

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

An application of the Piotroski F_Score to the South African market



Prepared for the Department of Accounting at the University of Cape Town
and Professor Carlos Correia (Supervisor)

by

Michael Richard Attwood (ATTMIC002), in partial fulfilment of a
M.Com in Financial Management

PLAGIARISM DECLARATION

1. I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is my own.
2. I have used the APA referencing guide for citation and referencing. Each contribution to, and quotation in this mini-dissertation from the work(s) of other people has been contributed, and has been cited and referenced.
3. This mini-dissertation is my own work.
4. I have not allowed, and will not allow, anyone to copy my work.

Signed by candidate

Michael Attwood (ATTMIC002)

ABSTRACT

This paper examines whether application of the Piotroski F_Score (Piotroski, 2000), to the South African market is feasible and whether or not the distribution of returns earned by an investor can be shifted upward through use of this investment screen. Initial analysis seeks to faithfully replicate Piotroski's methodology although alternative samples have also been considered. This paper shows that, although not statistically significant, the selection of financially strong high book-to-market firms can yield impressive results and can be applied to the South African market, albeit with less impressive and convincing results than those garnered elsewhere. In all tested cases, a portfolio comprised of financially strong firms having a high F_Score outperform a portfolio comprised of firms classified as financially weak and can be statistically significant when applied to ulterior samples. In addition, the mean return of financially strong firms over a two year investment period is substantially higher than that of the entire portfolio being analysed. Within each of the tested portfolios, it would appear that the benefits of financial statement analysis are not associated with firm size, Altman Z-Score or historical change in profitability. Overall this paper would suggest, as does Piotroski's, that the market does not fully take historical financial information into account in prices in a timely manner and that although not statistically significant, the use of Piotroski's F_Score does enable an investor to discriminate between financially strong and weak firms and may allow for improved returns. The lack of statistical significance is may be a function of limitations imposed by the availability and quality of data.

[KEYWORDS: Financial statement analysis; market efficiency, fundamental analysis, Piotroski.]

1. Introduction

Extensive research has been conducted on the high book-to-market investment strategy (e.g. Fama and French, 1992, 1995; and Lakonishok et al., 1994). In the South African context, similar research has been conducted on the Johannesburg Stock Exchange (Auret and Sinclair, 2006). In all instances it has been shown that a high book-to-market investment strategy yields superior returns as compared to those of the market itself. However, the success of this strategy is primarily the result of a small subset of firms yielding exceptional returns.

This paper shows that a 12-month buy-and-hold investor would have earned a mean return at least 12% above the market by investing in high book-to-market firms over the 2005 to

2010 period. A 24-month buy-and-hold investor would have earned a mean return at least 34.6% above that of the market over this same period. These gains are despite just 43.72% and 31.6% of these high book-to-market firms yielding positive market-adjusted returns over each of the respective periods. Given that less than 45% of all high book-to-market firms yield positive market-adjusted returns and the diversity of returns evidenced within these high book-to-market portfolios, investors could be rewarded by discriminating between future strong and weak firms. This paper, much like Piotroski's, asks whether a fundamental, accounting-based analysis technique can discriminate between high book-to-market firms that will outperform their peers and those that will not.

A high book-to-market ratio is frequently an indication of recent or perceived financial distress (Fama and French, 1992; Chen and Zhang, 1998; and Vassalou and Xing, 2004). Even should this not be the case, firms displaying this characteristic commonly suffer from thin trading or analyst neglect (Lakonishok et al., 1994; McNichols and O'Brien, 1997) with one reason being that analysts underestimate future prospects of high book-to-market firms (Dechow and Sloan, 1997). In addition, Cai and Zheng (2004), and Griffin et al. (2003), were able to show that many institutional investors focus on growth / glamour stocks as they are momentum return seekers despite there being no empirical evidence to suggest that such a strategy yields significant future abnormal returns.

As such, the very nature of high book-to-market firms makes them uniquely suited to an accounting-based fundamental analysis strategy. Lack of analyst forecasts and analyst following restricts the ability of the firm to communicate informally. The spectre of financial distress renders the limited informal communication undertaken by the firm subject to severe scepticism, with good reason according to Koch (2000), and further limits the rigour and credibility of traditional discounted cash flow or multiple based valuation techniques. A technique that relies primarily on reliable financial information – albeit historical – and the fundamental financial characteristics of a firm is therefore likely to be the most valuable tool for investment analysis.

This paper seeks to employ the Piotroski F_Score to assess whether discrimination between high book-to-market firms with above-average returns and those without, is possible in the South African market. In addition, it attempts to evaluate alternative portfolios comprised of more discerning selection criteria and broader scope. If successful, it will show that South African investors can create a stronger value portfolio through the use of simple accounting-based analysis on historical financial information. In order to be effective, it will be necessary to be able to distinguish between those firms that will yield above average

future returns and those that will not. As expected, the data does confirm that the mean return of a high-book to market investment strategy exceeds the mean return of the market as a whole. Further, the results seem to indicate that while it is possible to identify those firms that will underperform the market, it is not always possible to select financially strong portfolio's that will outperform the market. In every instance firms having a low F_Score and thus identified as being financially weak underperformed both the market and population within which they were included while high F_Score and thus financially sound firms consistently outperformed the market but at times underperformed the population within which they were included unless held for a period of 24 months. Although few of the results were found to be statistically significant, it is possible to draw the inference from this dataset that a 24 month buy-and-hold strategy for high F_Score firms and a shorting strategy for low F_Score firms over a similar period would yield the best results. Of particular interest is that while the picking of firms based on Piotroski's F_Score is not convincingly conclusive, applying a firm size, level of distress and / or historical change in profitability filter in no way improves on or provides additional reliability to the initial analysis. In fact, the only additional analysis seeming to provide further benefit is the application of Altman's Z-Score where firms having a supposedly high level of bankruptcy risk are removed from the sample of high book-to-market firms thereby eliminating some financially distressed firms which understandably underperform in subsequent periods.

The next section of this paper is intended to outline previous research pertaining to accounting-based investment techniques and in particular those papers related to a high book-to-market investment strategy. It will also outline the nine financial signals that Piotroski uses to discriminate between high book-to-market firms with exceptional returns and those without. Section 3 specifies the research design and empirical tests employed by both Piotroski and this paper, while section 4 presents the various outcomes of these tests on three separate samples of the population and an overall assessment of the efficacy of this technique in shifting the distribution of the returns earned by a South African investor. Section 5 is the conclusion.

2. Literature Review and Motivation

2.1 PRIOR ACCOUNTING-BASED INVESTMENT STRATEGY RESEARCH

Researchers have, for decades, attempted to develop an investment strategy which will consistently yield superior returns. Fundamental to this is the ability to discriminate between firms that will yield exceptional returns in future, and those that will not. Frankel and Lee

(1998), propose the purchase of stocks where fundamental values appear to predict future prospects in excess of those that stock prices might suggest. This strategy identifies undervalued stocks through the use of the discounted residual income model while concurrently considering consensus earnings forecasts - specifically the U.S. Institution Brokers' Estimate Forecasts (I/B/E/S) - as proxy for future earnings. This strategy was shown to be successful, over a three-year investment period, at generating significant positive returns. LaPorta (1996), was able to show that systematic errors in market expectations, where investors form incorrect earnings expectations and stock markets are not fully efficient, can partially account for superior returns earned by value stocks (with high book-to-market firms explicitly included within this category). This too would seem to indicate the possibility of discrimination between firms that will yield exceptional future returns and those that will not.

Research with a more fundamental approach has shown on numerous occasions that investors can benefit from focused investing on specific indicators of financial performance. These papers suggest that reliance can be placed on the market's lack of ability to fully process the implications of particular financial indicators. This research includes, but is not limited to, post-earnings announcement drift where cumulative stock returns continue to 'drift up' for up to 60 days after an unexpectedly good earnings announcement or vice versa but where the extent of post-earnings announcement drift is negatively correlated with the percentage of institutional ownership holding stocks in the firm and hence relevant for growth but not value stocks (Foster et al., 1984; Bernard and Thomas, 1989, 1990; Bartov et al., 2000; and Ke and Ramalingegowda, 2005), accruals where undue attention is paid to earnings without fully considering the implications of accruals and the related consequences for cash flow (Sloan, 1996), seasoned equity offerings where firms that issue equity, whether an initial public offering or a seasoned equity offering, significantly underperform relative to similar non-issuing firms for five years after the offering date with similar underperformance being evident for both small and large firms as well as both growth and value firms (Loughran and Ritter, 1995; Jegadeesh, 2000; Pontiff and Woodgate, 2008), dividend omissions / decreases where the initiation of a dividend is associated with a mean price increase while the omission of a dividend payment is associated with a relatively larger mean price decrease (Michaely, et al., 1995) and repurchases where a buy-and-hold decision in the month following the repurchase announcement on average realizes a return over the next four years that is 12% above that of a control portfolio (Ikenberry et al., 1995) although Zhang (2005), finds that repurchasing firms do not seem to exhibit superior abnormal performance

over long horizons when making actual share repurchases unless the repurchase is made by a small firm with a high book-to-market ratio.

Arguably more robust techniques employ multiple pieces of information located in the firm's financial statements over and above reliance on a single fundamental signal. Ou and Penman (1989), and Holthausen and Larcker (1992), find that financial statements have valuable information content and that, when certain of these numbers are summarized in to one measure, it is possible to enhance valuation through the more accurate prediction of future earnings. Lev and Thiagarajan (1993), make use of twelve financial signals indicated to be pertinent by market analysts's rather than statistical search procedure. By using an aggregate score reflecting the information in the fundamentals and an earnings response coefficient together with future earnings growth they are able to demonstrate a significant relationship between value-relevant information and contemporaneous returns after controlling for current earnings innovations, firm size and macroeconomic conditions.

Abarbanell and Bushee (1997), further scrutinise the Lev and Thiagarajan (1993), signals and find that they have the ability to explain both future earnings changes and future analyst revisions. Following on the success of this study Abarbanell and Bushee (1998), went on to show that an investment strategy grounded in these twelve fundamental signals does yield significant abnormal returns.

Similar to Lev and Thiagarajan (1993), and likely satisfied with the work of Abarbanell and Bushee (1997; 1998), Piotroski (2000), chose to consider nine financial signals to assess a firm's likely future financial performance. The nine signals were identified through professional and academic articles and once again, as with Lev and Thiagarjan's signals, were not based on statistical search procedure. No assertion was made that these nine signals were optimal for distinguishing good investments from bad investments but merely that these were likely appropriate signals for assessing the well-being of a firm based on three key performance areas i.e. profitability, financial leverage / liquidity and operating efficiency.

The population to which this research was applied consisted of high book-to-market firms. A portfolio constructed with this characteristic meets the definition of a 'value' portfolio and is likely, as evidenced through many research papers (e.g. Fama and French, 1992, 1995; and Lakonishok et al., 1994; Auret and Sinclair, 2006), to provide superior returns as compared to the market - even before additional discrimination. Remarkably, Piotroski's study was able to show an additional increase in the mean return earned by a high book-to-market investor of at least 7.5% annually through the selection of high book-to-market, financially strong firms based on Piotroski's model. .

In a similar vein, Mohanram (2005), developed a GSCORE to assist with fundamental analysis for growth oriented, low book-to-market stocks. Mohanram focused on traditional fundamentals such as earnings and cash flows while including other measures tailored for growth firms such as earnings stability, growth stability, intensity of research and development, capital expenditure and advertising. A long-short strategy based on this GSCORE was found to earn significant excess returns, though most of the returns were realised from the short side. Results were robust in partitions of size, analyst following and liquidity. They also persisted after controlling for momentum and accruals.

Duong, Pescetto & Santamaria (2010), believe there to be several concerns relating to both the Piotroski (2000), and Mohanram (2005), analysis and results. The two most pertinent of these being that firstly, while both Piotroski and Mohanram show that their models perform strikingly well when applied to high and low book-to-market stocks respectively, neither model's performance has been tested academically outside of the chosen samples. Secondly, due to well-documented concerns regarding the drawing of inferences from statistical tests of long-term buy-and-hold abnormal returns (e.g. Kothari and Warner, 1997; Barber and Lyon, 1997), it is not possible to infer whether Piotroski's or Mohanram's models illustrate a case of market mispricing, or rational behaviour. This is a distinction which Duong and his fellow authors believe to be central to understanding the usefulness of these models.

It is not the purpose of this paper to distinguish between market mispricing or rational behaviour but it is acknowledged that adaptability to the South African market and efficacy to discriminate between those high book-to-market firms that will yield exceptional returns and those that will not, will concomitantly expand the sample against which Piotroski's model has been tested and if successful, will somewhat mitigate the need for interpretation as to whether this efficacy arises through market mispricing or rational behaviour. It should be noted that similar work has been done by Lopes and Galdi (2007) in Brazil, and Almas and Duque (2008) on Euronext markets (Paris, Amsterdam, Brussels and Lisbon). Lopes and Galdi use Piotroski's model to show that an investor could have changed the mean of his high book-to-market portfolio one-year market-adjusted returns from 5.7% to 26.7% by selecting financially strong i.e. high Piotroski F_Score, high book-to-market firms listed in the Sao Paulo Stock Exchange over the 1994-2004 period. They were also able to show that an investor could have changed his high book-to-market portfolio two-year market-adjusted returns from 42.4% to 120.2% using the same selection techniques over this same period. Both results were statistically significant. Almas and Duque used three different accounting based investment strategies to separate good from troubled firms. They were able to show

that Piotroski's investment strategy was the most efficient of these three and that application thereof increased the mean annual return in their high book-to-market portfolio by a statistically significant, 9.2%, when applied to a sample of European stocks over an eleven year period. Of interest is that both academic applications of the Piotroski F_Score outside of the U.S. market yielded results which were superior to those attained in Piotroski's original paper.

One final inclusion to this research is that of Altman's Z-Score. Altman (1968), uses multiple discriminant analysis to establish five key ratios with corresponding coefficients thought to best describe a firm's bankruptcy risk. It was found that in the year prior to bankruptcy Altman's derived measure was 95% accurate and was still accurate 72% of the time in a period up to two years prior to bankruptcy. Similar results were obtained by Altman when updating this research (Altman, 2000) although Grice and Ingram (2001), do question this applicability when applied to a sample of their choosing.

Ultimately, this paper seeks to achieve similar goals to the Piotroski (2000), Lopes and Galdi (2007), and Almas and Duque (2008), papers but in a South African context and with an additional filter in an attempt to improve upon discrimination. These goals include forming high book-to-market portfolios which contain firms that are expected to be good investments and then assessing and attempting to maximise the benefit thereof to an investor before and after removing firms exhibiting high levels of financial distress once Altman's Z-Score is considered. Classification of a 'good investment' will be based on a firm's overall performance index as ascertained through use of the Piotroski F_Score which aggregates the information contained in an array of performance measures.

2.2 HIGH BOOK-TO-MARKET INVESTMENT STRATEGY

Firms with high book-to-market ratios exhibit certain unique characteristics which make them ideal candidates for fundamental accounting based analysis. Further, 'value' portfolios which comprise these firms often yield returns in excess of portfolios which are comprised primarily of low book-to-market firms (Fama and French, 1992, 1995). While this is consistent with the findings of Lakonishok et al. (1994), they also found that returns for book-to-market strategies are smaller for stocks of larger companies where arbitrage costs and investor sophistication limit the existence of mispricing. Of particular relevance to this paper is the study by Auret and Sinclair (2006), conducted on the Johannesburg Stock Exchange 'JSE' which shows that the book-to-market ratio is certainly associated with

variations in stock returns and that this coefficient is more significant than either the size attribute or price-to-earnings ratio.

Fama and French (1992), postulate that, 'a high book-to-market ratio may indicate that the firm in question has poor prospects, signalled by low stock prices and high ratios of book-to-market equity. As a result of this, future returns are necessarily higher than firms with strong prospects so as to provide adequate compensation for risk'. This theory is supported by the strong relationship between book-to-market, leverage, and other financial measures of risk observed by Fama and French (1992), and by Chen and Zhang (1998). Vassalou and Xing (2004), find that default risk is intimately related to the size and book-to-market characteristics of a firm and that this is particularly the case for the size effect which exists only within the top quintile of firms with the highest default risk. They find that the return difference between small and big firms in this quintile amounts to approximately 45 percent per annum. The small shares in the high-default-risk quintile tend to have the highest book-to-market ratios and be among the smallest of the small firms. Additionally, small firms have much higher default risk than big firms even when considering only the high-default-risk quintile. It is clear that the default risk decreases consistently as size increases. This is similar to the result obtained for the book-to-market effect which exists only in the two quintiles with the highest default risk. Within this quintile, the return differential when comparing value and growth shares is approximately 30 percent per annum, this decreases to just 12.7 percent for the shares in the second highest default risk quintile. The remaining shares in the market do not display any book-to-market effect although the value shares in these categories do have the highest book-to-market ratios of all shares in the market, and the smallest size. Vassalou and Xing (2004), also find that high-default-risk firms earn higher returns than low-default-risk firms but only to the extent that they are small in size and have high book-to-market ratios. If these characteristics are not met, they do not earn higher returns than low default risk firms, even if their risk of default is actually high.

Dichev (1998) refutes this somewhat by presenting evidence that bankruptcy risk is not related to future returns. Indeed, Griffin and Lemmon (2002), use Ohlson's (1980), measure which is designed to predict the likelihood of bankruptcy (O-Score) as a proxy for distress risk. They show that while companies having the highest level of distress risk frequently have high book-to-market ratios and low past share returns as well there are in fact, somewhat counter intuitively, more companies in this category with low book-to-market ratios and high past share returns. Although both these studies do cast some doubt on the original Fama and French explanation for superior returns of value investing, both studies are reliant on

accounting models or bond market information to estimate a firm's default risk and may not appropriately capture the prospective risk of default given their grounding in historical financial information.

An alternative proposition for the superior returns of a high book-to-market portfolio as compared to the returns of a low book-to-market portfolio is market mispricing rather than compensation for risk. Lakonishok et al. (1994), show that high book-to-market firms are often subject to investor and analyst 'neglect' with poor prior performance often resulting in highly cynical expectations for future earnings performance leading to reduced market valuations. Cai and Zheng (2004), and Griffin et al. (2003) show that many institutional investors are return momentum chasers and thereby focus on growth / glamour stocks even though such a strategy does not yield significant future abnormal returns. This sentiment explains why analysts do not recommend the selection of high book-to-market firms as an investment strategy and rarely provide buy / sell recommendations on these firms. In fact, Dechow and Sloan (1997), show that analysts themselves overestimate future prospects of low book-to-market firms and vice versa. LaPorta et al. (1997) and Skinner and Sloan (2002), illustrate this to be irrational behaviour as shown by positive earnings surprises at subsequent quarterly earnings announcements. Market participants underestimate future earnings for high book-to-market firms and overestimate future earnings for low book-to-market companies. More recently, Griffin and Lemmon (2002), show that companies with high distress risk exhibit the largest return reversals around earnings announcements. This is consistent with an argument for market mispricing. They also note that the book-to-market effect is largest in small companies with low analyst coverage. Among firms with the highest distress risk, the difference in returns between high and low book-to-market securities is more than twice as large as that in other firms. Ali, Hwang and Trombley (2003) find the book-to-market effect to be greater for stocks with higher idiosyncratic return volatility, higher transaction costs, and lower sophistication, consistent with this market-mispricing explanation. Duong et al. (2010), find that typical pessimistic value investors could under-react to recent good information but they process bad information quite rationally or even over-confidently.

With the above in mind, value stocks are inherently more conducive to financial statement analysis than growth stocks. Value stocks may not have credible long-term sales and cash flow forecasts due to financial pressures (Koch, 2000) and little reliance can be placed on nonfinancial information given lack of analyst corroboration. Moreover, Asness (1997), shows that most of the predictability in returns for growth shares appears to be momentum driven but that this is not the case with value shares. Consequently, the valuation or

evaluation of value shares should focus on recent changes in company fundamentals. This would include an analysis of company liquidity, financial leverage, cash flow adequacy and profitability. The most appropriate way to do so is through inspection and analysis of historical financial statements.

This paper, similar to the Piotroski (2000), paper, examines a refined, fundamental accounting based investment strategy based on a firm's book-to-market ratio where the benefits of financial statement analysis are investigated in an environment where historical financial information represents both the best and most relevant source of information about the firm's financial condition.

2.3 INVESTMENT DISCRIMINATION AND THE PIOTROSKI F_SCORE

Fama and French (1995), and Chen and Zhang (1998), were both able to show that financial distress is synonymous with the average high book-to-market firm. This financial distress could be for a number of different reasons i.e. diminishing and / or consistently low margins, profitability, cash flow together with liquidity and increasing and / or high levels of debt creating financial leverage and risk. It follows that financial signals reflecting variations in these financial distress indicators should prove useful in predicting future firm performance.

Accordingly, Piotroski (2000), chose nine fundamental signals to measure the three key areas of the firm's financial condition: profitability, financial leverage / liquidity, and operating efficiency. The signals chosen were not identified through statistical search procedure but rather professional judgement and consideration of academic research. No representation was or is made that these signals represent the ideal set of performance measures for distinguishing between good and bad investments. However, it is clear from Piotroski's results that the composite F_score has significant statistical significance as regards prediction of future firm performance. In addition, all but three of the nine fundamental signals are significantly associated with one-year returns on an individual basis.

Piotroski classifies each signal realisation as either 'good' or 'bad' depending on the signal's implication for future prices and profitability. If the signal is considered to convey positive news regarding future firm performance the indicator variable for the signal is equal to one while should the signal convey negative news regarding future performance the indicator variable for the signal is equal to zero. The sum of these nine binary signals or aggregate signal is defined as the firm's F_Score and is designed to measure the overall

quality, or strength, of the firm's financial position. The decision of whether or not to include a firm in an investment portfolio is ultimately based on the strength of this aggregate signal.

It is important to note that whether a signal conveys positive or negative news is open to some degree of interpretation. Leverage for example could be a positive firm attribute provided the firm is financially sound and able to use this debt financing to generate returns in excess of the interest cost of this debt. Piotroski assumes that all firms with a high book-to-market ratio are financially distressed and signals are considered in this context. Increased debt or leverage is seen as a necessity to survive and not as a means to increase returns. This increased debt thus comes with a corresponding increase in risk. Indeed, given the profile of these high book-to-market firms this seems more plausible than the alternative. Penman et al. (2007) provide research to support this plausible assumption by showing that the firm's book-to-market ratio can be split in to an operational and leverage component. The operational component of this ratio is positively associated to subsequent returns while the leverage component of this book-to-market ratio is negatively associated with these returns – although to a lesser extent. This finding holds even when controlling for size, estimated beta, return volatility, momentum and default risk.

Should these signals about future performance and the associated implications thereof not be uniform across the sample of high book-to-market firms, the aggregate score is likely to lose some ability to differentiate between strong and weak firms.

2.3.1. Discrimination: Profitability Signals. Current profitability and quality of earnings or cash flow realisation are both key indicators in evaluating the firm's ability to remain commercially viable. Indeed, these indicators are considered to provide information about the firm's ability to sustain itself. Value firms typically exhibit lacklustre historic earnings performance and likewise struggle with cash flow generation. Accordingly, any firm able to generate profits or positive cash flow is demonstrating an above average ability to manage operations and generate some funds through these operating activities. Similarly, a trend towards improved efficiency through better use of firm assets is suggestive of an improvement in the firm's underlying ability to generate positive future cash flows.

Piotroski (2000), uses four variables to measure these performance-related factors: *ROA*, *CFO*, ΔROA and *ACCRUAL*. Piotroski defines *ROA* and *CFO* as, 'net income before extraordinary items and cash flow from operations, respectively, divided by beginning-of-the-year total assets to allow for comparability'. If the firm's *ROA* (*CFO*) is positive, Piotroski defines the indicator variable F_ROA (F_CFO) equal to one, zero otherwise. The indicator

variable ΔROA is the current year's ROA less that of the prior year. If ΔROA is positive, the indicator variable $F_{\Delta ROA}$ equals one, zero otherwise.

The *ACCRUAL* variable considers the relationship between earnings and cash flow levels. It is defined as, 'the current year's net income before extraordinary items less cash flow from operations divided by beginning-of-the-year total assets'. The indicator variable $F_{ACCRUAL}$ equals one if CFO exceeds ROA , zero otherwise. Sloan (1996), was able to show that positive accrual adjustments which drive earnings i.e. where profits outstrip cash flow from operations, is a negative signal about future profitability and returns. Piotroski treats, depreciation as a negative accrual. As value firms are often subject to analyst neglect while simultaneously suffering some form of financial distress, the incentive to actively manage profits through accruals in order to attract capital is likely to be substantial.

2.3.2. *Discrimination: Leverage, Liquidity and Source of Funds Signals.* Of the nine financial signals chosen by Piotroski (2000), $\Delta LEVER$, $\Delta LIQUID$ and EQ_OFFER are designed to measure changes in capital structure and the firm's ability to service debt repayments as they fall due. Since most high book-to-market firms are financially distressed in some manner, Piotroski assumes that an increase in leverage, a deterioration of liquidity, or the use of external financing are all signals with negative connotations for the firm's future prospects.

$\Delta LEVER$ represents changes in the firm's long-term debt levels and is defined by Piotroski as 'the historical change in the ratio of total long-term debt to average total assets. An increase (decrease) in financial leverage is a negative (positive) signal'. By raising external capital, Piotroski believes, and is supported by research by Myers and Majluf (1984), that a financially distressed firm is signalling its inability to generate sufficient internal funds. Further, this additional long-term debt will likely restrict the firm's ongoing financial flexibility. The indicator variable $F_{\Delta LEVER}$ is equal to one (zero) if the firm's long-term debt to average total assets fell (rose) in the year immediately prior to portfolio formation.

The variable $\Delta LIQUID$ attempts to capture the change in the firm's prior and current year current ratio. Piotroski defines the current ratio as, 'the ratio of current assets to current liabilities excluding short-term debt at fiscal year-end'. Piotroski assumes that an improvement in liquidity, where $\Delta LIQUID$ is greater than zero, is a positive signal which indicates that the firm is able to meet current debt obligations. The indicator variable $F_{\Delta LIQUID}$ equals one if the firm's liquidity improved, zero otherwise.

Finally, Piotroski defines the indicator variable EQ_OFFER as, 'equal to one if the company did not issue ordinary shares in the year immediately prior to portfolio formation,

zero otherwise'. This logic is similar to that applied for an increase in long-term debt, raising of external capital by financially distressed companies could be a signal of inability to generate sufficient internal funds to meet future obligations. A further indicator of the unfortunate financial condition facing these firms is the willingness to issue equity when the share price is likely depressed due to financial distress. This will have the effect of inflating the company's cost of capital.

2.3.3. *Discrimination: Operating Efficiency Signals.* The remaining two signals are designed to measure changes in the efficiency of the firm's operations: $\Delta MARGIN$ and $\Delta TURN$. These ratios are of key importance as they directly reflect the operational characteristics of the business i.e. how well assets are used to generate returns and how these returns are maintained after allowing for running costs of the business.

Piotroski defines $\Delta MARGIN$ as, 'the firm's current gross margin ratio (gross margin divided by total sales) less the prior year's gross margin ratio'. An improvement in margins signifies a reduction in raw material and input costs, an increase in the price of a company's product or both. The indicator variable $F_{\Delta MARGIN}$ equals one if $\Delta MARGIN$ is positive, zero otherwise.

Piotroski defines $\Delta TURN$ as, 'the firm's current year asset turnover ratio (total sales divided by beginning-of-the-year total assets) less the prior year's asset turnover ratio'. An improvement in this ratio provides an indication that assets have been utilised more productively. This improvement could come about as a result of an increase in sales or simply more efficient operations where progressively fewer assets generate a consistent level of sales. This variable may also capture a general improvement in market conditions and demand for the company's products. The indicator variable $F_{\Delta TURN}$ equals one if $\Delta TURN$ is positive, zero otherwise.

As mentioned previously, several of the signals used in Piotroski's paper bear some resemblance to the constructs tested in Lev and Thiagarajan (1993), and Abarbanell and Bushee (1997; 1998). Indeed, prior academic research has influenced the signals included in Piotroski's analysis but without realising similar success. Several reasons exist for this difference. First, Piotroski examines smaller firms which are assumed to be more financially distressed than is the norm. Variables were chosen to measure profitability and default risk trends relevant for these companies. Primary signals that are responsible for knock-on effects such as *LIFO/FIFO* inventory choices, capital expenditure decisions, effective tax rates, and qualified audit opinions are used to capture changes in the overall health of these companies. The source of each company's financial health or distress is sought as opposed to simply

seeking the symptoms. An example of this is that most of these high book-to-market companies are subject to capital constraints or rationing. Consequently, Lev and Thiagarajan's capital expenditure variable does not show much cross-sectional variation in Piotroski's study. Piotroski also believes that the majority of these high book-to-market companies will probably have assessed tax losses to carry forward against which to offset future taxable income (due to poor historical performance), this also limits the information content of Lev and Thiagarajan's effective tax rate variable. Second, the work of Bernard (1994), and Sloan (1996), shows how crucial cash flows, accounting returns and the relationship between each of these is when attempting to establish the future performance potential of a company. It is for this reason that variables capturing these signals are considered to be vital to the current analysis. Finally, it is also important to note that neither Lev and Thiagarajan (1993), nor Abarbanell and Bushee (1997, 1998), claim to possess an optimal set of fundamental financial signals. By using different signals (some of which represent similar attributes of a company's financial performance to those relied upon by Lev and Thiagarajan and Abarbanell and Bushee) to great effect simply serves to demonstrate the robustness of a considered financial statement analysis technique.

2.3.4. Discrimination: Combined Score. As indicated earlier, Piotroski defines F_SCORE as 'the sum of the individual binary signals or, $F_SCORE = F_ROA + F_ΔROA + F_CFO + F_ACCRUAL + F_ΔMARGIN + F_ΔTURN + F_ΔLEVER + F_ΔLIQUID + EQ_OFFER$ '. As there are nine underlying signals, an F_SCORE can be as low as 0 and as high as 9. A low (high) F_SCORE is considered to indicate a company with very few (mostly) good signals. Piotroski expects an F_SCORE to be positively associated with changes in future company performance and share returns although this is reliant on the extent to which current fundamentals predict future fundamentals. Piotroski's investment technique is to select companies with a high F_SCORE , being the combination of the nine underlying signals rather than any one particular signal. This approach represents one simple application of fundamental analysis for identifying strong and weak value firms. In comparison to the work of Ou and Penman (1989), and Holthausen and Larcker (1992), Piotroski (2000), sought to be more pragmatic with his analysis. It is not necessary to estimate probability models and the data does not need to be fitted on an annual basis to implement this strategy.

Piotroski believed there to be two issues with his approach. First, 'the translation of the factors into binary signals, while being simple and easy to implement, could potentially eliminate useful information'. To address this issue Piotroski included an alternative methodology in his paper where each of the nine factors was annually ranked and summed

after being turned in to a continuous representation and aggregated with little to no improvement being noted.

Second, given a lack of theoretical justification for the combined use of the nine variables identified, Piotroski acknowledged that the methodology employed in his paper could be perceived as 'ad hoc'. He believed that any variable that was effective in assessing the financial health of a firm at the time of portfolio formation would suffice – to varying degrees – as the goal of the methodology is merely to separate strong value firms from weak value firms. Piotroski investigates several alternative measures to investigate this belief. In particular, he partitioned his high book-to-market portfolio by level of financial distress (according to each company's Altman Z-Score), historical change in profitability represented by ΔROA and further, a decomposition of this measure in to a gross margin and asset turnover component. Results of this further partitioning lent credence to the use of various fundamental analysis techniques for identifying strong and weak firms while also showing the benefit of using multiple items of historical financial information to form an opinion with respect to a company's future performance.

2.3.5. Discrimination: Altman Z-Score.

All iterations of the Piotroski model will include an additional screen for financial distress. Theoretically Piotroski's signals and the combination thereof should intrinsically establish a firm's likelihood of financial distress through calculation of the composite F_Score which is intended to indicate the financial health, or lack thereof, of the firm. However, the Altman Z-Score (Altman, 1968), was specifically developed for this purpose and is widely accepted as an appropriate tool having seen much practical application by investment analysts. The Z-Score provides an indication of a firm's risk of financial distress through use of a discriminant function comprised of five financial ratios with different weightings allocated to each. Altman's Z-Score was found to have an accuracy rate for classifying financially distressed firms of 95% when using data one financial statement prior to bankruptcy and 72% when using data from two years prior to bankruptcy. In more recent updates of this study, the success of this Z-Score at predicting financially distressed firms was consistently between 80 – 90% based on data from one financial reporting period prior to bankruptcy (Altman, 2000). The majority of financial ratios chosen do differ from those included in the Piotroski F_Score and may well yield additional benefit despite concerns raised by Grice and Ingram (2001), as to the reported accuracy of the model and present day applicability.

3. Data and methodology

3.1 SAMPLE SELECTION

All firms listed on the JSE between 2005 and 2010 were selected to form the initial population to be subjected to further analysis. Income statement, balance sheet and cash flow data for each firm was obtained from *BFA McGregor* using the 'Prelim Balance Sheet', 'Prelim Income Statement' and 'Prelim Cash flow' templates. Dividend yield, share price and market return history together with financial year end date per annum were obtained from *Datastream*. To ensure that the full six years of data could be analysed using the Piotroski methodology, it was necessary to supplement certain balance sheet and income statement information with additional detail for years 2002, 2003 and 2004. As the *BFA McGregor* dataset did not provide any data for periods prior to 2004 this information was obtained from the Standard Bank online share trading platform on a company by company basis.

Once the above information was obtained, the nine Piotroski variables and five Altman variables were calculated on an annual basis for each company. It is important to note that the supplementary balance sheet and income statement information was required to enable the calculation of the $F_{\Delta TURN}$ and $F_{\Delta LEVER}$ indicator variables for 2004 and 2005 – both of which require information from two years prior to portfolio formation. Without obtaining this additional information the first two years of sample data obtained from *BFA McGregor* would have been used solely for calculation of later year F_Scores and would not have been available for analysis thereby severely reducing the eventual sample.

In addition, certain adaptations were necessary to expand the available data points beyond that which a strict application of Piotroski's methodology might allow. It appears to be quite common for South African firms not to disclose cost of sales or a gross margin and thus it was frequently not possible to calculate the $F_{\Delta MARGIN}$ indicator variable. In these instances, $\Delta NETMARGIN$ has instead been used and is defined as the firm's current net margin ratio (net margin divided by total sales) less the prior year's net margin ratio. When assessing the operating efficiency of a firm $\Delta NETMARGIN$ is likely to be as valuable as considering only the improvement or deterioration of the annual gross margin ($\Delta MARGIN$). The ability to control, and improve upon, ancillary operational costs i.e. costs other than those directly related to the manufacturing of a product or delivery of a service, can be as much a sign of good business acumen and management as a positive gross margin or improvement therein. Attention to detail below the gross margin line item further indicates a holistic approach to operational excellence. The indicator variable $F_{\Delta MARGIN}$ equals one if $\Delta NETMARGIN$ is positive, zero otherwise. Likewise, if no interest bearing debt line item was

separately disclosed $F_ΔLEVER$ could not be calculated and non-current liabilities were substituted as a proxy for this change in capital structure.

After obtaining as many credible data points per indicator variable per company per year as possible the market value of equity and book-to-market ratio were calculated using financial year end net assets values and market capitalisation figures. The market value of equity and book-to-market ratio are used to create consistency between the book-to-market ratio used for portfolio assignments and the ratio used to determine book-to-market and size cut-offs. All firms with sufficient data to calculate a book-to-market ratio are ranked at each financial year end to identify book-to-market quintile and size tercile cut-offs. As each firm's book-to-market ratio is calculated at a different point in time, being the firm specific financial year-end date, observations are grouped by and ranked within financial report years. This means that all observations for the financial year ended 2004 are grouped regardless of the month which denotes year end within the 2004 year. This grouping is then used to determine the financial year 2004 size and book-to-market cutoffs. After the book-to-market quintiles are formed, only the firms in the highest book-to-market quintile with sufficient financial statement data to calculate various performance measurement signals are retained. This approach yields the final sample of 346 high book-to-market firm data points across the six years (refer Appendix A).

3.2 CALCULATION OF RETURNS

Returns are measured as 12- or 24-month buy-and-hold returns. Measurement of these returns commences from the beginning of the fifth month after the firm's financial year-end to ensure complete information dissemination at the time of investing. The average dividend yield over this period has been included on a share by share basis within the calculation of this return to allow for accurate comparison with a total return index of the market. If a firm delists, the effect of this will be neither positive nor negative as the buy-and-hold return will be excluded from the population of returns due to lack of a data point at the end of the 'hold' period. When calculation a market-adjusted return, this is obtained by subtracting the value-weighted market return from the buy-and-hold return over the corresponding time period.

In all cases, an attempt has been made to ensure that survivorship bias has not materially impacted upon the outcome of this paper. All JSE listed companies for each of the six years under review have been compiled in to a single complete listing and financial data has been obtained wherever possible for each of these companies for each financial year to ensure delisted companies are certainly taken in to account. Gilbert and Strugnell (2010), were able

to demonstrate that survivorship bias is an important factor to consider when analysing data from the JSE. This bias was clearly demonstrated in the difference of returns between the complete and listed group of firms where the mean levels of returns were higher for the listed group of firms (i.e. after certain firms have delisted) than those generated for the complete data set. This is as to be expected if the characteristics of the delisted firms are systematically different from those of the listed firms at each point in time.

3.3 RESULTS

The primary methodology of this paper is identical to that established by Piotroski (2000), but with application in a South African specific context. That is, to form portfolios based on the firm's nine combined signals where possible, represented by the firm's *F_SCORE*. Firms having the least positive signals (being equal to 0 or 1 out of at least 6 Piotroski variables) are categorised as 'Low *F_SCORE*' firms and these firms are expected to underperform both 'High *F_SCORE*' firms and the population from which they were taken. Firms having the most positive signals are categorised as 'High *F_SCORE*' firms and these firms are expected to outperform both 'Low *F_SCORE*' firms and the population from which they were taken. Given the consistency and strength of these fundamental signals, these firms are expected to have the best subsequent return performance. A high *F_SCORE* firm is defined as having 0 or 1 Piotroski variables below the total number of Piotroski variables it has been possible to calculate provided that at least six Piotroski variables are available for the analysis. A high *F_SCORE* firm could thus have 5 or 6 positive Piotroski variables out of 6, 6 or 7 positive Piotroski variables out of 7 or 8 or 9 positive Piotroski variables out of 9.

It has been necessary to adapt the selection criteria used by Piotroski for low and high *F_SCORE* firms due to a substantial number of unavailable data points which might otherwise have reduced the final sample of firms below that which is already a limited number – especially when compared to Piotroski's sample of 14,043. Classifying a firm as having a low *F_SCORE* regardless of the number of Piotroski variables available might make an inappropriate assumption based on insufficient information. Classifying a firm as having a high *F_SCORE* should be robust provided it is possible to calculate at least two-thirds of Piotroski's variables and permit at most one negative signal within this calculation.

The tests in this paper are designed to examine whether the high *F_SCORE* portfolio outperforms other portfolios constructed from the same sample of firms but using different selection criteria. These tests will be conducted against three separate samples. The first will attempt to remain faithful to Piotroski's methodology and select only the top 20% of high

book-to-market firms in each financial year, the second seeks to employ the book-to-market ratio as cut-off for the selection of a high book-to-market sample. Any firm having a book-to-market ratio equal to or exceeding 1 is considered to be a high book-to-market firm by virtue of the firm's net asset value being equal to or exceeding its share price. It is interesting to note that this method of sample selection allows for the consideration of a greater proportion of firms in years of economic strife when share prices are depressed and fewer firms when the market is booming. This is consistent with value investor findings. The final sample is comprised of the market as a whole and seeks to address the question as to whether or not there is value to be had in picking financially sound firms using Piotroski's *F_SCORE* with little regard for book-to-market ratios, firm size etc.

In each case, two primary tests are conducted. The first test compares the returns earned by high *F_SCORE* firms against the returns of low *F_SCORE* firms; the second test compares high *F_SCORE* firms against the complete portfolio of firms included in the selected sample. These results are then further analysed with the use of additional partitions.

4. EMPIRICAL RESULTS:

4.1 PIOTROSKI HIGH BOOK-TO-MARKET FIRMS EMPIRICAL ATTRIBUTES

Table 1 provides financial and return characteristics of high book-to-market firms included in the Piotroski high book-to-market portfolio of firms. Firms in the upper quintile of book-to-market ratios are selected from each financial year between 2005 and 2010. As can be seen in panel A, the average firm within this portfolio has a book-to-market ratio of 1.9226 while the median book-to-market ratio is 1.7144. Consistent with prior research findings (Fama and French, 1995), high book-to-market firms show evidence of poor performance. The majority of high book-to-market firms show an increase in leverage and reduction in turnover, cash generating ability, margins and *ROA*. A majority of high book-to-market firms also show manipulation of returns through annually increasing positive accruals where profits outstrip cash flow from operations. Despite this, almost all ratios have a positive mean and in most cases this positive mean is fairly substantial which would indicate that, although in the minority, there are high book-to-market firms with sound underlying financial characteristics that outweigh the poor characteristics evidenced by the majority. These findings are not dissimilar to those of Piotroski although it is interesting to note that Piotroski's high book-to-market firms had primarily negative, albeit negligibly so, means for each financial characteristic. It would appear that although the proportion of firms with positive signals is incredibly similar in both South Africa and Piotroski's sample of US firms, South African

TABLE 1

Financial and Return Characteristics of High Book-to-Market Firms

Panel A: Financial Characteristics				
Variable	Mean	Median	Standard Deviation	Proportion with Positive Signal
<i>MVE</i> ^a	1171.4244	147.5965	3781.5707	N/A
<i>ASSETS</i> ^b	5644.2209	497.7175	28010.5866	N/A
<i>BM</i> ^c	1.9226	1.7144	1.1256	N/A
<i>ROA</i> ^d	2.0120	0.0467	27.7788	0.7410
ΔROA ^e	1.3348	-0.0011	29.3732	0.4737
$\Delta MARGIN$ ^f	-0.0250	-0.0028	2.8025	0.4727
<i>CFO</i> ^g	0.5067	0.0318	7.5802	0.6787
$\Delta LIQUID$ ^h	0.0280	-0.0369	9.3050	0.4504
$\Delta LEVER$ ⁱ	0.1279	0.0008	0.4542	0.5099
$\Delta TURN$ ^j	2.3335	-0.0041	100.3961	0.4164
<i>ACCRUAL</i> ^k	-1.5081	-0.0088	27.6326	0.4518

Panel B: Buy-and-Hold Returns from a High Book-to-Market Investment Strategy				
Returns ^l	Mean	Median	Proportion with Positive Signal	
One-Year Returns				
Raw	0.3226	0.0426	0.5286	
Market-Adjusted	0.1634	-0.0861	0.4086	
Two-Year Returns				
Raw	0.6817	0.0523	0.5213	
Market-Adjusted	0.3810	-0.1849	0.3958	

^a*MVE* = Financial year end (*t*) market value of equity calculated as the closing share price times the number of shares outstanding at the financial year-end. This could also be defined as market capitalisation.

^b*ASSETS* = Financial year end (*t*) total assets.

^c*BM* = Financial year end (*t*) book value of equity divided by *MVE*.

^d*ROA* = Financial year net income divided by total assets at the beginning of year *t*.

^e ΔROA = Annual change in *ROA* being *ROA* of year *t* less *ROA* of year *t-1*.

^f $\Delta MARGIN$ = Annual change in gross margin being the gross margin of year *t* less gross margin of year *t-1*.

^g*CFO* = Cash flow from operations divided by total assets at the beginning of year *t*.

^h $\Delta LIQUID$ = Annual change in current ratio being current assets to current liabilities of year *t* less current assets less current liabilities of year *t-1*.

ⁱ $\Delta LEVER$ = Annual change in total long-term debt (including any portion thereof classified as current) of year *t* and *t-1*, divided by average total assets over these periods.

^j $\Delta TURN$ = Annual change in asset turnover being net sales divided by average total assets for years *t* less *t-1*.

^k*ACCRUAL* = Financial year net income less cash flow from operations and divided by total assets at the beginning of year *t*.

^lOne-Year (Two-Year) Raw Return is calculated as a 12- (24-) month buy-and-hold return starting at the beginning of the fifth month after financial year-end. Market-Adjusted Return is calculated as the Raw Return less the corresponding buy-and-hold return of the value-weighted market index over the same period.

high book-to-market, financially strong firms are in fact more financially robust sound than their US counterparts.

Panel B illustrates 12- and 24-month buy-and-hold returns for the complete Piotroski sample of high book-to-market firms along with the percentage of high book-to-market firms earning positive raw and market-adjusted returns in each of the respective periods. As is to be expected, panel B clearly shows that a portfolio comprised of high book to market firms does earn positive market-adjusted returns in the period following portfolio formation. This is consistent with the research conducted by Fama and French (1992), Lakonishok et al. (1994), and Auret and Sinclair (2006). Of particular interest is that, despite the incredibly strong mean performance of this portfolio, approximately 60% of these firms earn negative market-adjusted returns and thus, eliminating these underperforming firms which form the majority of a high book-to-market portfolio will inevitably improve the portfolio's mean return performance. In theory, these underperforming firms should be characterised by weak financial performance signals and should be the culprits for the net negative median performance signals in table A.

4.2 PIOTROSKI *F_SCORE* STRATEGY RETURNS – INITIAL PIOTROSKI SAMPLE

Spearman correlations between each individual Piotroski variable, one- and two- year returns, one- and two- year market-adjusted returns and the combined *F_SCORE* are presented in Table 2. Returns are not as strongly correlated with *F_SCORE* as was evidenced in Piotroski's paper although over a 12-month period a similar result was noted i.e. *F_SCORE* has the highest correlation with returns and particularly market-adjusted returns. For a 24-month period both the change in leverage of a firm and issue of equity in the year prior to portfolio formation have higher correlations with returns than seen in the *F_SCORE*. Thus, for a 12-month investment strategy use of the Piotroski *F_SCORE* is likely to outperform a strategy with fewer considerations but use of the Piotroski *F_SCORE* as part of a 24-month investment strategy may not prove to be of most benefit.

Table 3 shows the returns available to a high book-to-market investor making use of Piotroski's *F_SCORE*. Panel A provides raw return distributions for a 12-month buy-and-hold investment strategy, Panel B provides market-adjusted return distributions over this same period and Panel C provides market adjusted return distributions for a 24-month buy-and-hold investment strategy. For succinctness, only market-adjusted returns will be discussed and further analysis will focus on the 12-month period within this category.

As is to be expected, and similar to Piotroski's findings, most firms (91%) are unexceptional performers having an *F_SCORE* above 2 but insufficient positive variables to be classified as having a high *F_SCORE* either. These firms are considered to have

conflicting performance signals and no attempt is made to ascertain further details regarding return performance and share characteristics. Approximately 6% of firms within the population are considered to have high *F_SCORES* and thus be financially sound and 3% have low *F_SCORES* and are thus considered to be in a precarious financial position. Piotroski had a similar proportion of low *F_SCORE* firms within his population but a 66% greater proportion of high *F_SCORE* firms. This fundamentally different proportion of high *F_SCORE* firms to both the portfolio of high book-to-market firms and low *F_SCORE* firms will likely have an impact on subsequent analysis as these two extreme portfolios are the basis upon which this method of fundamental analysis has been tested.

Perhaps the most striking data presented in table 3 is the fairly consistent positive relationship between *F_SCORE* and subsequent returns. As mentioned previously, there appears to be some uncertainty with respect to firm wellbeing and return performance in the middle of the *F_SCORE* range but it is clear that higher *F_SCORE* firms tend to have positive market adjusted returns and lower *F_SCORE* firms tend to have negative market-adjusted returns. This holds true for both 12- and 24- month return distributions. This relationship is in turn mirrored in the mean return of both the high and low *F_SCORE* portfolios. In all instances high book-to-market firms having a high *F_SCORE* substantially outperform low *F_SCORE* counterparts. Unfortunately this relationship, while clearly observable, is not statistically significant. This is likely a result of the variability in the underlying return distribution of both high and low *F_SCORE* firms and a limitation imposed by the relatively small dataset of 346 firms for the one-year return portfolios and 279 for the two-year return portfolios.

Of particular concern is the fact that high *F_SCORE* firms appear to underperform the portfolio of high book-to-market firms in the short run although it should be noted that even though this is the case, these high *F_SCORE* firms do still outperform the market as a whole and appear to compensate for lack-lustre performance when held over a 24-month period. Once again, the relationship of high *F_SCORE* firms to all firms in the high book-to-market portfolio is not statistically significant. It is for this reason i.e. the overt lack of statistical significance, that additional non-parametric bootstrapping techniques have not been included in this analysis. Any such techniques cannot hope to change such a clearly statistical insignificant outcome.

TABLE 2
Spearman Correlation Analysis between One- and Two-Year Market-Adjusted Returns, the Nine Fundamental Signals, and the Composite Signal (F_SCORE) for High Book-to-Market Firms^a

	ROA	ΔROA	ΔMARGIN	CFO	ΔLIQUID	ΔLEVER	ΔTURN	ACCRUAL	EQ_OFFER	F_SCORE
<i>RETURN</i>	-0.020	-0.016	-0.003	-0.016	0.050	0.053	-0.007	0.016	0.089	0.101
<i>RETURN2</i>	-0.025	-0.019	0.001	-0.015	0.012	0.151	-0.007	0.021	0.127	0.071
<i>MA_RET</i>	-0.008	-0.005	0.000	-0.010	0.051	0.016	-0.005	0.005	0.084	0.107
<i>MA_RET2</i>	-0.017	-0.010	0.013	-0.009	0.010	0.105	-0.004	0.015	0.120	0.079
<i>ROA</i>	1.000	0.965	-0.004	0.155	0.002	0.037	0.240	-0.963	0.053	0.431
<i>ΔROA</i>	-	1.000	-0.003	0.152	-0.007	0.044	0.349	-0.928	0.058	0.536
<i>ΔMARGIN</i>	-	-	1.000	-0.006	0.048	-0.070	-0.009	0.003	0.049	0.553
<i>CFO</i>	-	-	-	1.000	0.013	-0.020	0.686	0.117	-0.051	0.462
<i>ΔLIQUID</i>	-	-	-	-	1.000	-0.023	0.010	0.001	0.024	0.388
<i>ΔLEVER</i>	-	-	-	-	-	1.000	-0.011	-0.041	0.178	0.220
<i>ΔTURN</i>	-	-	-	-	-	-	1.000	-0.053	0.005	0.422
<i>ACCRUAL</i>	-	-	-	-	-	-	-	1.000	-0.067	0.175
<i>EQ_OFFER</i>	-	-	-	-	-	-	-	-	1.000	0.295

^aOne-year returns (RETURN) and two-year returns (RETURN2) are measured as the buy-and-hold returns starting in the fifth month after financial year-end. One-year market-adjusted returns (MA_RET) and two-year market-adjusted returns (MA_RET2) are measured as the buy-and-hold returns starting in the fifth month after financial year-end less the corresponding value-weighted market return over the holding period. All raw variables underlying the binary signals are as defined in table 1. The nine individual factors in this table represent indicator variables equal to one (zero) if the underlying performance measure was a good (bad) signal about future firm performance. The prefix ("F_") for the nine fundamental signals was eliminated for succinctness.

TABLE 3

Buy-and-Hold Returns to a Value Investment Strategy Based on Fundamental Signals

This table presents buy-and-hold returns associated with each of the ten possible outcomes for the Piotroski F_SCORE . F_SCORE is equal to the sum of nine individual signals, or $F_SCORE = F_ROA + F_ΔROA + F_CFO + F_ACCRUAL + F_ΔMARGIN + F_ΔTURN + F_ΔLEVER + F_ΔLIQUID + EQ_OFFER$, where each binary signal equals one (zero) if the underlying realisation is a good (bad) signal about future firm performance. A Low F_SCORE (equal to zero) means the firm possesses the least favorable set of financial signals and vice versa. The Low F_SCORE portfolio consists of firms with an aggregate score of 0 or 1 out of a minimum of 6 Piotroski variables, the High F_Score portfolio consists of firms with a score of 5 or 6 out of a total of 6 Piotroski variables, 6 or 7 out of a total of 7 Piotroski variables, 7 or 8 out of a total of 8 Piotroski variables or 8 or 9 out of a total of 9 Piotroski variables.

Panel A: One-Year Raw Returns - Cumulative by Percentile ^a

	Mean	10%	25%	50%	75%	90%	Proportion with Positive Signal	<i>n</i>
High Book-to-Market firms	0.3226	-0.6478	-0.4879	-0.2833	-0.1206	-0.0010	0.5289	346
<i>F_SCORE</i>								
0 (L)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
1 (L)	0.0663	-0.0079	-0.1144	-0.1672	-0.1910	-0.1912	0.4000	10
2	0.1060	-0.6721	-0.4856	-0.2635	-0.1219	0.0099	0.5806	31
3	0.1322	-0.5729	-0.4313	-0.2600	-0.1063	-0.0068	0.4655	58
4	0.0276	-0.6661	-0.5192	-0.3153	-0.1701	-0.0524	0.4615	65
5	0.1599	-0.6584	-0.4737	-0.2689	-0.1007	0.0160	0.5663	83
6 out of 6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
6 out of 7 (H)	-0.0531	0.0000	-0.4934	-0.2047	-0.0531	-0.0531	0.6667	3
6 out of 8 ^b	11.0476	0.0000	-0.8571	-0.4286	11.0476	11.0476	0.3333	3
6 out of 9	0.2728	-0.5251	-0.4125	-0.2428	-0.0668	0.0855	0.5000	52
7 out of 7 (H)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7 out of 8 (H)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7 out of 9 ^b	1.4154	-0.4242	-0.1990	-0.0555	0.1062	0.2373	0.7826	23
8 out of 8 (H)	1.1000	0.0000	0.0000	0.0000	1.1000	1.1000	0.5000	2
8 out of 9 (H)	0.2186	-0.5509	-0.2821	-0.1277	-0.0103	0.1313	0.7273	11
9 out of 9 (H)	0.1347	0.0000	-0.6000	-0.4316	-0.3682	-0.3317	0.2000	5
Low F_Score (L)	0.0663	-0.0079	-0.1144	-0.1672	-0.1910	-0.1912	0.4000	10
High F_Score (H)	0.2437	-0.6009	-0.4917	-0.2949	-0.1277	-0.0096	0.5714	21

High less All	-0.0789	0.0469	-0.0038	-0.0115	-0.0070	-0.0086	0.0425	-
High less Low	0.1774	-0.5930	-0.3773	-0.1276	0.0634	0.1816	0.1714	-
<i>t</i> -Statistic (High less All)	0.3748							
<i>t</i> -Statistic (High less Low)	0.5467							

Panel B: One-Year Market-Adjusted Returns^c

	Mean	10%	25%	50%	75%	90%	Proportion with Positive Signal	<i>n</i>
All Firms	0.1634	-0.7849	-0.6133	-0.4178	-0.2625	-0.1483	0.4075	346
<i>F_SCORE</i>								
0 (L)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
1 (L)	-0.1453	-0.2143	-0.3046	-0.3420	-0.3569	-0.3561	0.4000	10
2	-0.0391	-0.7823	-0.5973	-0.4131	-0.2648	-0.1241	0.3871	31
3	-0.0659	-0.7492	-0.6249	-0.4628	-0.2990	-0.2069	0.3793	58
4	-0.1063	-0.7426	-0.6113	-0.4277	-0.2870	-0.1829	0.3538	65
5	0.0252	-0.7679	-0.5678	-0.3718	-0.2154	-0.1155	0.4458	83
6 out of 6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
6 out of 7 (H)	-0.1158	0.0000	-0.2332	-0.1506	-0.1158	-0.1158	0.0000	3
6 out of 8	11.0067	0.0000	-0.8472	-0.2935	11.0067	11.0067	0.6667	3
6 out of 9	0.1052	-0.6782	-0.4986	-0.3417	-0.2024	-0.0677	0.4231	52
7 out of 7 (H)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7 out of 8 (H)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7 out of 9	1.2579	-0.7027	-0.4606	-0.2310	-0.0461	0.0921	0.5652	23
8 out of 8 (H)	1.0339	0.0000	0.0000	-0.2349	1.0339	1.0339	0.5000	2
8 out of 9 (H)	-0.0472	-0.5698	-0.4193	-0.3353	-0.2501	-0.1209	0.3636	11
9 out of 9 (H)	0.0877	0.0000	-0.6979	-0.5680	-0.4558	-0.3530	0.2000	5
Low <i>F_Score</i> (L)	-0.1453	-0.2143	-0.3046	-0.3420	-0.3569	-0.3561	0.4000	10
High <i>F_Score</i> (H)	0.0781	-0.7576	-0.5103	-0.3714	-0.2691	-0.1779	0.2857	21
High less All	-0.0853	0.0273	0.1030	0.0464	-0.0066	-0.0297	-0.1218	-
High less Low	0.2233	-0.5433	-0.2057	-0.0294	0.0878	0.1782	-0.1143	-
<i>t</i> -Statistic (High less All)	0.4258							
<i>t</i> -Statistic (High less Low)	0.6764							

Panel C: Two-Year Market-Adjusted Returns^b

	Mean	10%	25%	50%	75%	90%	Proportion with Positive Signal	<i>n</i>
All Firms	0.3810	-1.1232	-0.8758	-0.6379	-0.4107	-0.2555	0.3978	279
<i>F_SCORE</i>								
0 (L)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
1 (L)	-0.4466	-1.4836	-1.2532	-1.0288	-0.6595	-0.6585	0.3750	8
2	-0.0977	0.2214	-0.4174	-0.5369	-0.3517	-0.1940	0.4074	27
3	-0.1285	-1.1253	-0.9438	-0.5473	-0.4315	-0.1684	0.4082	49
4	-0.1816	-0.9956	-0.8459	-0.6575	-0.4708	-0.3343	0.3019	53
5	1.1897	-1.1309	-0.8313	-0.6016	-0.3787	-0.2166	0.3871	62
6 out of 6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
6 out of 7 (H)	3.3050	0.0000	-0.4758	-0.2126	3.3050	3.3050	0.6667	3
6 out of 8	1.0954	0.0000	-0.4329	-0.1675	1.0954	1.0954	0.6667	3
6 out of 9	0.3594	-0.9356	-0.7288	-0.5671	-0.3494	-0.2233	0.3571	42
7 out of 7 (H)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7 out of 8 (H)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7 out of 9	1.3259	-0.7773	-0.5967	-0.3494	-0.0776	0.0898	0.5556	18
8 out of 8 (H)	0.0764	0.0000	0.0000	0.0338	0.0764	0.0764	1.0000	2
8 out of 9 (H)	0.0933	-0.8010	-0.7259	-0.3293	-0.0025	0.0933	0.5556	9
9 out of 9 (H)	-0.3192	0.0000	-0.9832	-0.5852	-0.5852	-0.3192	0.3333	3
Low <i>F_Score</i> (L)	-0.4466	-1.4836	-1.2532	-1.0288	-0.6595	-0.6585	0.3750	8
High <i>F_Score</i> (H)	0.5853	-0.8921	-0.7277	-0.4284	-0.1922	-0.0833	0.5882	17
High <i>less</i> All	0.2043	0.2311	0.1481	0.2095	0.2185	0.1722	0.1904	-
High <i>less</i> Low	1.0319	0.5915	0.5256	0.6004	0.4673	0.5752	0.2132	-
<i>t</i> -Statistic (High <i>less</i> All)	0.3187							
<i>t</i> -Statistic (High <i>less</i> Low)	1.4777							

^aRaw returns are calculated as 12- and 24-month buy-and-hold returns starting at the beginning of the fifth month after financial year-end.

^bThe unusual means for 6 out of 8 and 7 out of 9 Piotroski variables are due to two individual shares i.e. CPN and SVB respectively. Due to equal weighting in each of their respective Piotroski *F_Score* portfolios and their significant share price growth, portfolio means for these two Piotroski *F_Score* portfolios have been skewed.

^cMarket adjusted returns are calculated as 12- and 24-month buy-and-hold returns starting at the beginning of the fifth month after financial year-end less the buy-and-hold return on the market index over this same investment horizon.

This lack of statistical significance over a 12-month period does in fact make sense as further analysis of these returns does show that the high *F_SCORE* portfolio has not shifted the return distribution in a positive direction but simply resulted in a greater spread with a greater net positive result. In fact, there are relatively fewer high *F_SCORE* firms with positive returns than there are low *F_SCORE* firms with positive returns which is in itself quite concerning.

Clear observable benefit is only evident when analysing 24-month returns. In this case the entire return distribution is shifted in a favourable manner when investing in high *F_SCORE* firms and the result is that these high *F_SCORE* firms outperform both the entire high book-to-market portfolio and low *F_SCORE* portfolio by quite some margin.

Overall, it is possible to surmise that *F_SCORE* can pick firms with poor future return performance and that both the market and high *F_SCORE* portfolio will substantially outperform these firms. It is at this stage unclear as to whether *F_SCORE* can pick firms with superior future returns over and above those returns realised by a portfolio of high book-to-market firms. If *F_SCORE* were able to achieve this goal in a South African context it would likely only be possible over a longer investment horizon where high *F_SCORE* firms demonstrate returns well in excess of the market-at-large, a high book-to-market portfolio and low *F_SCORE* firms. It would also appear that this methodology can be applied to the South African market although with less statistically significant and credible outcomes than have been obtained elsewhere and with some effort required to ensure as large a dataset as possible and appropriate data integrity.

4.3 RETURNS CONDITIONAL ON FIRM SIZE, FINANCIAL DISTRESS OR HISTORICAL CHANGE IN PROFITABILITY – INITIAL PIOTROSKI SAMPLE

A key question is whether further partitioning of data will indicate areas in which Piotroski's methodology and sample selection criteria can yield statistically significant or simply improved results. In particular, further allocation in to firm size, level of financial distress and historical change in profitability is considered. In the case of firm size firms are classified in to upper, middle and lower tercile groups within the total population. Size allocation is based on the market capitalisation of each of the individual firms at year-end. The historical change in profitability is as calculated for use in Piotroski's ΔROA variable and firms within the selected sample are allocated to either a high, moderate or low ΔROA group. ΔROA had the strongest correlation to *F_SCORE* in table 2 thus the high ΔROA partition should consist primarily of high *F_SCORE* firms. Financial distress is determined with reference to each firm's specific Z-Score as calculated in accordance with Altman's seminal

paper. A Z-Score in excess of 2.99 is considered to indicate a firm that is financially sound while a Z-Score below 1.81 is considered to indicate a firm in financial distress. Tables 4 and 5 present the various outcomes of these further partitions.

As should be expected with high book-to-market firms, the vast majority are within the bottom third of market capitalisation (68%) while just a few (7%) fall within the top size portfolio. Table 4 provides one-year market-adjusted returns based on these size categories. It is clear that none of the size partitions result in the high F_SCORE firms outperforming the high book-to-market firms that fall within that same size partition. What is fascinating is that only in the small firm partition do we see high F_SCORE firms outstripping low F_SCORE counterparts. It would thus be possible to further improve upon the high *less* low F_SCORE returns as evidenced in table 1 panels A through C by including a size partition. It should be noted that, while this partition does have some limited information content, Piotroski was able to show statistical significance in both the small and medium firm categories and thus gained far more value from this additional analysis.

Classification of high book-to-market firms into financial distress partitions brought even more differences to light. Piotroski found nearly half of his high book-to-market firms to be financially distressed and indeed, this would be in line with accepted norms for a portfolio comprised of these high book-to-market firms. This is not the case in South Africa with just 28% of firms within the Piotroski high book-to-market portfolio falling within Altman's zone of financial distress. Once again, results are mixed. Firms identified as having low financial distress earn significantly stronger future returns than either high distress or intermediate distress firms. In addition, these firms earn future returns far in excess of both the market and a portfolio comprised of all high book-to-market firms. Disappointingly, this success does not transfer to high F_SCORE firms which now underperform the market and drastically underperform the average low distress firm. Despite the difference between low and high F_SCORE firms in this partition yielding the first statistically significant result thus far, both return sets are negative once adjusted for the market and thus little value is created.

Finally, results for ΔROA reflect the correlation with F_SCORE as determined in table 2. High and medium ΔROA firms do not have low F_SCOREs while low ΔROA firms do not have high F_SCOREs . ΔROA is thus further confirmed to be the best proxy for the aggregate F_SCORE should this be required.

TABLE 4
*One-Year Market-Adjusted Buy-and-Hold Returns to a Value Investment Strategy Based
on Fundamental Signals by Size Partition^a*

	Small Firms			Medium Firms			Large Firms		
	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>
All Firms	0.2482	-0.1334	235	-0.0546	-0.0906	88	0.1570	0.1309	24
<i>F_SCORE</i>									
0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
1	-0.4088	-0.6733	7	0.6276	0.6276	2	0.1539	0.1539	1
2	-0.0351	-0.2025	22	-0.1551	-0.1369	7	0.3230	0.3230	2
3	-0.0697	-0.2307	41	-0.0686	-0.0009	16	-0.1645	-0.1645	2
4	-0.1492	-0.2157	39	-0.1162	-0.1381	20	0.2059	0.2465	6
5	0.0209	-0.1140	47	-0.0083	-0.0839	28	0.1679	0.1329	8
6	0.8850	-0.0660	44	-0.1103	-0.1868	10	0.0772	-0.0151	4
7	1.5057	0.0892	19	-0.0291	-0.1254	3	0.4101	0.4101	1
8	0.1524	-0.1334	11	-0.0641	-0.0641	2	N/A	N/A	0
9	0.0877	-0.2313	5	N/A	N/A	N/A	N/A	N/A	0
Low <i>F_Score</i>	-0.4088	-0.6733	7	0.6276	0.6276	2	0.1539	0.1539	1
High <i>F_Score</i>	0.0642	-0.2353	17	-0.2973	-0.2973	3	-0.0461	-0.0461	1
High <i>less</i> All	-0.1841	-0.1019		-0.2427	-0.2067		-0.2032	-0.1770	
High <i>less</i> Low	0.4730	0.4381		-0.9249	-0.9249		-0.2000	-0.2000	
<i>t</i> -Statistic (High <i>less</i> All)		0.4752			0.1494			N/A	
<i>t</i> -Statistic (High <i>less</i> Low)		1.3466			1.0306			N/A	

^aEach year, all companies having sufficient data to provide a credible *F_SCORE* which fall in to the high book-to-market quintile of the market are further allocated to size terciles with reference to the most recent financial year-end market capitalisation. This method yields a small, medium, and large company High book-to-market portfolio each year. All other definitions and statistics are as described in table 3.

TABLE 5*Ability of Alternative Historical Financial Measures to Differentiate Winners from Losers*

Panels A and B below illustrate the relationship between one-year market-adjusted returns, financial distress and change in profitability. Each year, Altman's Z-Score is calculated from the most recent financial year-end data available. Companies are classified according to this Z-Score^a as being either Highly distressed, moderately distressed or minimally distressed. Historical change in profitability is measured using ΔROA as previously defined.

Panel A: Financial Distress

	High Distress			Indeterminate Distress			Low Distress		
	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>
All Firms	-0.0628	-0.1750	97	0.0226	-0.0752	55	0.3227	-0.0650	194
Low F_Score	0.3554	0.1539	5	N/A	N/A	0	-0.6459	-0.6979	5
High F_Score	-0.2173	-0.2582	5	-0.4381	-0.4381	1	-0.0257	-0.3151	15
High less All	-0.1545	-0.0833	-	-0.4607	-0.3629	-	-0.3484	-0.2501	-
High less Low	-0.5727	-0.4121	-	N/A	N/A	-	0.6202	0.3828	-
<i>t</i> -Statistic (High less All)	0.7395			N/A			0.4526		
<i>t</i> -Statistic (High less Low)	1.0326			N/A			2.8239		

Panel B: Historical Change in Profitability

	High ΔROA			Medium ΔROA			Low ΔROA		
	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>
All Firms	0.3759	-0.0998	108	0.2486	-0.0383	109	-0.0955	-0.1139	109
Low Score	N/A	N/A	0	N/A	N/A	0	-0.2145	-0.5747	7
High Score	-0.1040	-0.3298	12	-0.0328	-0.1690	7	N/A	N/A	0
High less All	-0.4799	-0.2300	-	-0.2815	-0.1308	-	N/A	N/A	-
High less Low	N/A	N/A	-	N/A	N/A	-	N/A	N/A	-
<i>t</i> -Statistic (High less All)	0.5700			0.7395			N/A		
<i>t</i> -Statistic (High less Low)	N/A			N/A			N/A		

^aA Z-Score above 2.99 is considered by Altman to signify a financially sound company while a signal below 1.81 is considered to represent a financially distressed company.

4.4 HIGH BOOK-TO-MARKET FIRM EMPIRICAL ATTRIBUTES – SAMPLE 2

Due to the inconclusive results achieved above through as strict an application of Piotroski's methodology as possible, it is necessary to consider alternative applications. It would appear from the online publication by PowerStocks Research (<http://powerstocks.co.za/piotroskilonqtest.php>) that it is possible to apply the Piotroski *F_SCORE* effectively. Admittedly, no mention is made of statistical significance and advantages noted may thus simply be sample specific. One key difference noted is the criteria applied for the selection of high book-to-market firms and inclusion of an analysis with reference to the market as a whole. Accordingly, Table 6 provides financial and return characteristics of firms having a book-to-market ratio greater than or equal to one. As a book-to-market ratio greater than one means that the net asset value of a firm exceeds its market capitalisation, this is felt to be a fair cut-off for high book-to-market classification. Classification on this basis results in fewer high book-to-market firms in years of economic prosperity but more in years of financial turmoil and stock market depression. Firms having a book-to-market ratio greater than or equal to one are selected from each financial year between 2005 and 2010.

As can be seen in panel A of table 6, the average firm within this portfolio has a book-to-market ratio of 1.7221 which is noticeably lower than that of the average firm in Piotroski's high book-to-market portfolio as a result of additional high book-to-market firms being included in the sample. This extended sample in turn yields a slightly less favourable set of financial characteristics than evidenced previously and likewise a slightly diminished 12- and 24-month return and market-adjusted return. Thus, once again we can see that firms having high book-to-market ratios tend to exhibit poor financial performance and yet the mean of each individual characteristic still tends to be positive indicating several financially superior firms outweighing the majority of financially weak firms. Panel B still shows that a portfolio comprised of high book to market firms does earn positive market-adjusted returns in the period following portfolio formations and that this is despite a majority of these firms earning negative market-adjusted returns.

Eliminating these underperforming firms which form the majority of this and the previous high book-to-market portfolio will inevitably improve the portfolio's mean return performance.

4.5 PIOTROSKI *F_SCORE* STRATEGY RETURNS - SAMPLE 2

Revised Spearman correlations between each individual Piotroski variable, one- and two-year returns, one- and two-year market-adjusted returns and the combined *F_SCORE* for the amended sample of high book-to-market firms are presented in Table 7. Returns are still not as strongly correlated with *F_SCORE* as was evidenced in Piotroski's paper and all correlations have declined slightly, once again a result of the extended sample. Still of concern is the stronger correlation between $\Delta LEVER$ and two-year market-adjusted returns and *EQ_OFFER* and two-year market-adjusted returns than *F_SCORE* and two-year market-adjusted returns. This would seem to imply that over a longer investment period an aggregate financial performance measure may actually hold less value than an individual financial signal provided it is appropriately selected.

Table 8 shows the returns available to an investor using a book-to-market ratio greater than or equal to one to construct a high book-to-market portfolio and then applying Piotroski's *F_SCORE* to this. Panel A provides raw return distributions for a 12-month buy-and-hold investment strategy, Panel B provides market-adjusted return distributions over this same period and Panel C provides market adjusted return distributions for a 24-month buy-and-hold investment strategy.

Of interest is that despite the increase in sample size by 84 data points or 24%, the ratio of firms having unexceptional performance has not changed at all and the proportion of high and low *F_SCORE* firms has remained constant – once again confirming that the distribution of firms within a high book-to-market portfolio in South Africa differs to that as identified by Piotroski in America. Barring one or two anomalies, it is once again clear that higher the 90% confidence level. The single most remarkable change is that the proportion of firms generating a positive market return has increased dramatically in this revised high *F_SCORE* portfolio and now outweighs the proportion of low *F_SCORE* firms having a positive market return.

F_SCORE firms tend to have positive market adjusted returns and lower *F_SCORE* firms tend to have negative market adjusted returns. This holds true for both 12- and 24- month return distributions. This relationship is in turn mirrored in the mean return of both the high and low *F_SCORE* portfolios. What is especially evident with this extended sample is that mean returns do seem to have shifted in a positive direction with every single percentile showing a slightly better return than that of the market and certainly better than that of low *F_SCORE* counterparts. This has resulted in very little difference between the mean return of a high *F_SCORE* portfolio and high book-to-market portfolio and a less pronounced but more consistent return over that of the low *F_SCORE* portfolio.

TABLE 6

Financial and Return Characteristics of High Book-to-Market Firms having a book to market ratio greater than or equal to one

Panel A: Financial Characteristics				
Variable	Mean	Median	Standard Deviation	Proportion with Positive Signal
<i>MVE</i> ^a	1425.1890	161.1300	4599.4637	N/A
<i>ASSETS</i> ^b	6822.6914	538.6130	36700.3436	N/A
<i>BM</i> ^c	1.7221	1.4707	0.7312	N/A
<i>ROA</i> ^d	1.5930	0.0467	24.8155	0.7495
ΔROA ^e	1.0262	-0.0066	26.0977	0.4388
$\Delta MARGIN$ ^f	-0.0163	-0.0046	2.4876	0.4458
<i>CFO</i> ^g	0.4314	0.0344	6.7606	0.6932
$\Delta LIQUID$ ^h	-0.0055	-0.0280	8.1777	0.4574
$\Delta LEVER$ ⁱ	0.0910	-0.0009	0.3944	0.5158
$\Delta TURN$ ^j	1.4776	-0.0398	88.7338	0.3676
<i>ACCRUAL</i> ^k	-1.1635	-0.0004	24.6740	0.4967

Panel B: Buy-and-Hold Returns for all companies				
Returns ^l	Mean	Median	Proportion with Positive Signal	
One-Year Returns				
Raw	0.2966	0.0929	0.5793	
Market-Adjusted	0.1199	-0.0510	0.4404	
Two-Year Returns				
Raw	0.6883	0.1032	0.5563	
Market-Adjusted	-0.3460	-0.1860	0.4038	

In fact, this extension in sample size, despite leading to a slight deterioration in almost all financial and return characteristics as indicated in table 6, has negated the negative performance of high *F_SCORE* firms relative to a portfolio of high book-to-market firms as previously experienced and evidenced in table 3 and has resulted in a statistically significant difference between the low and high *F_SCORE* means over a 24-month investment period at

Overall, it is clearly observable that *F_SCORE* can pick firms with poor future return performance and that both the market and high *F_SCORE* portfolio will substantially outperform these firms. In addition, it now appears likely that *F_SCORE* can pick firms with future returns at least equivalent to those returns realised by a portfolio of high book-to-market firms and indeed, over a 24-month investment horizon it is even more likely than that a high *F_SCORE* portfolio will earn returns well in excess of those earned from a high book-to-market portfolio.

4.6 RETURNS CONDITIONAL ON FIRM SIZE, FINANCIAL DISTRESS OR HISTORICAL CHANGE IN PROFITABILITY - SAMPLE 2

As before, it remains to be seen whether or not further partitioning of data will indicate areas in which Piotroski's methodology and sample selection criteria can yield statistically significant or simply improved results and further support the application of Piotroski's *F_SCORE* as a viable investment screen. Firm size, level of financial distress and historical change in profitability will once again form the required partitions. Tables 9 and 10 present the various outcomes of these further partitions.

The vast majority of high book-to-market firms are within the bottom third of market capitalisation (64%) while just a few (9%) fall within the top size portfolio. Table 9 provides one-year market-adjusted returns based on these size categories. With the introduction of additional high book-to-market firms in to the sample, medium size high *F_SCORE* firms now outperform their high book-to-market size counterparts. This is consistent with Piotroski's findings although there is still no statistical significance to support this observation and the fact that it does not extend to the small firm size portfolio sheds any significance of this finding in a doubtful light. What is however still evident is that only in the small firm partition do we see high *F_SCORE* firms outstripping low *F_SCORE* counterparts. It is thus still possible to further improve upon the high *less* low *F_SCORE* returns by including a size partition.

Classification of high book-to-market firms in to financial distress partitions has become a much more rewarding task with the introduction of additional firms in to the sample. The table shows that firms in both the high and intermediate categories of distress earn negative market-adjusted returns and that *F_SCOREs* appear to have little informational content in these scenarios. However, low distress firms yield highly positive mean returns well in excess of the mean returns available to be earned by simply investing in a high book-to-market portfolio and in addition, a high *F_SCORE* portfolio comprised of low distress firms – while not performing as well as a portfolio of low distress but high book-to-market firms - does improve returns as compared to normal high *F_SCORE* firms by 73%. Note that it is still considered an anomaly that such a relatively small percentage of relatively high-risk high book-to-market firms are considered to be financially distressed. Also note the statistical difference between the mean return of high and low *F_SCORE* firms with low financial distress at the 95% confidence level.

TABLE 7

Spearman Correlation Analysis between One- and Two-Year Market-Adjusted Returns, the Nine Fundamental Signals, and the Composite Signal (F_SCORE) for High Book-to-Market Firms with a book-to-market ratio greater than or equal to one^a

	ROA	ΔROA	ΔMARGIN	CFO	ΔLIQUID	ΔLEVER	ΔTURN	ACCRUAL	EQ_OFFER	F_SCORE
RETURN	-0.019	-0.015	-0.005	-0.016	0.051	0.056	-0.006	0.015	0.085	0.099
RETURN2	-0.025	-0.018	0.001	-0.016	0.019	0.157	-0.005	0.021	0.137	0.089
MA_RET	-0.006	-0.003	-0.001	-0.009	0.053	0.022	-0.004	0.004	0.085	0.104
MA_RET2	-0.016	-0.009	0.013	-0.009	0.020	0.118	-0.003	0.013	0.131	0.095
ROA	1.000	0.965	-0.004	0.157	0.003	0.044	0.240	-0.963	0.050	0.409
ΔROA	-	1.000	-0.003	0.153	-0.004	0.049	0.349	-0.928	0.053	0.542
ΔMARGIN	-	-	1.000	-0.006	0.040	-0.071	-0.008	0.003	0.031	0.517
CFO	-	-	-	1.000	0.014	-0.017	0.690	0.116	-0.040	0.471
ΔLIQUID	-	-	-	-	1.000	-0.022	0.011	0.001	0.027	0.362
ΔLEVER	-	-	-	-	-	1.000	-0.010	-0.047	0.178	0.265
ΔTURN	-	-	-	-	-	-	1.000	-0.052	0.004	0.424
ACCRUAL	-	-	-	-	-	-	-	1.000	-0.061	0.264
EQ_OFFER	-	-	-	-	-	-	-	-	1.000	0.346

TABLE 8

Buy-and-Hold Returns to a Value Investment Strategy Based on Fundamental Signals

Panel A: One-Year Raw Returns^a

	Mean	10%	25%	50%	75%	90%	Proportion with Positive Signal	<i>n</i>
All Firms	0.2966	-0.6589	-0.4757	-0.2570	-0.0919	0.0215	0.5791	430
<i>F_SCORE</i>								
0 (L)	-0.1124	0.0000	0.0000	-0.1124	-0.1124	-0.1124	0.0000	1
1 (L)	0.1609	-0.6596	-0.5852	-0.4491	-0.2633	0.0216	0.4615	13
2	0.0146	-0.6777	-0.5636	-0.3179	-0.1715	-0.0694	0.5405	37
3	0.1410	-0.6139	-0.4584	-0.2565	-0.1013	0.0103	0.5278	72
4	0.0532	-0.6991	-0.5246	-0.3048	-0.1442	-0.0344	0.5172	87
5	0.1694	-0.6487	-0.4515	-0.2326	-0.0693	0.0397	0.6020	98
6 out of 6	0.2500	0.0000	0.0000	0.2500	0.2500	0.2500	1.0000	1
6 out of 7 (H)	0.1670	0.0000	0.0841	0.0841	0.1670	0.1670	1.0000	2
6 out of 8	11.0476	0.0000	-0.8571	-0.4286	-0.4286	11.0476	0.3333	3
6 out of 9	0.2817	-0.5104	-0.3730	-0.1854	-0.0253	0.1004	0.5932	59
7 out of 7 (H)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7 out of 8 (H)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7 out of 9	1.1074	-0.3680	-0.1874	-0.0353	0.1339	0.2330	0.7813	32
8 out of 8 (H)	1.1000	0.0000	0.0000	0.0000	1.1000	1.1000	0.5000	2
8 out of 9 (H)	0.2501	-0.4304	-0.2469	-0.0475	0.0707	0.2501	0.8000	15
9 out of 9 (H)	0.2169	-0.4316	-0.3682	-0.1987	-0.0378	0.2169	0.5000	8
Low <i>F_Score</i> (L)	0.1414	-0.1124	-0.5079	-0.4382	-0.3087	0.0113	0.4286	14
High <i>F_Score</i> (H)	0.2954	-0.6149	-0.3740	-0.1447	-0.0070	0.0851	0.7143	27
High <i>less</i> All	-0.0012	0.0440	0.1017	0.1123	0.0850	0.0636	0.1352	-
High <i>less</i> Low	0.1540	-0.5025	0.1340	0.2936	0.3018	0.0739	0.2857	-
<i>t</i> -Statistic (High <i>less</i> All)	0.0051							
<i>t</i> -Statistic (High <i>less</i> Low)	0.6017							

Panel B: One-Year Market-Adjusted Returns^a

	Mean	10%	25%	50%	75%	90%	Proportion with Positive Signal	<i>n</i>
All Firms	0.1199	-0.8278	-0.6417	-0.4249	-0.2595	-0.1491	0.4372	431
<i>F_SCORE</i>								
0 (L)	-0.1732	0.0000	0.0000	-0.1732	-0.1732	-0.1732	0.0000	1
1 (L)	-0.0337	-0.9537	-0.8197	-0.6918	-0.4623	-0.1714	0.4615	13
2	-0.1577	-0.8179	-0.6876	-0.4941	-0.3524	-0.2399	0.3243	37
3	-0.0673	-0.7935	-0.6506	-0.4620	-0.2998	-0.1947	0.3889	72
4	-0.1059	-0.8141	-0.6684	-0.4533	-0.2938	-0.1919	0.4138	87
5	0.0093	-0.8284	-0.6005	-0.3891	-0.2184	-0.1184	0.4694	98
6 out of 6	-0.0425	0.0000	0.0000	-0.0425	-0.0425	-0.0425	1.0000	1
6 out of 7 (H)	-0.0571	0.0000	-0.0680	-0.0680	-0.0571	-0.0571	0.0000	2
6 out of 8	11.0067	0.0000	-0.8472	-0.2935	-0.2935	11.0067	0.6667	3
6 out of 9	0.1054	-0.6492	-0.4845	-0.3083	-0.1780	-0.0627	0.4576	59
7 out of 7 (H)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7 out of 8 (H)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7 out of 9	0.8858	-0.7922	-0.5142	-0.2859	-0.0889	0.0229	0.5758	32
8 out of 8 (H)	1.0339	0.0000	0.0000	-0.2349	1.0339	1.0339	0.5000	2
8 out of 9 (H)	0.0311	-0.5989	-0.4519	-0.2590	-0.1468	0.0311	0.5333	15
9 out of 9 (H)	0.1597	-0.5680	-0.4558	-0.2567	-0.0819	0.1597	0.5000	8
Low <i>F_Score</i> (L)	-0.0437	-0.1732	-0.6946	-0.6647	-0.4360	-0.1715	0.4286	14
High <i>F_Score</i> (H)	0.1305	-0.7396	-0.4899	-0.2998	-0.1835	-0.0860	0.4643	27
High less All	0.0106	0.0882	0.1518	0.1252	0.0760	0.0631	0.0271	-
High less Low	0.1742	-0.5664	0.2047	0.3649	0.2525	0.0855	0.0357	-
<i>t</i> -Statistic (High less All)	0.0523							
<i>t</i> -Statistic (High less Low)	0.6624							

Panel C: Two-Year Market-Adjusted Returns^a

	Mean	10%	25%	50%	75%	90%	Proportion with Positive Signal	<i>n</i>
All Firms	0.3460	-1.1626	-0.9098	-0.6582	-0.4253	-0.2575	0.3160	307
<i>F_SCORE</i>								
0 (L)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
1 (L)	-0.4576	-1.4836	-0.6415	-0.6983	-0.7607	-0.6244	0.3000	10
2	-0.2635	-1.2544	-1.0768	-0.8279	-0.5967	-0.4355	0.2759	29
3	-0.1176	-1.1476	-0.9849	-0.7207	-0.4786	-0.3068	0.3750	56
4	-0.2132	-1.1017	-0.9239	-0.7280	-0.5369	-0.3860	0.3175	63
5	1.1635	-1.2503	-0.8587	-0.5896	-0.3667	-0.2177	0.4063	64
6 out of 6	-0.5187	0.0000	0.0000	-0.5187	-0.5187	-0.5187	0.0000	1
6 out of 7 (H)	5.1953	0.0000	0.0506	0.0506	5.1953	5.1953	1.0000	2
6 out of 8	1.0954	0.0000	-0.4329	-0.1675	-0.1675	1.0954	0.6667	3
6 out of 9	0.4634	-0.9994	0.4634	-0.4865	-0.2822	-0.1415	0.4545	44
7 out of 7 (H)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7 out of 8 (H)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7 out of 9	1.2301	-0.8738	-0.6593	0.7973	-0.1370	0.0348	0.5500	20
8 out of 8 (H)	0.0764	0.0000	0.0338	0.0338	0.0764	0.0764	1.0000	2
8 out of 9 (H)	0.3034	-0.6507	-0.4304	-0.0786	0.1327	0.2239	0.7500	8
9 out of 9 (H)	0.1446	-0.9832	-0.9832	-0.3192	-0.0595	0.1446	0.6000	5
Low <i>F_Score</i> (L)	-0.4576	-1.4836	-0.6415	-0.6983	-0.7607	-0.6244	0.3000	10
High <i>F_Score</i> (H)	0.7319	-0.8169	-0.5907	-0.2420	-0.0367	0.0676	0.7647	17
High <i>less</i> All	0.3859	0.3456	0.3191	0.4162	0.3886	0.3251	0.4487	-
High <i>less</i> Low	1.1895	0.6667	0.0508	0.4563	0.7241	0.6920	0.4647	-
<i>t</i> -Statistic (High <i>less</i> All)	0.6347							
<i>t</i> -Statistic (High <i>less</i> Low)	1.8841							

TABLE 9
*One-Year Market-Adjusted Buy-and-Hold Returns to a Value Investment Strategy Based
on Fundamental Signals by Size Partition^a*

	Small Firms			Medium Firms			Large Firms		
	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>
All Firms	0.1893	-0.1334	275	-0.0304	-0.0224	119	0.1109	0.0775	37
<i>F_SCORE</i>									
0	N/A	N/A	0	-0.1732	-0.1732	1	N/A	N/A	0
1	-0.1847	-0.6005	10	0.6276	0.6276	2	0.1539	0.1539	1
2	-0.1466	-0.2878	26	-0.3900	-0.2315	6	0.0633	0.0416	5
3	-0.1067	-0.3000	45	0.0065	0.0138	22	-0.0377	-0.0752	5
4	-0.1537	-0.2157	53	-0.1245	-0.0361	25	0.2269	0.2078	9
5	-0.0079	-0.0998	56	0.0104	-0.0238	33	0.1129	0.1474	9
6	0.8514	-0.0465	46	-0.0261	-0.0067	13	0.0430	-0.0249	6
7	1.4350	0.1784	20	0.0025	-0.0378	11	0.2524	0.2524	2
8	0.2029	-0.0459	12	0.0198	0.0442	5	N/A	N/A	0
9	0.1139	-0.0446	7	0.4799	0.4799	1	N/A	N/A	0
Low <i>F_Score</i>	-0.1847	-0.6005	10	0.3607	0.0491	3	0.1539	0.1539	1
High <i>F_Score</i>	0.1149	-0.0999	21	0.0965	0.1256	6	-0.0461	-0.0461	1
High <i>less</i> All	-0.0744	0.0335		0.1269	0.1479		-0.1570	-0.1236	
High <i>less</i> Low	0.2996	0.5006		-0.2642	0.0764		-0.2000	-0.2000	
<i>t</i> -Statistic (High <i>less</i> All)	0.1771			0.5531			N/A		
<i>t</i> -Statistic (High <i>less</i> Low)	0.9939			0.5851			N/A		

TABLE 10

Ability of Alternative Historical Financial Measures to Differentiate Winners from Losers

Panel A: Financial Distress									
	High Distress			Indeterminate Distress			Low Distress		
	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>
All Firms	-0.0622	-0.1442	115	-0.0724	-0.1077	77	0.2730	-0.0240	239
Low F_Score	0.4506	0.1539	7	-0.3632	-0.3632	1	-0.5671	-0.6856	6
High F_Score	-0.2173	-0.2582	5	-0.1582	-0.1582	3	0.2262	0.0863	20
High less All	-0.1552	-0.1141	-	-0.0858	-0.0505	-	-0.0469	0.1103	-
High less Low	-0.6680	-0.4121	-	0.2051	0.2051	-	0.7933	0.7719	-
<i>t</i> -Statistic (High less All)	0.8192			0.0961			0.1847		
<i>t</i> -Statistic (High less Low)	1.6006			N/A			3.2504		
Panel B: Historical Change in Profitability									
	High ΔROA			Medium ΔROA			Low ΔROA		
	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>
All Firms	0.0410	-0.0393	143	0.4499	-0.0167	144	-0.1258	-0.2008	144
Low Score	-0.1047	-0.1047	2	N/A	N/A	0	-0.0335	-0.3739	12
High Score	0.3001	0.1642	9	0.0425	-0.0684	17	-0.2012	-0.2012	1
High less All	0.2591	0.2035	-	-0.4074	-0.0517	-	-0.0754	-0.0004	-
High less Low	0.4048	0.2689	-	N/A	N/A	-	-0.1677	0.1727	-
<i>t</i> -Statistic (High less All)	0.8858			1.1483			N/A		
<i>t</i> -Statistic (High less Low)	1.0517			N/A	N/A		N/A		

Finally, results for ΔROA reflect the correlation with F_SCORE as determined in table 7. High and medium ΔROA firms tend not to have low F_SCOREs while low ΔROA firms tend not to have high F_SCOREs . ΔROA is thus further confirmed to be the best individual proxy for the aggregate F_SCORE .

4.7 ALL FIRMS EMPIRICAL ATTRIBUTES

The last sample against which to test the ability of Piotroski's F_SCORE to separate winners from losers must simply be the market as a whole. The obvious lack of consistent and statistically significant results might be an indication of application to an inappropriate sample rather than lack of applicability of the technique. Table 11 provides financial and return characteristics for all companies listed on the JSE over the period 2005 to 2010.

Of particular interest is that general firm characteristic's of the market reflect those of high book-to-market firms but with less variability. This would imply that high book-to-market firms in South Africa do not have significantly different financial profiles. Year-on-year earnings, profitability, and turnover are all negative while leverage for the average firm has increased marginally. The fact that the mean market-adjusted return is negative for both a 12- and 24-month period may appear strange but is in fact a result of missing data. Several companies had to be eliminated from both 2010 and 2009 for want of final share price data. In order to calculate returns for 12- or 24- months beginning 5-months after financial year-end share price data well in to 2011 would be required. In addition, several companies had to be excluded from this analysis due to insufficient financial information being readily available.

4.8 PIOTROSKI F_SCORE STRATEGY RETURNS - SAMPLE 3

Table 12 provides Spearman correlations for each of the 9 Piotroski indicator variables, the aggregate F_SCORE and market returns being both adjusted and raw. It is most interesting to note that now, unlike previously, F_SCORE is without doubt the variable most closely associated with future returns over both a 12- and 24-month period. As is to be expected, and also evident in all previous results, ΔROA , $\Delta MARGIN$ as well as CFO are the Piotroski indicator variables with the most explanatory power for the aggregate F_SCORE but individually have little ability to explain future return performance. Table 13 lays out the returns available to an investor using Piotroski's F_SCORE to select financially sound firms within the market-at-large. While approximately 91.5% of the market falls within unexceptional F_SCORE categories and 6.5% of the market is considered to have a high

TABLE 11

Financial and Return Characteristics of all JSE listed companies

Panel A: Financial Characteristics				
Variable	Mean	Median	Standard Deviation	Proportion with Positive Signal
<i>MVE</i> ^a	14805.1130	1048.9755	68144.8946	N/A
<i>ASSETS</i> ^b	18461.9232	998.3710	94665.5764	N/A
<i>BM</i> ^c	0.7095	0.5315	0.8199	N/A
<i>ROA</i> ^d	0.4744	0.0856	12.5251	0.8122
ΔROA ^e	0.0462	-0.0013	17.5855	0.4824
$\Delta MARGIN$ ^f	-0.0641	-0.0002	2.9126	0.4941
<i>CFO</i> ^g	0.1006	0.0498	4.3378	0.7254
$\Delta LIQUID$ ^h	-0.4071	0.0021	21.7358	0.5081
$\Delta LEVER$ ⁱ	0.1036	-0.0006	0.4780	0.4861
$\Delta TURN$ ^j	0.4488	-0.0002	45.5168	0.4828
<i>ACCRUAL</i> ^k	-0.3778	-0.0124	12.8188	0.4382

Panel B: Buy-and-Hold Returns from a High Book-to-Market Investment Strategy				
Returns ^l	Mean	Median	Proportion with Positive Signal	
One-Year Returns				
Raw	0.1902	0.0556	0.5526	
Market-Adjusted	-0.0474	-0.1339	0.3629	
Two-Year Returns				
Raw	0.3206	0.0079	0.5040	
Market-Adjusted	-0.0556	-0.2658	0.3284	

F_SCORE, the number of financially weak firms has almost halved to just 1.8% of the total population.

The positive relationship between *F_SCORE* and mean return as previously commented upon is still evident and the positive shift in the return distribution by investing in high *F_SCORE* firms is once again clear – if not in fact even clearer than before with all but one percentile bracket being positive for high as compared to all firms in the sample and low *F_SCORE* firms. Most importantly, high *F_SCORE* portfolios now outperform the market, population from which they are drawn and low *F_SCORE* firms without exception. It appears once again that an increased sample size allows for a more reliable and robust implementation of Piotroski's *F_SCORE*.

TABLE 12

Spearman Correlation Analysis between One- and Two-Year Market-Adjusted Returns, the Nine Fundamental Signals, and the Composite Signal (F_SCORE_ for High Book-to-Market Firms^a

	ROA	ΔROA	ΔMARGIN	CFO	ΔLIQUID	ΔLEVER	ΔTURN	ACCRUAL	EQ_OFFER	F_SCORE
<i>RETURN</i>	-0.013	-0.001	-0.064	-0.008	0.013	0.052	0.000	0.010	0.067	0.033
<i>RETURN2</i>	-0.016	-0.008	-0.069	-0.006	-0.001	0.132	-0.001	0.014	0.111	0.035
<i>MA_RET</i>	-0.005	0.005	-0.064	-0.003	0.015	-0.008	0.001	0.004	0.010	0.107
<i>MA_RET2</i>	-0.010	-0.002	-0.063	0.001	0.002	0.054	0.002	0.010	0.052	0.088
<i>ROA</i>	1.000	0.970	0.003	0.117	0.001	0.004	0.242	-0.942	0.023	0.387
<i>ΔROA</i>	-	1.000	0.002	0.161	0.003	0.033	0.306	-0.933	0.008	0.501
<i>ΔMARGIN</i>	-	-	1.000	0.004	-0.004	-0.093	-0.001	-0.002	-0.023	0.497
<i>CFO</i>	-	-	-	1.000	0.003	0.231	0.685	0.224	-0.034	0.504
<i>ΔLIQUID</i>	-	-	-	-	1.000	-0.009	0.003	0.000	-0.016	0.308
<i>ΔLEVER</i>	-	-	-	-	-	1.000	0.002	0.069	0.149	0.247
<i>ΔTURN</i>	-	-	-	-	-	-	1.000	-0.055	0.005	0.449
<i>ACCRUAL</i>	-	-	-	-	-	-	-	1.000	-0.034	0.222
<i>EQ_OFFER</i>	-	-	-	-	-	-	-	-	1.000	0.045

TABLE 13
Buy-and-Hold Returns Based on Fundamental Signals

Panel A: One-Year Raw Returns^a								
	Mean	10%	25%	50%	75%	90%	Proportion with Positive Signal	<i>n</i>
All Firms	0.1902	-0.6691	-0.4810	-0.2752	-0.1211	-0.0207	0.5543	1667
<i>F_SCORE</i>								
0 (L)	-0.1124	0.0000	0.0000	-0.1124	-0.1124	-0.1124	0.0000	1
1 (L)	0.0592	-0.7277	-0.6581	-0.4226	-0.2305	-0.0598	0.4828	29
2	0.2367	-0.7738	-0.6496	-0.4366	-0.2750	-0.1694	0.4252	127
3	0.1483	-0.6684	-0.4938	-0.2934	-0.1493	-0.0728	0.4856	243
4	0.0999	-0.7216	-0.5453	-0.3412	-0.1829	-0.0842	0.4790	357
5	0.0876	-0.6622	-0.4736	-0.2663	-0.1171	-0.0269	0.5740	385
6 out of 6	-0.1159	0.0000	0.0000	-0.4818	-0.4818	-0.1159	0.5000	2
6 out of 7 (H)	0.0385	-0.5931	-0.5086	-0.3490	-0.1631	-0.0408	0.4800	25
6 out of 8	3.7680	-0.6677	-0.4168	-0.2779	0.4089	3.7680	0.4000	10
6 out of 9	0.2138	-0.4552	-0.3038	-0.1416	-0.0041	0.0877	0.6429	238
7 out of 7 (H)	0.3107	-0.4239	-0.1991	-0.0530	0.1735	0.3107	0.8000	5
7 out of 8 (H)	1.0619	0.0000	0.6953	0.8145	0.8145	1.0619	1.0000	3
7 out of 9	0.3968	-0.5137	-0.3079	-0.1326	0.0080	0.1072	0.7073	164
8 out of 8 (H)	1.1000	0.0000	0.0000	0.0000	1.1000	1.1000	0.5000	2
8 out of 9 (H)	0.2682	-0.4818	-0.2677	-0.0586	0.0769	0.1803	0.7895	57
9 out of 9 (H)	0.1095	-0.4822	-0.3716	-0.2593	-0.0793	0.0045	0.3684	19
Low <i>F_Score</i> (L)	0.0535	-0.5458	-0.6092	-0.4603	-0.2512	-0.1156	0.4667	30
High <i>F_Score</i> (H)	0.2216	-0.5558	-0.4188	-0.2020	-0.0372	0.0789	0.6577	111
High less All	0.0314	0.1133	0.0623	0.0732	0.0839	0.0996	0.1034	-
High less Low	0.1681	-0.0100	0.1904	0.2583	0.2140	0.1944	0.1910	-
<i>t</i> -Statistic (High less All)	0.4807							
<i>t</i> -Statistic (High less Low)	1.2149							

Panel C: Two-Year Market-Adjusted Returns^a

	Mean	10%	25%	50%	75%	90%	Proportion with Positive Signal	<i>n</i>
All Firms	-0.0556	-1.1382	-0.8765	-0.6550	-0.4340	-0.2991	0.3562	1342
<i>F_SCORE</i>								
0 (L)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
1 (L)	-0.3778	-1.4984	-1.2634	-0.9590	-0.6917	-0.4887	0.3750	24
2	0.1239	-1.2047	-0.9892	-0.7812	-0.5876	-0.4274	0.2816	103
3	-0.0926	-1.2297	-0.9902	-0.7137	-0.4980	-0.3533	0.3299	194
4	-0.1045	-1.2688	-0.9712	-0.6108	-0.5116	-0.3818	0.3045	289
5	0.1153	-1.0313	-0.8118	-0.5955	-0.4161	-0.2874	0.3378	299
6 out of 6	-0.5226	0.0000	-0.5264	-0.5264	-0.5226	-0.5226	0.0000	2
6 out of 7 (H)	0.0955	-0.9697	-0.8796	-0.7258	-0.5596	-0.4278	0.2917	24
6 out of 8	0.2526	-1.3229	-1.0308	-0.7313	-0.5747	-0.0879	0.3636	11
6 out of 9	0.1201	-0.9506	-0.6940	-0.4765	-0.2880	-0.1690	0.4384	203
7 out of 7 (H)	-0.1710	0.0000	-0.5524	-0.3513	-0.3513	-0.1710	0.3333	3
7 out of 8 (H)	0.3205	0.0000	-0.8362	-0.2052	-0.2052	0.3205	0.6667	3
7 out of 9	0.1867	-0.8898	-0.7432	-0.4591	-0.2710	-0.1303	0.4567	127
8 out of 8 (H)	0.0764	0.0000	0.0338	0.0338	0.0764	0.0764	1.0000	2
8 out of 9 (H)	-0.0255	-0.7705	-0.5821	-0.4146	-0.2722	-0.1450	0.4000	45
9 out of 9 (H)	-0.0275	-0.8609	-0.6587	-0.4141	-0.2517	-0.1099	0.4615	13
Low <i>F_Score</i> (L)	-0.3778	-1.4984	-1.2634	-0.9590	-0.6917	-0.4887	0.3750	24
High <i>F_Score</i> (H)	0.0038	-0.9071	-0.7294	-0.5458	-0.3644	-0.2545	0.4000	90
High <i>less</i> All	0.0594	0.2312	0.1472	0.1092	0.0696	0.0447	0.0438	-
High <i>less</i> Low	0.3815	0.5913	0.5340	0.4132	0.3273	0.2342	0.0250	-
<i>t</i> -Statistic (High <i>less</i> All)	0.1882							
<i>t</i> -Statistic (High <i>less</i> Low)	1.9535							

TABLE 14
*One-Year Market-Adjusted Buy-and-Hold Returns to an Investment Strategy Based
on Fundamental Signals by Size Partition^a*

	Small Firms			Medium Firms			Large Firms		
	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>
All Firms	0.2241	-0.1425	559	-0.0869	-0.1292	558	-0.0491	-0.0607	553
<i>F_SCORE</i>									
0	N/A	N/A	0	-0.1732	-0.1732	1	N/A	N/A	0
1	-0.1494	-0.4358	13	-0.0462	-0.1298	9	0.0518	0.0586	6
2	0.5806	-0.2177	54	-0.3222	-0.2784	37	-0.1065	-0.1531	36
3	0.0448	-0.3000	101	-0.1055	-0.1258	77	-0.0435	-0.0666	68
4	0.1193	-0.2007	117	-0.1706	-0.1685	115	-0.1090	-0.0864	127
5	-0.1148	-0.1857	110	-0.0675	-0.1090	136	0.0161	-0.0130	136
6	0.5285	-0.0465	86	-0.0063	-0.0862	89	-0.0740	-0.0588	99
7	0.8644	0.0892	47	-0.0073	-0.0763	66	-0.0210	-0.0629	61
8	0.1349	-0.1034	22	0.1047	0.1073	22	-0.0490	-0.1328	16
9	0.1045	-0.0446	9	-0.0568	-0.2128	6	0.0986	0.1318	4
Low <i>F_Score</i>	-0.1494	-0.4358	13	-0.0589	-0.1515	10	0.0518	0.0586	6
High <i>F_Score</i>	-0.0526	-0.3434	40	0.1129	-0.0783	40	-0.1389	-0.0479	29
High less All	-0.2767	-0.2008		0.1998	0.0509		-0.0899	0.0129	
High less Low	0.0968	0.0925		0.1718	0.0732		-0.1908	-0.1065	
<i>t</i> -Statistic (High less All)	1.1842			2.1544			0.7835		
<i>t</i> -Statistic (High less Low)	0.7921			0.5277			0.3322		

TABLE 15

Ability of Alternative Historical Financial Measures to Differentiate Winners from Losers

Panel A: Financial Distress									
	High Distress			Indeterminate Distress			Low Distress		
	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>
All Firms	0.1115	-0.1199	431	-0.0968	-0.0779	173	0.0103	-0.1092	1083
Low F_Score	0.0396	-0.1109	19	-0.1495	-0.1495	2	-0.4079	-0.2385	9
High F_Score	0.4642	0.4411	29	-0.0238	0.5894	14	-0.6683	-0.9772	81
High less All	0.3527	0.5609	-	0.0730	0.6673	-	-0.6787	-0.8680	-
High less Low	0.4246	0.5519	-	0.1257	0.7389	-	-0.2604	-0.7387	-
<i>t</i> -Statistic (High less All)	0.7051			0.9124			0.5786		
<i>t</i> -Statistic (High less Low)	0.1503			0.6974			2.6921		

Panel B: Historical Change in Profitability									
	High ΔROA			Medium ΔROA			Low ΔROA		
	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>	Mean	Median	<i>n</i>
All Firms	0.1399	-0.1273	518	-0.0243	-0.0610	519	0.0075	-0.1170	519
Low Score	N/A	N/A	0	0.3383	0.0643	3	-0.1466	-0.2385	21
High Score	0.0144	-0.2165	81	2.2758	2.3609	21	-0.0907	-0.0907	1
High less All	-0.1255	-0.0892	-	2.3000	2.4219	-	-0.0982	0.0264	-
High less Low	N/A	N/A	-	1.9375	2.2966	-	0.0560	0.1478	-
<i>t</i> -Statistic (High less All)	0.9549			2.0356			N/A		
<i>t</i> -Statistic (High less Low)	N/A			0.4064			N/A		

^aA Z- Score above 2.99 is considered by Altman to signify a financially sound company while a signal below 1.81 is considered to represent a financially distressed company.

4.9 RETURNS CONDITIONAL ON FIRM SIZE, FINANCIAL DISTRESS OR HISTORICAL CHANGE IN PROFITABILITY - SAMPLE 3

Partitioning of data is illustrated in tables 14 and 15. Partitions based on firm size no longer hold any true information content with signals being contradictory between partitions. The only valuable observation is that the small firm size category is the only category able to yield positive mean market-adjusted returns over the period.

As with partitioning of data based on firm size, partitioning of data based on financial distress no longer seems to hold much informational content. In fact, high distress firms are shown to have positive mean market-adjusted returns while low and indeterminate distress firms have minor positive and large negative mean returns respectively. Perhaps of most relevance to this anomaly is the fact that high *F_SCORE* firms in the high distress category are responsible for significant future returns well above returns available in the market. Provided firms having a high *F_SCORE* are in fact financially sound, these 'highly distressed' firms when classified using a Z-Score will likely have been unfairly penalised for this presumed sorry financial state and will later recover allowing for the share price to rebound. Finally, a high *F_SCORE* firm with either high or medium ΔROA appears to have the best opportunity for superior returns.

5. Conclusions

Application of the Piotroski *F_SCORE* to the South African market is an unconfirmed success. While it is possible to collect data and analyse this in a manner consistent with Piotroski methodology, it is difficult to do so without making certain adaptations. Data, and the number of years over which this analysis can be conducted, are at a premium due to the stringent requirements imposed by Piotroski's selected variables and return functions. A couple of variables require the use of opening balances for the two years preceding portfolio formation and the *BFA McGregor* data set found to most reliably present Piotroski required line items is not available prior to 2004. In order to retain 2005 / 2006 data for analysis purposes it has been necessary to manually collect the data points for these additional variables in the 2003 and 2002 financial years. As returns are calculated with reference to a starting date five-months following year-end, several companies having otherwise viable data are not available for analysis due to 12- and 24-month return periods falling outside of the currently available data.

Further, in an effort to retain as many individual company data points as possible, it was necessary to manually alter the calculation of variables like $\Delta MARGIN$ and $\Delta LEVER$ in situations where data was insufficient or inadequately detailed. This was done by including data proxies intended to have similar information content to that of the original Piotroski variable. While this improved upon the number of Piotroski variables available for calculation for each firm, a substantial number of firms still had less than the prescribed nine variables. As the sample size against which the application of Piotroski's methodology would be appropriate was rapidly shrinking it became necessary to adapt the criteria for selection of a low and more particularly high F_SCORE firm. All firms having more than 5 indicator variables available for analysis were considered and classified based on number of Piotroski variables out of the total number present for each firm. Firms having 0 or 1 positive Piotroski variables out of a minimum of 6 were classified as having a low F_SCORE and firms having 0 or 1 indicator variables below the total number present for that firm – provided greater than 5 – were classified as having a high F_SCORE . After all these allowances, adaptations and manual interventions there were still just 346 data points available for analysis as compared to some 10,000 used by Piotroski.

The resultant outcomes were admittedly disappointing. While it was possible to observe certain positive relationships between F_SCORE and mean returns within both market-adjusted and raw returns, these observations were not statistically significant nor did they provide particularly consistent or robust arguments for the creation of a high F_SCORE portfolio. In fact, the only real conclusions that could be drawn with any degree of confidence are that low F_SCORE portfolios consistently underperform both the market and high F_SCORE portfolios regardless of investment horizon and that investment on the basis of a Piotroski F_SCORE could conceivably hold substantial benefit in the longer term. It is noted that this ability to further strip away underperforming firms from the overall high book-to-market investment strategy does in itself hold value due to the impact this will have on the revised portfolio mean. What was most certainly evident, as is to be expected based on prior research, is that a portfolio of high book-to-market firms does significantly outperform the market

Once it was established that firm size, level of financial distress and historical profit performance could not yield additional value from this initial application of Piotroski's methodology to the South African market it became apparent that further samples should be tested. All conceivable and reasonable adjustments had been made to ensure as many data points and as pragmatic an application of Piotroski's F_SCORE as possible but the sample

upon which this methodology was applied appeared to limit the descriptive ability of this measure.

This observation was supported by Piotroski backtesting performed by PowerStocks Research where a very positive return result was obtained using similar methodology but noticeably different selection criteria. With this in mind the sample upon which to test the Piotroski methodology described in this paper was altered to include not just the upper quintile of high book-to-market firms but all firms having a book-to-market ratio greater than or equal to one. These firms, with a net asset value equal to or exceeding their market capitalisation, in themselves contained some information content about the underlying market. In times of high stock returns fewer firms met the definition of a high book-to-market firm while in periods of financial uncertainty and lacklustre stock performance many-more high book-to-market firms became available.

This revised sample selection criteria also managed to extend the sample size and, once results were obtained, did seem to lend credence to the assumption that the Piotroski methodology was likely sound but that the limited sample upon which it was initially applied was arguably incorrect. While high *F_SCORE* firms did not suddenly consistently outperform the high book-to-market portfolio within which they fell, in all cases the revised results showed at least a negligible difference between these two alternative portfolios and did in fact yield positive results when applied to market-adjusted 12- and 24- month returns. For the first time it was clearly observable that the distribution of high book-to-market firm returns had indeed been shifted upward and a statistically significant difference between high and low *F_SCORE* portfolios was evident over a 24-month period. It was also clear that high *F_SCORE* firms only outperform low *F_SCORE* firms when both firms are small in size. Once again, some value can be garnered by removing high *F_SCORE* firms of medium and large size prior to analysis as this will further improve the high versus low *F_SCORE* disparity and could be used to yield positive returns in a long / short strategy.

Finally, when applying the Piotroski *F_SCORE* to the market as a whole, it is evident that an extended sample does most certainly show the intended, albeit more diluted, results as initially demonstrated by Piotroski. These include an upward shift in the mean returns of a high *F_SCORE* portfolio over and above those of the market and low *F_SCORE* firms. It is also plain to see that in all instances high *F_SCORE* firms now outperform both the market and low *F_SCORE* firms and, although not by a particularly large margin over a 12-month period, that cumulatively these excess returns would quickly compound in to a significant abnormal return. Size, financial distress and historical profit performance do however lose

any descriptive ability they once had as a result of the entire sample of firms available for testing in the market being tested.

Overall, this paper sought to establish whether or not Piotroski's methodology could be implemented in a South African context and if so where most value could be gained. It would appear that this methodology can indeed be implemented in South Africa provided some attempt is made to adequately address data and analysis issues. It would also appear that there are observable benefits evident, some of which are substantial. That said, these observations are not by-and-large supported by statistical significance and it may be unwise to rely upon them without also including additional research or analysis. Key findings that should be subjected to further research include improved mean market-adjusted portfolio returns for small firms and those firms showing low financial distress. Focussing on the intersection of these two characteristics may have astonishing results.

REFERENCES

- ABARBANELL, J., AND B. BUSHEE. "Fundamental Analysis, Future Earnings, and Stock Prices." *Journal of Accounting Research* 35 (Spring 1997): 1-24.
- _____. "Abnormal returns to a Fundamental Analysis Strategy." *The Accounting Review* 73 (January 1998): 19-45.
- ALI, A.; L. HWANG; AND A. TROMBLEY. "Arbitrage Risk and the Book-To-Market Anomaly." *Journal of Financial Economics* 69 (2003): 355-373.
- ALMAS, D., AND J. DUQUE. "Value Investing: The Book-to-Market Effect, Accounting Information, and Stock Returns." Working Paper, Instituto Superior de Economia e Gest3o (2008).
- ASNESS, C. "The Interaction of Value and Momentum Strategies." *Financial Analysts Journal* (March / April 1997): 19:45.
- ALTMAN, E. "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy." *The Journal of Finance* 23 (1968): 589-609.
- _____. "Predicting Financial Distress of Companies: Revisiting the Z-Score and Zeta^o Models." Working paper, Stern School of Business, 2000.
- AURET, C., AND R. SINCLAIRE. "Book-to-Market Ratio and Returns on the JSE." *Investment Analysts Journal* 63 (2006): 31-38.

- BARBER, B., AND J. LYON. "Detecting Long-Run Abnormal Stock Returns: The Empirical Power and Specification of Test Statistics." *Journal of Financial Economics* 43 (1997): 341-72.
- BARTOV, E.; S. RADHAKRISHNAN; AND I. KRINSKY. "Investor Sophistication and Patterns in Stock Returns after Earnings Announcements." *The Accounting Review* 75 (2000): 43-63.
- BERNARD, V. "Accounting Based Valuation Methods, Determinants of Market-to-Book Ratios and Implications for Financial Statement Analysis." Working paper, University of Michigan, 1994.
- BERNARD, V.; AND J. THOMAS. "Post-Earnings Announcement Drift: Delayed Price Response or Risk Premium?" *Journal of Accounting Research* 27 (Supplement 1989): 1-36.
- _____. "Evidence That Stock Prices Do Not Fully Reflect the Implications of Current Earnings for Future Earnings." *Journal of Accounting and Economics* 13 (1990): 305-40
- CAI, F., AND L. ZHENG. "Institutional Trading and Stock Returns." *Finance Research Letters* 1 (2004): 178-189.
- CHEN, N., AND F. ZHANG. "Risk and Return of Value Stocks." *Journal of Business* 71 (October 1998): 501-35.
- DECHOW, P., AND R. SLOAN. "Returns to Contrarian Investment Strategies: Tests of Naive Expectations Hypotheses." *Journal of Financial Economics* 43 (1997): 3-27.
- DICHEV, I. "Is the Risk of Bankruptcy a Systematic Risk?" *Journal of Finance* 53 (June 1998): 1131-47.
- DUONG, C.; G. PESCIOTTO; AND D. SANTAMARIA. "Fundamental Analysis in Value-Glamour Contexts." (2010)
- FAMA E., AND K. FRENCH. "The Cross-Section of Expected Stock Returns." *Journal of Finance* 47 (June 1992): 427-65
- _____. "Size and Book-to-Market Factors in Earnings and Returns." *Journal of Finance* 50 (1995): 131-55.
- FOSTER, G.; C. OLSEN; AND T. SHEVLIN. "Earnings Releases, Anomalies, and the Behaviour of Security Returns." *The Accounting Review* 59 (1984): 574-603.
- FRANKEL, R., AND C. M. C. LEE. "Accounting Valuation, Market Expectation, and Cross-Sectional Stock Returns." *Journal of Accounting and Economics* 21 (June 1998): 283-319.

- GILBERT, E., AND D STRUGNELL. "Does Survivorship Bias Really Matter? An Empirical Investigation into its Effects on the Mean Reversion of Share Returns on the JSE (1984-2997)." *Investment Analysts Journal* 72 (2010): 31-42.
- GRICE, J., AND R. INGRAM. "Tests of Generalizability of Altman's Bankruptcy Prediction Model." *Journal of Business Research* 54 (2001): 53-61.
- GRIFFIN, J., AND M. LEMMON. "Book-to-Market Equity, Distress Risk, and Stock Returns." *The Journal of Finance* 5 (2002): 2317-36.
- GRIFFIN, J.; J. HARRIS; AND S. TOPALOGLU. "The Dynamics of Institutional and Individual Trading." *The Journal of Finance* 6 (2003): 2285-320.
- HOLTHAUSEN, R., AND D. LARCKER. "The Prediction of Stock Returns using Financial Statement Information." *Journal of Accounting and Economics* 15 (1992): 373-411.
- IKENBERRY, D.; J. LAKONISHOK; AND T. VERMAELEN. "Market Underreaction to Open Market Share Repurchases." *Journal of Financial Economics* 39 (1995): 181-208.
- JEGADEESH, N. "Long-Term Performance of Seasoned Equity Offerings: Benchmark Errors and Biases in Expectations." *Financial Management* 29 (Autumn 2000): 5-30.
- KE, B., AND S. RAMALINGEGOWDA. "Do Institutional Investors Exploit the Post-Earnings Announcement Drift?" *Journal of Accounting and Economics* 39 (2005): 25-53.
- KOCH, A. "Financial Distress and the Credibility of Management Earnings Forecasts." Working paper, Carnegie Mellon University, 2002.
- KOTHARI, S. P., AND J. WARNER. "Measuring Long-Horizon Security Price Performance." *Journal of Financial Economics* 43 (1997): 1541-78.
- LAKONISHOK, J.; A. SHLEIFER; AND R. VISHNY. "Contrarian Investment, Extrapolation and Risk." *Journal of Finance* 44 (December 1994): 1541-78.
- LAPORTA, R. "Expectations and the Cross-Section of Stock Returns." *Journal of Finance* 51 (December 1996): 1715-42.
- LAPORTA, R.; J. LAKONISHOK; A. SHLEIFER; AND R. VISHNY. "Good News for Value Stocks: Further Evidence on Market Efficiency." *Journal of Finance* 52 (1997): 859-74.
- LEV, B., AND R. THIAGARAJAN. "Fundamental Information Analysis." *Journal of Accounting Research* 31 (Autumn 1993): 190-214.
- LOPEZ, A., AND F. GALDI. "Does Financial Statement Analysis Generate Abnormal Returns Under Extremely Adverse Conditions?" 7th *Brazilian Finance Meeting* (2007).
- LOUGHRAN, T., AND J. RITTER. "The New Issues Puzzle." *Journal of Finance* 50 (1995): 23-51.

- MCNICHOLS, M., AND P. O'BRIEN. "Self-Selection and Analyst Coverage." *Journal of Accounting Research* 35 (Supplement 1997): 167-99.
- MICHAELY, R.; R. THALER; AND K. WOMACK. "Price Reactions to Dividend Initiations and Omissions: Overreaction or Drift?" *Journal of Finance* 50 (1995): 573-608.
- MOHANRAM, P. "Separating Winners from Losers among Low Book-to-Market Stocks using Financial Statement Analysis." *Review of Accounting Studies* 10 (2005): 133-70.
- MYERS, S., AND N. MAJLUF. "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have." *Journal of Financial Economics* 13 (1984): 187-221.
- OHLSON, J. "Financial Ratios and the Probabilistic Prediction of Bankruptcy." *Journal of Accounting Research* 18 (1980): 109-31.
- OU, J., AND S. PENMAN. "Accounting Measures, Price-Earnings Ratio, and the Information Content of Security Prices." *Journal of Accounting Research* 27 (Supplement 1989): 111-43.
- PENMAN, S.; S. RICHARDSON; AND I. TUNA. "The Book-to-Price Effect in Stock Returns: Accounting for Leverage." *Journal of Accounting Research* 45 (2007): 427-68.
- PIOTROSKI, J. "Value Investing: The Use of Historical Financial Statement Analysis to Separate Winners from Losers." *Journal of Accounting Research* 38 (2000): 1-41.
- PONTIFF, J., AND A. WOODGATE. "Share Issuance and Cross-Sectional Returns." *The Journal of Finance* 63 (2008): 921-45.
- SKINNER, D., AND R. SLOAN. "Earnings Surprises, Growth Expectations, and Stock Returns or Don't Let and Earnings Torpedo Sink Your Portfolio." *Review of Accounting Studies* 7 (2002): 289-312.
- SLOAN, R. "Do Stock Prices Fully Reflect Information in Accruals and Cash Flows about Future Earnings?" *The Accounting Review* 71 (July 1996): 289-316.
- VASSALOU, M., AND Y. XING. "Default Risk in Equity Returns." *The Journal of Finance* 59 (2004): 831-68.
- ZHANG, H. "Share Price Performance Following Actual Share Repurchases." *Journal of Banking and Finance* 29 (2005): 1887-1901.