this is the case, then alternative investing strategies will not yield returns greater than that of the market. Similarly, the concept should hold for the United States (US) market which is believed to be efficient, yet Greenblatt (2006) claims to have systematically beaten market returns from 1988 to 2004. Hoffman (2012), studied stock market anomalies on the JSE between 1985 and 2010 and found strong evidence of said anomalies and concluded that the JSE was not efficient, at least not strong or semi-strong form.

The magic formula is based on simple principles and identifies value through information available to all participants in the market. If market outperformance occurs it will provide strong evidence of inefficient markets, or at least support the Hoffman' (2012) notion that strong and semi-strong form efficiency doesn't exist. It will also provide evidence that the formula works in developing economies and not just the US.

Joel Greenblatt created a formula for stock selection whereby he identified stocks that he believed were undervalued in the market and would grow as investors realized the same. From this he built portfolios of 30 stocks, where he would buy stocks on a rolling basis and sell them exactly one year from their purchase date. Following the method outlined by him in the little book that beat the market he claims to have earned far superior returns to the

market over the course of 17 years. Not only did he earn superior returns he also claimed to have had lower risk. Greenblatt identifies risk different to most, he claims it is the number of negative returns and not necessarily the variance of returns.

The purpose of this report is to investigate the EMH, value investing, and specifically back test Joel Greenblatt's Magic Formula in South Africa, using the companies listed on the Johannesburg Stock Exchange (JSE) from 1 January 2000 to 31 March 2016. The annualized return generated from these portfolios will then be benchmarked against the JSE All Share Index, the JSE Value Index, the JSE Basic Materials Index, the JSE Growth Index, the JSE Small Cap Index and the JSE Equally Weighted Top 40 Index. This determined if the portfolios would beat the market.

To determine if markets were efficient in South Africa, three ratios often used to identify value in stocks were selected to create new portfolios, these were Return on Assets (ROA), Return on Equity (ROE) and Earnings Yield (EY). ROA is a profitability ratio that provides investors with an indication of how efficiently a business is using its assets to generate profit (Dao, 2016). ROE is another profitability ratio that lets investors know how well a company is generating revenue with shareholder's investments (Dao, 2016). EY provides investors with a means to measure returns and allows investors to evaluate if the returns commensurate for risk (Dao, 2016). The returns from these portfolios were then compared to the returns generated by the market and the magic formula to determine market efficiencies and the optimal value investing strategy.

The rest of this study is divided into five more chapters and is constructed as listed: Chapter two is a comprehensive literature review of previous research done on the topics. Chapter three defines the Magic Formula, how it is constructed and how it performed as stated by

Greenblatt. Chapter four outlines the research methodology and data collection process. Chapter five presents the findings of the report. Chapter six concludes the report and proposes potential areas for future research.

CHAPTER 2
LITERATURE REVIEW

2.1 Efficient Market Hypothesis

The Efficient Market Hypothesis (EMH) is a largely debated investment theory that states it is impossible for an investor to continuously deliver a return above that of the market as a result of market efficiency (Olin, 2011).

An efficient market exists when all available information, as well as, the cumulative knowledge of investors is reflected in stock market prices (Perrson and Selander, 2009). The result of which would be shares always trading at their fair value, making the purchase of undervalued shares and selling of overvalued shares an impossibility. As such, expected returns on equity are merely a function of risk, rendering expert stock selection and market timing ineffective (Olin, 2011). Because all investors have the same information and stocks trade at their fair values, investors would not be able to earn a premium on market returns without taking on additional risk (Howard, 2015).

The concept of market efficiency, which originated in the 19th century, reached the height of its academic popularity in the nineteen eighties but its popularity and validity has been declining since (Degutis & Novickytė, 2014). The roots of efficient market theory trace back as far as 1889, to a man by the name of George Gibson. He wrote that when “shares become publicly known in an open market, the value which they acquire may be regarded as the judgment of the best intelligence concerning them” (Gibson, 1889). Thus, markets price stocks relative to the opinions of the smartest market participants. Gibson (1889) was of the belief that valuation of stocks is a voting game, where all market participants would vote on whether stock prices should rise or fall (De Moor, Van den Bossche, & Verheyden, 2013). The

“Smartest participants would eventually gain more votes for their correct guesses which would allow them to accumulate more funds” (Degutis & Novickytė, 2014).

In 1933 and 1944 US economist A. Cowles analyzed trade statistics of professional investors and was able to conclude that investors were in fact unable to predict future stock prices in order to earn excess profits (Degutis & Novickytė, 2014). The year 1953 saw Maurice Kendall publish his work on stock and commodity prices, which found that prices did not move in regular cycles but rather followed a random walk (Persson & Stahlberg, 2006). 12 years later Professor Eugene Fama of the University of Chicago was able to confirm that stock prices were in fact random and defined the “efficient market” concept for the first time (Fama, 1965). It was H. Roberts who coined the term “Efficient Market Hypothesis” and separated markets into strong and weak form (Sewell, 2011). The EMH as we know it today was formulated and published by Fama in 1970 and included three forms of EMH: strong form, semi-strong form and weak form (Fama, 1970).

The strong form of the EMH states that prices reflect all private and public information, even information that is only accessible to company insiders (Persson & Stahlberg, 2006). Under strong form efficiency not even company insiders would be able to make abnormal profits and insider trading would essentially not exist. This level of efficiency is not meant to represent reality but is rather a benchmark created to measure the importance of deviation from an efficient market (Olin, 2011).

The semi-strong form of the EMH states that prices adjust rapidly to new information entering the market and all information available publically is reflected in share prices. This form of the EMH states one cannot continuously outperform the market using either technical or fundamental analysis (Howard, 2015).

The weak form of the EMH infers that all historical information and stock prices are reflected in current stock prices. In other words, stock prices reflect all information that can be derived by examining the markets trading data (Guo & Wang, 2007). This in turn renders technical analysis (trend analysis) ineffective and unlikely to produce abnormal returns, as historical stock price data would be readily available to the market and would essentially be costless. If the data did present reliable signals about the potential future profits, investors would have learned to exploit these signals, which would result in these signals losing their value as they become universally known by investors (Guo & Wang, 2007). Fundamental analysis on the other hand has the potential to contribute to excess returns.

2.2 Misconceptions surrounding the EMH

(i) The first misconception is that investors are unable to beat the market.

The EMH does not state that investors cannot beat the market but rather that they should not expect to consistently deliver or earn returns abnormal to that of the market. Clark, Jandik & Mandelker (2001) state that in fact investors could make abnormal returns for a prolonged period just by chance.

(ii) *The second misconception claims attempts to perform financial analysis will not result in superior returns because all investors are exposed to the same information and attempting security selection is frivolous* (Persson & Stahlberg, 2006). *Malkiel (1973) states "a blindfolded chimpanzee throwing darts at the Wall Street Journal could select a portfolio that would do as well as the experts". Financial professionals have not lost their places in financial markets, which imply their*

services are valuable or at least perceived as valuable. Critics thus argue that the EMH must be invalid (Clark, Jandik & Mandelker, 2001).

The EMH does not dispute that different individual investors will have different investing preferences (Howden, 2009). Some investors will be willing to invest in high-risk strategies, while others will only be willing to invest in low-risk strategies. Finance professionals should provide investors with portfolios that match the risk and return requirement of each individual investor (Clark, Jandik & Mandelker, 2001). Another important point to note here is that financial analysis itself is far from pointless in efficient markets. Efficient markets are in hindsight created by the competition amongst investors who are analyzing information to take advantage of mispriced securities. Clark, Jandik & Mandelker, (2001) describe financial analysis as the engine that allows new information to rapidly filter into stock prices. Howden (2009) goes further in stating that professionals can gain from their analysis, but there is a cost incurred with analysis and these gains will not be sufficient to compensate for the added costs.

(iii) The third misconception pertaining to the EMH is that new information cannot be fully reflected in the market prices because prices fluctuate constantly.

Many observers view the fluctuations as the absence of new information, when in reality new information pertaining to securities enters the markets constantly causing these fluctuations in price (Howden, 2009). Instead of viewing price adjustments as market inefficiency, it should rather be viewed as a market operating in an efficient manner. (Clark, Jandik & Mandelker, 2001).

(iv) *The fourth misconception of the EMH is that it is incorrect; it assumes that all investors have similar skills and ability to analyze information. This is not true and in fact many investors are essentially layman and not financial experts* (Clark, Jandik & Mandelker, 2001).

While not all investors are skilled professionals, market efficiency can be achieved if only a fraction of core skilled investors are well informed (Howden, 2009).

2.3 Behavioural Finance and Contradictions of the EMH.

The EMH is widely accepted as valid and was once touted as the most empirically supported proposition in economics, but more recent research has questioned its robustness (Sewell, 2011). This is not surprising given the EMH questions professional investors' ability to detect mispriced securities.

The EMH is built on three preconditions: (i) there are no transaction costs incurred when trading (ii) information is publicly available and costless and (iii) the pricing implications from current information entering the market is agreed upon by those participating in the market (Guo & Wang, 2007). The EMH states that because these three conditions are present all investors will act in a rational manner (Fama, 1970).

By the beginning of the twenty first century the EMH was losing favour, with many finance professionals believing that stock prices were to some degree predictable (Malkiel, 2003).

Malkiel (2003) argues that there are numerous cases in market history which support the notion that market prices were not set by rational investors. One such case can be seen by the pricing of stocks during the internet stock boom of the early 2000's. Another would be

the stock crash of October 1987, whereby stock markets lost one third of their value overnight (Malkiel, 2003).

The EMH has been described by some as the most significant error in the history of economics (Malkiel, 2011). Several patterns contradicting the EMH, known as anomalies, have been identified. These anomalies have given rise to what is known as Behavioural Finance, behavioural theorists believe that investors do not behave rationally but are rather irrational when making investing decisions. They believe this irrational behavior is generating the opportunity for stock market anomalies to occur and results in abnormal returns (Howard, 2015). Shiller (2003) describes behavioural finance as looking at finance from a psychological and social perspective in an attempt to understand why investors do not act rationally.

As the world moves to increased knowledge sharing, improved legislation surrounding financial reporting and easier access to such information via improved technological infrastructure these anomalies seem to be fading out. The section below will interrogate some of the more researched and reported anomalies that have emerged because of behavioural finance.

2.3.1 Low Price to Earnings (P/E) Ratio

The Price-earnings ratio (P/E) is the most widely used earnings multiple and articulates what an investor will pay for one dollar of a company's earnings (Persson and Stahlberg, 2006). This is calculated by dividing the current market price of a share by the earnings generated per share (Persson and Stahlberg, 2006). Basu (1977) set out to test whether earnings ratios provide indications of future performance.

Basu's (1977) set out to determine if stocks performance is linked to their P/E ratio. His research compiled data from more than 1400 listed or delisted industrial firms on the New York Stock Exchange (NYSE) from September 1956 to August 1971. Basu (1977) found that on average low P/E portfolios outperformed high P/E portfolios and the market, even when adjusting for risk. Rather than interpreting his results as a failure of the EMH he theorises that information does not reflect quickly enough to satisfy semi-strong form or strong form efficiency. He states it was because of this that markets remained in disequilibrium for the period under study (Basu, 1977). Basu (1977) interpreted high P/E ratios as indicating investors having confidence in future earnings and that these expectations are exaggerated and slow to react. He goes further to explain that these lags are part of the general market mechanism and that the anomaly did exist during the period under study, however, transaction costs and taxes significantly impeded investors from yielding excess returns (Basu, 1977).

Reinganum (1981) proved that the P/E effect disappears when it is considered in conjunction with the size effect, whereas Jaffe, Keim and Westerfield (1989) found that both the P/E ratio and the size effect are significant.

Fama and French (1992) argue that low P/E ratio stocks carry more risk. Whereas, Lakonishok, Shleifer and Vishny (1994), prove that low P/E portfolios like other value investing portfolios produce abnormal returns through exploiting suboptimal investor behaviour and not due to additional risk.

2.3.2 Book-to-Market (B/M) ratio

This is an anomaly whereby firms with high book value of firm equity (B) to market value of firm equity (M) provide abnormal returns to investors. The anomaly was first discovered by Stattman (1980) who found a return premium for US stocks with a high B/M value.

Fama and French (1992) determined that both B/M and size anomalies explained most variation in US stock returns. Fama and French (1993) hold the stance that B/M and size effects are purely compensating investors for holding riskier assets. Haugen (1995) finds differently, he argues that it is not risk compensation but rather investors using past performance to infer too far into the future regarding stock performance. It is this inference that results in markets under-pricing high B/M firms (value shares) and overpricing low B/M firms (growth shares). Daniel and Titman (1997) believe the B/M effect to be a result of investor preference for growth stocks over those of value stocks.

2.3.3 Dividend-to-price (D/P) ratio

As is the case with P/E, D/P is a measure of value which is frequently used in practice and in academia to try predict future stock prices. The D/P ratio is derived by dividing the dividend by the current stock price. Campbell and Shiller (1988) found evidence to suggest that the initial dividend outlay made by a company is a good predictor of the variance in future stock prices or rather returns of said stock. Campbell and Shiller (1988) have shown that investors who buy a basket of equities with high initial dividends have earned abnormal returns to that of the market.

Stocks that pay high dividends yields outperform stocks that provide investors with lower yields. This makes sense as investors are looking for returns and capital gains are not certain

or tangible until the stocks are sold. Companies that provide higher dividends yields are likely to continue doing so in the near future, as changing their dividend policy could send signals to the market which could negatively affect stock prices.

Fluck, Malkiel and Quandt (1997) argue that this may not be the case when picking individuals stocks. Malkiel (2003) proved that dividend yields have not being able to predict future earnings since the eighties. It has been argued that this may have been caused as a result of changing dividend policies of companies, which now make extensive use of share buy backs as a means to pay shareholders (Fama & French , 2001). This train of thought suggests that the D/P ratio may no longer be a useful predictor of future earnings.

2.3.4 Turn-of-the-Year Effect/January Effect:

This is the phenomenon whereby share prices tend to appreciate and the volumes of shares traded increase during the turn-of-the-year, resulting in January having greater returns than in other months (Yavrumyan, 2015). The turn-of-the-year refers to the very last week of the year and the first two weeks of a New Year.

Guo and Wang (2007) showed that returns for the rest of the year averaged 0.42% while January produced returns of 3.48%, this showing the turn-of-the-year effect is in fact a January effect. Rozeff and Kinney (1976) conducted empirical studies based on the NYSE which confirmed the January effect between 1904 and 1974. They found that on average returns were seven times higher in comparison to other months.

Keim (1983) while conducting a study on the size effect found that small-size firms excess stock returns were not obtained evenly throughout time. Research by Jordan, Miller & Dolvin

(2015) showed that most of the abnormal returns for small-sized firms over that of large-sized firms occurred in January, especially near the turn-of-the-year.

Numerous researchers have hypothesised why the January effect exist, two of the main theories are: the information hypothesis and the tax-loss selling hypothesis (Guo and Wang, 2007).

The tax-selling hypothesis states investors tend to offload underperforming stocks late in the year to drive up capital losses and lower the tax liability they incur. The consequence of such action is that the poorly performing stocks face downward pressure on prices. This downward pressure however disappears at the beginning of the next year in the absence of selling pressure allowing stock prices to normalize (Guo and Wang, 2007). Roll (1983) found that small-sized firms will be more affected by the tax-loss selling than big-sized firms.

Evidence has suggested that tax while a strong explanatory variable may not be alone in explaining the January effect. Thaler (1987) identified the January effect in both Great Britain and Australia even though their tax years do not occur in January. Ho (1990) provided evidence that most Asian countries do not experience the January effect. Only 3 of 9 countries under investigation experienced a tax effect. Thaler (1987) and Brown, Kleidon, & Marsh (1983) were able to show that returns were abnormally high for the countries under study during the start of a new tax year, proving tax can help explain the excess returns experienced but it is not the only explanatory variable.

One such explanatory variable could be the release of new information and the uncertainty that it creates, more commonly known as the information hypothesis (Persson and Selander, 2009). Keim (1983) states the information hypothesis would have a greater effect on small-

sized firms. This is because publishing of such information is easier, more cost effective and less onerous than for that of large-sized firms.

2.3.5 Size effect

Banz (1981) studied the relationship between the market value of shares on the NYSE and returns they generated. He found that the stocks of small firms earned higher returns than stocks of large firms after accounting for risk between the years 1936 to 1975. This finding became known as the size effect.

Herrera and Lockwood (1994) found a monthly premium of 4.16% for small stocks on the Mexican stock exchange. A similar premium has been found in Japan, which showed a size premium of 1.2% (Ziemba, 1991).

It was Klein and Bawa (1977) that determined small firms often have a scarcity of information available and this led to investors having less desire to hold these stocks because of estimation risk. Recent studies such as the one done by Horowitz, Loughran, and Savin (2000) have suggested that this effect has all but vanished since the eighties. They examined average stock return data between 1982 and 1997 and found no signs of it.

2.3.6 Weekend Effect:

This is the phenomenon within financial markets whereby stocks have significantly lower prices on Monday's than they did at the close of the preceding Friday (Yavrumyan, 2015). Calculating a daily return on the stock market is accomplished by taking the change in closing price from one trading day to the next as a percentage. This would entail a 24-hour period for each day in the week except Monday which would include the weekend and result in a 72-

hour period. This longer period would lead one to believe that Monday's should have the highest returns but it in fact has the lowest average return (Jordan, Miller & Dolvin, 2015).

Various authors believe Monday's tend to produce relatively large negative returns for financial assets. Howard (2015) states that this is due negative news/information about companies being released on weekends. It was French (1980) who theorised companies release negative information on weekends in order to avoid panicked sales of their shares. Miller (1988) was of the belief that trading patterns of individual investors resulted in what is now known as the weekend effect. He believed individuals followed brokerage communities to make buy decisions on working/weekdays, then on weekends when time allowed they would review their positions and make sell decisions to adjust portfolios on the Monday.

This anomaly was originally referred to as the Monday effect (Cross, 1973). French (1980) showed that between 1953 and 1977 many of the negative returns where a result of non-trading periods from Friday-close to Monday-open. Similar results were found by Keim and Stambaugh (1984) for the period 1928 to 1952. It was these arguments that confirmed the Monday effect was in fact the weekend effect (Howard, 2015). The weekend effect is quite possibly the strongest calendar anomaly, but it is not sufficient enough to support an entire trading strategy alone (Persson and Selander, 2009).

The weekend effect appears to have disappeared after 1987. In fact, Rubenstein (2001) highlights that between the years 1989 to 1998 Monday produced the highest returns of any trading day. This would indicate that the weekend effect no longer exist (Rubenstein, 2001).

2.3.7 Momentum and Contrarian Strategies/Effects

These are strategies where success is derived from a shares past performance in comparison to a given benchmark, this is in contradiction to the random walk hypothesis and market efficiencies.

2.3.7.1 Contrarian Strategy

This strategy is derived off the back of behavioural psychology, which tells us that when making investment decisions people do not behave in a rational manner because they overreact to unexpected/recent information, good or bad. This in turn will lead to a stock market overreaction to said news, with stock prices rising (falling) too far but eventually returning to their intrinsic value upon investors realising they overreacted (Hamalainen, 2007). De Bondt and Thaler (1985) referred to this as the contrarian effect whereby, investors overreact to recent news and respond by selling loser shares below their intrinsic value and buying winner shares at a premium. Contrarian investors take advantage of this situation by investing in the undervalued shares and selling of overpriced shares, thus allowing them to earn returns above that of the market (Lakonishok, Shleifer, & Vishny, 1994).

It was De Bondt and Thaler (1985) who first investigated this return reversal phenomenon in stock markets. They constructed winner and loser portfolios using monthly data consisting of all stocks on the NYSE for the period between 1926 and 1982. A stock was labelled a winner or loser based on its past performance, ranging from one to five years (Howard, 2015). They ranked stocks according to their cumulative returns in descending order to create what would be winner and loser portfolios. The winner portfolios consisted of the top 35 shares and the loser portfolio of the bottom 35 shares. (Hamalainen, 2007). A three to five-year period was then used to measure the performance of these portfolios (Persson and Selander, 2009). The

result was that losers out performed winners by roughly 24% over the next three-year period and roughly 32% over the next five-year period (De Bondt and Thaler, 1985). The most peculiar result was that winners were significantly riskier than losers.

While many accept the findings De Bondt and Thaler (1985), Conrad and Kaul (1993) dispute these findings stating they are not valid. Conrad and Kaul (1993) studied a sample of stocks listed on the NYSE between 1926 and 1988 and found that winner portfolios outperformed losers' portfolios by 1.7%. Kryzanowski and Zhang (1992) suggest that the contrarian effect is only applicable when applied to U.S. markets. They applied the framework defined by De Bondt and Thaler (1985) to the markets in Canada and were not able to produce results that proved the hypothesis. Baytas and Cakici (1999) found similar results to Kryzanowski and Zhang (1992) when applying a similar framework to various industrialised countries such as, Canada, UK, Japan, Germany, France and Italy.

2.3.7.2 Momentum Strategy

A momentum strategy unlike the contrarian sells past losers and buys past winners. Momentum investing is a strategy whereby the investors are not concerned with meticulous analysis of a company's performances or share price but rather with monitoring what other parties in the market are doing (Beunza & Stark, 2004). It strays away from attempts to understand the stock's value instead they focus on if stocks are going up or down in the market – the identifications of trends (Hamalainen, 2007). They believe that momentum is a self-fuelling social process that can be understood through study and profited from.

Despite the contrarian effect and evidence found regarding the topic, many mutual funds to this day buy shares on an upward trend from the previous quarter (Hamalainen, 2007). Levy

(1967) was the first to study the momentum effect, but his results were found to be controversial.

Jegadeesh and Titman (1993) were the first study to provide evidence of momentum strategies providing excess returns. Their study used data from 1965 to 1989 and the strategy that they implemented was to buy shares performing well in the last 12 months and sells those that had performed poorly. What they proved was that a momentum strategy will produce abnormal returns in the first 12 month holding period, but they found that these returns tend to dissipate over a 24-month holding period (Jegadeesh and Titman, 1993). Moskowwitz and Grinblatt (1999) not only confirmed the existence of the momentum effect but went one step further in determining that the effect is stronger when viewed per industry, rather than by individual stock.

Unlike the contrarian effect the momentum effect seems to be consistent across countries and not just in the U.S. Rouwenhorst (1998) studied the momentum effect between 1978 and 1995 within 12 countries in Europe using a data set of just below 2200 companies. He showed that the excess return of winner over loser portfolios was 1.16% per month. When Rouwenhorst (1998) tested the 12 European countries separately, he found that 11 of the 12 countries showed evidence of the momentum effect.

2.4 Value investing as investment strategy

Value investing is the school of thought by which investors buy a share at a low price and sell it at a higher price (Beunza & Stark, 2004). An investor believes that through fundamentals analysis, such as a reviewing a company's annual financial statements, they can identify and purchase stocks that are on the market at a price below that of their intrinsic value (Howard,

2015). This is the opposite of Growth investing, whereby investors believe in the principles of the EMH and purchase stocks that have shown fast or consistent growth (Howard, 2015).

Importantly, value investors believe that "property" has intrinsic value that is entirely independent of other investor's views or perspectives. It is their belief that markets are inefficient but that this mispricing or inefficiency will eventually be corrected (Basu, 1977). In other words, markets will slowly realize a security is mispriced increasing demand and driving up the price to its intrinsic value.

Value investing can be traced back to two professors at the Columbia Business School namely, Benjamin Graham and David Dodd. In 1928 they performed research using the net current asset value (NCAV) as a proxy for the intrinsic value of a stock. Later a study was performed by Oppenheimer (1986) who studied a variety of stocks for the period 1970 to 1983 in which he was able to confirm that the NCAV strategy yielded returns abnormal to that of the NYSE.

A similar study was performed by Basu (1977) who studied companies on the NYSE between the periods of 1957 – 1971 to determine if the P/E ratio could be used to explain the performance of stock returns. What he discovered was a market inefficiency that presented itself in the form of public information not instantaneously reflecting in the stock price. Dhatt, Kim and Mukherji (1999) found that growth stocks tend to underperform value stocks in their study of value versus growth effects in returns for small-cap stocks.

Vast arrays of studies have found evidence of the value premium on the US market. Fama and French (1998), Lakonishok, Shleifer and Vishny (1994) and Larkin (2009) are amongst the many authors who have verified abnormal returns from value stocks over that of growth stocks in the US market.

Lakonishhok, Shleifer and Vishny (1994) proved that for the period under research, 1963 to 1990, value strategies using the cash flow-to-price (C/P) ratio were able to provide abnormal returns within the US. Larkin (2009) made use of US stocks for the period between 1998 and 2006 to show that value strategies based on the B/M ratio can provide investors with abnormal returns. Larkin (2009) documented that this was even the case when the anomalies had been known.

Evidence of value investing providing abnormal returns is not limited to the US markets, with much research having been done internationally as well. Chan, Hamao and Lakonishok (1991) researched the Japanese market and found similar results to that of the US for value stocks, using both B/M and cash flow yields. Chahine (2008) was able to confirm the existence of a value premium within Europe. Fama & French (2012) were able to confirm the existence of the value premium relating to size and momentum within Asia Pacific, Europe and North America. Their study included Japan, but they were unable to find evidence pertaining to a value premium in the region. Capaul, Rowley and Sharpe (1993) examined the period of 1981 – 1992 for France, Germany, Japan, Switzerland, the United Kingdom and the United States and were able to confirm the B/M ratio used for a value investing strategy provided a premium on returns.

Lakonishhok, Shleifer and Vishny (1994) wrote that whilst there are multiple studies that provide proof of a value premium, few seem to provide a reason for its existence and those that do differ amongst each other. Haugen (1995) argues that investors undervalue distressed stocks and overvalue growth stocks thus creating the premium. Larkin (2009) presented findings that while value strategies had higher volatility (risk), this volatility was accompanied by considerably higher expected returns which in turn reduced the probability of financial loss

occurring. Fama and French (1992) state the premium is merely a function of risk, in that value stocks are riskier than growth stocks and must be compensated for accordingly.

Value investing strategies are not always the optimal choice for institutional investors, because these strategies selection criteria often select smaller stocks. If large quantities of these stocks are bought or sold the price is heavily affected (Larkin, 2009).

2.5 Conclusion

Whilst the EMH rose to popularity in the 1970's its validity has since been in question. Once touted as the most empirically supported proposition in economics it has since been called the single greatest mistake in economic history.

There are a number of reasons for the change in perceptions. Many have misconceptions about what the EMH entails, as detailed in the report. It is this misunderstanding that has contributed to the decline in the popularity. Contributing to this decline are a large number of anomalies that have presented themselves since the discovery of the EMH. These anomalies speak to the ability to outperform markets over prolonged periods of time, which should not be possible if the EMH held true.

In addition, the pre-conditions for the EMH to exist may not hold true. For example, trading cannot take place without incurring transaction cost. The pre-conditions are meant to result in rational investors, which the boom of the early 2000s and crash of the stock market of 1987 proves isn't true.

In saying the above, it is noted that the anomalies that presented themselves have all but disappeared which again gives rise to the possibility that the EMH holds true. The topic definitely warrants further discussion and research.

CHAPTER 3
GREENBLATT'S MAGIC FORMULA

3.1 Introduction

Joel Greenblatt is the founder and investment fund manager of Gotham Capital, as well as, a professor at Columbia University. Greenblatt created a simple investment philosophy based on systematic formula he developed off the back of value investing principles. The magic formula makes use of a strategic ranking system. A matrix is created using companies Return on Capital (ROC) and Earnings Yield (EY) data and companies are ranked accordingly (Greenblatt, 2006). When making use of the Magic Formula one would invest in the companies that achieve the highest combined rankings.

3.2 The Magic Formula

Greenblatt (2006) points out that expected future returns are not certain, that they are derived from estimates and predictions and are therefore flawed. The Magic Formula only makes use of factors that are known and avoids making use of predictions. According to Greenblatt (2006) the best proxy to rank stocks and build a portfolio is last year's financial performance which can be obtained from their annual financial statements.

The Magic Formula makes use of two factors/ratios when ranking companies:

I. Earnings Yield = EBIT/Enterprise Value

EY is used instead of the more frequently used Price Earnings (P/E) ratio, because the EY ratio accounts for the price of debt whereas the P/E ratio does not.

The most important part of the EY ratio is the calculation of the Enterprise Value.

Enterprise Value = Market value of equity + interest bearing debt – excess cash

> Greenblatt (2006) states "Enterprise Value considers both the price paid for an equity stake in a business as well as the debt financing used by a company to help generate operating earnings".

Calculating Enterprise Value this way penalizes companies with excessive debt while rewarding companies for holding cash. The Magic Formula uses the EY ratio to determine how competitively priced a company's stock is (Postma, 2015).

II. Return on Capital = EBIT/Net Tangible Assets

Greenblatt defined ROC as a ratio of last year's Earnings Before Interest and Tax (EBIT) to tangible assets employed.

Greenblatt makes use of the ROC ratio over the more frequently used Return on Assets (ROA) or Return on Equity (ROE) ratios. This is because it identifies how much capital (net tangible assets) a company employed to achieve its profit, which in turns measures how efficiently a company performs (Postma, 2015).

Tangible assets employed are calculated as:

Net tangible assets = Accounts receivable + Inventory + Cash – Accounts payable + Net fixed assets.

This can be expressed as the inventory, net fixed assets and net working capital a firm requires to fund its receivables in order to continue operations. In his book Greenblatt argues

receivables and inventory require funding by the company itself but payables do not, reasoning that payables are essentially interest free loans (Greenblatt, 2006).

Assets that are not required to conduct business such as, goodwill and excess cash are excluded from tangible capital employed. Goodwill is the result of historical acquisitions that cannot be traded in the future and will not be replaced, they are not required for the company to be seen as a going concern moving forward (Howard, 2015).

Greenblatt (2006) uses EBIT instead of net profits for comparative purpose, on the grounds that companies operate with differing debt levels and tax rates. EBIT allows fair comparisons of companies without implications caused by distortion of differing tax and debt levels (Perrson and Selander, 2009). Without EBIT the ROC ratio wouldn't provide insightful information for comparative purposes. Greenblatt (2006) assumes depreciation and amortization are offset against the capital replenishment and maintenance requirements. Thus:

EBIT = EBITDA – capital expenditure.

3.3 Greenblatt's ranking system

Joel Greenblatt identified the largest 3 500 stocks on the US Stock exchanges but excluded utilities and financial stocks. Stocks were ranked in ascending order for the two ratios mentioned above, ROC and EY. These rankings were then used to create a single matrix to evaluate stocks. A company that ranked 4th for ROC and 6th for EY would score a combined score of 10. Greenblatt created a portfolio of the 30 best ranked companies, the lower the score the more valuable the company. The 30 stocks are not purchased simultaneously but

rather spread over time; with anywhere from three to six stocks being selected in a given month until the 30 is reached (Greenblatt, 2006). Rebalancing of the portfolio is done once a year and the best ranked stocks replace the previously held ones.

The theoretical justification that Greenblatt (2006) uses for the formula, is that the combined rankings of EY and ROC identifies stocks using real information, which helps avoid speculation and selects value stocks [1]. This formula and ranking system allowed Greenblatt to select stocks which are cheap relative to the value they provide (EY) and stocks/companies that are run effectively and efficiently (ROC).

3.4 Results

Table 3.1: Magic Formula Results

Year	Magic Formula	Market Average	S&P 500	Year	Magic Formula	Market Average	S&P 500
1988	27.1%	24.8%	16.6%	1997	40.4%	16.8%	33.4%
1989	44.6%	18%	31.7%	1998	25.5%	(2.0%)	28.6%
1990	1.7%	(16.1%)	(3.1%)	1999	53.0%	36.1%	21.0%
1991	70.6%	45.6%	30.5%	2000	7.9%	(16.8%)	(9.1%)
1992	32.4%	11.4%	7.6%	2001	69.6%	11.5%	(11.9%)
1993	17.2%	15.9%	10.1%	2002	(4.0%)	(24.2%)	(22.1%)
1994	22.0%	(4.5%)	1.3%	2003	79.9%	68.8%	28.7%
1995	34.0%	29.1%	37.6%	2004	19.3%	17.8%	10.9%
1996	17.3%	14.9%	23.0%	Average annual return	**30.8%**	**12.3%**	**12.4%**

Source: Greenblatt, 2006.

[1] Value investing stocks are shares that are currently undervalued and it is believed they will appreciate at some time in the future.

Table 3.1 above shows the results of the magic formula as document by Greenblatt (2006) in relation to the performance of the S&P500 and the market average. The table above shows that the magic formula provided far superior returns to either.

Greenblatt (2006) examined the performance of his portfolio by using rolling periods, specifically 193 individual one-year and 169 individual three-year rolling time periods. The one-year rolling periods worked as follows: January 1988 to January 1989, February 1988 to February 1989 and so on, with an end date of December 2004. The three-year rolling periods follow the same procedure with the last period being tested running from January 2002 and ending December 2004 (Persson & Selander, 2009). What is remarkable, is that for all 169 three-year rolling periods under study not one produced a negative return and 95 percent of the periods outperformed the market (Greenblatt, 2006). The lowest return produced by Greenblatt's formula was 11%, whilst the markets worst performance was a loss of 46%. (Greenblatt, 2006).

Previous back testing of the magic formula in locations other than the United States have been performed by Xia and Fu (2016), Persson & Selander (2009) and Postma (2015). Xia & Fu tested a variant of the magic formula in Hong Kong. They applied the magic formula to Hong Kong but didn't compare it to the market, rather they compared the top rated stocks according to the magic formula against the lowest ranked stocks. The top 10% of stocks outperformed the bottom 10% by 14.61%. Persson & Selander (2009) tested the magic formula in the Nordic region between 1998 and 2008. They found that the magic formula produced annualised returns of 14.68% versus the 9.28% produced by the MSCI Nordic index. Postma (2015) back tested the magic formula on the Benelux stock market between 1995 and

2014. The results from the study were that the magic formula produced a premium of 7.70% above the market.

3.5 Greenblatt versus the EMH

The EMH states that stock markets are efficient therefore stocks prices reflect all relevant information and stocks are valued at their fair price always. Those that believe this to be true criticize the magic formula of mispricing of risk, the size effect, looking ahead bias, survivorship bias and data mining, each of which will be discussed below.

3.5.1 Mispricing of risk

Greenblatt (2006) states that a three-year period is the minimum time frame that can be used to compare risk of different investments. In line with this he measured the risk of the magic formula with that of the market average by comparing them over individual three-year periods. Greenblatt (2006) believes risk to be the chance of losing money, rather than the variation from the expected return. A positive return is still a gain even if it does not net what was initially believed to be possible. Greenblatt (2006) showed that not only did the magic formula perform better than the market average over most three-year periods; it also produced less negative returns. This provided evidence that a portfolio created using the magic formula is in fact less risky than the market.

3.5.2 The size effect

Greenblatt (2006) acknowledges that that the magic formula does achieve its best results using small stocks but shows that outperformance of the market average still occurs when using the largest companies on the US stock market. This means that the magic formula is

effective using large or small stocks and provides superior returns to that of the market while maintaining lower risk as detailed above.

3.5.3 Looking ahead bias

Daniel, Sornette, & Wohrmann (2009) state looking ahead bias occurs when a researcher makes use of data in their study that would not have been available to them at the time, for the period under investigation. To perform his tests Greenblatt used a new Standard & Poor's system called Compustat (Greenblatt, 2006). This system allowed him to extract only information available to the rest of the market on the dates under study, which in turn ensured that there was no looking ahead bias present in his findings.

3.5.4 Survivorship bias

Survivorship bias occurs if companies from the past cease to exist today, because of acquisitions, bankruptcy or for any reason and they do not get included in one's research (Pawley, 2006). Compustat addresses this issue by reinserting companies that would otherwise have been removed. Thus, the criticisms surrounding survivorship bias can be discarded as they are unfounded (Howard, 2015).

3.5.5 Data mining

> According to Giudici (2003) data mining is "the process of selection, exploration, and modeling of large quantities of data to discover regularities or relations that are at first unknown with the aim of obtaining clear and useful results for the owner of the database".

Greenblatt (2006) makes a point to assure critics that no data mining occurred, he claims to have made use of both ROC and EY for investing purposes even before the development of the magic formula. He goes one step further to reiterate that these two factors were in fact the ones that were back tested.

CHAPTER 4
RESEARCH METHODOLOGY

4.1 Introduction

Joel Greenblatt created a method to analysis shares and select a portfolio that enabled him to earn greater returns than the market, which he called the magic formula. This formula allowed him to narrow a large stock universe in the United States to a portfolio of 30 stocks. This study replicated Joel Greenblatt's Magic Formula in South Africa for the period 2000 to 2016, to determine if the formula could be used to produce consistent market beating returns from portfolios created on the Johannesburg Stock Exchange (JSE). In doing so testing whether the markets in South Africa (JSE) are efficient, either supporting or rejecting the efficient market hypothesis.

4.2 Data Collection and Processing

To produce the magic formula portfolios, analysis of both stock price data and data from companies' financial statements is required, this study obtained the relevant data off McGregor BFA.

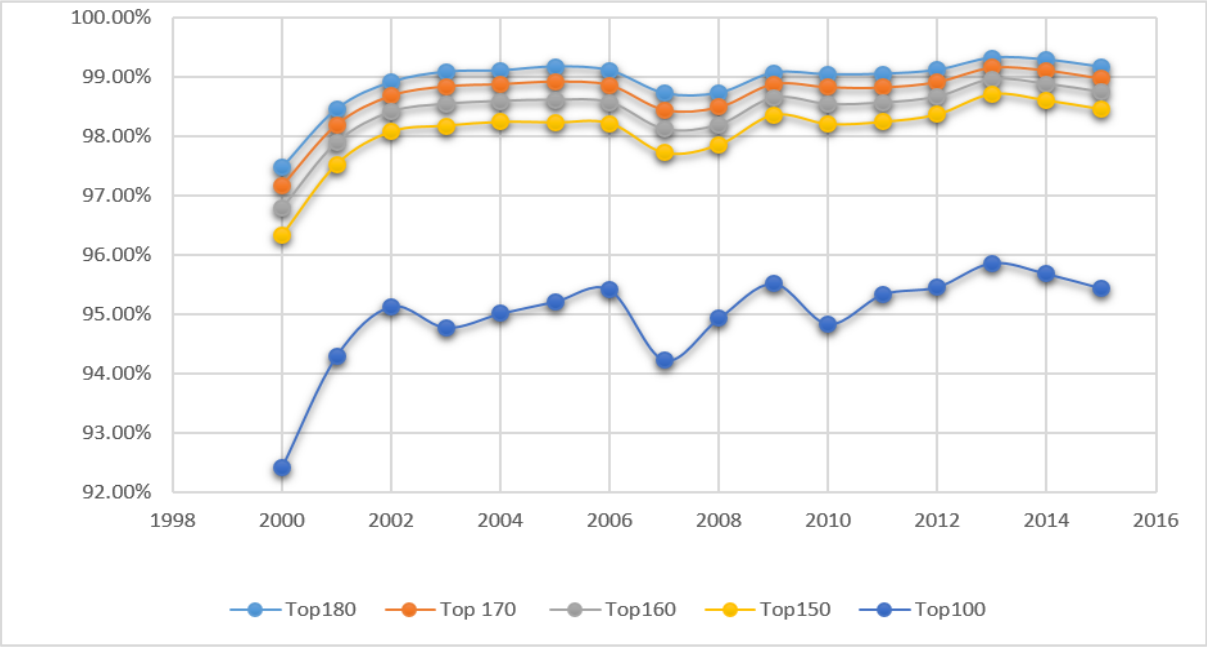
To determine portfolio returns, daily stock prices for all shares listed or since delisted from the JSE between 2000 and 2016 were collected. Financial statement data is not available daily, but rather at a point in time and was thus collected from the most recent financial statements.

It was noted that the number of companies listed on the JSE ranged from 332 to 553 between the years 2000 and 2016. The market capitalization of these listed companies was analyzed to determine what sample size should be used to create the magic formula portfolios.

Greenblatts' method needed to be adjusted here slightly due to the size of the US Stock markets in comparison to the JSE. The stock universe Greenblatt had at his disposal was 3, 500 stocks, with the lowest having a market value of $ 50 million. He narrowed this down to the top 2, 500 stocks by market value and then narrowed it yet again to the top 1, 000 stocks. In doing so he raised the minimum market value to $200 million and $1 billion respectively. This Greenblatt states this is important because it allows individual investors to purchase reasonable quantities of shares without causing movements in stock prices (Greenblatt, 2006).

The analysis performed in this study showed that the top 100 shares by market capitalization make up roughly 95% of the total value of the JSE, the top 160 make up roughly 99%, and the top 170 and top 180 only marginally increasing that percentage, see figure 4.1 below.

Figure 4.1: Market capitalization percentage of JSE listed shares



Source: Adapted from data retrieved from McGregor BFA (2017).

It was found that these shares makeup the majority of the trades on the JSE annually and hence are the most liquid. The All Share Index consists of the top 164 shares by market value on the JSE and hence makes up roughly 99% of its value and most of the traded volumes. It is for these reason that this study like Howard (2015) will use the All Share Index as a proxy for the market. In line with the above analysis only the top 164 shares will be considered for the magic formula portfolios. Shares falling outside the top 164 were determined to be too small, likely to be volatile and illiquid. Purchases of a significant number of shares outside the top 164 would likely cause price changes to said shares.

When stocks held in the magic formula portfolio were delisted prior to the predetermined sale date, said shares were sold on their last trading day. If a company whose share was held was unbundled into a new subsidiary, the returns from the subsidiary were included in the portfolio returns for the remainder of the holding period, thereafter the new subsidiary is treated as a separate entity. Because the magic formula requires both stock price data and financial statement data, new shares are only considered upon submission of their first financial statements. All other shares that were unaffected by such events were held in the portfolio till end of the period.

Returns are calculated by adding both capital gains and dividends paid out while holding the share, this is also referred to as the dividend adjusted return. It should be noted that no transaction costs or taxes were accounted for. It is the researchers believe that because both the market and the portfolios are traded in the same way for this study (discussed later) this should have no influence on the outcome.

All the data collected from McGregor BFA was loaded onto Microsoft Excel, where pivot tables and XLSTAT was used to validate and analyze the data. Excel was used to create the graphs/tables for this study.

4.3 Avoiding Statistical Bias

The main criticism that the magic formula faces surrounds statistical biases critics believe are present in the construction of the portfolios, such as mispricing of risk, the size effect, looking ahead bias, survivorship and data mining. The following steps were taken to minimize the impact of such bias or eradicate it altogether.

Risk is defined by most as the variation or standard deviation of returns that a portfolio provides. Greenblatt (2006) accounts for this in a different manner, he only recognizes negative returns as risky, as a positive return regardless of how small are still gains. In other words, a portfolio should be judged by how many negative returns it provides in comparison to the market or other portfolios. To avoid mispricing of risk this study applied a risk-adjusted return for derived portfolios, which allows fair comparison with the market and other portfolios/indices. A Sharpe ratio was calculated for all portfolios including the market to determine if excess returns were a result of additional risk. In addition to the two more conventional methods for analyzing risk, Greenblatt's method was applied. Portfolios were compared according to which had the least negative returns.

It is widely accepted that creating a portfolio from small cap stocks can provide superior returns, albeit with significantly greater risk. To avoid this occurring only the top 164 stocks, which account for roughly 99% of the JSE market capitalization were used as detailed in section 4.2 above.

Daniel, Sornette, & Wohrmann (2009) state looking ahead bias occurs when a researcher makes use of data in their study that would not have been available to them at the time, for the period under investigation. If a company is listed on the JSE, they are required through the corporate governance standards set by the JSE to publish their financial statements within three months of the financial-year end. To avoid the look ahead bias April was selected as the month to purchase stocks and analysis was done on the previous financial year's data. As an example, the information derived from the year 2001 was used to purchase stocks in April 2002. This means companies with a financial-year end of February would release results in May 2001 and a company that has a year end of December would release by March of 2002. Thus, avoiding look ahead bias. In addition to this, companies were not considered unless they had been in operations long enough to submit audited financial statements.

Survivorship bias occurs if companies from the past cease to exist today and as a result do not get included into the population pool. This problem is avoided by using McGregor BFA which allowed the researcher to include all delisted companies over the period and treat them in the same manner as listed companies.

Data mining, or the intentional modeling of large quantities of data to uncover results is avoided in the study by sticking to the magic formula using EY and ROC as defined by Joel Greenblatt before this study took place.

4.4 Methods:

<u>This study created two portfolios:</u>

Portfolio A: The magic formula as stated by Greenblatt, purchasing stocks on a rolling basis.

Portfolio B: The magic formula as stated by Greenblatt, purchasing all stocks once off.

Portfolio A:

This portfolio followed the magic formula with minimal interpretation, this method will be explained below:

Step 1: Rank all stocks [2] according to the magic formula's two key performance indicators of Return on Capital (ROC) defined in equation 4.1 and Earnings Yield (EY) defined in equation 4.2 below. While previous back testing has substituted ROC with Return on Assets (ROA) or Return on Equity this study replicates the magic formula equation precisely. [3]

(4.1) Return on Capital = EBIT / Net Tangible Assets

Where:

(4.1.1) Net Tangible Assets = (Net Working Capital + Net Fixed Assets)

(4.1.2) Net Working Capital = Accounts receivable + Inventory + Cash – Accounts payable

(4.1.3) Net Fixed Assets = Fixed assets – Accumulated depreciation

(4.2) Earnings Yield = EBIT / Enterprise Value

Where:

(4.2.1) Enterprise Value = Market value of equity + Net interest-bearing debt – Excess cash

[2] All stocks in this instance refers to the top 164 stocks by market capitalization as defined in section 4.2
[3] ROA, ROE and EY portfolios were created for comparison purposes

Step 2: Create the Magic Formula matrix by combining the ROC and EY ranking of each stock. If stock A ranked 5th on the ROC list and 25th on the EY list, it would have a combined score of 30.

Step 3: Select the top 30 ranked stocks in the Magic Formula matrix from step 2. If 30 was the lowest score in the matrix it would be ranked number 1 and if 30 was the highest score it would be ranked last.

Step 4: Purchase the top 6 shares in the matrix in month one or 20% of your portfolio of funds. An assumption is made here that we will be working with an equally weighed portfolio and hence 6 shares will equate to 20%. [4]

Step 5: Repeat step 4 until entire portfolio of funds has been invested. Thus, shares will be purchased according to the table below:

Table 4.1: Portfolio Construction

Month	Share Ranking	Share Grouping
Month 1 – April	1 – 6	1
Month 2 – May	7 – 12	2
Month 3 – June	13 – 18	3
Month 4 – July	19 – 24	4
Month 5 – August	25 – 30	5

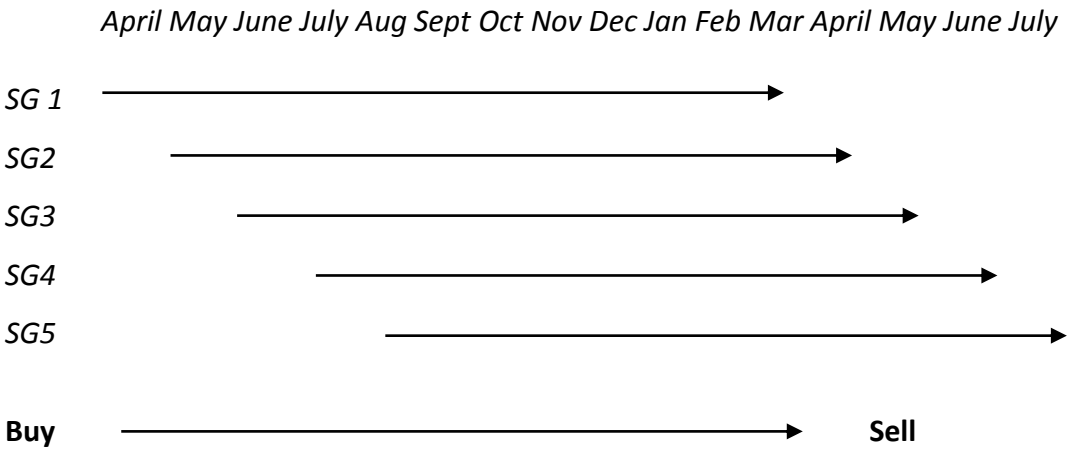
Step 6: Sell each share/share group (SG) after holding it for one year. Greenblatt (2006) states that loser shares should be sold a few days short of a year and winners a few days

[4] Greenblatt (2006) states that five to seven shares should be purchased every two to three months. This study will purchase 6 shares every consecutive month till funds are depleted.

longer than a year for tax purpose. In this study shares were sold after exactly a year because taxes were ignored.

The purchase and sale of shares is represented in figure 4.2 below:

Figure 4.2: Purchase and sale representation



Step 7: Repeat steps 1 – 6 from 2000 through to 2015, recording the outcome.

Portfolio B:

Portfolio B followed step 1 to 3 from Portfolio A precisely, however, instead of purchasing shares in a staggered pattern as can be seen from *Figure 4.1* above the entire 30 stocks as determined by the magic formula are purchased at 01 April each year and sold on 31 March the following year.

This method of purchasing stocks all in one go, as is the case in Portfolio B, has been used in previous studies around the world by the likes of Larkin (2009), Muller and Ward (2013) and Howard (2105) and thus was included in this study.

The Market or JSE All Share Index:

To ensure that the study was comparing apples with apples it was decided that money would be invested into the All Share Index in the same pattern it was invested into Portfolio A and B respectively. In other words, for Portfolio A, the money was invested on a rolling basis. That is 20% was invested monthly for 5 months and then sold exactly one year from purchase date. For Portfolio B on the other hand all the money available for the investing was invested on day one of the investment period.

It was decided that the first investment period would always be 01 April of that particular year. This study required the annual financial statements of companies for calculation purposes, thus to avoid any bias selected April as the month investments would begin. It is the researcher's belief that this would be sufficient time to obtain the relevant information. Other studies such as Howard (2015) seem to ignore this entirely.

4.5 Calculating Returns

Returns from shares come in two forms: capital gains and dividends. To calculate the returns for each share in the portfolio, dividend adjusted returns were used. This allowed the researcher to account for both the gains/losses from movements in share price, as well as, account for dividends received during the time the share was held[5]. ***Dividend adjust returns*** are calculated using equation 4.5.1 below:

[5] When purchasing shares, dividends were only accounted for if the shares were purchased before the ex-dividend date. For sales of shares, dividends were only accounted for if they were sold after the ex-dividend date.

4.5.1 $((P_t + D_t) – P_{t-1}) / P_{t-1}$

Where:

- P_t = Stock Price at time t
- P_{t-1} = Stock Price at time t-1
- D_t = Dividend at time t

Back testing was performed over the period 2000 to 2015, thus the geometric mean was used to calculate the annualized return for the magic formula in both Portfolio A and B, the formula for this ***geometric mean return*** is represented in 4.5.2 below:

4.5.2 $((1 + r_1) \times (1 + r_2) \times \dots \times (1 + r_n))^{1/n} - 1$

Where:

- r = Annual Return
- n = Number of Periods

Annualizing the returns of the portfolios, as well as, the returns of the market (JSE All Share) allowed for better comparison.

4.6 Accounting for Risk

Calculating the returns is an important first step and provides a good indication of how well the portfolio performed in general terms. Everyone has heard the saying “the greater the risk the greater the reward”. This generally holds true, but it highlights the importance of understanding the risk associated with obtaining a return.

This study made use of two widely accepted formulas to account for risk. The first was the ***risk-adjusted return*** formula represented in equation 4.6.1 below, using the JSE All Share Index to provide the market return and market variance as previously stated:

4.6.1 $$\overline{\boldsymbol{R}}_{\boldsymbol{Market}} + \frac{\sqrt{\boldsymbol{VAR}\ \boldsymbol{market}}}{\sqrt{\boldsymbol{VAR}\ \boldsymbol{portfolio}}}(\overline{\boldsymbol{R}}_{\boldsymbol{portfolio}} - \overline{\boldsymbol{R}}_{\boldsymbol{Market}})$$

Where:

- $\overline{R}_{\text{market}}$ = Annualized Return of the market
- $\overline{R}_{\text{portfolio}}$ = Annualized Return of the portfolio
- VAR $_{\text{market}}$ = Variance of the market
- VAR $_{\text{portfolio}}$ = Variance of the portfolio

The second formula used is what is commonly known as the Sharpe Ratio. The Sharpe ratio indicates the return an investment provides with regards to excess risk. It shows an investor if the returns are obtained through taking on additional risk or not. ***The Sharpe ratio*** is calculated according to equation 4.6.2 below:

4.6.2 $$\frac{\overline{\boldsymbol{R}}\boldsymbol{portfolio} - \boldsymbol{R}_{\boldsymbol{risk-free}}}{\sqrt{\boldsymbol{VARportfolio}}}$$

Where:

- $\overline{R}_{\text{portfolio}}$ = Annualized Return of the portfolio
- $R_{\text{risk-free}}$ = Risk-free rate
- VAR $_{\text{portfolio}}$ = Variance of the portfolio

CHAPTER 5

FINDINGS

5.1 Introduction:

This section will discuss the research findings applicable to this report. It is noted here that the JSE All Share Index was used throughout as a reference for the market.

Section 5.2 below will discuss the individual performance of both Portfolio A and Portfolio B against the market. Section 5.3 will compare Portfolio A and Portfolio B against each other. Section 5.4 will compare the two portfolios against alternative market indexes available on the JSE. The final section of this chapter Section 5.5 will compare the performance of other value investing strategies/portfolios to that of Portfolio B.

All data pertaining to the market, other indexes and alternative portfolios was obtained from McGregor BFA.

5.2 Portfolio A and Portfolio B performance versus the Market

Figure 5.1: Graphical representation of Portfolio A versus the Market

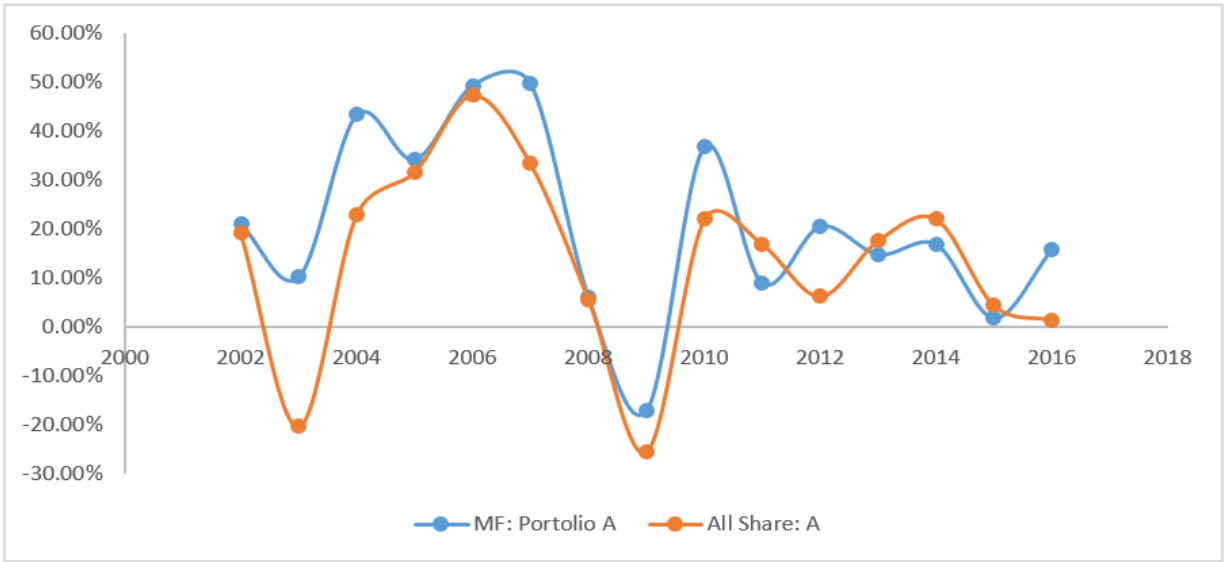


Figure 5.1 above, constructed from Appendix 1, gives us a visual illustration of how Portfolio A: the rolling magic formula performed in comparison to the market. This shows that the market and Portfolio A tend to move in a similar direction, it is however noted that the market had more negative returns and that the positive returns tended to be lower than that of Formula A.

Appendix 1 was used to analyse this further. From a total of 15 years/periods studied the market experienced two periods with negative returns versus the one of Portfolio A. This is important as Greenblatt (2006) defines risk as the chance of losing money, rather than the variation from the expected return. By this definition Portfolio A would be less risky than the market. The author does not stand solely by this definition of risk and thus they will analyze the variation of each. It should also be noted that the negative return experienced from Portfolio A was significantly lower than that of the market in the corresponding period, 8.44% lower to be precise. This is potentially an indication of less risk, but this is delved into with the analysis of the portfolio's risk-adjusted return.

Further examination shows that Portfolio A outperformed the market in 11 out of 15 periods, with 2003, 2004, 2007, 2010, 2012 and 2016 providing double digit (>10%) returns greater than the market. 2011 was the first year/period that the market beat Portfolio A, but significantly enough all four occurrences of market outperformance of Portfolio A occurred in the last 6 periods/years and none of them broke through double digits.

Table 5.1: Key statistics of Portfolio A versus the Market

MF: Portfolio A Annualized Return	All Share: A Annualized Return	MF: Portfolio A Standard Deviation	All Share: A Standard Deviation	MF: Portfolio A Risk-adjusted return	MF: Portfolio A Sharpe Ratio	All Share: A Sharpe Ratio
0.1946	0.12012	0.1873	0.1918	0.19622	0.5742	0.1726

Table 5.1 above was derived from Appendix 1 and provides the annualized return, standard deviation and Sharpe ratios for Portfolio A and the market over the full holding period. It also provides a risk-adjusted return for Portfolio A.

The annualized return for Portfolio A is significantly higher at 19.46% for the holding period than that of the market at 12.012%. Not only are the returns higher but it also produced a standard deviation lower than that of the market, 0.1873 versus 0.1918 indicating it is less volatile. This in conjunction with having less negative returns over the period shows that Portfolio A is in fact less risky than the market. The author then analyzed the Sharpe Ratios and noted that Portfolio A had a higher Sharpe ratio at 0.5742 than the market at 0.1726 indicating that Portfolio A produced greater excess returns per unit of volatility. Calculating a risk-adjusted return provides further evidence of lower risk with the return of Portfolio A increasing to 19.622% or by 0.162%.

Figure 5.2: Cumulative returns Portfolio A versus the Market

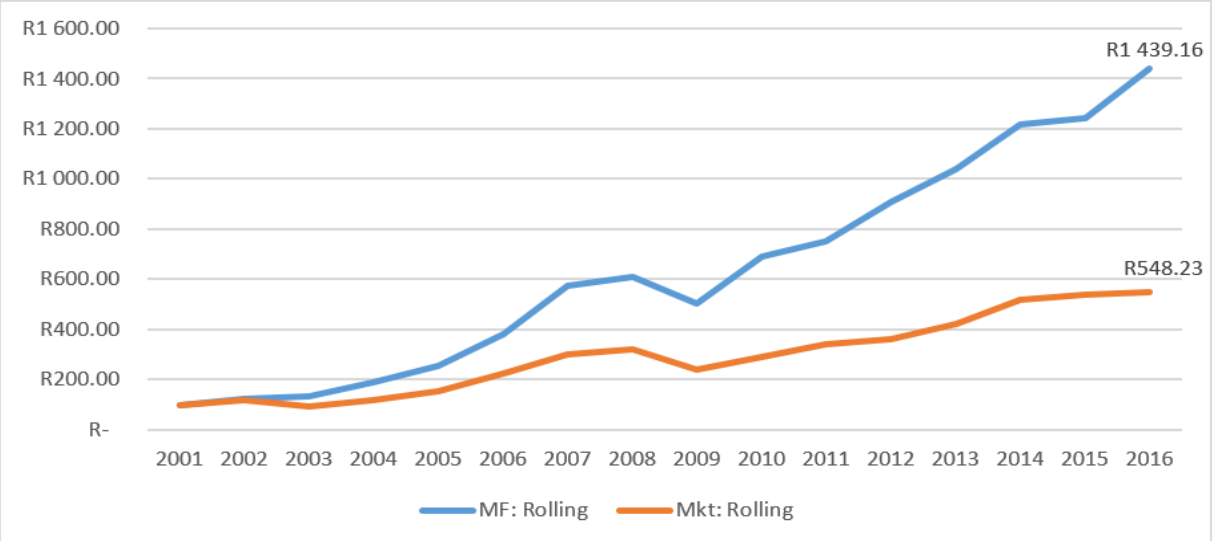


Figure 5.2 provides a good illustration of how Portfolio A outperforms the market. Investing R100 in each at time period one, Portfolio A would have produced R1 439.16 by the end of the holding period versus the R548.23 from the market.

Figure 5.3: Graphical representation of Portfolio B versus the Market

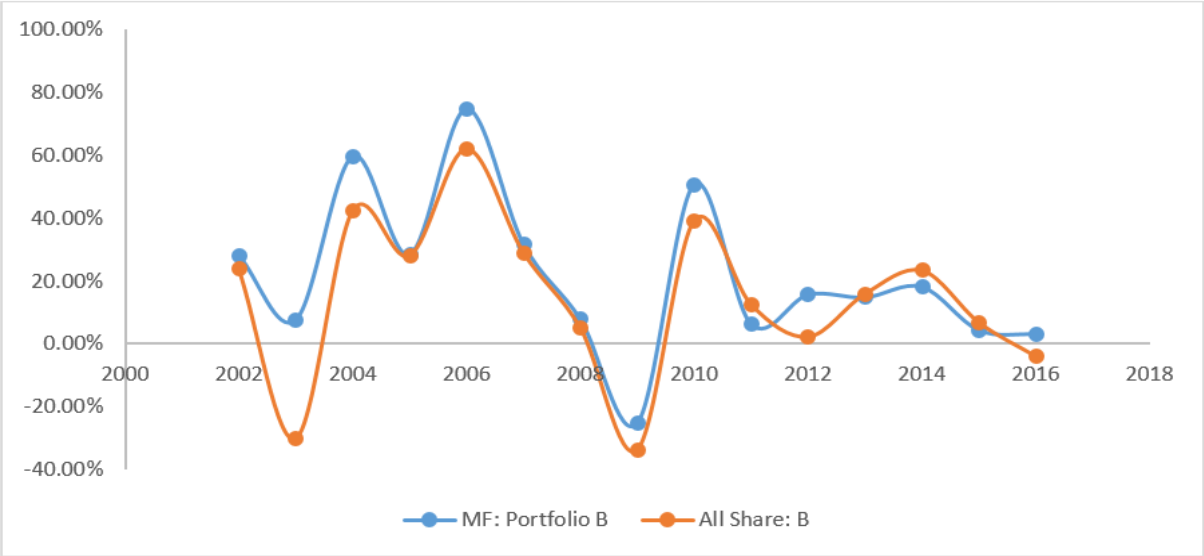


Figure 5.3 above, constructed from Appendix 2, gives one a visual illustration of how Portfolio B: The magic formula (stocks purchased at a point in time) performed in comparison to the market. This shows that the market and Portfolio B tend to move in a similar direction, even more so than that of Portfolio A and the market.

Using Appendix 2 one can analyse these findings. As was the case with Portfolio A and the market, from a total of 15 years/periods studied the market experienced more negative returns than Portfolio B. In this case the market experienced three periods of negative yields versus the one of Portfolio B. This is again significant by Greenblatt's definition of risk. Again, it is noted that the negative return experienced from Portfolio B was significantly lower than that of the market in the corresponding period, 8.72% lower. While lower than the market it was significantly higher than the only negative return in Portfolio A, roughly 8%. It is

interesting to note that for both Portfolio A and B the negative return occurred in 2009, the peak of the financial crisis. While it looks as though the magic formula has provided superior results so far, it was unable to protect investors from the crisis.

Further examination shows that Portfolio B outperformed the market in 11 out of 15 periods, just like Portfolio A. With 2003, 2004, 2006, 2010, and 2012 providing double digit (>10%) returns greater than the market, this is one less than Portfolio A. 2011 was the first year/period that the market beat Portfolio B as was the case with Portfolio A, with all four outperformances also occurring in the last 6 periods/years and none of them broke through double digits.

Table 5.2: Key statistics of Portfolio B versus the Market

MF: Portfolio B Annualized Return	All Share: B Annualized Return	MF: Portfolio B Standard Deviation	All Share: B Standard Deviation	MF: Portfolio B Risk-adjusted return	MF: Portfolio B Sharpe Ratio	All Share: B Sharpe Ratio
0.19361	0.11851	0.2508	0.2562	0.19508	0.4251	0.1230

Table 5.2 above was derived from Appendix 2 and provides the annualized return, standard deviation and Sharpe ratios for Portfolio B and the market over the full holding period. It also provides a risk-adjusted return for Portfolio B.

The annualized return for Portfolio B is significantly higher at 19.361% for the holding period than that of the market at 11.851%. Not only are the returns higher but it also produced a standard deviation lower than that of the market all be it marginally, 0.2508 versus 0.2562 indicating it is marginally less volatile, making it slightly less risky. This in conjunction with having less negative returns over the period shows that Portfolio B is in fact less risky than the market. Upon analyzing the Sharpe ratios, it was noted that Portfolio B had a higher Sharpe ratio at 0.4251 than the market at 0.1230 indicating that Portfolio B produced greater

excess returns per unit of volatility. Calculating a risk-adjusted return provides further evidence of lower risk with the return of Portfolio A increasing to 19.508% or by 0.147%.

Figure 5.4: Cumulative returns Portfolio B versus the Market

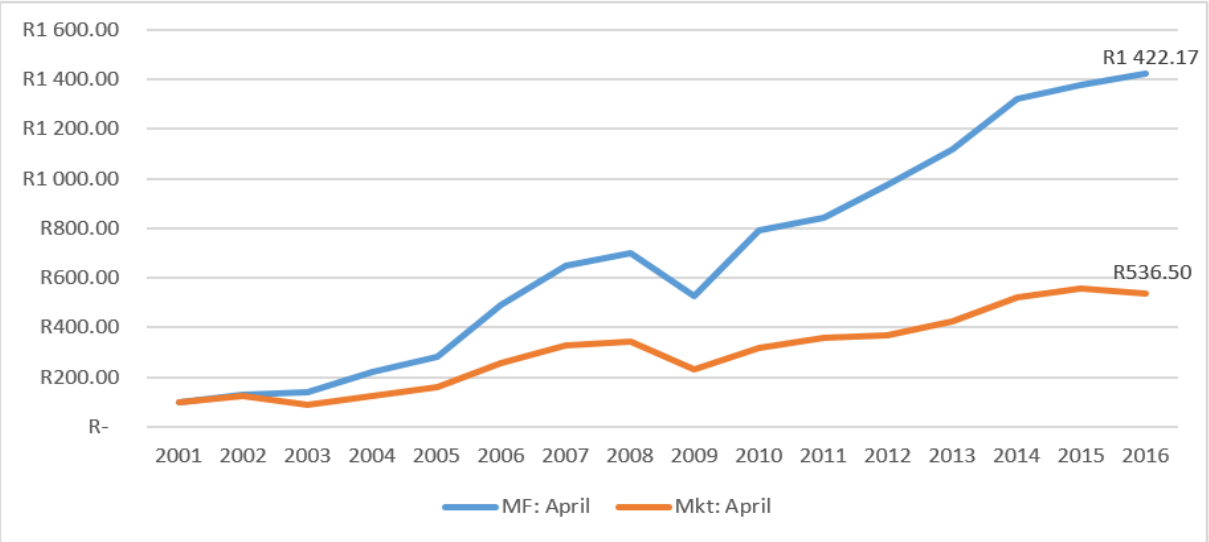


Figure 5.4 provides a good illustration of how Portfolio B outperforms the market. Investing R100 in each at the first period, Portfolio B would have produced R1 422.17 by the end of the holding period versus the R536.50 from the market.

5.3 Portfolio A versus Portfolio B

Portfolio A and B consist of the same stocks, the fundamental difference between the two portfolios is when stocks are bought and sold. Portfolio A is a purer form of the Greenblatt magic formula as defined by Greenblatt himself, while Portfolio B is a slightly modified version widely used in previous research.

The question becomes, does the timing of purchases affect the outcome or does the formula identify value regardless?

Table 5.3: Key statistics of Portfolio A versus Portfolio B

MF: Portfolio A Annualized Return	MF: Portfolio B Annualized Return	MF: Portfolio A Standard Deviation	MF: Portfolio B Standard Deviation	MF: Portfolio A Sharpe Ratio	MF: Portfolio B Sharpe Ratio	MF: Portfolio A Risk-adjusted return	MF: Portfolio B Risk-adjusted return
0.1946	0.19361	0.1873	0.2508	0.5742	0.4251	0.19622	0.19508

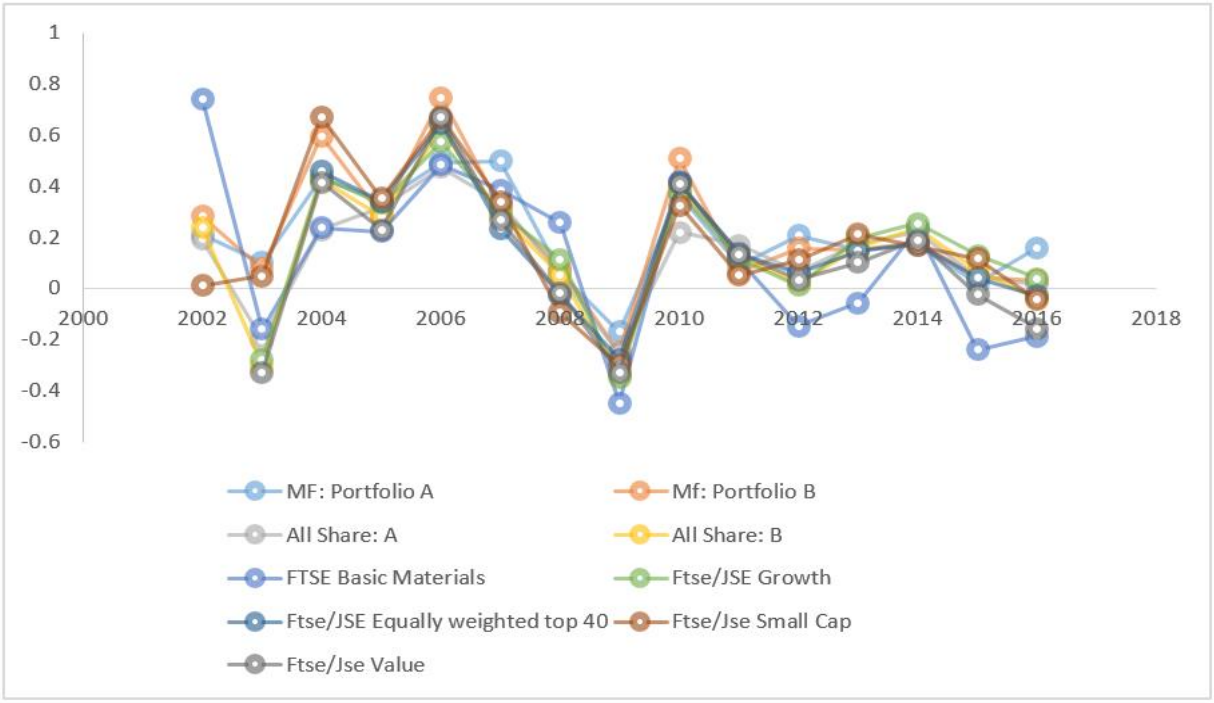
The annual mean return of the two portfolios is very similar with Portfolio A producing 0.099% greater return than Portfolio B. It is only when analyzing the risk coefficients, one noticed a meaningful difference. Portfolio A has a considerably lower standard deviation at 0.1873 in comparison to the 0.2508 of Portfolio B. This results in a risk-adjusted return of 19.622% for Portfolio A and 19.508% for portfolio B. This increases the spread between the two to 0.114%, which is marginally higher than the original 0.099%. It is also noted that the Sharpe ratio for Portfolio A is higher at 0.5742 than that of Portfolio B at 0.4251, indicating that Portfolio A produced greater excess returns per unit of volatility.

The above analysis has pointed out that the fundamental difference between the two portfolios/methods of applying Greenblatts formula is risk. Staggered purchases of stocks tended to lower the overall risk that the investor was exposed to, while still producing excess returns.

While this report did not originally set out looking for the above it is a key finding none the less and should be noted in research going forward.

5.4 The Magic Formula (Portfolio A and B) versus various other Market Indexes

Figure 5.5: Graphical representation of all annualized returns for indexes



Through inspection of figure 5.5 and the data pertaining to it we can state that most of the indexes tend to move together [6]. It is however noted, that over the period the two exceptions to this (at least to some degree) would be the JSE Basic Minerals Index and the JSE Value Indexes. The JSE Basic Minerals Index suffered six negative periods from a total of 15 and the JSE Value Index amassed five. The next highest was three, why this is the case is outside the scope of this report.

Table 5.4 in Appendix 3 allows one to analyze the various statistics relevant to the different indexes and portfolios such as, the annualized returns, standard deviation, and the Sharpe ratio.

[6] The market will not be included in comparisons in this section as it was already compared to the magic formula in section 5.2.

From this analysis one can see that the annualized return from the magic formula: Portfolio A and B are significantly higher than any of the index including the market as previously stated. The best performing index was the JSE Small Cap with an annualized return of 14.74%, which is 4.72% lower than Portfolio A and 4.62% lower than Portfolio B. The JSE Equally Weighted Top 40 produced the next best return with 13.23%.

It is interesting to note that all indexes had at least two periods with negative returns with the majority having three or more, unlike the magic formula which only had one in Portfolio A and B respectively. Which again according to Greenblatt's definition of risk makes Portfolio A and B less risky than the market and all the indexes they are compared with in this study.

Moving one's attention to the standard deviation of each portfolio/index one can again notice that Portfolio A is substantially lower than all the others at 0.1873, the next best being the JSE Equally Weighted Top 40 at 0.2428. Portfolio B coming in third with 0.2508 and the rest being marginally higher than the last.

The Sharpe ratios tell the same story noted throughout the report, Portfolio A will produce the greatest excess returns per unit of volatility with a Sharpe ratio of 0.5742, followed by Portfolio B with a Sharpe ratio of 0.4251. The JSE Small cap would come in third at 0.2282 and the JSE Equally Weighted Top 40 fourth at 0.1865.

Figure 5.6: Cumulative returns for Portfolio A, B, and the various indexes

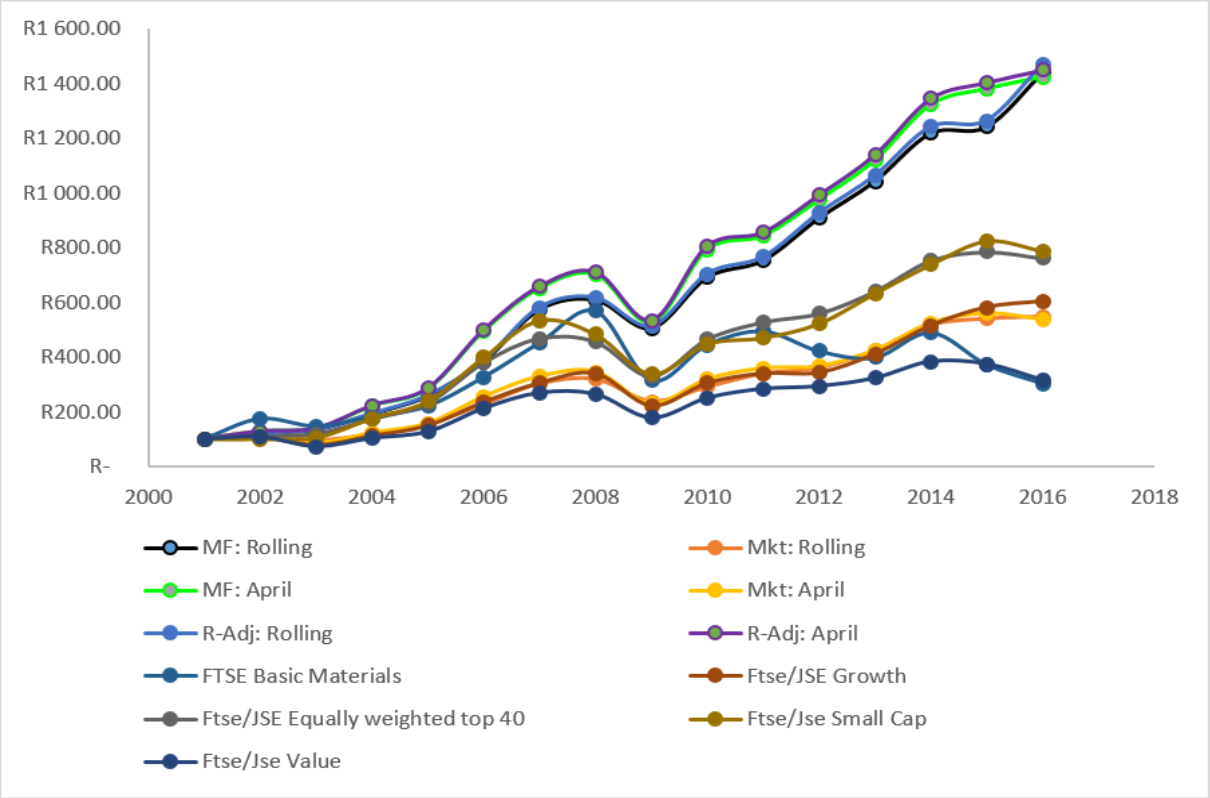


Figure 5.6 provides an illustration of the cumulative returns that would have been earned from each Portfolio or Index listed in Table 5.9. The assumption is that R100 was invested on day one in each of the Portfolios. As can be seen Portfolio A and B would have accumulated the most by a significant margin, each ending above R1420. The JSE Small cap would be third amassing R786, fourth would be the JSE Equally Weighted Top 40 at R761.The JSE Growth coming in R50 above the market. Only the JSE Value and JSE Basic Materials performing worse than the market.

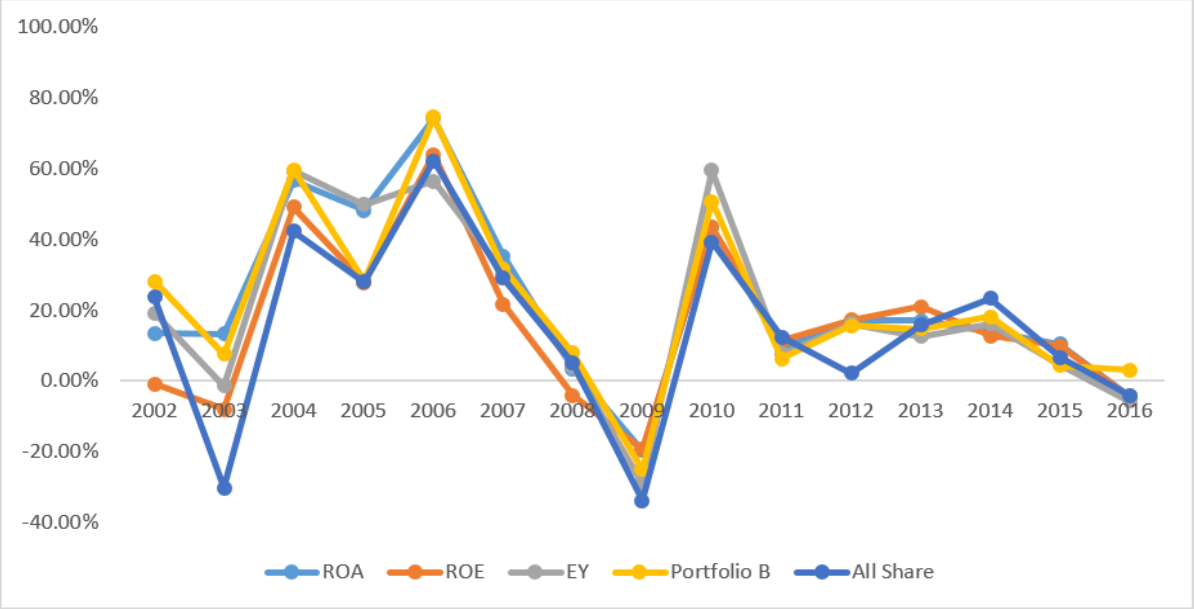
These finding are important because they show that in South Africa it is possible to outperform the market on a consistent basis. It shows us that even if the Top 40 were used as the market the magic formula would still have outperformed it. It also gives one an indication that other investing strategies might also have outperformed the market, such as a growth strategy or investing in a small stocks portfolio.

5.5 The Magic Formula versus alternative value investing portfolios

The alternative value portfolios were derived using key financial ratios that are commonly used to signal value in a company namely, ROA, ROE and EY. The three ratios were selected because Greenblatt himself refers to them and the need to modify them for superior gains.

These portfolios were constructed in a similar manner to that of Portfolio B, where by the top 30 stocks for each year were identified, purchased on day one of the trading period and sold exactly one year after they were purchased. It is for this reason that all comparisons in this section will only make use of Portfolio B and exclude Portfolio A.

Figure 5.7: Graphical representation of all annualized returns for alternative portfolios



Examination of figure 5.7 gives us a visual comparison of the yearly returns earned by each of the portfolios against the market. The author noticed a similar trend to previous comparisons; the portfolio returns tend to move in the same direction. It is however interesting to note, that in 2003, 2004, 2009, 2010 and 2012 all portfolios had returns

greater than the market. 2011 and 2014 saw every portfolio underperform the market. 2003, 2005 and 2012 were marked by the biggest variations in returns between portfolios.

Table 5.5: Key statistics for the alternative portfolios, Portfolio B and the market

	Return on Assets (ROA)	Return on Equity (ROE)	Earnings Yield (EY)	The Magic Formula: Portfolio B	The market: JSE All Share Index
Annualised Return	19.86%	14.10%	17.30%	19.36%	11.85%
Standard Deviation	0.2473	0.2289	0.2626	0.2508	0.2562
Sharpe Ratio	0.4513	0.2357	0.3276	0.4251	0.1230
Risk-Adjusted Return	20.114%	14.26%	17.18%	19.51%	

Using Table 5.5 derived from Appendix 4 one can analyze the performance of each portfolio against the market and the magic formula. Through this analysis one can see that all the portfolios produced annualized returns far greater than that of the market over the 15 periods/years. Even the worst performing portfolio (ROE) netted 2.25% more than the market on an annualized basis. The ROA portfolio produced the greatest return at 19.86%, this was 0.5% higher than the magic formula return.

Turning our attention to the standard deviation, little variation between the portfolios is noted. The ROE portfolio was the least volatile with a standard deviation of 0.2289 and EY being the most volatile at 0.2626. This information is misleading to an extent, upon closer examination of Appendix 4 one can see that the ROE portfolio had 5 negative periods, all be it smaller ones. The magic formula again performed best in terms of having less negative periods with just one, with the ROA portfolio suffering two and the EY portfolio and the market suffering three.

The Sharpe ratio is again used to determine which portfolio produces the most excess returns per unit of volatility. The ROA portfolio comes out on top here, followed closely by the magic formula and some way behind in third is the EY portfolio.

To properly account for risk, a risk-adjusted return was calculated for each portfolio mentioned above. This resulted in increased returns for three of the four portfolios, with EY being the only exception and this is explained by the higher than market standard deviation of the portfolio. The increases and one decrease however had no impact on their rankings.

Figure 5.8: Cumulative returns for alternative portfolios, Portfolio B and the market

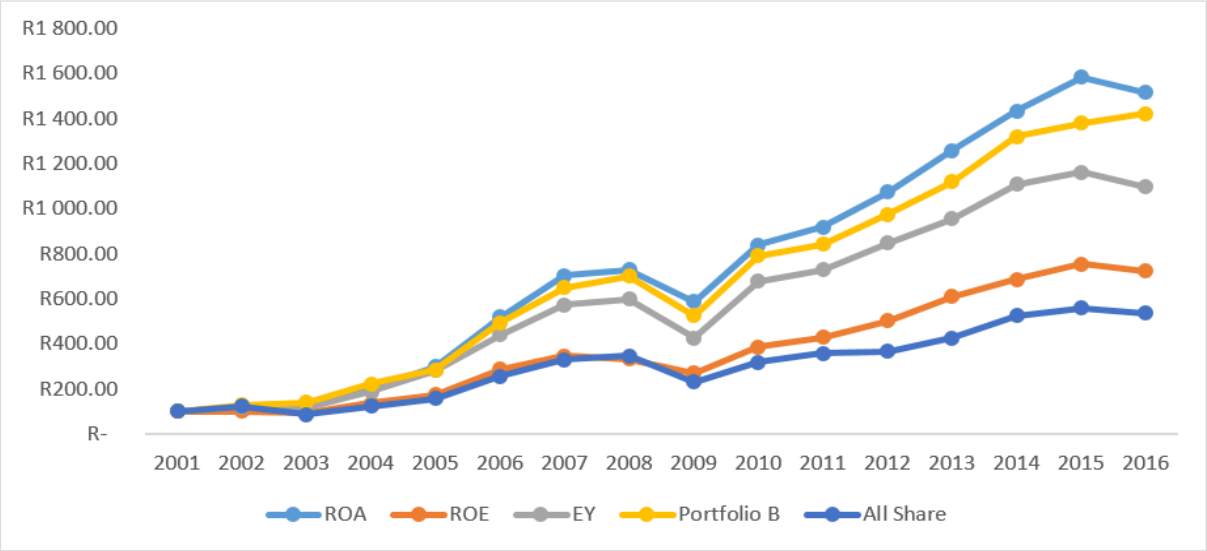


Figure 5.8 provides the graphical illustration of the cumulative returns that would have been earned from each Portfolio listed in Table 5.5 above. The assumption remains the same, invest R100 on day one in each of the portfolios. The ROA Portfolio would have amassed slightly above R1500, the magic formula would have come second with marginally over R1400, the EY portfolio third with just under R1100, the ROE portfolio fourth with R720 and last would be the market with R536.

CHAPTER 6
CONCLUSION

6.1 Conclusion

This report set out to back test Joel Greenblatt's magic formula in South Africa and other value investing strategies to determine if it was possible to systematically beat the market. This report constructed both a rolling and static magic formula Portfolio and used the JSE All Share Index as the market. The findings from this report were interesting and could add value to future discussion regarding market efficiency.

Both magic formula portfolios managed to significantly outperform the market over the 15 years under investigation. What was interesting was that the ROA portfolio produced the greatest return over the period and that all four value investing strategies outperformed the market. It was interesting to see that even by testing other market indices the magic formula still outperformed them. While this outperformance was there, it is noted that the market started to outperform the magic formula in the latter years of the study. It is interesting to note that the rolling portfolio outperformed the static portfolio over the same time period.

Not only did they outperform the market, but they had significantly lower risk. Not only was risk lower by conventional measures but also by the definition outlined by Greenblatt. The magic formula only produced one negative return during the period, which coincided with the biggest financial crisis in a century. All other index or value strategies had at least two negative years over the 15-year period. The higher Sharpe ratios of the value investing portfolios shows us that these portfolios earned higher returns without taking on additional risks.

Greenblatt's formula makes use of data from previous years' annual financial data and hence would be available to everyone, the fact that this formula outperformed the market indicates to us that the JSE in South Africa is not operating efficiently. This is further substantiated through the outperformance of the other value investing strategies against the market.

6.2 Further Research

It was stated earlier that the rolling portfolio performed better and had a lower risk profile than that of the static portfolio. This study bought shares over a period of five months, in other words six shares per month. It would be interesting to see if rolling over differing periods would make a difference on risk and reward. In other words, buy six shares every two months or be more extreme and try two to four shares every month.

It is suggested that in 5 years this study be performed again bringing the years under study forward. This would be in the hopes of discovering why the market started to outperform the magic formula in later years. It could be an indication that the South African market was/is maturing and becoming efficient.

The final recommendation is for a student to perform factor analysis and determine if there are any other variables that could add value to the magic formula by lowering risk, increasing returns or both.

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Appendix 1:

Table A: Portfolio A Results versus the Market

	Portfolio: A	***All Share: A***	***MF – All Share***
2002	20.99%	19.14%	1.85%
2003	10.22%	**-20.28%**	30.50%
2004	43.32%	22.95%	20.37%
2005	34.22%	31.61%	2.61%
2006	49.34%	47.28%	2.05%
2007	49.62%	33.31%	16.31%
2008	6.05%	5.60%	0.46%
2009	**-16.95%**	**-25.39%**	8.44%
2010	36.79%	22.02%	14.77%
2011	8.99%	16.87%	**-7.88%**
2012	20.57%	6.28%	14.28%
2013	14.85%	17.70%	**-2.85%**
2014	16.87%	22.03%	**-5.15%**
2015	1.91%	4.40%	**-2.49%**
2016	15.94%	1.46%	14.48%
Mean	**19.46%**	**12.012%**	**7.448%**

Appendix 2:

Table B: Portfolio B Results versus the Market

	Portfolio: B	***All Share: B***	***MF – All Share***
2002	28.18%	23.73%	4.45%
2003	7.67%	**-30.23%**	37.90%
2004	59.57%	42.37%	17.20%
2005	28.40%	28.05%	0.36%
2006	74.59%	62.09%	12.50%
2007	31.67%	29.01%	2.66%
2008	7.87%	5.03%	2.84%
2009	**-25.04%**	**-33.76%**	8.72%
2010	50.66%	39.23%	11.43%
2011	6.34%	12.46%	**-6.12%**
2012	15.65%	2.19%	13.46%
2013	14.80%	15.88%	**-1.07%**
2014	18.16%	23.33%	**-5.16%**
2015	4.41%	6.78%	**-2.37%**
2016	3.10%	**-4.02%**	7.12%
Mean	**19.361%**	**11.851%**	**7.51%**

Appendix 3:

Table: 5.4 Key Statistics for the Magic Formula and Various Market Indexes

	MF: Portfolio A	**MF: Portfolio B**	**All Share: A**	**All Share: B**	**JSE Basic Materials**	**JSE Growth**	**JSE Equally weighted top 40**	**JSE Small Cap**	**JSE Value**
Mean	**0.19456**	**0.1936**	**0.12012**	0.1185	0.0767	0.1210	0.1323	0.1474	0.0736
Median	0.1687	0.1565	0.1770	0.1588	0.2207	0.1633	0.1453	0.1166	0.1178
Max	0.4962	0.7459	0.4728	0.6209	0.7406	0.5724	0.6451	0.6709	0.6689
Min	-0.1695	-0.2504	-0.2539	-0.3376	-0.4481	-0.3476	-0.2778	-0.3003	-0.3271
Standard Deviation	0.1873	0.2508	0.1918	0.2562	0.3225	0.2546	0.2428	0.2648	0.2819
Sharpe Ratio	0.5742	**0.4251**	0.1726	0.1230	-0.0319	0.1336	0.1865	0.2282	-0.0474

Appendix 4:

Table C: Alternative investment strategies

	ROA	ROE	EY	Portfolio B	All Share
2002	13.45%	**-0.82%**	19.23%	28.18%	23.73%
2003	13.24%	**-7.95%**	**-1.41%**	7.67%	**-30.23%**
2004	56.59%	49.10%	59.33%	59.57%	42.37%
2005	48.26%	27.77%	49.80%	28.40%	28.05%
2006	74.22%	64.04%	56.44%	74.59%	62.09%
2007	35.27%	21.75%	30.70%	31.67%	29.01%
2008	3.51%	**-4.10%**	4.14%	7.87%	5.03%
2009	**-19.55%**	**-19.30%**	**-28.84%**	**-25.04%**	**-33.76%**
2010	43.37%	43.35%	59.42%	50.66%	39.23%
2011	9.39%	11.36%	7.58%	6.34%	12.46%
2012	16.99%	17.25%	16.13%	15.65%	2.19%
2013	17.08%	21.02%	12.68%	14.80%	15.88%
2014	14.08%	12.84%	16.12%	18.16%	23.33%
2015	10.37%	9.85%	4.80%	4.41%	6.78%
2016	**-4.34%**	**-4.24%**	**-5.64%**	3.10%	**-4.02%**
Mean	19.86%	14.10%	17.30%	19.361%	11.851%
Std Dev	0.2473	0.2289	0.2626	0.2508	0.2562
Sharpe Ratio	0.4513	0.2357	0.3276	0.4251	0.1230
Risk-Adjusted Return	20.114%	14.26%	17.18%	19.51%	