



The effectiveness of the Piotroski screen for value stock selection on the JSE

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A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfillment of the requirements of the degree of Master of Business Administration

7 November 2012

Abstract

This research project investigated the effectiveness of the Piotroski screen to select financially sound stocks from the upper quintile of high book-to-market value (growth) stocks on the Johannesburg Stock Exchange (JSE). The period chosen for this study was all the years since the publication of the Piotroski screen in 2000 until the most recent financial year, 2011.

Although no conclusive evidence was found that the mean returns from the portfolio of financially strong firms that were selected by means of the Piotroski screen were significantly better than the portfolio of value stocks, it was strongly suspected that the small group of firms that were signified as financially the strongest by the Piotroski screen had a decreased probability of containing firms with negative one year buy-and-hold returns compared to the other portfolios. Although the outcome was inconclusive due to small sample sizes, it was also strongly suspected that the one year buy-and-hold strategy yielded returns that were in the order of almost four times better than the five year buy-and-hold strategy.

It was recommended that, in order to minimise suboptimal investor behaviour caused by psychological biases on the JSE, investors should adopt a mechanical investment method based on objective financial statement analysis, using the Piotroski screen to select financially strong firms from the pool of value firms. It was further recommended that an annual portfolio balancing strategy should be used.

Keywords

Piotroski screen, value investing, Johannesburg Stock Exchange, financial statement analysis

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

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Date:

Acknowledgements

I would like to express my gratitude to my supervisor, Dr Trevor Taft, whose expertise, understanding, patience, gentle prodding and kind words of support added considerably to my MBA experience.

Silvia Philips was like a breath of fresh air with an inexhaustible list of expert contacts who assisted abundantly where my knowledge of the intricacies of financial statement terminology, shares and Excel macros threatened to increase my stress levels and decrease my amount of sleep.

Dedication

This work is dedicated to my two precious children, Michelle and Christo van der Merwe, who continue to enrich my life and who are the best children any father could ever wish for.



List of Figures

Figure 1. Histogram of high BM one year buy-and-hold portfolio's F-scores spanning the portfolio forming years 2000 till 2010.....	44
Figure 2. JSE Industrial index Indi25.	45
Figure 3. Performance measure frequencies.	46
Figure 4. Distribution of firm sizes for the complete one year buy-and-hold portfolio.	47
Figure 5. Distribution of BM values for the complete one year buy-and-hold portfolio.	47
Figure 6 Histogram of high BM quintile five year buy-and-hold portfolio's F-scores spanning the portfolio forming years 2000 till 2006.	50
Figure 7 Distribution of firm sizes for the complete one year buy-and-hold portfolio..	51
Figure 8. Distribution of BM values for the complete one year buy-and-hold portfolio	51
Figure 9. Histogram of the returns of the high BM sample.....	53
Figure 10. Box plots of the high BM group and the high F-score group.....	54
Figure 11. Histogram of the complete portfolio of one year buy-and-hold returns spanning the years 2000 till 2010.	56
Figure 12. Histogram of five year annualized buy-and-hold returns of the high F-score group.....	59
Figure 13. Box plot of five year annualized buy-and-hold returns of the high F-score group.....	60
Figure 14. Box plot of high BM one year buy-and-hold portfolio by market size.	61

List of Tables

Table 1. Research questions and objectives.....	8
Table 2. Definitions of the ratios and trends used in the determination of Piotroski's nine performance measures.....	22
Table 3. 80th Percentiles of the sample of one year buy-and-hold observations.	32
Table 4. 80th Percentiles of the sample of five year buy-and-hold observations.....	32
Table 5. Calculation of Piotroski's ratios and trends using financial statement line items from McGregorBFA.....	34
Table 6. Binary value allocation algorithms for Piotroski's nine performance signals...	35
Table 7. The number of observations per financial year with complete information to study holding periods of one year.	43
Table 8. Descriptive statistics of the quintiles of the complete one year buy-and-hold portfolio.	48
Table 9. The number of observations per financial year with complete information to study holding periods of five years.....	49
Table 10. Descriptive statistics of the quintiles of the complete one year buy-and-hold portfolio.	52
Table 11. Mean one year buy-and-hold returns of the samples compared.	57
Table 12. Hypothesis test for the difference between population proportions.....	57

List of Abbreviations

BM	Book-to-Market
CAPM	Capital Asset Pricing Model
EMH	Efficient Market Hypothesis
JSE	Johannesburg Stock Exchange
P/E	Price: Earnings ratio

Contents

Abstract.....	i
Keywords.....	i
Declaration.....	ii
Acknowledgements	iii
Dedication.....	iv
List of Figures	v
List of Tables	vi
List of Abbreviations	vii
Chapter 1. Introduction to the research problem.....	1
1.1 Purpose of the study	1
1.2 Overview of share market theories and investment methods.....	1
1.2.1 Background	1
1.2.2 Asset classes.....	2
1.2.3 Theoretical financial models.....	2
1.2.4 Stock market anomalies and investor psychology	3
1.2.5 Value investing, growth investing and technical analysis	4
1.3 Research motivation	5
1.4 Scope and research objectives.....	6
Chapter 2. Theory and literature review	9
2.1 Value and growth investing background	9
2.2 Theoretical foundations of value and growth investing.....	10
2.2.1 The Efficient Market Hypothesis	10
2.2.2 The capital asset pricing model	11
2.3 Value and growth investing research	12
2.4 Theoretical foundations of the Piotroski screen.....	15

2.4.1	Introduction	15
2.4.2	Fundamental financial statement analysis	16
2.5	The Piotroski screen	18
2.5.1	Properties of distressed firms.....	18
2.5.2	Profitability performance measures.....	19
2.5.3	Financial leverage/liquidity performance measures	20
2.5.4	Operating efficiency performance measures	20
2.5.5	Composite signal.....	22
2.6	Research contribution	23
Chapter 3.	Research hypotheses	25
3.1	Background	25
3.2	Research Question 1: Hypothesis 1	25
3.3	Research Question 1: Hypothesis 2	26
3.4	Research Question 2: Hypothesis	26
3.5	Research question 3: Hypothesis.....	27
Chapter 4.	Research methodology	28
4.1	Research design	28
4.2	Unit of analysis	29
4.3	Relevant population.....	30
4.4	Sampling frame	30
4.5	Sampling method and sample sizes	30
4.6	Data analysis process	33
4.6.1	Data extraction	33
4.6.2	Calculation of input ratios and trends	33
4.6.3	F-score calculation	35
4.6.4	Calculation of returns	36

4.6.5	Empirical tests.....	36
4.7	Research limitations.....	40
Chapter 5.	Results.....	42
5.1	Introduction	42
5.2	Descriptive statistics.....	42
5.2.1	Introduction	42
5.2.2	Characteristics of the one year buy-and-hold portfolio.	43
5.2.3	Characteristics of the five year buy-and-hold portfolio.	48
5.3	Research question one: Hypothesis 1.....	52
5.4	Research question one: Hypothesis 2.....	57
5.5	Research question two.....	57
5.6	Research question three	60
5.7	Summary	62
Chapter 6.	Discussion of results	63
6.1	Introduction	63
6.2	Research question one.....	64
6.3	Research question two.....	67
6.4	Research question three	70
6.5	Summary	71
Chapter 7.	Conclusions and Recommendations.....	72
7.1	Conclusions	72
7.2	Recommendations	73
7.3	Future Research	74
References	75

Chapter 1. Introduction to the research problem

1.1 Purpose of the study

The purpose of this study was to test the effectiveness of various aspects of the Piotroski screen (Piotroski, 2000) when applied to companies listed on the Johannesburg Stock Exchange (JSE). Research by Basu (1977) and others indicated that high book-to-market (BM) (value) stocks gave better returns than low BM (growth) stocks. The pool of high BM firms tends to be mostly firms that are struggling financially (Piotroski, 2000).

Piotroski proposed a set of nine criteria based on fundamental financial statement analysis to determine with greater confidence which stocks from a pre-screened universe of high book-to-market firms (value firms) are financially sound. The analysis was conditioned on smaller firms in financial distress and reportedly worked best for short investment time horizons in order to capitalise on the improved share price when the first good earnings announcements follow portfolio formation. Depending on the effectiveness of the Piotroski screen to select financially sound firms from the pool of high BM firms on the JSE an investment strategy devoid of investor psychological biases can be developed.

1.2 Overview of share market theories and investment methods

1.2.1 Background

The primary goal of investing is to make money (Crowder, Kazemi, & Shneeweis, 2010), or more specifically, to achieve a reasonable return on investment while at the same time controlling the risk of loss of principal (Graham & Zweig, 2006). John Maynard Keynes postulated that “the social object of skilled investment should be to defeat the dark forces of time and ignorance which envelop our future” (Walsh, 2008).

The choice of investment strategies are influenced by individual preferences as well as by investor psychology. Therefore, the following sections briefly covers the different

types of financial assets, the top performing asset class over the long run and the main foundations of investment theory pertaining to it.

1.2.2 Asset classes

South African financial securities comprise two main categories namely those that represent ownership and those that represent lending interests. While there is a wide range of financial assets available for investment the best returns in the long run came from share investments (Howe & Mistic, 2003) and (Firer & Staunton, 2002). Common stock represents an ownership interest in part of a business. Since common stock outperformed other financial securities as an investment instrument in the long run, it is therefore sensible to investigate the investment strategies pertaining to it. These strategies are mostly underpinned by theoretical financial models that provide guidance in the efforts to extract useful wisdom from financial data and in so doing, help to formulate and execute prudent investment strategies.

1.2.3 Theoretical financial models

Early attempts at applying rigorous mathematical modeling to stock market analysis include the assertion that returns should be considered in conjunction with risk, which is actually the standard investment term for a volatility measure (Markowitz, 1952). Sharpe (1964) extended this idea by developing a market equilibrium theory of asset prices under conditions of risk. The model attempts to correlate the required rate-of-return of an asset and its non-diversifiable risk when that asset is added to a well-diversified portfolio. This model, known as the Capital Asset Pricing Model (CAPM), is still used to determine asset pricing, assess the performance of managed portfolios and for risk evaluation (Hirschey & Nofsinger, 2010). In efforts to take the budding science of financial theory to new elegant heights of analysis, rigorous and sometimes severely restricting assumptions had to be made. Fama (1970), for instance, published his famous efficient-market hypothesis (EMH) which is simply a statement that every security at every point in time is fairly priced with all available relevant information taken into account. The EMH attracted much academic interest and controversy and its flaws were reviewed and discussed by its originator (Fama E. F., 1991).

1.2.4 Stock market anomalies and investor psychology

One implication of the EMH is that no securities investor can beat the market. However, there are ample examples of stock mispricing (Chen, Lung, & Wang, 2009). When theory fails to predict or explain the real returns in practice, it is euphemistically referred to as a return anomaly (Hirschey & Nofsinger, 2010).

Basu (1977), for instance, showed that neglected stocks, referred to as value stocks, yielded better returns than glamour stocks, referred to as growth stocks. This phenomenon, known as the value premium, was also observed by other researchers (Davis, Fama, & French, 2000). These superior returns could not be explained by financial theory. This observation, or return anomaly, was closely correlated with high book-to-market value stocks which tended to comprise predominantly smaller firms. This tendency of superior returns by stocks of smaller market capitalization firms became known as the small-cap effect. There is no evidence that this phenomenon is consistently true in general, hence the need to test Piotroski's screen on both small and large capitalization stocks on the JSE.

There is also evidence that investors are susceptible to cognitive failures and psychological biases in the short term (Hirschey & Nofsinger, 2010). These behavioral anomalies include conservatism and representative biases.

The conservatism bias is manifested in the fact that people are slow to change their views when presented with evidence of a changed situation. This bias tends to cause investors to discount initial evidence of a turnaround in an unpopular company until several positive financial performance announcements have been made.

The representativeness bias is based on stereotyping and is the tendency of people to project the characteristics of something that is known to something that is unknown. For instance, the tendency of investors to project a company's past successful, or unsuccessful, performance incorrectly into the future is an instance of representativeness bias.

These psychological biases give rise to suboptimal investor behaviour. Furthermore, fear and greed that depended on opinions about future prospects which are, per definition, based on beliefs which cannot be sustained by solid evidence or strong roots of conviction (Desmedt, Piégay, & Sinapi, 2010) also play a role in suboptimal investor behaviour. A random tipping event can cause unpredictable overreactions in the market which may result in herd-like behaviour and consequent mispricing of stocks (Brown, 2011).

1.2.5 Value investing, growth investing and technical analysis

Based on investor preferences, conventional wisdom and market theories, three major investment styles emerged. These are growth investing (Gwilym, Seaton, & Thomas, 2008), value investing (Liu & Wang, 2010) and technical analysis (Falbo & Pelizzari, 2011). Value investing was established in 1934 by Graham and Dodd (Graham & Zweig, 2006) and is based on the observation that stocks priced relatively cheaply in relation to a value measurement like earnings or book value tend to yield a return premium over the general index returns. These stocks are perceived to have low growth potential and are out-of-favour. Growth investing, on the other hand, is based on forming portfolios of firms that are believed to be on the verge of rapid expansion of their operations over time. These stocks are referred to as growth stocks or glamour stocks.

Value investing is largely based on fundamental financial statement analysis while growth investment is largely based on projections of future growth based on qualitative factors and growth momentum. Therefore, where value investing depends for the most part on fundamental quantitative analysis, growth investing already introduces a measure of speculation about the future growth prospects which has the potential to disappoint and lead to a reduction in market capitalisation and loss of investor principal as a result. In fact, studies (Fama & French, 1992) have shown that value stock tend to outperform growth stock.

Finally, the practice of studying past price movements and trading volume information to predict future price movements is known as technical analysis. Since technical

analysis relies heavily on efforts to identify past patterns and projecting it into the future without a sound basis for the projections, it is a risky strategy.

1.3 Research motivation

Graham and Dodd (2006) emphasised the necessity of protecting loss of principle when investing in stocks. Therefore they drew a distinction between investing and speculating. The speculator's view is essentially forward looking and is reflected in his emphasis on trying to profit from betting on anticipated stock market movements. In contrast, investors' views are rearward looking and based on acquiring stocks in good businesses at reasonable prices (Cunningham, 2009). Per definition, reasonable prices are found among the pool of businesses with high book-to-market values for instance. However, a proven method for identifying good businesses from the high book-to-market value pool which invariably consists of mediocre businesses too, is required. Piotroski's screen proved to have the capability to identify financially sound firms from a pool of businesses that by implication also contain a large number of mediocre businesses (Piotroski, 2000), also known as value traps. Furthermore, since the screen only utilizes objective financial statement analysis, it has the telling benefit of eliminating any need for subjective analysis and the influence of psychological biases that could lead to suboptimal investor behavior.

Since an investment strategy also depended on margin of safety as espoused by Graham (Graham & Zweig, 2006) it would be advantageous if the Piotroski screen would result in a diminished possibility of selecting a stock with negative returns especially if an investor only selected a few stocks in a particular year instead of all stocks that are screened out as being financially sound. Logically an investor that buys only a few stocks would only buy a stock with the strongest indication of financial soundness by the screen, as was done by the Powerstocks research (Piotroski long term JSE backtest). In order to test the ability of Piotroski's screen to decrease the odds of selecting stocks with negative returns, it is necessary to investigate if the proportion of stocks with negative returns in the portfolio consisting of one year buy-and-hold stocks with the strongest indication of financial soundness was lower than

the proportion of stocks with negative returns of the high BM one year buy-and-hold portfolio.

One of Graham's requirements (Graham & Zweig, 2006) for a value stock selection is that the company must be of adequate size. Hence, a screen must also be applicable to sizeable companies with larger balance sheet values. If it turns out then that Piotroski's screen also increases the return of a portfolio consisting of both small and large book value stocks on the JSE bought for a reasonable price and held over either a short or long investment horizon, its usefulness will increase.

Studies have already been conducted on the usefulness of Piotroski's screen on the JSE for the purpose of devising an investment strategy with positive market adjusted returns (Piotroski long term JSE backtest). However, for a value investor intent on accumulating quality firms with a buy-and-hold strategy in mind it is necessary to know if Piotroski's screen is also effective on the JSE for applications slightly outside its intended purpose. In other words, a study into the ability of the Piotroski screen to yield a premium on high book-to-market companies on the JSE which are large for the JSE but still small enough when compared to stocks on the American stock exchanges where the Piotroski screen was initially tested will fill a knowledge gap which is of interest to investors wishing to invest on the JSE. The usefulness of such a study will be further enhanced if it investigates the yields on returns for portfolios consisting of stocks held over long investment periods. Furthermore, since the screen became widely known and since the general adoption of a winning strategy by the market tends to erode its ability to provide superior returns against the backdrop of the new-classical financial framework of competitive equilibrium (Zhang, 2005), it is necessary to test Piotroski's screen on the JSE for robustness over the recent past too.

1.4 Scope and research objectives

Based on the above research motivations, the research questions and objectives for this study are formulated and listed in Table 1.

Since one of the aims of the study is to employ Piotroski's screen with confidence as an investment tool in the immediate future, only the most recent applicable investment

periods are used. In order to span some of the dramatic events on stock exchanges recently, like the dot-com bubble of 2000 and the bubble in the property market that caused the financial crisis of 2008, only data from 1998 onwards are used for the study. This choice of study period also fits in with the research aim to test the effectiveness of the Piotroski screen on the JSE since it became known in 2000.

Chapter two provides a background of the extant literature on value investment and the properties of small companies that compelled some of Piotroski's criteria. Not included in the study is a general overview of all stock market theories and methods, since the focus is specifically on a successful method of accomplishing value investing. In chapter three the hypotheses of the study are discussed. Chapter four describes the research method, including data collection and analysis. Chapter five contains the research results which are discussed in chapter six. The conclusions and recommendations are contained in chapter seven.

Table 1. Research questions and objectives

Research Question	Research Objective
<p>1. Is the Piotroski screen still effective on the JSE for its intended purpose of picking winners from losers among financially distressed stocks and thereby improving short-term portfolio returns?</p>	<p>1. Establish if the Piotroski screen's effectiveness on the JSE has been eroded by market take-up of his method</p>
<p>2. Is the Piotroski screen effective in picking winners from businesses falling in the high book-to-market value pool when a buy-and-hold strategy is employed?</p>	<p>2. Establish the effectiveness of the Piotroski screen over long-term investment horizons for high book-to-market value companies on the JSE.</p>
<p>3. Does the average size by market value of firms that passed the Piotroski screen differ from the average size of firms on the JSE?</p>	<p>3. Determine if the high F-score firms selected by the Piotroski screen (with F-scores of 8 or 9) differ from the complete sample of firms (with enough information to form one year buy-and-hold portfolios) in terms of size by market value.</p>

Chapter 2. Theory and literature review

2.1 Value and growth investing background

Value investing has been formalised by Graham and Dodd (Graham & Zweig, 2006) as early as 1934. It involves investing in stocks that are temporarily undervalued when analysed in terms of the economic value of assets in place. The economic value of the assets in place can be expressed in terms of past earnings, dividends, historical prices and book values amongst others. In contrast, growth investing focuses on companies that are temporarily undervalued when analysed in terms of the economic value of future growth possibilities. In both cases, therefore, investors seek bargains that are selling at prices below their perceived economic values. The difference in investment decisions is as a result of the difference in emphasis when calculating a firm's economic value. Whereas growth investors calculate economic value by means of forward-looking indicators, value investors calculate value by means of rearward-looking indicators.

Value investors calculate economic value in terms of a value measure of tangible assets. When the market capitalisation of a stock is near or below the asset value, a bargain exists. The danger of value investing is that some firms are in disfavour because they are struggling financially with little hope of recovery. These firms are known as value traps. Therefore, low prices alone do not indicate an undervalued firm. Consequently, a method for screening winning firms from losing ones, based on rearward-looking fundamental analysis need to be employed. Once positive financial announcements are made by an undervalued firm, the information is disseminated quickly by the generally efficient market and, consequently, the stock price is re-valued upwards to reflect the true economic value of the firm. After this event, value investors tend to lock in their profits by selling their stock and acquire stock in other undervalued firms again. This mode of operation tends to cause a fairly high turnover in stock in value portfolios.

Growth investors calculate economic value in terms of expected future earnings growth. This requires that a company must be in a business where competition does

not materially threaten its profit margins. These businesses are characterised by high profit margins which signal that the firm has market power with low levels of competition and superior levels of operating efficiency. These types of firms usually have unique products or services that are protected against imitation by patents or advertising campaigns among others. Another feature of firms with high growth potential is an above average return on assets (ROA) that cause enough internal funds to be generated for future growth and obviates the need for long term loans. This diminished need for external funds was manifested by a low leverage ratio which is typical of highly profitable firms. This also lowered the risk of bankruptcy during an economic downturn considerably. Since investors that were investing in growth stocks had to keep these stocks in their portfolios while waiting for long-term growth to follow, growth investing led to lower stock turnover in growth stock portfolios.

2.2 Theoretical foundations of value and growth investing

2.2.1 The Efficient Market Hypothesis

Fama (1970) stated that “The primary role of the capital market is the allocation of ownership of the economy’s capital stock.” Therefore, the market needed to provide accurate signals for investors to enable the owners of the capital stock to effectively distribute their capital to those firms where they will get optimum returns on their investments. For these signals to be accurate, in other words for the prices of the ownership stakes in the various companies to reflect the true economic value of those ownership stakes, it is required that all available information that has a bearing on the values of those ownership stakes were taken into account in the determination of those prices. This assumption, where the price of any given stock effectively represents the expected economic value of an ownership stake in that firm based on known information, is termed the efficient market hypothesis (EMH). The implication is that the buyer and the purchaser of a stock have, theoretically, an equal chance of profiting from a stock transaction.

While the EMH initially enjoyed wide academic support, its validity was subsequently challenged (Fama E. F., 1991). Brown (2011) stated that very few people today believe

in the literal truth of the EMH. Basu (1977) found evidence of the existence of an EMH anomaly known as the price-earnings (P/E) hypothesis or value premium. The price-ratio hypothesis posits that the P/E ratio may be an indicator of future financial performance; low (high) P/E-ratios may indicate high (low) future performance of the stock price as a result of exaggerated investor pessimism (optimism). If this hypothesis was true it would be contrary to the EMH which denies the possibility of excess returns. Basu (1977) stated that

“Contrary to the growing belief that publicly available information is instantaneously impounded in security prices, there seem to be lags and frictions in the adjustment process.”

Therefore, evidence existed that securities were occasionally mispriced. This mispricing created arbitrage opportunities for investors. Basu (1977) attributed the value premium to exaggerated investor expectations based on poor or good past performance that has been blithely extrapolated into the future. In other words, he attributed the value premium to suboptimal investor behaviour. A counter argument to explain the value premium was proposed by supporters of the neo classical financial framework of rational expectations and competitive equilibrium. This schism in academic literature has not yet been resolved and will be covered more thoroughly in section 2.3.

2.2.2 The capital asset pricing model

Further to the EMH, Sharpe (1964) and Lintner (1965) developed an asset pricing model, known as the Capital Asset Pricing Model (CAPM), based on the investment theory that risk and return are related. The CAPM is a theoretical construct that is embedded completely in the neo classical financial framework of rational expectations and competitive equilibrium. However, Fama and French (2006) concluded that the CAPM had fatal problems throughout the 1926 to 2004 period. Moreover, they found that the main explanatory variable used in the CAPM, namely beta, which is the sensitivity of a security's returns to the systematic market risk factor, had little or no independent predictive power. Instead, they reported that size and Book-to-Market

(BM) ratios are important in expected returns. This observation corresponded with Basu's (1977) observation that value stocks tended to outperform growth stocks if BM is interpreted as an indicator of the confidence that the market had in a firm where high (low) BM's indicate low (high) investor confidence.

2.3 Value and growth investing research

Since Basu's (1977) study of a CAPM anomaly that became known as the price-earnings effect, and the increasing doubts about the explanatory power of the CAPM pointed out by researchers such as Fama and French (1992) and (2006), the attention of academicians turned towards the growing pile of evidence that showed the existence of mispricing of stocks in the market place. This mispricing manifests itself in the general superior performance of value stocks over glamour stocks. As a result of the lack of explanatory power of the CAPM, the BM and P/E ratios of equity became popular as explanatory variables. Several studies (Jaffe, Keim, & Westerfield, 1989), (Chan, Hamao, & Lakonishok, 1991), (Fama & French, 1992), (Lakonishok, Schleifer, & Vishny, 1994) and (Brouwer, Van der Put, & Veld, 1997) reported evidence in support of the existence of superior performance of value stocks over growth stocks. Jaffe et al. (1989) studied the value premium of both size and P/E ratio as well as the existence of the January effect. Where Basu (1977) postulated that the size effect is subsumed by the P/E effect, Jaffe et al. (1989) found both size and P/E effects to be relevant over all months during the period of 1951-1986. Furthermore, a difference between January and the rest of the year was found; both E/P and size effects are significant in January but only E/P is significant outside of January. "High returns" were consistently found in firms of all sizes with negative earnings by Jaffe et al (1989).

However, empirical evidence to the contrary was also given. Stocks classified as growth stocks on account of their high P/E-values outperformed value stocks over longer portfolio holding periods, especially during bull markets (Siegel, 1995), (Beneda, 2002) and (Cheh, Kim, & Zheng, 2008). Cheh et al. (2008) found that for the period of April 1986 to March 2003 high P/E-stocks (growth stocks) outperformed low P/E stocks (value stocks.) It was also found that more frequent portfolio rebalancing tended to

improve the performance of low P/E stocks and lower the performance of high P/E stocks.

The reasons for the value premium of growth stocks are still debated with two distinct schools of thought that emerged soon after Basu's description of this phenomenon. The one school is based on behavioural science while the other school attempts to find a relationship between quantitative explanatory variables and the value premium in line with the CAPM.

De Bondt and Thaler (1985) were among the first to introduce aspects of behavioural psychology in search of explanations for the outperformance of prior "losing" stocks, characterised by low P/E ratios, over prior "winning" stocks, characterised by high P/E ratios at the moment of portfolio formation. Specifically, they reported that research in experimental psychology suggested that most people overreact to dramatic and unexpected news events. Consequently, they attributed the value premium of value stocks characterised by low P/E or high BM ratios to this overreaction hypothesis. However, they also acknowledged that the overreaction hypothesis could not account for other stock market anomalies like abnormally high returns of low P/E stocks during the months of January in their data that spanned a period of several years. Other notable researchers like Lakonishok et al. (1994) also supported the view that the explanation for the value effect was the suboptimal behaviour of investors and not because value stocks were inherently riskier.

In contrast to the behavioural school of thought, researchers like Fama and French (1992), (1995) and (1996) and Zhang (2005) argued that value strategies produced superior returns because they are fundamentally riskier. These explanations are consistent with the new classical financial framework of rational expectations and competitive equilibrium. They used firm size (market value) and BM ratios as proxies for risk. Chan (1988) also attempted to explain the value strategy's superior returns by arguing that it is commensurate with the now discredited CAPM. However, Chan acknowledged that the estimation of returns of the contrarian approach were sensitive to the model and estimation methods used and, secondly, that the betas of the winning and losing stocks varied over time, which rendered Chan's conclusions

somewhat arbitrary in this author's view. The Fama-French duo again (1998) advocated a two-factor risk based model based on a broader previously published data set but were somewhat cautious in their conclusions. They suggested that a hitherto unidentified risk factor may better explain the value premium.

Piotroski's (2000) screening method identified winning stocks from the pool of value stocks which drastically increased the returns of a value portfolio. He found that these stocks were not commensurably riskier than the rest of the stocks. Therefore, his findings discredited the hypothesis that tried to relate returns to some measure of risk. Chan and Lakonishok (2004) reviewed all previous literature and concluded that "...the superior performance of value stocks cannot be attributed to their risk exposure." They claimed that their review found several studies in support of extrapolative biases in investment behaviour.

The debate between the supporters of the rational (risk-return correlation) view, like the Fama-French duo and the supporters of the irrational (behaviourist) view like Lakonishok, continued unabated in recent times. In their most recent studies Fama and French (2007) softened their advocacy of the rational view and acknowledged that "our results do not allow us to distinguish between the rational and irrational views of asset pricing." In one of the most recent studies, Magnuson (2011) reported poor correlation between the fundamental financial performance and the improvement (deterioration) in price of value (growth) stocks. He attributed this behaviour of value and growth stocks to irrational investor behaviour where "...overreaction and over optimism may be influential tendencies at respective extremes of the value/glamour spectrum." Significantly, Magnuson made the following observation:

"...concentrating on what is cheap and applying this approach across an applicable opportunity set put the odds in investors' favour for achieving excess returns no matter how business fundamentals developed."

It is in applying an effective screen to the selection of undervalued stocks where Piotroski's research (Piotroski, 2000) became so relevant.

2.4 Theoretical foundations of the Piotroski screen

2.4.1 Introduction

Recall that research showed that errors in market expectations about long-term earnings growth led to the ability of contrarian investors and those who make use of the value premium of value stocks, to earn above average returns. These errors were attributed to the naïve expectations of analysts that past growth rates can be extrapolated into the future (Lakonishok, Schleifer, & Vishny, 1994), or that analysts may have biased forecasts of future earnings growth (Dechow & Sloan, 1997), or that stocks with depressed prices may be inherently more risky than glamour stocks and that the market somehow compensates investors for taking on more risk (i.e. volatility) when they embark on a contrarian investment strategy (Fama & French, 1996). Frankel and Lee (1998) proposed that undervaluation should be identified by means of analysts' earnings forecasts in conjunction with an accounting-based valuation model. However, research (Barniv, Hope, Myring, & Thomas, 2010) have shown that analysts' earnings forecasts relate negatively or insignificantly to analysts stock recommendations in countries with high investor participation. The opposite is true for countries with low investor participation. In all countries they found a positive correlation between earnings forecasts by analysts and future earnings. Therefore, Frankel and Lee's (1998) reliance on analyst forecasts of future earnings to identify stocks with good future earnings prospects can be used for firms with a high analyst following.

Piotroski (2000) pointed out that high BM firms suffer from a lack of analyst following and that forecast data, therefore, was not readily available. Furthermore, small firms as well as distressed firms have credibility issues when trying to communicate forward-looking information to the market (Schleicher, Hussainey, & Walker, 2007). Hence, an analyst forecast-based approach, such as that of Frankel and Lee (1998) could not readily be applied to value (i.e. high BM) stocks. Investors, therefore, have to rely on financial reports in an effort to determine the difference between the market value and intrinsic value of a high BM firm.

2.4.2 Fundamental financial statement analysis

Financial analysts like Penman (1992) expressed the view that the central role of fundamental financial statement analysis was to predict accounting earnings. Three features of accounting made it eminently suitable for predicting accounting earnings namely, its measuring system attributes, secondly, its disciplined and rules-bound nature and thirdly, its connection to future dividends.

Before the Piotroski's proposed his stock screen that was based on the fundamental analysis of financial statements, several methods based on financial statement analysis were developed to measure the financial health of a company. These included the Altman bankruptcy risk check (Altman, 1968), Ohlson's bankruptcy risk check (Ohlson, 1980) and Merton's distance to failure (Merton, 1974) amongst others. Boritz, Kennedy and Sun (2007) tested Altman's and Ohlson's models on the Canadian stock exchange and found that the accuracy of the models depended to some extent on stock market conditions. Ohlson's model was found to be more robust and accurate than Altman's model. While Altman's model heavily relied on the predictive power of EBIT and working capital, Ohlson's model also took cash earned from operations and recent negative earnings into account. Merton's model is based on the Black-Scholes framework. It was found that none of these models could reliably predict improved future earnings and therefore could not be used as a stock selection tool in an investment strategy.

One aspect of financial information that can be utilised is financial signals like post-earnings announcement drift, share repurchases, high or low dividend announcements or omissions, accruals and equity offerings. Another aspect of financial information that can be utilised is fundamental financial statement analysis.

Lev and Thiagarajan (1993) took a more indirect approach and studied a set of 12 fundamental financial statement-based signals usually considered by analysts. These signals are related to simultaneous changes in inventories, accounts receivables, gross margins, selling expenses, capital expenditures, effective tax rates, inventory methods, audit qualifications, and labour force sales productivity. Crucially, they found that

these signals were positively correlated with changes in future earnings which will eventually be priced by a relatively efficient market.

Further studies by Abarbanell and Bushee (1997) showed that many, but not all, of the collection of signals used by Lev and Thiagarajan (1993) are correlated with short-term changes in future firm earnings growth as well as to a lesser extent, changes in analysts' predictions of earnings. This association between contemporaneous returns and the fundamental signals reflect the importance of these signals to predict value-relevant information. Of particular significance is Abarbanell and Bushee's (1997) finding that not all the information contained in these fundamental signals are contained in analysts' forecasts. They found evidence that analysts tend to generally underreact to fundamental financial signals based on recent financial reports. This raises the possibility that investors who rely on analysts' forecasts will also tend to neglect the information contained in basic financial statement analysis. This situation could cause the share prices to lag behind fundamental financial statement information. Abarbanell and Bushee (1997) could not find evidence that all the information contained in the signals was impounded immediately into stock prices. They found a similar underreaction by investors who did not fully exploit the information contained in fundamental signals. Therefore, investors should be able to exploit the information contained in the fundamental financial statement analysis signals of Lev and Thiagarajan (1993) even for growth (i.e. glamour) stocks with large analyst following.

Emanating from their initial research, Abarbanell and Bushee (1998) subsequently investigated the investment question whether the application of fundamental analysis can yield significant abnormal returns. They found that since the collection of signals of Lev and Thiagarajan (1993) provided information about future returns associated with future earnings news, they could form portfolios that yielded an average 12-month cumulative return which outperformed the particular stock market that they researched. They also found that, consistent with the underlying focus of fundamental analysis on the prediction of earnings, a significant portion of the abnormal returns was generated around subsequent earnings announcements. These abnormal earnings

were mainly restricted to the first year of portfolio formation however. The strategy also performs better for firms that suffered from bad news. Hence, Abarbanell and Bushee's (1998) strategy worked best for firms that were temporary out-of-favour and were bought and held until the good earnings news predicted by fundamental financial analysis was announced. These announcements usually happened within a year of portfolio formation (Abarbanell & Bushee, 1998).

2.5 The Piotroski screen

2.5.1 Properties of distressed firms

Instead of examining the relationships between future returns and particular financial signals, Piotroski (2000) aggregated the information contained in an array of performance measures into an overall signal that provided an indication of the overall quality of a firm's financial position. The performance measures were selected with the particular economic properties of high BM (i.e. value) firms in mind.

As pointed out by Fama and French (1995) the average high BM firm was financially distressed. Financially distressed firms were generally suffering from low or declining profit margins, cash flows, and liquidity as well as rising levels of debt. Therefore, Piotroski (2000) based his performance measures on these aspects of distressed firms. Furthermore, the performance measures are conditioned on the fact that the firms that were measured were financially distressed. A signal that indicated a deterioration in the financial health of a distressed firm may indicate a worsening in the financial health of a financially sound firm. Piotroski (2000) gave the increase of leverage as an example.

The screen or signal comprised nine performance measures that evaluate three areas of a firm's financial health. The three areas were profitability, financial leverage/liquidity, and operating efficiency. A performance measure was classified as either good or bad, depending on its implication for future earnings increases. A good performance measure was given the score of one, while a bad signal was given the score of zero. The aggregate signal or screen was the sum of the nine binary performance measures. Piotroski (2000) hinted that these nine performance measures

were chosen based on literature studies about the performance of distressed firms and may not necessarily represent the optimum combination of available performance measures. In order to determine the optimum set of performance measures the correlation between all available performance measures and future growth and return performance of a firm needed to be determined statistically; an exercise which was deemed outside the scope of his study.

2.5.2 Profitability performance measures

Recall that distressed firms (i.e. value firms) suffer from low or declining profits and cash flows amongst others. In order to determine if these particular aspects of a business show signs of improvement, Piotroski (2000) used four performance measures namely Return on Assets (ROA), Cash flow from Operations (CFO), changes in ROA (Δ ROA) and, the relationship between earnings and CFO (ACCRUAL). These four performance measures indicated a firm's capability to generate funds internally from operations as well as the ability to generate positive future cash flows.

ROA and CFO are the net income before extraordinary items and cash flow from operations, respectively, scaled by beginning-of-the-year assets. If the ROA (CFO) is positive, it is deemed to add one to the overall signal, otherwise zero. The Δ ROA is the current year's ROA less the prior year's ROA. If Δ ROA > 0, it is deemed to add one to the overall signal, otherwise zero.

Piotroski (2000) cited literature studies that showed that earnings driven by positive accrual adjustments constituted a bad signal about future profitability and returns. Positive accruals were characterised by profits that were greater than cash flow from operations. In financially stressed firms the incentive to manage earnings through positive accruals was particularly strong. Therefore, ACCRUAL was defined as the current year's net income before extraordinary items less cash flow from operations, scaled by beginning-of-the-year total assets. If CFO > ROA, ACCRUAL was deemed to add one to the overall signal, otherwise zero.

2.5.3 Financial leverage/liquidity performance measures

Piotroski (2000) assumed that since high BM firms were financially constrained in general, an increase in long-term debt, a deterioration of liquidity, or the use of external financing was a bad signal about financial risk. Therefore, these three changes were used as performance measures to warn of increased risk in a firm's ability to meet future debt service obligations and negative changes in the firm's capital structure.

An indication of a high BM firm's inability to raise sufficient internal funds to service future obligations was its appetite for external funds. External funds were supplied by means of debt and common equity. Therefore, Piotroski (2000) considered the issuance of common equity and an increase in long-term debt of a high BM firm as warning signals. Furthermore, an increase in long-term debt was likely to hamper a firm's financial flexibility. In order to measure the changes in long-term debt Piotroski (2000) considered the historical change in the ratio of total long-term debt to average total assets (ΔLEVER). An increase (decrease) in financial leverage was considered as negative (positive) signal. Therefore, if the firm's leverage fell (rose) in the year preceding portfolio formation, ΔLEVER was deemed to add one (zero) to the overall signal. An issuance of common equity (EQ_OFFER) in the year preceding portfolio formation was considered as a signal of financial distress for struggling firms and therefore its binary value was zero. Otherwise, if no common equity was issued in the year preceding portfolio formation it was deemed to add one to the overall signal.

An improvement in liquidity was a good sign about a firm's ability to service current debt obligations. Piotroski measured an improvement in a firm's liquidity by changes in the current ratio between the current year and the prior year (ΔLIQUID). An improvement in liquidity (i.e. $\Delta\text{LIQUID} > 0$) was deemed to add one to the overall signal, otherwise zero.

2.5.4 Operating efficiency performance measures

Two measures of operating efficiency were chosen by Piotroski (2000), namely changes in the gross profit ratio and asset turnover ratio. The gross profit ratio was an

indication of a firm's price-making ability and its ability to differentiate its products and services in the market place. It may also be indicative of an improvement in factor costs or a reduction in inventory costs. It was also an indication of the contribution of each sales Rand to fixed costs and profits (Higgins, 2009). Therefore, a positive (negative) change in the gross profit ratio diminished (increased) the influence of fixed costs on net profits. An improvement in the asset turnover ratio signalled more cost efficient use of the firm's assets or an increase in sales.

Changes in the gross profit ratio (Δ MARGIN) were defined as the current gross margin ratio (i.e. gross margin scaled by total sales) less the prior year's gross margin ratio. The asset turnover ratio was defined as the total sales scaled by beginning-of-the-year total assets. Changes in the asset turnover ratio (Δ TURN) were defined as the firm's current year asset turnover ratio less the prior year's asset turnover ratio.

A positive Δ MARGIN therefore indicated improved operating efficiencies and therefore its performance signal was one in that case. Otherwise it was zero. Similarly, a positive Δ TURN indicated an improvement in operations and therefore its performance signal was one, otherwise zero. The ratios and trends that are used to determine the performance ratios are shown in Table 2.

Table 2. Definitions of the ratios and trends used in the determination of Piotroski's nine performance measures.

<i>Profitability</i>	
ROA _t	$\frac{\text{Net income before extraordinary items}_t}{\text{Total assets}_{t-1}}$
CFO	$\frac{\text{Cash flow from operations}_t}{\text{Total Assets}_{t-1}}$
ΔROA	$\text{ROA}_t - \text{ROA}_{t-1}$
ACCRUAL	$\frac{\text{Net income before extraordinary items} - \text{Cash flow from operations}_t}{\text{Total Assets}_{t-1}}$
<i>Leverage, Liquidity and Source of Funds</i>	
ΔLEVER	$\frac{2 * \text{Long-term debt}_t}{\text{Total Assets}_t + \text{Total Assets}_{t-1}} - \frac{2 * \text{Long-term debt}_{t-1}}{\text{Total Assets}_{t-1} + \text{Total Assets}_{t-2}}$
ΔLIQUID	$\frac{\text{Current Assets}_t}{\text{Current Liabilities}_t} - \frac{\text{Current Assets}_{t-1}}{\text{Current Liabilities}_{t-1}}$
EQ_OFFER	$\text{Issuance of equity}_t$
<i>Operating Efficiency</i>	
ΔMARGIN	$\frac{\text{Gross Margin}_t}{\text{Total Sales}_t} - \frac{\text{Gross Margin}_{t-1}}{\text{Total Sales}_{t-1}}$
ΔTURN	$\frac{\text{Total Sales}_t}{\text{Total Assets}_{t-1}} - \frac{\text{Total Sales}_{t-1}}{\text{Total Assets}_{t-2}}$

The Beginning-of-the-year total assets are the same as the End-of-previous-year total assets. This is denoted as Total Assets_{t-1}

2.5.5 Composite signal

The performance measures chosen by Piotroski (2000) are specifically selected to examine the performance issues pertaining mainly to high BM firms which by their

nature tended to be smaller and financially distressed. These performance issues included a lack of profitability and the risk to default on debt payments amongst others. Therefore, some of Piotroski's performance measures differ from those used in previous research (Abarbanell & Bushee, 1998). Piotroski also referred to previous research (Sloan, 1996) that demonstrated the importance of accounting returns and cash flows when assessing future performance prospects of a firm. Therefore he included performance measures that capture these constructs.

The composite signal consists of the sum of the nine binary performance measures. A zero for a performance measure indicated that a specific aspect of a high BM firm posed a risk to the financial health and future prospects of the firm. That was akin to a red flag being raised about the firm's financial health and future prospects. A one for a performance measure was akin to the red flag being eliminated. Finally, the four profitability performance measures, three leverage and liquidity performance measures and two operating efficiency performance measures were aggregated into a final score, known as the F-score. The higher the F-score the fewer red flags about the firm's financial health existed.

Since the F_SCORE comprised binary performance binary measures, it can range from zero to nine. A high BM firm with a low F_SCORE have an almost full complement of red flags that signals that the firm's financial health and future financial prospects are bleak. Conversely, a high F_SCORE indicated that there were few or no remaining red flags concerning the firm's financial health and that the firm's future prospects were healthier. Therefore, a high F_SCORE for a high BM firm should be positively correlated with that firm's future performance and stock returns. The Piotroski screen was applied to investment decisions by calculating the F_SCORE signals of high BM firms and buying those firms with high F_SCORE signals.

2.6 Research contribution

Studies (Thorp, 2011) have shown that the Piotroski screen remained one of the most successful high BM screens available. Apart from being used on stock exchanges of developed economies the screen was also tested on small capitalisation stocks in India

by Bhardwaj (2010) who found that six firms passed the Piotroski screen, they all happened to be small caps and the Piotroski portfolio delivered one-year returns of 259% in comparison with that stock exchange's small caps return of 188%. The screen was also applied on the JSE where on average two firms per annum were identified by means of Piotroski's screen for portfolio formation by Powerstocks Research (Piotroski long term JSE backtest). The study was done for the period 1994 until 2007. It was found that a strategy of forming portfolios consisting only of high BM firms that had an F-score of 9 (strongest signal) yielded compound annual growth rate (CAGR) of 48%. Significantly, portfolios formed of firms that had an F-score of 8 yielded a CAGR of only 11%.

The abnormally high returns of value stocks was also observed on the JSE for the period of 1983 to 2005 (Cubbin, Eidne, Firer, & Gilbert, 2006). Cubbin et al. (2006) formed winner (loser) portfolios by dividing shares in high (low) price-earnings (P/E) ratios. Their portfolio of low P/E shares outperformed the high P/E shares and thereby illustrated the tendency of stock prices to revert back to the mean. They reported studies that found that mean reversion led to underperformance during the Great Depression but large profits after the Great Depression as well as during the 1980's.

This study makes a contribution to current knowledge by specifically determining if the Piotroski screen has been consistently successful during the recent past too. Furthermore, since the companies listed on the JSE are mainly South African based companies and since South African based companies tend to be smaller than American and international companies based on the New York Stock Exchange, this research will also establish to what extent JSE-listed firms can be included in the high BM and small stock portfolio for which the Piotroski screen was specifically devised.

Chapter 3. Research hypotheses

3.1 Background

In order to investigate the research questions, share data from the JSE and financial statement data were available for statistical analysis. Therefore, the three research questions were investigated by means of hypotheses in order to allow them to be tested by statistical analysis. These hypotheses are set out below.

3.2 Research Question 1: Hypothesis 1

The aim of this research question was to establish if Piotroski's screen is still applicable on the JSE since the screen was published in 2000 or whether its effectiveness has been eroded by market take-up of his method. This hypothesis was applied by aggregating all one year investment horizons from 2000 till 2011 and then comparing the mean returns of the sample of high BM firms with the sample of firms with high F-scores selected from the sample of high BM firms.

The null hypothesis, H_0 :

On the JSE there is no difference in short term returns between the general population of high BM value companies (μ_{bh}) and high BM value companies with an F-score of 8 or 9 (μ_{fh}).

The alternative hypothesis, H_a :

On the JSE the short term returns from the general population of high BM value companies (μ_{bh}) are lower than the short term returns from high BM value companies with an F-score of 8 or 9 (μ_{fh}).

$$H_0: \mu_{bh} - \mu_{fh} = 0$$

$$H_a: \mu_{bh} - \mu_{fh} < 0$$

3.3 Research Question 1: Hypothesis 2

Let the proportion of stocks yielding negative returns of the population of high BM one year buy-and-hold stocks be p_{BM} and the proportion of stocks yielding negative returns of the population of stocks with an F-score of nine be p_9 and let \hat{p}_{BM} and \hat{p}_9 be the corresponding sample proportions, based on sample sizes n_{BM} and n_9 . As stated in textbooks like those of Allbright, Winston and Zappe, the goal was to test whether the sample proportions differ enough to conclude that the population proportions are not equal. Since the aim is to determine if the proportion of negative returns in the high BM one year buy-and-hold population is higher than the proportion of negative returns in the population of one year buy-and-hold returns with an F-score of 9 that was selected from the high BM population, the appropriate test is one-tailed:

$$H_0: p_{BM} - p_9 \leq 0$$

$$H_a: p_{BM} - p_9 > 0$$

3.4 Research Question 2: Hypothesis

The aim of this hypothesis was to establish if Piotroski's screen was applicable on the JSE for long term investment horizons since the screen was published in 2000. The investment horizon chosen was 5 years. This research question was studied by comparing the measurements of central location of the returns for the sample of annualised five year buy-and-hold observations and the sample of one year buy-and-hold observations. To eliminate all sources of variation except for the investment horizon effect, the two samples that were compared were the high F-score sample for one year buy-and-hold observations and the high F-score sample for the five year buy-and-hold observations. Therefore, the following hypotheses were researched:

The null hypothesis, H_0 :

On the JSE there is no difference in the mean of annualised returns between the high F-score companies consisting of one year buy-and-hold returns (μ_{1fh}) and the high F-score companies consisting of five year buy-and-hold returns (μ_{5fh}).

The alternative hypothesis, H_a :

On the JSE there is a difference in the mean of annualised returns between the high F-score companies consisting of one year buy-and-hold returns (μ_{1fh}) and the high F-score companies consisting of five year buy-and-hold returns (μ_{5fh}).

$$H_0: \mu_{1fh} - \mu_{5fh} = 0$$

$$H_a: \mu_{1fh} - \mu_{5fh} < 0$$

3.5 Research question 3: Hypothesis

The aim of the third research question was to determine if the high BM firms differed from the complete sample of firms (with enough information to form one year buy-and-hold portfolios) in terms of size by market value. The statistic with which the two samples were compared for this purpose was the applicable measurement of central location which was the mean (median) for interval (ordinal) data.

The null hypothesis, H_0 :

On the JSE there is no difference in firm size by market value between the general population of companies (μ_s) and high BM value firms (μ_{BM}).

The alternative hypothesis, H_a :

On the JSE there is a difference in firm size by market value between the general population of companies (μ_s) and high BM value firms (μ_{BM}).

$$H_0: \mu_s - \mu_{BM} = 0$$

$$H_a: \mu_s - \mu_{BM} < 0$$

Chapter 4. Research methodology

4.1 Research design

This research project was conducted as a formal study with the aim to examine the ability of the Piotroski screen to identify predominantly winning firms from amongst high BM (i.e. value) firms on the JSE. Since the primary methodology of this study was to firstly form a high BM portfolio based on book value and market value of equity, and then form portfolios based on the firms' aggregate score (i.e. F_SCORE), the data used in the study was numerical. Since the study was based on the analysis of numerical data and making inferences from these analyses, it was per definition a quantitative study. Because the nature of the research precluded any form of experimental control over the firms, the research design was of an ex-post facto nature. Data was collected from data warehouses by means of data-mining and then analysed to test the hypotheses.

According to Blumberg, Cooper and Schindler (2008) in its simplest form a hypothesis consists of a case and one or more variables. For this study, the case (i.e. the subject) was high BM firms on the JSE. The variables (i.e. the attributes of the case) were the average returns of the portfolio of high BM firms and the F-scores of those firms. The hypotheses were posed in such a way that the influence of the F-scores on the average portfolio returns could be researched and not vice versa. This was done by comparing the dependent variable (average portfolio returns) at a point in time with the dependent variable at a later point in time, allowing the influence of the independent variable (F-score) to take effect. Therefore the hypotheses were explanatory (i.e. causal) hypotheses consisting of independent variables that could cause a change in the dependent variables. This implied that the research was aimed at studying the explanatory power of the F-score in increasing the returns of portfolios consisting of high BM firms. Therefore, the study was generally causal instead of descriptive in nature. However, since it was an ex-post facto study, no control could be exercised over the variables. This greatly diminished the causal nature of the study. The biggest drawback of the ex-post facto nature of the study was that the dependent variable could not be controlled. At best, it could be assumed that the independent variable

changed to a high F-score at the moment that the baseline samples were taken and that it was this change that caused a change in the dependent variable by the time the comparative samples were taken in order to calculate the returns. Since there was no guarantee that the independent variable behaved in this way, the causal nature of the study was greatly diminished and the results should be treated with the necessary caution.

For research questions 1 and 2 the study focused on the aggregate relationship between the dependent and independent variables instead of on a trend. Therefore, the research into hypotheses 1 and 2 was designed as a cross sectional study. Similarly, research question 3 was based upon data samples that consisted of data collected over a period of 11 years and then aggregated into a single sample. The research into question three is therefore a cross sectional study too.

The fact that the study was of an ex-post facto design complicated the design of the data analysis procedure because the independent variable could not be controlled or manipulated. Therefore the samples had to be chosen in such a way that a sample that has been exposed to the independent factor is compared with a sample that has not (Blumberg, Cooper, & Schindler, 2008). In this regard, Keller (2005) advised that care had to be taken to choose samples in such a way that all sources of variability except for the independent factor (F-score) were eliminated as far as possible.

4.2 Unit of analysis

The research questions focused on the financial performance of high BM firms on the JSE in an attempt to establish a relationship between the firms' financial performance and their future share price movements. Therefore the research was done on the level of high BM firms on the JSE. As the unit of analysis describes, per definition, the level at which the research was performed (Blumberg, Cooper, & Schindler, 2008) the unit of analysis was high BM firms that were listed on the JSE since January 1998 until December 2011.

4.3 Relevant population

The population was all the firms that appeared on the main board of the JSE from January 1998 until December 2011. Restricting the research to the main board enabled the study to focus on the South African registered and dual listed companies with a trading history and balance sheet that were adequate for main board listing. These companies had to be duly incorporated with a proper corporate governance system in place and had to produce properly audited annual financial statements (Manning, 2011). The time frame from January 1998 until December 2011 was chosen to include enough data to compile significant sample sets. The period chosen also included the significant stock market crash of 2000 led by the crash in technology stocks, the general economic and financial meltdown of 2007/8 with the accompanying stock market crash and the bull market spanning these two stock market crashes. December 2011 was chosen as the end of the period under study since it caused the time frame of the study to encompass a number of full financial years. Since three years' financial statements were needed to calculate the F-scores, portfolios could only be formed and results could only be obtained from the year 2000 onwards.

Companies listed on the JSE's African board, the AltX and the BEE Segment were excluded from the study. These boards contained JSE listed companies that were outside the scope of the research questions like entrepreneurial companies, BEE shares listings as well as companies listed outside South Africa.

4.4 Sampling frame

The sampling frame is the list of high BM firms that appeared on the main board of the JSE from January 1998 until December 2011 for which sufficient stock price and financial statement data were available on the McGregorBFA research domain.

4.5 Sampling method and sample sizes

For one year buy-and-hold portfolios, firms with adequate stock price and book value data with which to calculate the nine performance parameters of the Piotroski screen were identified for each year from 2000 to 2010. Similarly for five year buy-and-hold portfolios firms with adequate stock price and book value data with which to calculate

the nine performance parameters of the Piotroski screen were identified from 2000 to 2006. For the sake of consistency between all financial statement ratios and share price based ratios, fiscal year-end share prices were used to form share price based ratios like BM ratios and market values.

The data needed came from financial statements of the years 1998 to 2011 and resulted in observations from the years 2000 onwards because the last three years' financial statements were needed to calculate the input ratios and trends needed to calculate the nine performance parameters on which the Piotroski screen is based. From these nine performance measures a number, called the F-score, was calculated which ranged from zero to nine.

An observation was uniquely identified by the combination of the firm's name and the year of portfolio formation. This resulted in several independent observations that contained the same firm but for different years of portfolio formation.

Following Piotroski, the share prices were taken at the end of five months after the year-end financial reporting month in order to allow the reported financial information to be fully impounded in the market. Observations with stock splits or mergers were eliminated in order to eliminate errors caused by share conversion between the final share price and dividends and the initial share price.

The sample that contained observations with five year buy-and-hold annualised returns consisted of 975 observations. The sample that contained observations with one year buy-and-hold returns consisted of 1877 observations.

In order to obtain the upper quintile of firms on the JSE the variation of the BM ratios of the one year and five year buy-and-hold portfolios was observed. The variations in the 80th percentile varied significantly between the years of portfolio formation as shown in Table 3 and Table 4. Therefore, in order to compensate for the variation in BM-ratio percentiles between portfolio formation years, the upper quintile of each separate portfolio formation year was selected to form the total sample of the high BM firms. This was done separately for the one year and five year buy-and-hold samples. This high BM sample of one year buy-and-hold observations contained 379

observations while the high BM sample of five year buy-and-hold observations contained 199 observations.

Table 3. 80th Percentiles of the sample of one year buy-and-hold observations.

<i>Year of Portfolio Formation</i>	<i>BM Percentile80</i>
2000	1.892198633
2001	1.766637651
2002	1.520774399
2003	1.304856456
2004	0.947184376
2005	0.795456788
2006	0.700539613
2007	0.615630184
2008	0.987425807
2009	1.303854052
2010	1.255348628

Table 4. 80th Percentiles of the sample of five year buy-and-hold observations.

<i>Year of Portfolio Formation</i>	<i>BM Percentile80</i>
2000	1.892199
2001	1.699323
2002	1.581368
2003	1.339599
2004	0.941837
2005	0.782444
2006	0.725473

From the two samples of high BM firms those with an F-score of eight or nine were selected and pooled into the samples of one year buy-and-hold high F-score firms and five year buy-and-hold high F-score firms. These samples consisted of 37 and 20 observations respectively. The F-scores of eight and nine were arbitrarily chosen by Piotroski (2000) and was deemed to be the criteria for passing the Piotroski screen's

test for firms that were financially strong enough to be included in an investment portfolio.

4.6 Data analysis process

4.6.1 Data extraction

The financial statement line items that were needed to calculate the Piotroski screen's nine performance measures were obtained from McGregorBFA's database. These line items were from all companies listed on the JSE at October 2012. The data obtained were from January 1998 till December 2011. Monthly share price data were obtained from January 2000 till December 2011.

All firms with financial data that were not listed in ZA Rand currency were eliminated because of the lack of reliable conversion rates from other currencies to Rand required for the selection of companies to be included in the high BM sample set. This caused 376 observations to be eliminated from the initial set of raw data before the complete one year and five year samples of buy-and-hold observations could be formed.

4.6.2 Calculation of input ratios and trends

The nine performance measures of the Piotroski screen required several financial ratios and trends that needed to be calculated from the last three years' financial statement line items as shown in Table 2. The line items from the McGregorBFA database that were used to calculate the input ratios and trends are shown. in Table 5

Table 5. Calculation of Piotroski's ratios and trends using financial statement line items from McGregorBFA.

<i>Profitability</i>	
ROA	$\frac{02020101 \text{ Profit Attributable To Ordinary Shareholders} - 02020075 \text{ Discontinued Operations} - 02020079 \text{ Extra Ordinary Items}_t}{02010050 \text{ Total Assets}_{t-1}}$
CFO	$\frac{01030733 \text{ Cash From Operating Activities}_t}{02010050 \text{ Total Assets}_{t-1}}$
ΔROA	$ROA_t - ROA_{t-1}$
ACCRUAL	No calculation required.
<i>Leverage, Liquidity and Source of Funds</i>	
ΔLEVER	$\frac{2*(02010022 \text{ Total Liabilities})_t}{02010050 \text{ Total Assets}_t + 02010050 \text{ Total Assets}_{t-1}} - \frac{2 * (02010022 \text{ Total Liabilities})_{t-1}}{02010050 \text{ Total Assets}_{t-1} + 02010050 \text{ Total Assets}_{t-2}}$
ΔLIQUID	$\frac{02010034 \text{ Current Assets}_t}{02010041 \text{ Current Liabilities}_t} - \frac{02010034 \text{ Current Assets}_{t-1}}{02010041 \text{ Current Liabilities}_{t-1}}$
EQ_OFFER	If (01080275 New Share Issues _t > 0) then EQ_OFFER = 0, else 1
<i>Operating Efficiency</i>	
ΔMARGIN	$\frac{(02020060 \text{ Turnover} - 01020053 \text{ Cost Of Sales})_t}{02020060 \text{ Turnover}_t} - \frac{(02020060 \text{ Turnover} - 01020053 \text{ Cost Of Sales})_{t-1}}{02020060 \text{ Turnover}_{t-1}}$
ΔTURN	$\frac{020060 \text{ Turnover}_t}{02010050 \text{ Total Assets}_{t-1}} - \frac{02020060 \text{ Turnover}_{t-1}}{02010050 \text{ Total Assets}_{t-2}}$

where t is current year, t-1 is previous year and t-2 is 2 years ago.

4.6.3 F-score calculation

From the ratios and trends the binary values of the nine performance measures were calculated as shown in Table 6. The composite signal, denoted as F_SCORE by Piotroski (2000) was calculated by summing the individual values of the binary performance scores:

$$F_SCORE = F_ROA + F_CFO + F_ΔROA + F_ACCRUAL + F_ΔLEVER + F_ΔLIQUID + F_EQ_OFFER + F_ΔMARGIN + EQ_OFFER$$

Table 6. Binary value allocation algorithms for Piotroski's nine performance signals

<i>Profitability</i>		
F_ROA	if ROA > 0	F_ROA = 1, else 0
F_CFO	if CFO > 0	F_CFO = 1, else 0
F_ΔROA	if ΔROA > 0	F_ΔROA = 1, else 0
F_ACCRUAL	if CFO > ROA	F_ACCRUAL = 1, else 0
<i>Leverage, Liquidity and Source of Funds</i>		
F_ΔLEVER	if ΔLEVER < 0	F_ΔLEVER = 1, else 0
F_ΔLIQUID	if ΔLIQUID > 0	F_ΔLIQUID = 1, else 0
EQ_OFFER	If no equity issued	EQ_OFFER=1, else 0
<i>Operating Efficiency</i>		
F_ΔMARGIN	if ΔMARGIN > 0	F_ΔMARGIN = 1, else 0
F_ΔTURN	if ΔTURN > 0	F_ΔTURN = 1, else 0

4.6.4 Calculation of returns

Following Piotroski (2000) the firm-specific returns were measured as one-year and five-year returns earned from the end of the fifth month after the firm's fiscal year-end through the entire period of analysis: one year and five years respectively. The fifth month was chosen to ensure that all the necessary annual financial information was available in the market at the time of portfolio formation. The n-year annualised returns were calculated as follows:

$$\text{Yield}\%_n = \left[\left(\frac{(P_n - P_0) + \sum_{i=1}^n D_i}{P_0} \right)^{\frac{1}{n}} - 1 \right] * 100$$

where P_0 is the share price at the year of portfolio formation, P_n is the share price n years after portfolio formation and D_i is the total dividends issued to common shareholders during year i after portfolio formation while n is the length of the buy-and-hold strategy which was chosen as either one or five for this research project.

4.6.5 Empirical tests

4.6.5.1 Observation characteristics

An observation consisted of various variables of a firm with enough financial statement information available to allow the F-score to be calculated for the year of portfolio formation as well as share price and dividends at the end of the portfolio period.

Variables contained in an observation are:

1. Company ticker symbol and financial year combination as ID
2. F-score
3. Market capitalisation
4. BM ratio (Book-to-Market)
5. Annualised portfolio return.

4.6.5.2 Research question one

The aim of the first research question was to determine if the Piotroski screen was still effective at determining which companies from among the sample of low priced (high

BM) companies were undervalued and bound to yield superior returns in the near future. To determine this, the average returns of the sample of high F-score firms that were screened from the high BM firms were compared with the mean return from the sample of high BM firms. Since the Piotroski screen was designed for short investment horizons, the test was conducted on the one year buy-and-hold group. Further to the first test, a second test was conducted to determine if there was a difference between the mean high F-score returns and the general population of one year buy-and-hold returns. The first test eliminated most sources of variation and focussed on differences in F-score, in other words on the Piotroski screen's ability to discern between winners and losers. The second test also introduced at least differences in the market capitalisation of firms. Therefore, differences in the mean returns between the portfolio of high F-score group and the complete portfolio of one year buy-and-hold returns could not be ascribed to the Piotroski screen's ability to discern between winners and losers alone since the size-effect is also subsumed in the data (Keller, 2005).

According to the central limit theorem, the sampling distribution of the mean of a random sample drawn from any population is approximately normal for a sufficiently large sample size. However, if the population is extremely non-normal then the sampling distribution will also be non-normal for even moderately large sample sizes (Keller, 2005). Further to that, the portfolio of one-year buy-and-hold returns was run over several years consisting of bull markets and bear markets. Researchers like Kothari and Warner (1997) pointed out that samples containing observations that were collected over a long time span consisting of several years should be tested by the bootstrap method or by nonparametric studies. The Kolmogorow-Smirnov test was performed on the distribution of the returns of the high BM and high F-score portfolios to test if the returns were normally distributed. It was found that not enough statistical evidence existed to assume that the distribution of returns of the two sets of portfolios was normally distributed. Even for relatively normally distributed populations, sample sizes of 30 or more are usually required. In order to normalise a sampling distribution taken from a highly non-normal population, statisticians like Montgomery and Runger (2003) also prescribed the bootstrapping technique. Therefore, the bootstrapping

approach to the t-test for the comparison of the mean returns between independent samples was used to compare the mean returns of the high F-score sample and the high BM sample as well as between the high F-score sample and the general portfolio of one year buy-and-hold returns.

Following Piotroski (2000), the bootstrapping procedure for the first test was done by constructing a pseudo high F-score portfolio by randomly selecting, with replacement, firms with high F-scores from the complete portfolio of high BM firms. This replacement sampling was continued until the pseudo-portfolio contained the same number of observations as the actual high F-score portfolio. Then the difference between the mean returns of the pseudo high F-score portfolio and the entire high BM portfolio was calculated. This difference represented an observation under the null hypothesis of no difference in the mean return performance. This process was repeated 1000 times to generate 1000 observations. The empirically created distribution of these return differences were used to make inferences about the population's return differences. The bootstrapping procedure for the second test was conducted in a similar manner.

To make inferences about the proportion of negative returns of the population of high BM one year buy-and-hold stocks and the proportion of negative returns of the population of one year buy-and-hold stocks with an F-score of nine, the following test statistic was recommended by Albright, Winston and Zappe (2009).

$$z - \text{value} = \frac{\hat{p}_{BM} - \hat{p}_9}{SE(\hat{p}_{BM} - \hat{p}_9)}$$

where the Standard Error for difference between sample proportions are

$$SE(\hat{p}_{BM} - \hat{p}_9) = \sqrt{\hat{p}_c(1 - \hat{p}_c)(1/n_{BM} + 1/n_9)}$$

and \hat{p}_c is the pooled proportion of the two samples combined.

4.6.5.3 Research question two

The aim of the second research question was to determine if Piotroski's screen was applicable on the JSE for long term investment horizons after the screen became known in 2000. To limit the outcomes of the test to the difference in investment horizons only, the sample with which the five year buy-and-hold firms that passed the Piotroski screen could be compared was chosen in such a way that all other sources of variance, like the size effect of the high BM group, was eliminate as far as possible. Therefore, the portfolio of five year buy-and-hold returns that passed the Piotroski screen (high F-score five year buy-and-hold portfolio) was compared with the portfolio of one year buy-and-hold returns that passed the Piotroski screen (high F-score one year buy-and-hold portfolio).

The Kolmogorow-Smirnov test for a normal distribution was performed on the distribution of five year buy-and-hold returns of the high F-score group of high BM firms. The test indicated that there was enough statistical evidence to reject the assumption that the returns were normally distributed. Therefore, for the same reasons as for the first research question, the bootstrapping approach to the independent samples t-test was performed. The number of bootstrapping observations done was 1000.

4.6.5.4 Research question three

The third research objective was to determine if the high F-score firms (with F-scores of 8 or 9) differed from the complete sample of firms (with enough information to form one year buy-and-hold portfolios) in terms of size by market value. Careful consideration had to be given to the question of whether duplication in firms that could occur when sampling was done on a longitudinal basis instead of a cross-sectional basis, should be eliminated or not. Each observation, however, was considered to be an independent chance event and both samples were drawn over the same time span. Therefore, no sources of variability were introduced by not eliminating the duplication of firms as a result of sampling over various years and it was decided not to eliminate observations that contained the same firm for different portfolio formation years.

The Kolmogorow-Smirnov test for normality that was conducted on the market value distributions of the two portfolio sets indicated that there was enough statistical evidence to reject the assumption that the market values (firm sizes) were normally distributed. Therefore, in order to determine if there was a difference in the average size of the complete portfolio of firms with enough information to form one year buy-and-hold portfolios and the average size of the portfolio of firms that passed the Piotroski screen (high F-score firms selected from the High BM quintile of the one year buy-and-hold portfolio), a nonparametric test had to be performed. The two populations consisted of independent samples and therefore the Mann-Whitney U test was performed (Pallant, 2010) to test the third hypothesis.

4.7 Research limitations

Although the study was designed as a causal study, there were usually too many factors that may influence the dependent variable in order to determine causality with absolute certainty. Therefore, despite the design of the study and the formulation of the hypotheses, the study should be viewed as a predictive study rather than a study that could determine cause and effect between the dependent and independent variables with absolute certainty. A factor that strengthened the case for causality was that there was a temporal relationship between the independent variable (i.e. the F-score) and the dependent variable (i.e. the portfolio returns). The F-score preceded the portfolio returns in time by at least one year.

Only data from listed firms could be obtained. The fact that some firms could have delisted during the period of study could have given rise to a phenomenon known as survivorship bias. This phenomenon is the skewing of results caused by ignoring the negative effect on earnings as a result of the loss of investments in firms that delisted during the period of the study.

Blumberg et al. (2008) points out that the covariation found between variables cannot be viewed as irrefutable evidence of a causal relationship between them when the results are based on ex-post facto analysis. Offhand acceptance of a causal relationship in such a case is tantamount to committing the so-called post hoc fallacy. Although ex-

post facto analysis are widespread in business research for practical reasons, the lack of experimental control over the variables as well as the plethora of unaccounted for external factors influencing businesses complicates any attempt at finding causal relationships between the researched variables. At best, predictive conclusions could be drawn in this case.

Chapter 5. Results

5.1 Introduction

As discussed in chapters one and three, there are three research questions being examined. These are

1. Is the Piotroski screen still effective on the JSE for its intended purpose of picking winners from losers among financially distressed stocks (high BM portfolio) and thereby improving one year portfolio returns? This will be tested by means of the hypotheses:

$$H_0: \mu_{bh} - \mu_{fh} = 0$$

$$H_a: \mu_{bh} - \mu_{fh} < 0$$

2. Is the Piotroski screen effective in picking winners among financially distressed stocks (high BM portfolio) when a buy-and-hold strategy of five years is employed? This will be tested by means of the hypotheses:

$$H_0: \mu_{1fh} - \mu_{5fh} = 0$$

$$H_a: \mu_{1fh} - \mu_{5fh} < 0$$

3. Is there a significant difference in the mean market values of the portfolio of firms that passed the Piotroski screen and the general portfolio of firms?

$$H_0: \mu_s - \mu_{sfh} = 0$$

$$H_a: \mu_s - \mu_{sfh} < 0$$

This chapter will first give an overview of the results by means of graphical and tabular descriptive techniques as described in textbooks like those of Keller (2005). Then the hypotheses and research questions will be examined by means of the data produced from the sample of firms.

5.2 Descriptive statistics

5.2.1 Introduction

To form one year buy-and-hold portfolios, the share prices and dividends up to one year after portfolio formation was needed. Data was obtained until the end of 2011.

Therefore, portfolios could be formed for each year from 2000 till 2010 inclusive. For the five year buy-and-hold investment horizon, share prices and dividends up to five year after portfolio formation were needed. This resulted in only seven years available for portfolio formation (2000 – 2006). Therefore, the portfolio of five year buy-and-hold returns was smaller than the portfolio of one year buy-and-hold returns which consisted of eleven portfolio formation years (2000 – 2010). The one year buy-and-hold portfolio contained 1877 observations while the five year buy-and-hold portfolio contained 975 observations.

5.2.2 Characteristics of the one year buy-and-hold portfolio.

The number of observations that contain complete information for all the variables necessary to study portfolio holding periods of one year spanning the years 2000 and 2010 inclusive, were 1877 as shown in Table 7. This sample was all-inclusive, in other words the sample consisted of all observations, not only the high-BM portion.

Table 7. The number of observations per financial year with complete information to study holding periods of one year.

<i>Year of portfolio formation</i>	<i>Number of observations</i>	<i>Percentage of Grand Total</i>
2000	122	6.50%
2001	149	7.94%
2002	159	8.47%
2003	164	8.74%
2004	171	9.11%
2005	173	9.22%
2006	172	9.16%
2007	182	9.70%
2008	194	10.34%
2009	222	11.83%
2010	169	9.00%
Grand Total	1877	100.00%

The frequency distribution of the F-scores of the portfolio of consisting of the upper quintile of each portfolio forming year of the one year buy-and-hold portfolio from 2000 till 2010 is shown in Figure 1. The F-score frequency distribution is bell shaped, relatively symmetrical and unimodal. The fact that the distribution was unimodal is a strong indication that only one distribution is present (Keller, 2005). This means that most probably only one mechanism is responsible for the F-score distribution despite the fact that the period under study spans both bull and bear markets as shown in Figure 2. The median and mode were 6 which were slightly more than the middle of the range of possible F-scores (4.5). Very few firms have F-scores blow 3.

Figure 1. Histogram of high BM one year buy-and-hold portfolio's F-scores spanning the portfolio forming years 2000 till 2010.

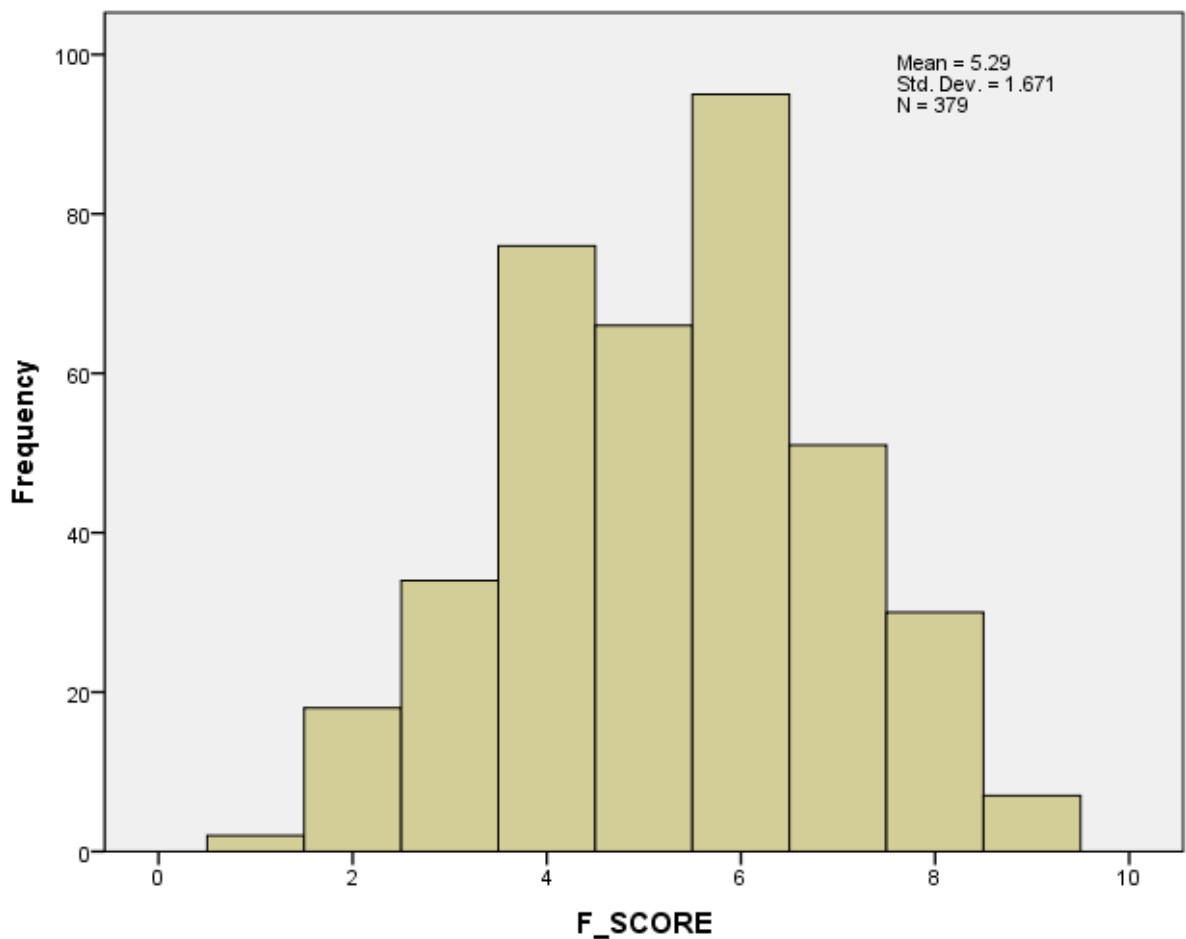
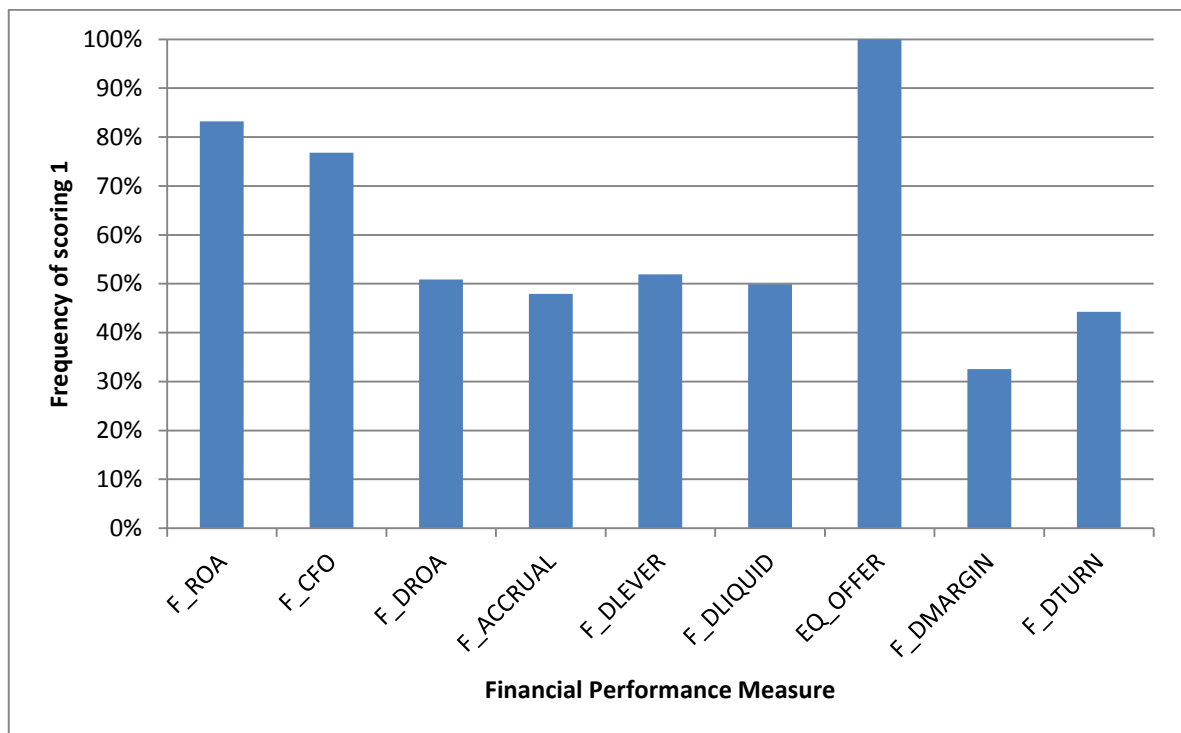


Figure 2. JSE Industrial index Indi25.



Interestingly, there were no firms with an F-score of zero. This is most probably due to the fact that the non-issuance of equity (which would cause EQ_OFFER to be one) was an extremely frequent occurrence and if equity was issued (which would cause EQ_OFFER to be zero), there was at least one other performance measure that scored a one instead of a zero which would cause the aggregated F-score of that observation to be larger than zero. The frequency of each performance measure's contribution to the F-score in an observation is shown in Figure 3. It is clear from Figure 3 that for almost all observations no equity was issued.

Figure 3. Performance measure frequencies.



The distribution of firm sizes of the one year buy-and-hold portfolio is shown in the histogram of Figure 4. The distribution is unimodal and highly positively skewed. This means that the vast majority of the firms are small in relation to the few high market value firms.

The distribution of Book-to-Market values (BM) is shown in Figure 5. The distribution of BM values has a wide range that spans from -97.7 to 41.5. However, for a normal distribution, or an almost normal distribution like the one shown in Figure 5, almost all the observations are concentrated within the 6 standard deviations around the mean value of 0.75. Therefore, almost all BM values are concentrated between -7 and +9.

Figure 4. Distribution of firm sizes for the complete one year buy-and-hold portfolio.

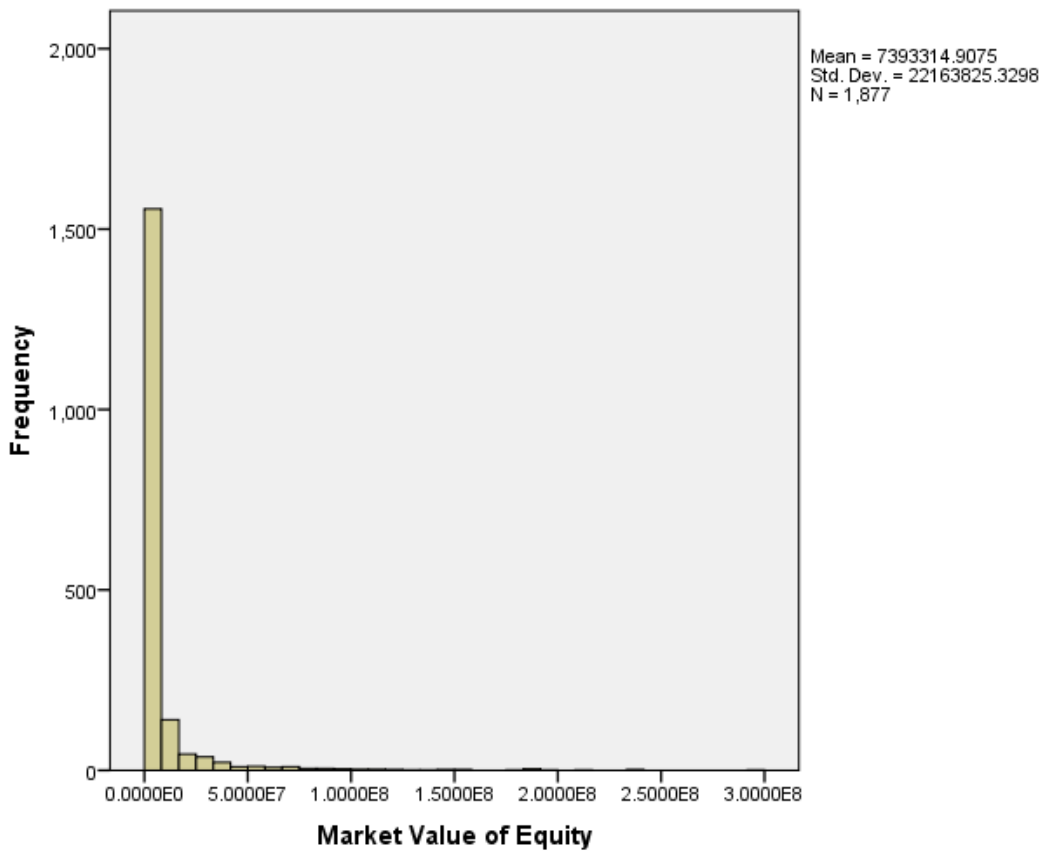
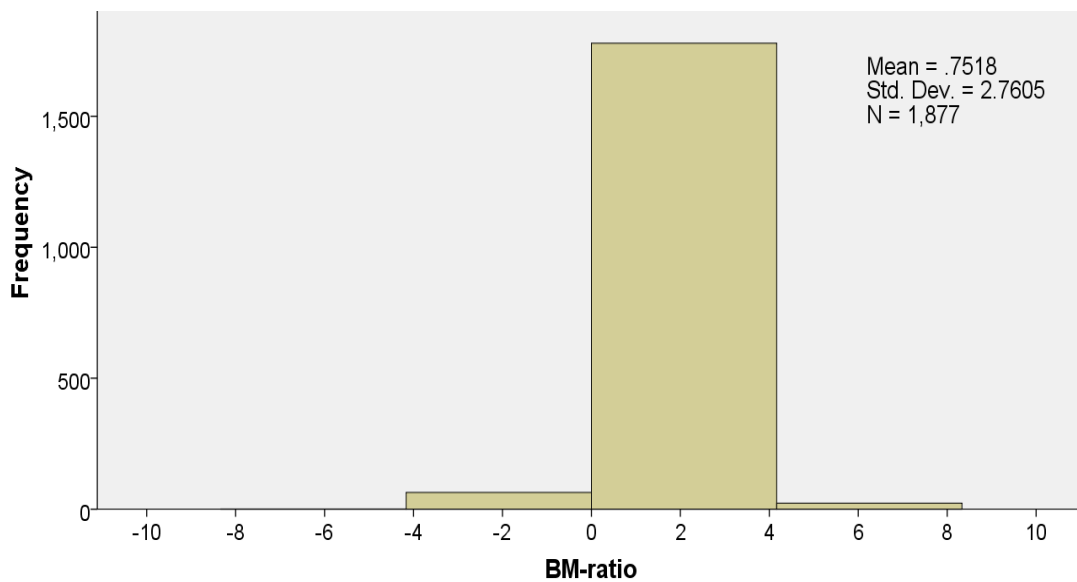


Figure 5. Distribution of BM values for the complete one year buy-and-hold portfolio.



The descriptive statistics of one year portfolio returns for the five quintiles by BM, are shown in Table 8. A one-way ANOVA test revealed that the difference in mean returns between the five quintile groups was statistically significant at the $p < 0.05$ level. Post-hoc comparisons using the Tukey HSD test revealed that the difference in mean returns was significant between the high BM group and the lowest three BM groups that comprise the observations from the lowest BM observation up to the observation of the 60th percentile. For the sample used for this research, the mean returns of a one year hold portfolio of value stocks (highest BM group) was significantly better than the mean returns of the lowest BM groups which, per definition, are the most expensive stocks (glamour stocks) as shown in Table 8.

Table 8. Descriptive statistics of the quintiles of the complete one year buy-and-hold portfolio.

<i>Description</i>	<i>Number of observations</i>	<i>Mean returns%</i>	<i>Std. Deviation</i>
1 1stBM Quintile	376	28.063277	103.9775045
2 2nd BM Quintile	375	26.062105	70.0037252
3 3rd BM Quintile	375	23.797895	50.1066891
4 4th BM Quintile	375	36.401842	68.6323604
5 High BM group	376	47.381153	90.8236452
Total	1877	32.346988	79.3810901

5.2.3 Characteristics of the five year buy-and-hold portfolio.

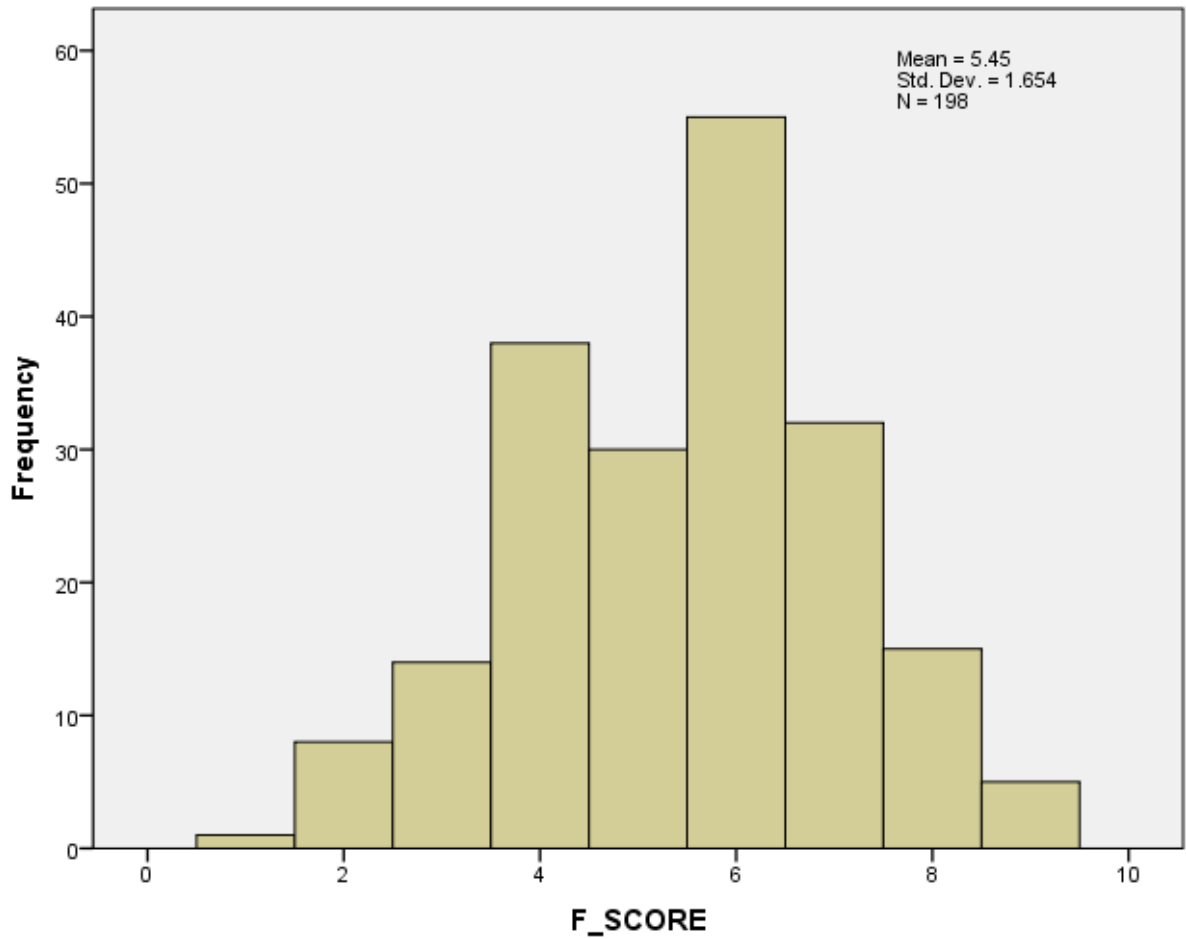
The number of observations that contain complete information for all the variables necessary to study portfolio holding periods of five year spanning the years 2000 and 2006 inclusive, were 975 as shown in Table 9. This sample was all-inclusive, in other words the sample consisted of all observations, not only the high-BM portion.

Table 9. The number of observations per financial year with complete information to study holding periods of five years.

<i>Year of portfolio formation</i>	<i>Number of observations</i>	<i>Percentage of Grand Total</i>
2000	117	12.00%
2001	142	14.56%
2002	146	14.97%
2003	153	15.69%
2004	159	16.31%
2005	155	15.90%
2006	103	10.56%
Grand Total	975	100.00%

The frequency distribution of the F-scores of the high BM quintile of the five year buy-and-hold portfolio from 2000 till 2006 is shown in Figure 6. Figure 1. The F-score frequency distribution is bell shaped and relatively symmetrical. Again, this is indicative of only one mechanism responsible for the F-score distribution despite the fact that the period under study spans both bull and bear markets. The median and mode of the F-scores were 6 which were slightly more than the middle of the range of possible F-scores (4.5). Very few firms have F-scores blow 3. A visual comparison between Figure 1 and Figure 6 revealed that the F-score distribution characteristics of the upper BM quintile of one year buy-and-hold portfolio closely resembled the F-score characteristics of the upper BM quintile of the five year buy-and-hold portfolio.

Figure 6 Histogram of high BM quintile five year buy-and-hold portfolio's F-scores spanning the portfolio forming years 2000 till 2006.



The distribution of firm sizes of the five year buy-and-hold portfolio is shown in Figure 7. The distribution is unimodal and highly positively skewed. This means that the vast majority of the firms are small in relation to the few high market value firms. A visual inspection of Figure 7 and Figure 4 reveals that the distributions of firm sizes between the complete one year and five year buy-and-hold portfolios are almost similar.

The distribution of Book-to-Market values (BM) is shown in Figure 8. Similar to the one year buy-and-hold portfolio's BM distribution the values ranged from -97.7 to 41.5. Again, similar to the one year buy-and-hold portfolio almost all BM values for the five year buy-and-hold portfolio are concentrated between -7 and +9.

Figure 7 Distribution of firm sizes for the complete one year buy-and-hold portfolio

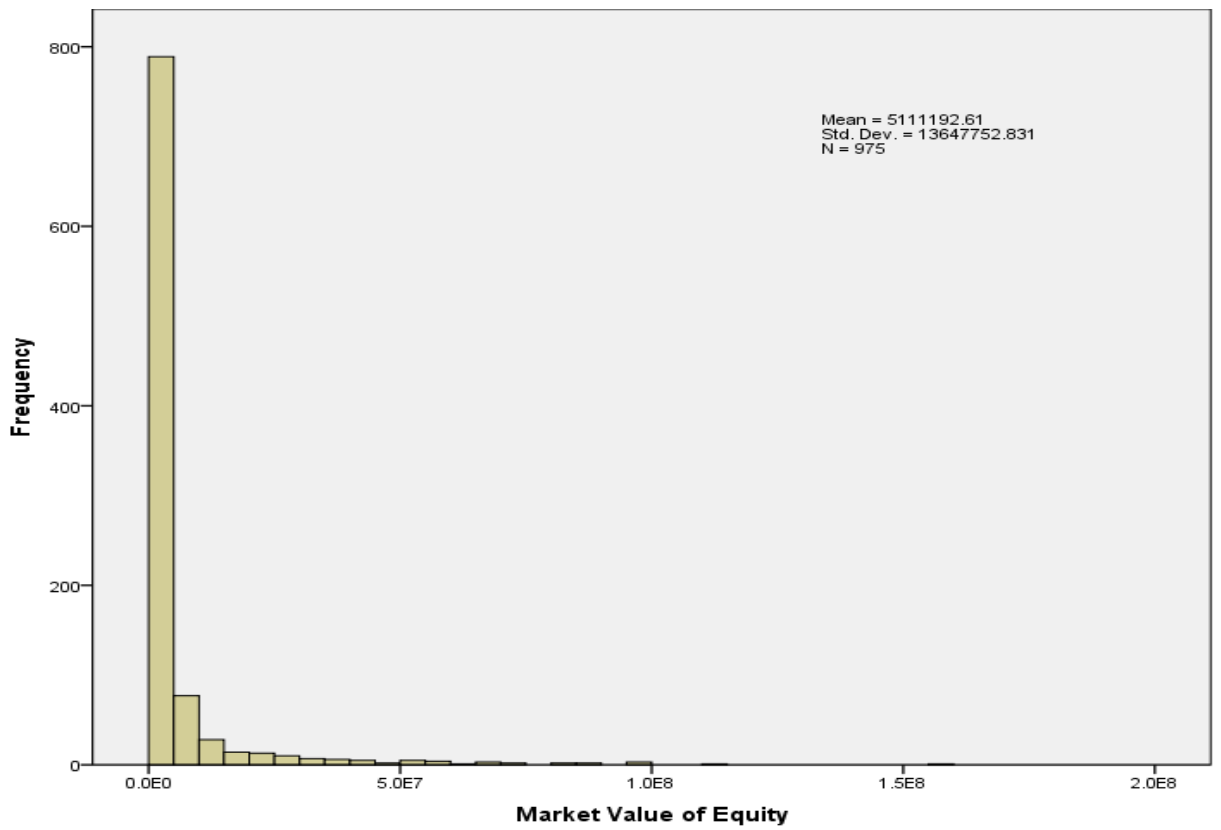
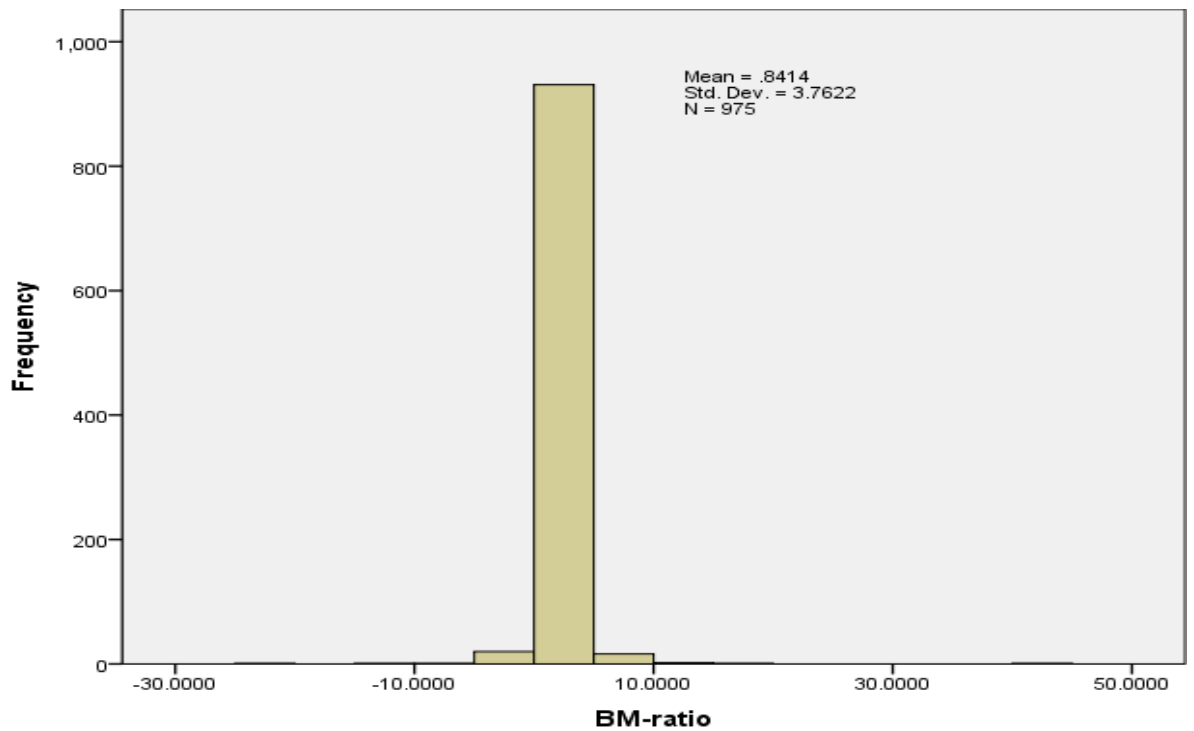


Figure 8. Distribution of BM values for the complete one year buy-and-hold portfolio



The descriptive statistics of the five year buy-and-hold portfolio returns for the five quintiles by BM, are shown in Table 10. A one-way ANOVA test revealed that the difference in mean returns between the five quintile groups was statistically significant at the $p < 0.05$ level. Post-hoc comparisons using the Tukey HSD test revealed that the difference in mean returns was significant between the high BM group and the lowest three BM groups that comprise the observations from the lowest BM observation up to the observation of the 60th percentile. For the sample used for this research, the mean returns of a one year hold portfolio of value stocks (highest BM group) was significantly better than the mean returns of the lowest BM groups which, per definition, are the most expensive stocks (glamour stocks) as shown in Table 8. Significantly, although the high BM group consistently yielded better returns than the BM groups below the 60th percentile for both the one year buy-and-hold portfolio as well as the five year buy-and-hold portfolio, the average returns from the five year portfolio was significantly less than the average returns of the one year portfolio.

Table 10. Descriptive statistics of the quintiles of the complete one year buy-and-hold portfolio.

<i>Description</i>	<i>Number of observations</i>	<i>Mean returns%</i>
1 1stBM Quintile	195	-17.1643
2 2nd BM Quintile	195	-22.0768
3 3rd BM Quintile	195	-17.5399
4 4th BM Quintile	195	0.7410
5 High BM group	195	12.5275
Total	975	-8.7025

5.3 Research question one: Hypothesis 1

To test the hypothesis that the Piotroski screen is still effective on the JSE for its intended purpose of picking winners from losers among financially distressed stocks (high BM stocks) and thereby improving short-term portfolio returns it was hypothesised that the mean returns of the entire high BM group as a whole (μ_{bh}) and the high F-score group (μ_{fh}) consisting of observations with an F-score of 8 or 9 that

was selected from the high BM group, are not different from each other. Therefore, the alternative hypothesis is that there is a statistically significant difference between the mean returns of the two groups:

$$H_0: \mu_{bh} - \mu_{fh} = 0$$

$$H_a: \mu_{bh} - \mu_{fh} < 0$$

Following Piotroski (2000), only the highest quintile of each year of portfolio formation was aggregated into a high BM portfolio and used to test the effectiveness of the Piotroski screen on the JSE since the performance variables that constitute the final F-score are designed for financially distressed firms, which are typically high BM firms. Furthermore, since the Piotroski screen was primarily based on a short-term buy-and-hold strategy, only the one year buy-and-hold portfolios were tested.

Figure 9. Histogram of the returns of the high BM sample.

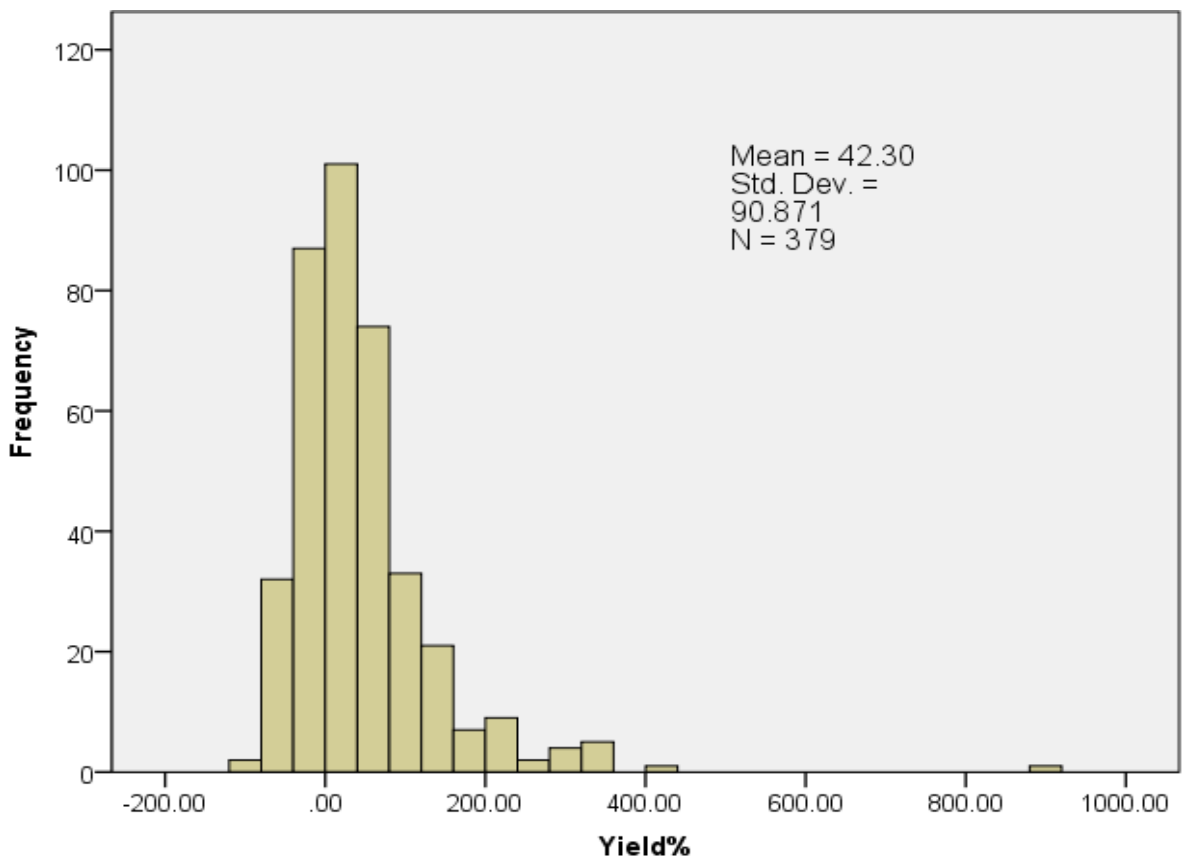
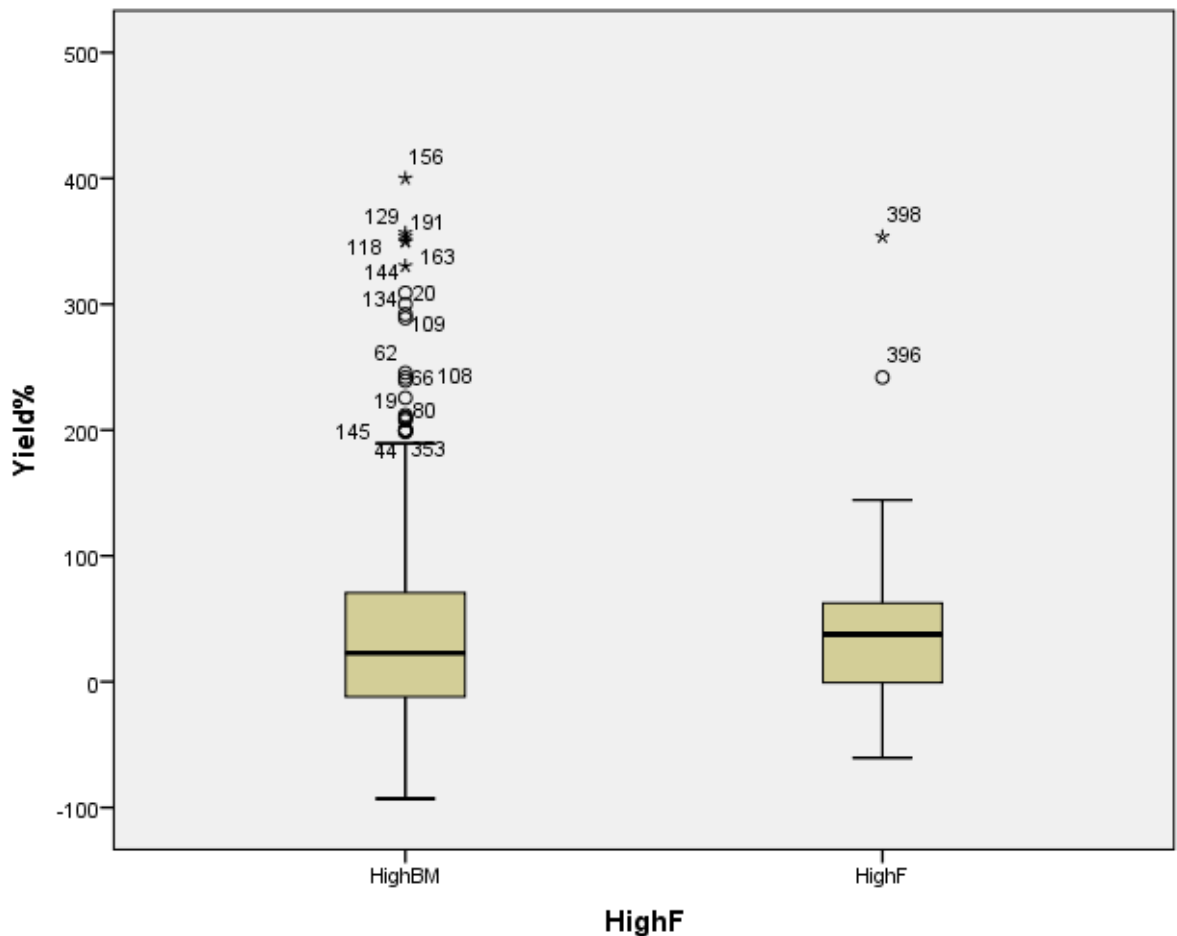


Figure 9 shows that this group, labelled the High BM group, consisted of 379 observations. These observations comprised all firms with enough data that allow F-scores to be calculated from the year 2000 to 2010. Observations with incomplete variables were eliminated.

In order to determine which statistical method to use to assess the difference in returns between this high BM sample and the sample of high F-score observations (F-score 8 or 9) selected from this high BM sample, the high BM sample was tested for normality since many statistical techniques assume that the returns are normally distributed (Pallant, 2010). The histogram of the yields of the sample is shown in Figure 9. It was unimodal and positively skewed instead of bell shaped and symmetrical like a normal distribution. The Kolmogorow-Smirnov test for normality confirmed that the distribution of returns for the high BM sample was not normally distributed. The box plot distributions of returns of the two groups are shown in Figure 10. These observations spanned a fairly significant time period of 11 years. Therefore, as discussed in Chapter 4, the bootstrap approach to the independent samples t-test was used to compare the mean returns of the high BM and the high F-score one year buy-and-hold portfolios. One thousand samples were drawn at a confidence level of 95%.

Figure 10. Box plots of the high BM group and the high F-score group.

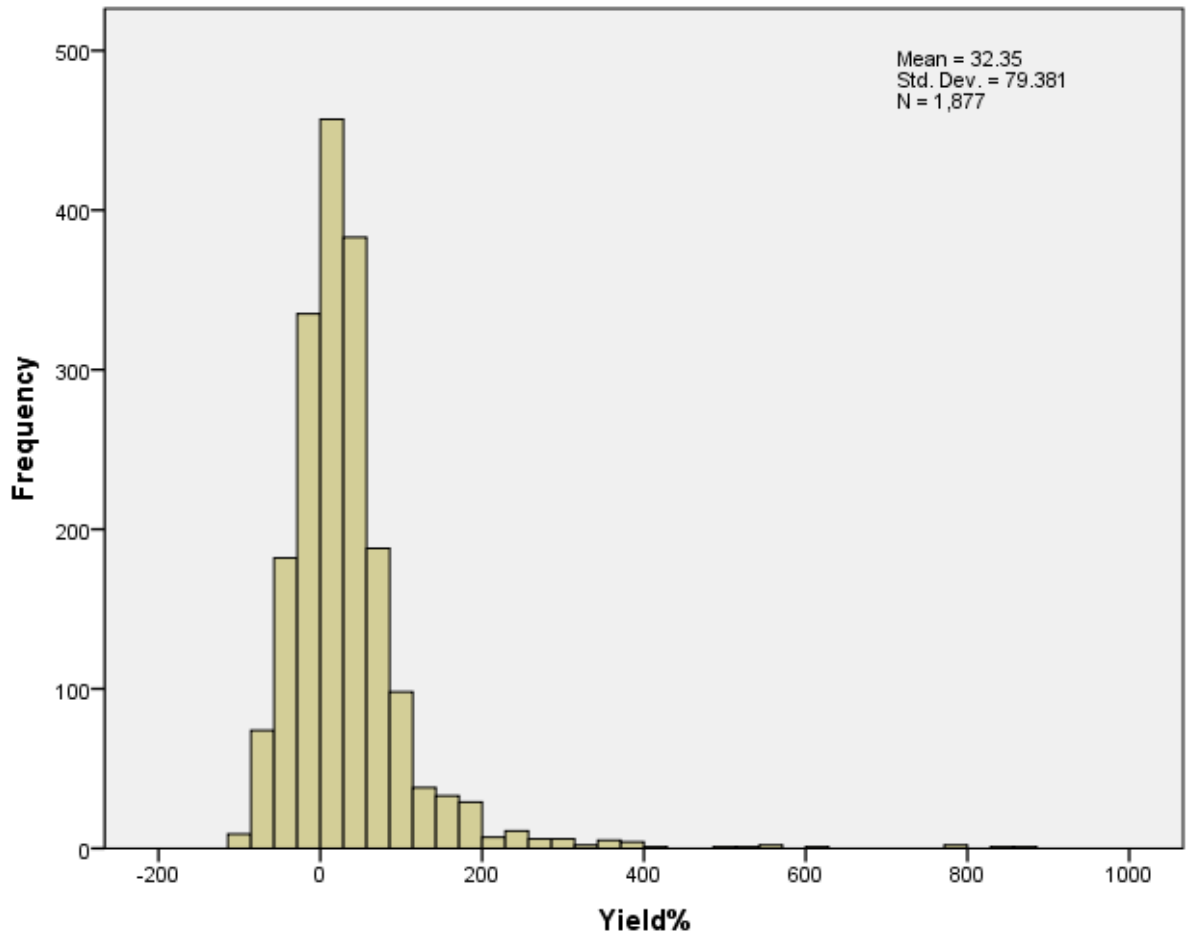


The independent-samples t-test was conducted to compare the yield for the high BM portfolio and the high F-score portfolio. There was no significant difference in yields for the high F-score group (Mean = 43.70%, Std. Dev. = 79.1) and the high BM group (Mean = 42.30%, Std. Dev. = 90.87). The magnitude of the differences in the means (mean difference = -1.4%, 95% confidence interval: -30.1% - 24.9%) was insignificant (eta squared = 0). Therefore, the null hypothesis was not rejected in favor of alternative hypothesis. This implies that no statistical evidence was found that the mean return of the high F-score group was different from the mean returns of the entire high BM group.

The one year buy-and-hold portfolio of the high F-score group was also compared with the complete one year buy-and-hold portfolio. The distribution of returns for the complete portfolio is shown in Figure 11. The distribution was unimodal, non-symmetric and positively skewed, suggesting that a single mechanism was responsible for the distribution. The Kolmogorow-Smirnov test for normality indicated that there was enough statistical evidence to reject the assumption of a normal distribution of returns. Therefore, again following Piotroski (2000), the bootstrapping technique was applied to the independent samples t-test to examine the difference between the mean returns of the high F-score sample and the total sample of one year buy-and-hold returns.

Furthermore, while the mean of the complete one year buy-and-hold sample's returns of all the observations spanning the period 2000 till 2011 was 32.3% (rounded) the 5% trimmed mean returns was much lower at 24.6% (rounded) per year. This indicated that a small number of very high return observations had a large skewing effect on the mean returns of the total sample. The maximum observed return was 880% (rounded) while the minimum observed return was -97.7% (rounded).

Figure 11. Histogram of the complete portfolio of one year buy-and-hold returns spanning the years 2000 till 2010.



Another 1000 sample bootstrapped independent-samples t-test was then conducted to compare the returns of the high BM portfolio (Mean = 42.3%, Std. Dev. = 90.87) and the complete one year buy-and-hold portfolio (Mean = 32.3%, Std. Dev. = 79.38) revealed a significant difference in returns for the two portfolios ($t(2256) = -1.985$, $p = 0.061$ two-tailed). The magnitude of the differences in the means (mean difference = -9.95% at a 90% confidence interval: 1.31% to 18.55%) was small (eta squared = 0.002). Therefore, the null hypothesis that there is no difference in the average returns of the two portfolios was rejected. The mean returns of all three samples are shown in Table 11.

Table 11. Mean one year buy-and-hold returns of the samples compared.

<i>Sample</i>	<i>Mean one year buy-and-hold returns</i>
Total sample of one year buy-and-hold returns (1877 observations)	32.3%
Upper quintile by market value (379 observations)	42.30%
High F-score sample (37 observations)	43.7%

5.4 Research question one: Hypothesis 2

The second hypothesis tested if there was a difference in the proportions of negative returns between the populations of high BM buy-and-hold stocks (High BM) and the stocks with an F-score of nine (F9) that was selected from the high BM buy-and-hold stocks. The results are shown in Table 12.

Table 12. Hypothesis test for the difference between population proportions

<i>Description</i>	<i>Count</i>	<i>Proportion</i>
F9 Positive returns	6	
F9 Negative returns	1	0.142857143
Total F9	7	
High-BM Positive returns	247	
High-BM Negative returns	132	0.34828496
Total High-BM	379	
pooled proportion		0.344559585
Standard Error		0.181269111
Test statistic		1.133275366
p-value		0.128549317

5.5 Research question two

The second research objective was to determine if Piotroski's screen is applicable on the JSE for long term investment horizons after the screen became known in 2000. As stated in chapter four, to limit the sources of variability as far as possible to the effect of the change in investment horizon of the firms selected by the Piotroski screen, the

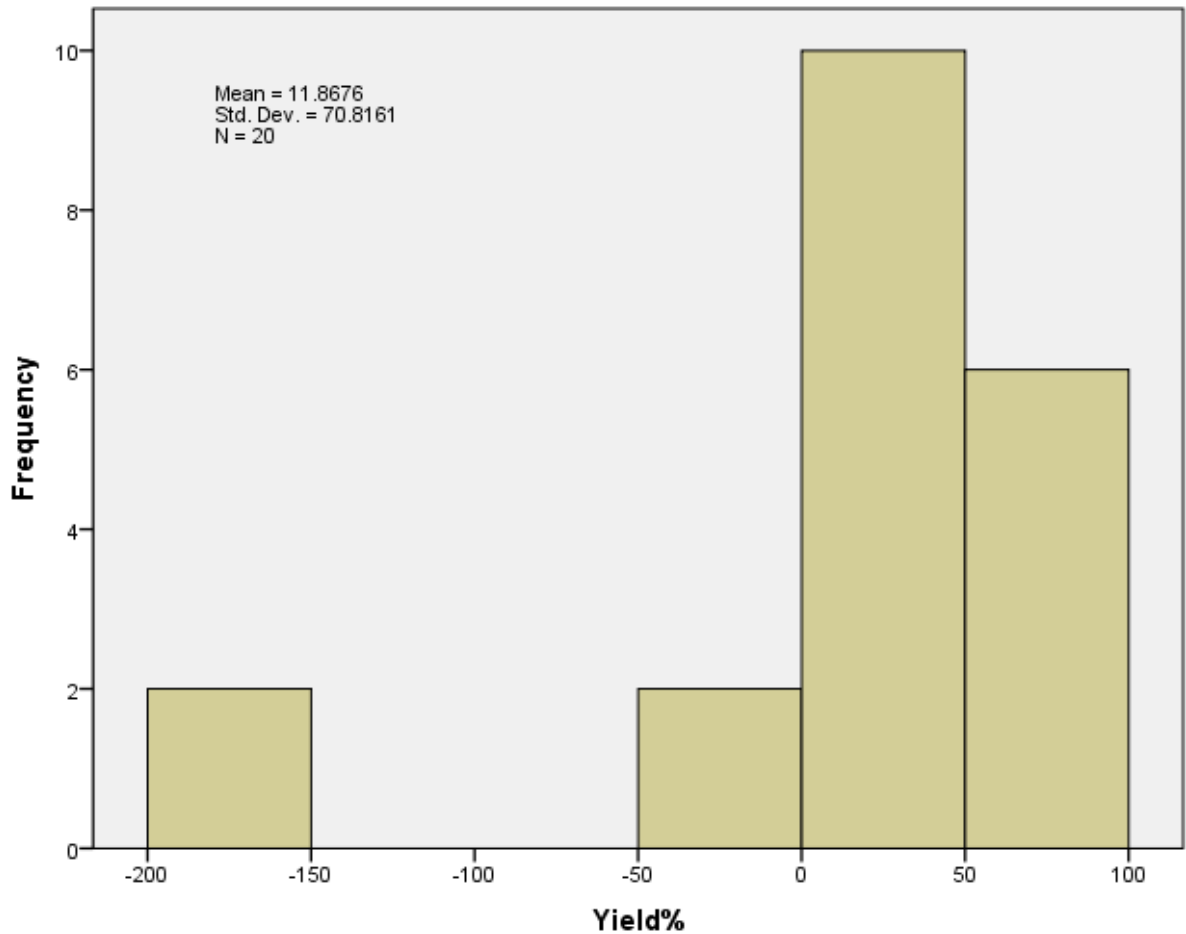
comparison was done between the returns of the five year buy-and-hold observations of firms that passed the Piotroski screen (high F-score firms in the high BM group) μ_{5fh} and one year buy-and-hold observations of firms that passed the Piotroski screen μ_{1fh} . Therefore the following hypotheses were tested:

$$H_0: \mu_{1fh} - \mu_{5fh} = 0$$

$$H_a: \mu_{1fh} - \mu_{5fh} < 0$$

The Kolmogorow-Smirnov test for a normal distribution was performed on the distribution of five year buy-and-hold returns of the high F-score group of high BM firms. The sample consisted of 20 observations. The test indicated that there was enough statistical evidence to reject the assumption that the returns were normally distributed. The histogram of the returns is shown in Figure 12. The box plot, shown in Figure 13, indicates that there are two outliers with large negative values. It was decided to keep the outliers in the sample set as the nature of the sampling method and the universe is such that the presence of such an outlier is a possibility and not due to a fault in the sampling method.

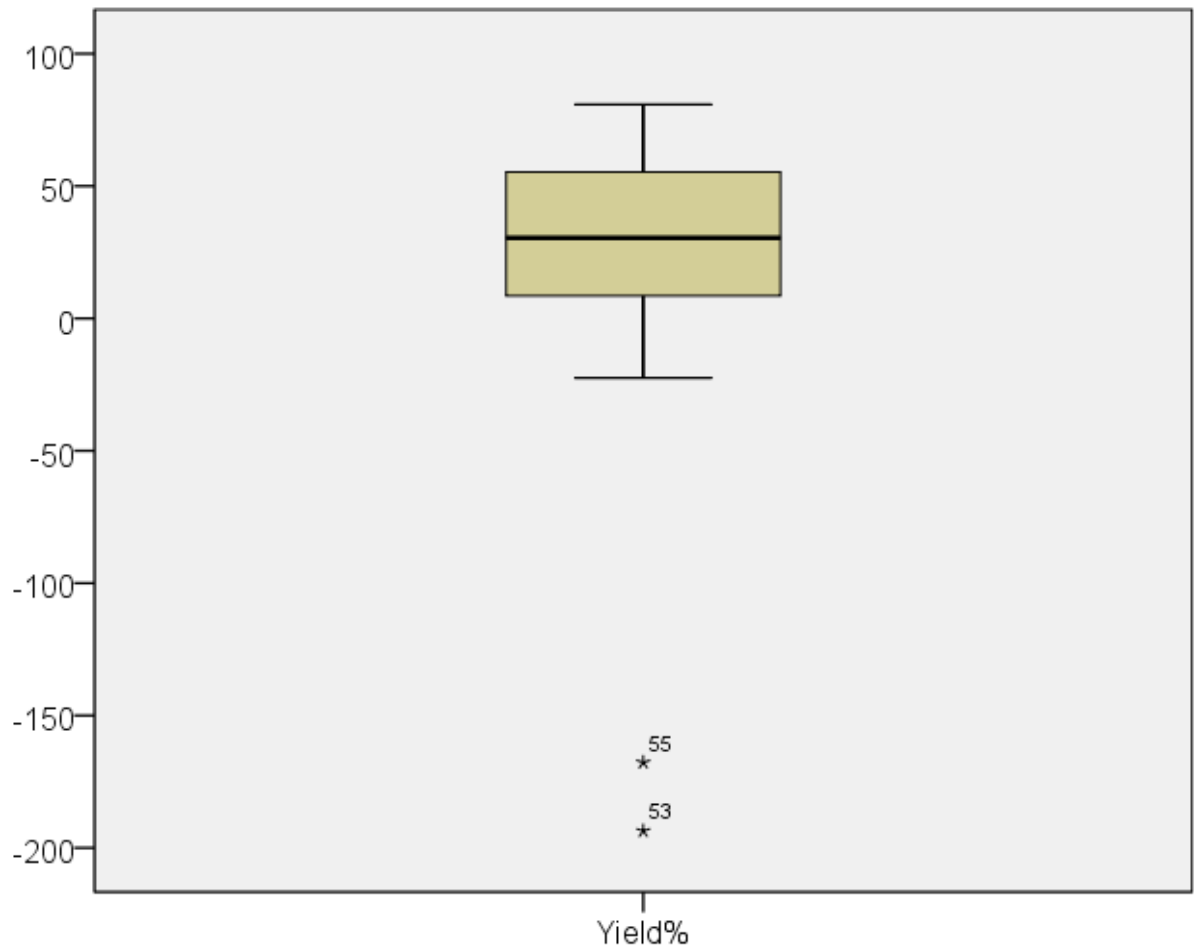
Figure 12. Histogram of five year annualized buy-and-hold returns of the high F-score group.



As explained in chapter four the returns of the one year and five year high F-score portfolios were compared with the bootstrapped independent samples t-test with 1000 bootstrap samples. The bootstrapped independent-samples t-test revealed that there was no significant difference in returns for the one year (Mean = 43.7%, Std. Dev. = 79.1) and the five year high F-score portfolios (Mean = 11.9%, Std. Dev. = 70.8, $t(55) = -1.503$, $p = 0.138$ two-tailed). The magnitude of the differences in the means (mean difference = -31.8, 90% confidence interval: -70.03 to -1.33) was moderate (eta squared = 0.04) (Pallant, 2010). Therefore there was not enough evidence to reject the null hypothesis in favour of the alternative hypothesis. However, due to the small sample size, the probability of a Type 2 error was large and the p-value indeed gave a weak to moderate indication that null hypothesis could be rejected although the norm in statistical analysis precluded a rejection for $p \geq 0.1$. The difference in mean returns were 31.8% and the p-value could be interpreted as a statistical probability of 13.8%

that a difference of 31.8% or larger would have been observed between the two samples.

Figure 13. Box plot of five year annualized buy-and-hold returns of the high F-score group



5.6 Research question three

The third research objective was to determine if the high BM firms differed from the complete sample of firms (with enough information to form one year buy-and-hold portfolios) in terms of size by market value. As explained in chapter four, the firm sizes of the complete one year buy-and-hold portfolio was compared to that of the high BM one year buy-and-hold portfolio.

The histogram of the complete sample of one year buy-and-hold observations by firm size (measured by the market value variable) is shown in Figure 4. The distribution is

unimodal, right skewed and highly unsymmetrical. The Kolmogorow-Smirnov test for normality indicated that there was enough statistical evidence to reject the assumption that the market values (firm sizes) were normally distributed. Therefore, in order to compare the market sizes of the two groups a nonparametric test had to be performed. The two groups consisted of independent samples and therefore the Mann-Whitney U test was performed (Pallant, 2010) to test the third hypothesis:

$$H_0: \mu_S - \mu_{BM} = 0$$

$$H_a: \mu_S - \mu_{BM} < 0$$

The sample size of firms that belonged to the high BM sample was 379. Since the sample size was larger than 30, a z-approximation test was conducted which included a correction for ties in the data (Pallant, 2010).

Figure 14. Box plot of high BM one year buy-and-hold portfolio by market size.

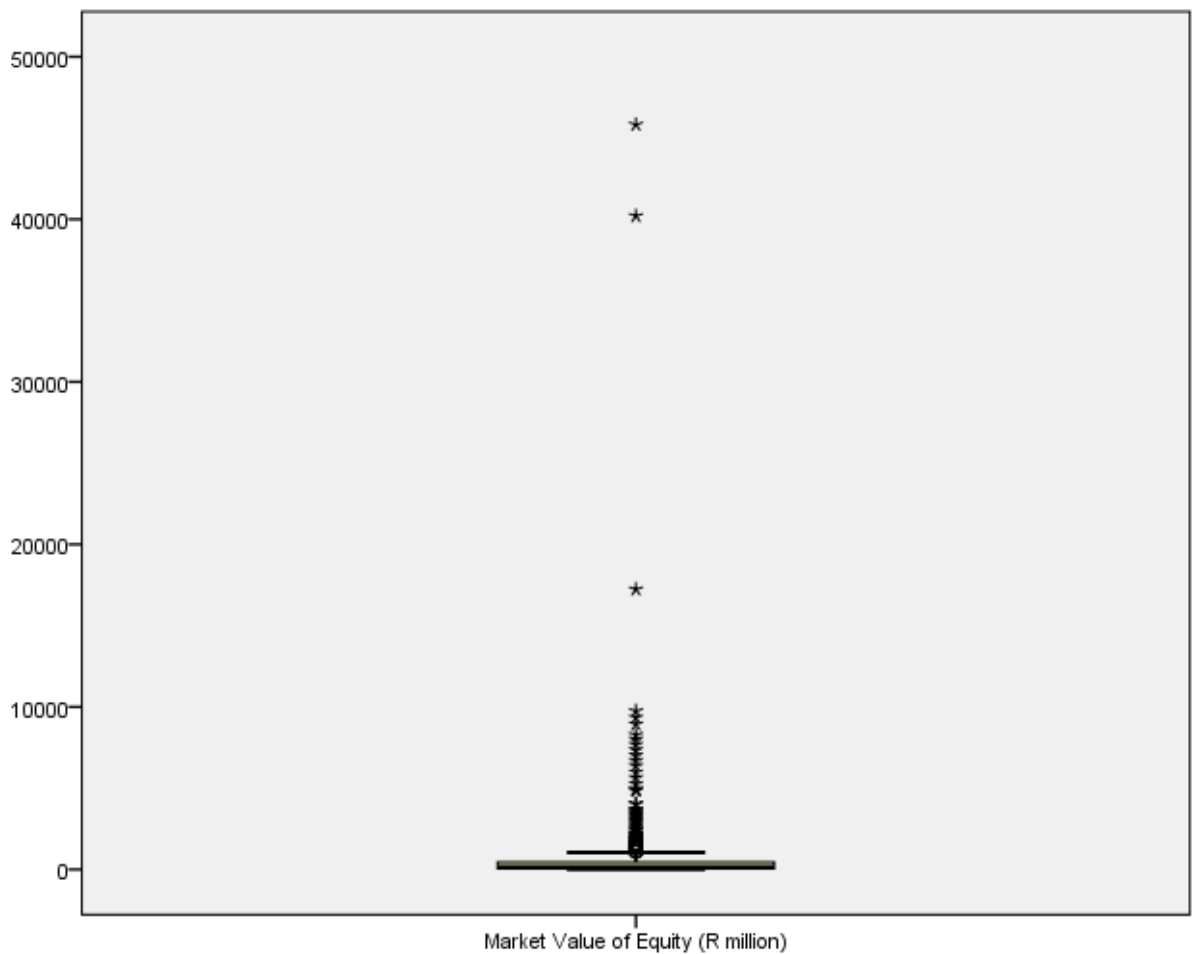


Figure 14 shows the box plot of the high BM one year buy-and-hold portfolio by market value. It indicates that the firms are highly concentrated around the median with a remarkable number of outliers up to R10 billion as well as a few extreme outliers to the value of almost R50 billion.

The Mann-Whitney U Test revealed a significant difference in the market size values of the general one year buy-and-hold portfolio (Median = R804666 thousand, N = 1877) and the high BM one year buy-and-hold portfolio (Median = R121965 thousand, N = 379, U = 215358, z = -12.132, p = 0.000 two-tailed, r = -0.255). Therefore, the null hypotheses that stated that there is no difference in the average size, measured by market value, of the firms in the high BM population and the average size of firms on the JSE's one year buy-and-hold portfolio as a whole was rejected in favour of the alternative hypothesis that stated that there was indeed a difference. The median size by market value of the general sample of firms from the JSE was R804.7 million (rounded) and the median size by market value of the population of high BM firms selected from the upper quintile of the one year buy-and-hold population of each year was R122.0 million (rounded). Therefore, the median size by market value of the high BM one year buy-and-hold population was only 15% of the median size of the total population of one year buy-and-hold firms from the JSE.

5.7 Summary

The main research objective was to evaluate the effectiveness of the Piotroski screen on the JSE since it was published in 2000. Independent samples t-tests were performed between the portfolio of firms that passed the Piotroski screen and the general portfolio of firms that were assembled on a one year buy-and-hold basis. The data showed that the returns from the portfolio of firms that passed the Piotroski test did not differ significantly from the general portfolio of returns. This result is at odds with the findings of Piotroski (2000) and others (Bhardwaj, 2010). These results are discussed in chapter 6.

Chapter 6. Discussion of results

6.1 Introduction

The primary aim of this research was to determine if Piotroski's screen could be used as a basis for an investment strategy centred on forming a portfolio of shares selected on the JSE. An investment strategy based on investment in stocks entails a stock selection method and, secondly, the determination of an investment horizon.

Since Basu (1977) published evidence of the value premium, numerous studies (Jaffe, Keim, & Westerfield, 1989), (Chan, Hamao, & Lakonishok, 1991), (Fama & French, 1992), (Lakonishok, Schleifer, & Vishny, 1994), (Brouwer, Van der Put, & Veld, 1997) and (Zhang, 2005), concurred that low-priced stocks (value stocks), identified by high Book-to-Market (BM) values, yield better returns than expensive stocks (growth stocks). However, high BM stocks consisted of many poor-performing firms and the superior returns were mainly driven by a small group of firms that recovered from financial distress (Piotroski, 2000). The literature agrees that the Piotroski screen was one of the most effective screens in discerning winning firms from amongst the pool of high BM firms. However, nothing in the literature was found that rigorously tested the effectiveness of the Piotroski screen on the JSE by means of the scientific method of hypothesis testing on the basis of the methods used by Piotroski (2000), however. Hypothesis one investigated the effectiveness of Piotroski's screen on the JSE since its publication in 2000. Since the premium obtainable from the application of successful stock selection strategies tend to erode with time in line with the neoclassical financial framework of rational expectations and competitive equilibrium (Long & Plosser, 1983), it was imperative to determine the effectiveness of the Piotroski screen on the JSE post its disclosure in 2000.

Successful stock investors, like Warren Buffet, advocated long investment horizons (Cunningham, 2009). Hypothesis two investigated the most effective investment horizon based on the Piotroski stock selection strategy.

The Piotroski screen was conditioned on the properties that characterise smaller firms in financial distress. Since the portfolios of firms that were used for the Piotroski stock

screening process were based on high BM-values alone, hypothesis three investigated the propensity of the selection process to cause selected portfolios to be biased toward smaller capitalisation firms without deliberately restricting the selection process to small capitalisation firms in the process. If this was the case, it would not be necessary to deliberately preselect small-cap firms when applying the Piotroski screen on the upper quintile by BM-values of a particular portfolio forming year.

6.2 Research question one

The effectiveness of the Piotroski screen on the JSE was determined by testing if there was a statistically significant improvement in returns between two portfolios that were chosen in such a way that all sources of variation except for the effect of Piotroski's screen were eliminated. These two portfolios were the high Book-to-Market (BM) firms selected from the upper quintile of each portfolio forming year and the portfolio of all firms that had an F-score of eight or nine that was screened from this portfolio of high BM firms.

The conclusion drawn from the bootstrapped independent samples t-test that compared the mean returns of the high F-score portfolio and the high BM portfolio was that there was not enough statistical evidence to reject the null hypothesis in favour of the alternative hypothesis. The null hypothesis stated that there was no difference in the mean annual returns between the high BM and high F-score portfolios consisting of one year buy-and-hold stock investments. The immediate conclusion that could be drawn from this result was that the Piotroski screen did not select stocks that yielded significantly improved returns in comparison with the returns of the high BM portfolio. However, this result should be seen in the context of the general market conditions.

Figure 2 shows that the study was done amidst one of the most persistent and strongest bull markets on the JSE. The period under study started with a mild bear market that lasted from 2000 till 2003. This was followed by a long bull market that lasted until the dangerous international unravelling of financial markets caused a

short, sharp correction on the JSE from 2008 to 2009. The JSE quickly resumed its bull market for the rest of the period under study.

During the time under study, the JSE Indi25 index had a compound growth rate of 13.5% (rounded) per annum based in the data in Figure 2. This figure reflected only the share price increases of the JSE's Indi25 index. When the investment returns were calculated on the basis of one year buy-and-hold share price increases and the dividends that were paid out for firms that were selected from the general JSE board, the annual returns increased to 32% as shown in Table 11. However, due to the fact that the delisted companies were not taken into account in the calculation of the mean returns of the general one year buy-and-hold portfolio, the annual returns of 32% was suffering from survivorship bias. De-listings would have caused investment losses and will have diminished the mean return of 32% for a one year buy-and-hold strategy. Nevertheless, this does not detract from the fact that the data illustrated that the JSE was predominantly strongly bullish during the period that was studied.

A further remarkable result of the complete one year and five year buy-and-hold portfolios was that there was a statistically significant difference in the returns of the upper quintile of each of the complete portfolios and the returns of the lowest three quintiles respectively as discussed in section 5.2.2. The returns from the upper quintile of each of these two portfolios were markedly better than the returns of the lowest three quintiles. Furthermore, a bootstrapped independent samples t-test also showed that there was enough evidence to infer that the mean returns of the general population of one year buy-and-hold returns on the JSE was significantly lower than the mean returns from the high BM population. This finding corresponds with the findings of other studies that value stocks (high BM stocks) in general give better returns than glamour stocks (low BM stocks) (Fama & French, 1992) and Basu (1977). Although the absolute values of the mean returns suffered from survivorship bias and would therefore overstate the real mean returns, the relative relationship between the mean returns of the various quintiles would not have been compromised unless delisted companies mainly fell in a particular quintile.

The firms that were screened by the Piotroski screen and grouped in the high F-score group was selected from the highest BM quintiles of each portfolio forming year. For the period under study, where the general portfolio of one year buy-and-hold stocks on the JSE gave a mean one year return of 32% (rounded), the portfolio formed by selecting the highest quintile by BM of each portfolio forming year, gave a mean return of 42% (rounded) as shown in Table 11.

Piotroski found that the high BM portfolio consisted predominantly of firms in financial distress (Piotroski, 2000). The positive returns of the high BM group were generally driven by a small number of firms that managed to shrug off their financial difficulties and surprised investors with good results which led the market to correct the prices on the basis of the new positive results.

However, for the period of this study, more than half of the high BM portfolio comprised stocks with positive one year buy-and-hold returns as shown in Figure 9. A significant portion of the returns were outliers with large positive returns ranging from between 200% to 400% which contributed largely to the high mean return of 42.3% of the high BM portfolio as shown in Figure 10. Also shown in Figure 10 is the fact that the high F-score portfolio screened from the high BM portfolio by the Piotroski screening method comprised only two positive return outliers. Therefore, the high BM portfolio that resulted from the selection of stocks from the JSE contrasted sharply with Piotroski's high BM samples that predominantly comprised stocks with poor returns (Piotroski, 2000). Consequently, the high BM portfolios from Piotroski's sample selection lent itself ideally to a screening process that was effective in discerning winners from losers. Since the high BM sample that resulted from stocks selected on the JSE during a strong and persistent bull market period comprised stocks with predominantly positive returns already, there was little scope for a screening process to improve returns. This explains why the results from the first hypothesis in determining the effectiveness of Piotroski's screen on the JSE were inconclusive.

Further to the above, the small sample size of 37 of the high F-score portfolio hampered the accuracy of the statistical comparison method used. Textbooks like those of Keller (2005) and Montgomery & Runger (2003) pointed out that the

probability of a Type 2 error (failure to reject H_0 when H_0 is false) is increased by smaller sample sizes. The reason for that is that smaller sample sizes give rise to larger sampling distribution standard deviations. The accuracy of a t-test is decreased by larger sampling distribution standard deviations, especially if the mean returns of the populations are close to each other which seemed to be the case in this instance as a result of the strong bull market that underlie the data.

In order to make inferences about the proportions of negative returns of the high BM one year buy-and-hold stocks and the stocks with an F-score of 9 selected from the high BM group, the sample proportions were tested as shown in Table 12. The sample size of the F-score nine portfolio was extremely small and consisted of only seven observations. This would have caused a high probability of a Type 2 error as explained above. The p-value was 0.12 (rounded) which constituted weak to moderate evidence in favour of the rejection of the null hypothesis in favour of the alternative hypothesis that the proportion of negative returns of the population with an F-score of nine was indeed smaller than the proportion of negative returns from the high BM population.

Due to the particular market conditions that reigned for the period when the data was collected as well as the small sample sizes, no conclusive evidence was found that the Piotroski screen improved returns from high BM firms. However, there was some evidence that the proportion of stocks with negative returns from the population of high BM stocks with an F-score of nine was lower than from the high BM population.

6.3 Research question two

This research specifically investigated a possible stock investment strategy that capitalised on the value premium that was found to exist among high BM stocks and the use of the Piotroski screen to increase the returns from a selection of high BM stocks. One of the aspects of an investment strategy is the frequency with which stocks are traded, or the time frame that a stock is kept in a portfolio.

Highly successful stock investors like Buffett proclaimed that “if you are not willing to own a stock for ten years, don’t even think about owning it for ten minutes” (Cunningham, 2009). In contrast, Saville (2011) showed that the general trend on the

JSE, the London Stock Exchange and the New York Stock Exchange was a reduction in stock holding periods from about 20 years on average to about one year in 2010.

Buffett's investment style, however, is a mixture of growth and value investing (Saville, 2011). Buffett recommended only investments in firms with extremely stable operations that operate in a business environment that is highly unlikely to experience disruptive developments (Cunningham, 2009) that could jeopardise their net profit growth. In contrast, Piotroski's screen was developed to discern firms with healthy financial prospects based on fundamental financial statement analysis alone without regard for the underlying conditions in which the firm operated, from amidst a pool of out-of-favour firms. Contrary to Buffett's recommendations for stable firms operating in a decidedly stable environment, Cheh et al. (2008) found that more frequent portfolio rebalancing of high BM (value) stocks tended to improve its performance. Their findings corresponded with Buffett's recommendations for high P/E (growth) stocks since they found that frequent portfolio rebalancing tended to lower the performance of such stock.

The contrast between proponents of long-term portfolio holdings and short-term portfolio holdings lie in the underlying basis for future profits. The proponents for long-term buy-and-hold strategies, like Buffett, focus on buying fundamentally sound businesses that operate in stable environments. The obvious lack of any future disruptive technology that could threaten the future profits of the firm and the long established need for the product or service, like Coke sodas or Gillette razors, virtually guaranteed its future growth and income. On that basis, a firm was selected and bought if the price was low enough to eliminate downside risks and guaranteed good future profits. The emphasis was, crucially, on firms with a durable competitive advantage (Cunningham, 2009). In this way, good growth stock with virtually guaranteed above normal growth was selected from the general pool of stocks. This method of stock selection required astute knowledge of the market and product and these investors therefore strictly limited their investments to their "circle of knowledge." In contrast, the value premium was only observed for short-term buy-and-hold periods (Basu, 1977) and (Cheh, Kim, & Zheng, 2008). The basis for the

above-average returns of value stock was the arbitrage opportunities created by discredited firms whose financial statements showed that they are not in financial distress anymore and are about to surprise the market with good future earnings as a result of their sound financial position. This finding was supported by Lev and Thiagarajan (1993) who found that a significant proportion of the abnormal returns obtainable from the method of screening out potentially good firms from a pool of unpopular firms by means of fundamental financial statement analysis was generated around subsequent earnings announcements. As a result, these abnormal earnings were mainly restricted to the first year of portfolio formation. The same pattern of short-term abnormal earnings generation was reported by Abarbanell and Bushee (1998).

The five year buy-and-hold sample set contained only 20 observations. Smaller sample sizes cause wider sampling distributions and a higher probability of a Type 2 error (Keller, 2005) which is the failure to reject a false null hypothesis. Although the bootstrapped independent-samples t-test indicated that there was not enough statistical evidence to reject the null hypothesis which stated that there was no difference in the returns of the populations of one year and five year buy-and-hold portfolios, the sample sizes were extremely small and the probability of a type 2 error commensurably high. The mean returns from the one year buy-and-hold portfolio (Mean = 43.7%) was almost four times more than the mean returns from the five year buy-and-hold portfolio (Mean = 11.9%). The probability of observing a wider gap in returns between these two portfolios was only 13.8% which was considered to be weak to moderate evidence that the null hypothesis should be rejected. Since the probability of a Type 2 error was large and the p-value indeed gave a weak to moderate indication that the null hypothesis could be rejected the consequent high probability that the alternative hypothesis that the returns from short investment horizon population was indeed better than the returns from the longer investment horizon would be commensurate with research findings by Cheh at al. (2008), Abarbanell and Bushee (1998) and Lev and Thiagarajan (1993) as explained above.

6.4 Research question three

Graham, the father of value investing tended to protect stock investments from loss of principal by advocating investments in large firms (Graham & Zweig, 2006) instead of small firms. The reason for this was that during structural market corrections, those smaller firms that were created during boom times to profit from demand that outstripped supply, were forced out of the market due to factors like a lack of economies of scale and lack of balance sheet reserves and could therefore not compete with larger firms. Large firms tended to be established and entrenched in the economy since it took time to build a balance sheet by means of a combination of retained earnings and borrowing. Small firms, therefore, tended to be more risky than larger firms.

In contrast to Graham's insistence on investing in large companies, Piotroski (2000) looked for value in the pool of high BM firms. He conditioned his screen specifically on small, financially distressed firms that were out-of-favour with little or no analyst following. Large firms tended to have large analyst following which caused news of those firms to be impounded in the market price much quicker. The value investment model was conditioned on the market "lags and frictions" as Basu (1977) described it. The value premium, therefore, depended on the ability to detect, from fundamental financial statement analysis alone, firms that recovered from financial distress and were bound to report good future earnings before the market realised that the firm acquired the ability to post good future returns. Such neglected firms were typically small firms that were all viewed by investors as too risky to warrant investment.

Hypothesis three examined the properties of the high BM pool of firms on the JSE. It was found that enough statistical evidence existed to infer that the population of high BM firms were on average smaller than the general population of one year buy-and-hold firms on the JSE. This meant that the high BM firms probably did not need to be partitioned in small capitalisation and large capitalisation firms before selecting the high BF portfolios. It can therefore be safely assumed that the size effect reported by Jaffe et al. (1989) was largely subsumed in the high BM portfolio. No partition between small cap and large cap firms were made for this study. The partitions would have

been arbitrary unless research indicated a logical cut-off point. Such a study was beyond the scope of this research project.

6.5 Summary

This chapter investigated the results of the hypotheses that were investigated with the of determining if Piotroski's screen could be used as a basis for an investment strategy centred on forming a portfolio of shares selected on the JSE. Two main aspects of an investment strategy were investigated namely the effectiveness of the Piotroski screen as a stock selection method and, secondly, the determination of an investment horizon.

The Piotroski screen is firmly conditioned on the properties of neglected firms in financial distress and meant to screen out firms with sound financial prospects that were highly likely to surprise the market with good returns in the near future. It was found that the effect of the bull market that existed during the time frame from 2000 to 2011 that was used for the study sufficiently obscured the effect of the Piotroski screen to preclude a clear inference about the effectiveness of the screen. This was due to the fact that, where the high BM group usually consisted of only a few firms that yielded positive one year buy-and-hold returns (2000) the high BM group selected on the JSE for the time period under study, consisted predominantly of firms that yielded positive one year buy-and-hold returns. This diminished the effectiveness of the screen. Closely linked to the value investing concept was the issue of the small-cap effect and the fact. The investigation of the third research question indicated that the small-cap effect was largely subsumed in the high BM population and therefore did not need further attention. Although the investigation into the second research question regarding time frames was inconclusive, a strong suspicion nevertheless existed that the one year buy-and-hold strategy was likely to yield far better returns than the five year buy-and-hold strategy.

Chapter 7. Conclusions and Recommendations

7.1 Conclusions

The purpose of this research was to determine if the Piotroski screen was still effective on the JSE since it was published in 2000 (Piotroski, 2000). Research indicated that returns from value stocks were mostly better than returns from growth stock (Basu, 1977) and (Fama & French, 2006). Piotroski (2000) found that, due to the propensity of high BM firms to be financially distressed, the superior returns of high BM firms were driven by only a few firms that proved to be financially sound as reflected by their financial statements. Due to poor investor following and neglect by the investor community, this was usually not immediately picked up by the market (Basu, 1977). These market “lags and frictions” allowed investors to use a screen to discern “winners from losers” (Piotroski, 2000) a priori based on fundamental financial statement analysis alone and profit from the subsequent price corrections as the market is surprised by good financial performance which usually happened within the first reporting year after portfolio formation (Abarbanell & Bushee, 1998).

This research that was done on the JSE did not find conclusive evidence that the returns from the high F-score portfolio of one year buy-and-hold stocks could be better than the mean returns from the high BM one year buy-and-hold portfolio. At least two reasons for this were found. Contrary to the high BM portfolio that Piotroski used for his analysis (Piotroski, 2000) this high BM portfolio contained a large number of firms with positive returns. Secondly, the high F-score sample size of 37 was small and increased the danger of not rejecting a statement that the high F-score portfolio did not increase the mean returns if it was false. However, indications are that the portfolio of one year buy-and-hold shares with an F-score of nine (the highest F-score) contained less firms with negative returns than the portfolio of high BM one year buy-and-hold stocks. Furthermore, even though no conclusive evidence was found that the mean return of the one year buy-and-hold high F-score portfolio was better than the mean return of the five year buy-and-hold portfolio the conditions of the statistical tests and the borderline p-value aroused suspicions that the returns of the one year

buy-and-hold high F-score population may very well be better than the five year buy-and-hold high F-score portfolio. The mean return of the one year buy-and-hold sample was almost 400% better than the mean returns of the five year buy-and-hold high F-score sample. This finding was consistent with previous research Cheh et al (2008).

Finally, it was found that the mean firm size by market value of the high BM population of the one year buy-and-hold stocks was significantly smaller than the general population of one year buy-and-hold stocks. Therefore, it was not considered necessary to divide the high BM portfolio into small cap stocks and large cap stocks for the purpose of selecting winners from losers by means of the Piotroski screen.

7.2 Recommendations

Research showed that the returns from value stocks were better than the returns from growth stocks. Against this backdrop the Piotroski screen proved to be effective in screening out winning stocks from the population of value stocks (for this research, identified as the upper quintile of stocks by BM value). Although inconclusive, it was strongly suspected that the Piotroski screen was also effective at screening out winning stocks, especially stocks with positive returns in the case of firms with F-scores of nine, on the JSE since 2000. It is further strongly suspected that a holding period of one year for these screened out value stocks was better than longer term holding periods of five years for example.

Therefore, based on the literature and the research findings, it was evident that investors seeking above normal returns on the JSE should concentrate on selected value stocks and follow a one year buy-and-hold strategy. The value stock selection must be based on firstly, selecting stocks from the highest quintile by BM values on the JSE and then selecting those stocks with an F-score of nine in order to minimise the risk of negative returns. Secondly, these stocks must be kept in the portfolio for one year during which its prices should rise on the back of positive earnings announcements.

This value stock screening method was solely dependent on objective financial statement analysis and therefore eliminated the need for extensive knowledge of the economic bedrock in which the firms operate or the intimate details of the firms. This mechanical method of stock selection therefore eliminated the suboptimal investor behaviour that caused poor stock investment returns.

7.3 Future Research

Based on the theory and this research future research could focus on addressing the limitations of the datasets obtained for this research. Especially the high F-score datasets were quite small and unduly increased the probability of type 2 errors which led to the inconclusive outcomes of the critical research questions.

Because of the neo economic framework of competitive equilibrium and rational decisions, easily applicable stock market strategies that allow investors to obtain above average returns like the above value stock screening strategy, may be subsumed in the general market activities and thereby eliminate the premium afforded by such a strategy. It will therefore be advantageous to conduct on-going research in connection with the effectiveness of the Piotroski screen on the JSE for investors interested in using this strategy on the JSE.

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