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Fusion investing: an innovative approach to asset selection

Abstract

This research aims to encapsulate the idea by Lee (2003) and Bird and Casavecchia (2007b) by designing an investment strategy that exploits value, fundamental and momentum anomalies. This fusion strategy has underpinnings in the realm of behavioral finance, namely the value-growth phenomenon and the momentum effect. Using data of all shares listed on the Johanesburg Securities Exchange (JSE) in South Africa, those considered value shares are selected. From that sample, those that are fundamentally sound and exhibit winning momentum characteristics are chosen. Nominal returns of the strategy show promising results as the fusion strategy outperformed both active and passive benchmarks chosen, after costs. The coefficient of variation, a simple measure of variability in the mean return, indicates that an investor seeking higher returns (with higher volatility) would invest in the fusion strategy. On a risk adjusted basis, the results were inconclusive based on the Sharpe and Treynor ratios, but fairly promising based on the Sortino ratio. The Sortino ratio shows that the fusion strategy outperforms all benchmarks chosen, except the Absa Select Equity Fund (known as Fund A). Statistical testing shows that the returns of the strategy are significantly different from zero and follow a non-linear data generating process. Although the screening methods are chosen based on prior studies, no published study has utilized these screens in the sequence outlined above.

Keywords: portfolio management, fusion investing, behavioral finance, active management.
JEL Classification: C44, D03, D53, D70, D82.

Introduction

Finance theory unequivocally states that in efficient markets, a portfolio manager who utilizes active strategies cannot outperform his counterpart who utilizes passive strategies, after transaction costs. Many academics and practitioners have investigated this claim and whilst there is consensus amongst groups of individuals, there is no ruling on the claim itself. In this study, focus is given as to whether pricing anomalies found in the literature can be exploited simultaneously. This study contributes to the debate on active and passive portfolio management by providing an alternative means of constructing an active portfolio. The strategy is referred to as a fusion strategy and has underpinnings in the realm of behavioral finance, namely the value-growth phenomenon and the momentum effect.

"Fusion investing is a relatively new approach that attempts to integrate traditional and behavioral paradigms to create more robust investment models" (Lee, 2003, p. 1). The term, fusion investing, was first presented by Lee (2003). The concept of incorporating behavioral finance into share valuation was new at this stage of the financial markets profession. Although the author did not formalize the idea, this presentation was simply to raise awareness of incorporating behavioral finance into share valuation.

Bird (2007) provided the first formal introduction to fusion investing. Using his prior studies as examples, Bird (2007) expanded upon the idea of fusion investing. He suggested that three different approaches to exploiting pricing differences be

investigated: the value approach, fundamental approach (accounting-based analysis) and momentum approach. The earliest (and perhaps only known literature) on the evaluation of fusion strategy is that of Bird and Casavecchia (2007b). The study focuses on European markets during the period of 1989-2000 and they find that both enhancements (momentum and fundamentals), independently and in combination, improve the timing ability of the manager in selecting value and growth stocks and that the momentum enhancement subsumes the fundamental enhancement in better identifying value shares.

van Rensburg and Robertson (2003a) investigate the cross-sectional explanatory power of various style characteristics on the Johannesburg Securities Exchange Ltd. (JSE). Six candidate factors are found to be significant out of a total of 24 effects investigated. In the construction of a multifactor model, size and price-earnings are found to have the most explanatory power. This supports the work of van Rensburg (2001) in testing a multifactor pricing model on South African shares. Whilst the factors (and ensuing model) had no theoretical explanation at the time of publishing, the authors (van Rensburg and Robertson, 2003a) acknowledge that the above mentioned factors are anomalies on the JSE. Thus, an investment strategy should (hypothetically) be able to exploit these anomalies profitably.

Given that literature (both local and international) has documented the existence and non-existence of the value-growth and momentum anomalies in South Africa, an attempt is made to design a strategy that utilizes these pricing inefficiencies, assuming the above inefficiencies to be present in the South African market, not necessarily throughout the entire sample period. Further, literature has shown that a

combination of a value strategy or fundamental strategy with a momentum strategy seems a viable means of achieving above average returns (see Bird & Casavecchia, 2007a; 2007b). Thus, this research aims to encapsulate the idea by Lee (2003) and Bird and Casavecchia (2007b) by designing an investment strategy that exploits value, fundamental and momentum anomalies. Although the screening methods are chosen based on prior studies, no published study has utilized these screens in the sequence outlined below. This study therefore offers an interpretation of fusion investing.

From the population of all shares available for trade on the JSE (around 400 as at 2014), those considered value shares are selected. From that sample, those that are fundamentally sound (the company's financial statements are considered to be "strong" or "healthy" according to the Piotroski score[1]) and exhibit winning momentum characteristics are chosen. The first two screens are evaluated on an annual basis whereas the final screen is evaluated monthly. As firms release financial statements annually, any significant information contained in this release would cause the firm's share price, as well as related data, to change in the long term. The inclusion of a monthly momentum screen should be effective in capturing short term fluctuations present between releases of financial statements. Thus, any share that passes all of the above criteria is considered inexpensive (the value screen), financially sound (the Piotroski screen) and has positive prior performance (the momentum screen).

This study will proceed as follows. An overview of the literature surrounding this field and its direct relations will be examined in section 1. Thereafter, section 2 outlines the fusion strategy and appropriate statistical methodology for analysis of returns. Section 3 presents and discusses the results along with particular sensitivity tests and biases that were present in this study. Lastly, section 4 provides an excursus into the caveats and avenues for future research of this study, ending with a conclusion.

1. Literature review

1.1. Value investing. There is a vast array of literature that documents the performance of shares selected on relative valuation multiples. The evidence points to value shares (those with low relative price multiples) outperforming growth shares (those with high relative price multiples). The most common of these multiples are price to earnings (P/E) ratios, price to book (P/B) ratios and

price to cash flow (P/CF) ratios. Value shares ranked according to P/E, P/B and P/CF have been shown to outperform growth shares ranked accordingly (see for example, Lakonishok, Shleifer & Vishny, 1994).

Fama and French (1993) propose that the outperformance of value shares over growth shares, in effect, a value premium, is due to the inherently riskier nature of value shares relative to growth shares. The authors note that this premium is not captured by the standard CAPM of Sharpe (1964). Others, such as Black (1993) and Kothari, Shanken and Sloan (1995) suggest that the value premium is a result of data mining or data selection biases. There is, however, a third explanation offered by Lakonishok et al. (1994). The first two explanations above attempt to reconcile the value anomaly with the current paradigm of efficient markets. Lakonishok et al. (1994) instead deviate from this paradigm and suggest that the value premium is a consequence of judgemental mistakes of investors. This is in line with the earliest philosophy of value investing by Graham and Dodd (1934) – a value strategy works because it is contrary to the market. The relative valuation multiples used would appear to reflect the systematic errors made by investors in their forecasting. A high (low) P/B value may indicate that the current price of the share is inflated (deflated) relative to its book value. This implies that investors irrationally attribute too large (small) a weighting to the good (poor) performance of the firm in the recent past and assume this performance would continue into the near future. If (or perhaps when) the firm fails to meet investors' expectations, the P/B multiple would correct itself to reflect this updating of information. Relative valuation multiples can thus provide good proxies for mean reversion of shares and market performance. Further, Rousseau and van Rensburg (2004) point out that whilst the performance of value shares is impressive in most markets, this performance is typically attributed to only a handful of shares in the value portfolio. As the value of these multiples become extreme, there is a greater probability that the share's price will adjust to correct for this, such that the multiple reverts to "acceptable levels".

The weakness of a value strategy lies in determining when this reversion will occur. A possible way of enhancing a value strategy would then be to delay the purchase of the value share until it reaches its turning point. This can be achieved via a screening criterion. Recent studies have suggested two distinct approaches – enhancement of a contrarian strategy with fundamentals or with momentum.

1.2. Fundamental investing. *1.2.1. The univariate approach.* LaPorta (1996) and Dechow and Sloan

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[1] The Piotroski score is scoring model which calculates the financial health of a firm based on financial statement data. Piotroski (2000) used this model to create a portfolio strategy, where firms with high scores were bought. These firms outperformed those with low scores.

(1997) show that systematic errors in market expectations about long-term earnings growth rates partially explain the success of a contrarian strategy (given by book-to-market values). Many investment strategies have been designed and tested based on the market's inability to fully incorporate signals of financial performance by firms[1].

Frankel and Lee (1998) implement a fundamental analysis approach that identifies shares whose prices lag their fundamental values. These undervalued shares are identified via earnings forecasts and accounting-based valuation models (such as a residual income model). Over the three year investment period analyzed, this strategy is successful at generating significantly positive returns. Generally, analysts prefer not to follow poor performing, low volume and small firms (Hayes, 1998). Thus, these firms are less likely to have forecast data, a consequence of the neglected firm effect[2]. This poses a significant problem for using Frankel and Lee's (1998) forecast based method to select value shares. As all listed shares (irrespective of analyst following) are required to publish financial statements, it is logical to use financial statements as a basis for share analysis.

1.2.2. The multivariate approach. Holthausen and Larcker (1992) show that a statistical model can be used to accurately predict future excess returns. Given the complexity of these methodologies and the vast amount of data required, Lev and Thiagarajan (1993) use 12 financial signals that are popular amongst analysts. These signals are shown to be correlated with contemporaneous returns after controlling for current earnings innovations, firm size and macroeconomic conditions. Ou and Penman (1989) develop such a strategy to predict future changes in earnings. This strategy is based on various financial ratios obtainable from historic financial statements, similar to the Piotroski score used in this study. Abarbanell and Bushee (1997) test the ability of Lev and Thiagarajan's (1993) strategy to predict future changes in earnings and future revisions of analysts' forecasts thereof. They find that some of the signals suggested by Lev and Thiagarajan (1993) are economically justified in assessing future firm performance.

Piotroski (2000) provides a strategy similar in spirit to Lev and Thiagarajan (1993). Whilst some of the signals are common to both studies, many used in Piotroski (2000) do not correspond to prior research. The reasons for this deviation are threefold. First,

the population under investigation in Piotroski (2000) is restricted to value firms. These firms are typically smaller in size and often more financially distressed compared to growth firms. Thus, the signals used in the Piotroski score are chosen to specifically measure profitability and default risk trends. Second, whilst signals such as capital expenditure decisions would be reasonably good indicators of financial performance, they are of secondary importance relative to the signals chosen to capture the health of a firm. Bernard (1994) shows that accounting returns and cash flow, each relative to the other, is of importance when assessing future performance prospects. Third, neither Lev and Thiagarajan (1993) nor Abarbanell and Bushee (1997) offer an optimal set of signals. There is thus room for the use of alternative and perhaps complementary signals to demonstrate the performance of a fundamental analysis strategy, in general. The Piotroski score is the aggregate sum of each signal, once that particular signal has been reduced to binary form. By focusing only on value firms, the Piotroski score is able to provide a reliable gauge of financial health and investment potential of a firm. Further, Piotroski (2000) postulates that if analysts exhibit under-reaction to financial statements – analysts are inefficient in analyzing and interpreting financial statements – this will lend to the success of both the Piotroski score and momentum strategies.

1.3. Momentum investing. Momentum can be defined as the "continuation of the direction of prior stock returns" (Griffin, Ji & Martin, 2003, p. 2515). Jegadeesh and Titman (1993) examine the profitability of a relative strength trading strategy (buying past winners and selling past losers) for a holding period that varies between three and twelve months. The findings show that significant profits can be made using this strategy during the sample period 1965 to 1989. The particular strategy examined in detail is the $J = 6$, $K = 6$ strategy[3]. The evidence is consistent with a delayed price reaction to firm-specific information and inconsistent with the lead-lag effect of Lo and MacKinlay (1990). Further, the results are not due to the systematic risk of the trading strategy (Jegadeesh & Titman, 1993).

The momentum effect was thus discovered by Jegadeesh and Titman (1993) and still remains an anomaly that defies traditional finance theory. In a subsequent study, Jegadeesh and Titman (2002), the authors find that their momentum strategy continued to remain profitable. Rouwenhorst (1998) examines

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[1] See Piotroski (2000) for an extensive discussion.
[2] Arbel and Strebel (1982) document the neglected firm effect – the tendency of firms that are not closely followed by analysts to provide unexpectedly high returns

[3] Where *J* refers to the number of months used to calculate past returns and *K* refers to the holding period. Therefore, a $J = 6$, $K = 6$ strategy picks those shares that have the highest past 6 months returns and holds them for a period of 6 months.

a momentum strategy in twelve European markets and finds its existence apparent. Chui, Titman and Wei (2000) find the effect in emerging markets and Fraser and Page (2000) find its persistence in the South African market.

1.3.1. Related empirical findings. Grinblatt, Titman and Wermers (1995) examine the performance of mutual funds in the United States. On average, those that followed a momentum strategy realized significantly better returns than those funds that did not. Indeed, the authors found that fund performance was highly correlated with a fund's ability to implement momentum stratagies and to herd. Intuitively, if a fund lacks the ability to time entry and exit in and out of the market, its next best strategy would be to follow the consensus (herd). Benson, Gallagher and Teodorowski (2007) examine the role of momentum in the active asset allocation environment using data on Australian securities. Their results show that momentum investing does exist amongst Australian mutual funds and that those funds with no market timing ability are most likely to be momentum investors.

1.4. Fusion investing. Bird and Casavecchia (2007b) evaluate the approaches by Bird and Whitaker (2004) and Piotroski (2000) to enhance value style portfolios. The study focuses on European markets during the period from 1989 to 2004. To identify value shares, the authors use a price to sales ratio, as this was found to be the most effective in European markets. The earnings forecast method of Ou and Penman (1989) is used as a fundamental indicator and the specific momentum indicator used is an acceleration indicator. It is used to split the top momentum quintile − those stocks that exhibit more winning characteristics. Further, they find that both enhancements (momentum and fundamentals), independently and in combination, improve the timing ability of the manager in selecting value and growth stocks and that the momentum enhancement subsumes the fundamental enhancement in better identifying value shares. Specifically, the success rate of enhancing a value style with a momentum indicator increases from 42% to 53% over a one year holding period. Thus, Bird and Casavecchia (2007b) provide evidence of the success of the fusion strategy (without using that particular terminology) in European markets.

The sorting and ranking procedure in Bird and Casavecchia (2007b) differs from that used in this study. The authors first sort shares into value and growth groupings and thereafter simultaneously sort these shares according to fundamentals and momentum; with each sort conducted on an annual basis. Further, the acceleration measure used by the

authors is not used in this study, primarily due to data constraints.

2. Data and methodology

2.1. Data and sample selection. Data was obtained from FinData@Wits[1], I-Net and McGregor BFA. The data consisted of B/M ratios, fundamental (financial statement) data and monthly closing prices for all firms that were listed and subsequently delisted on the Johannesburg Securities Exchange Ltd. (JSE) during the period from January 1989 to December 2010. As of time of writing (2014) there are approximately 400 shares listed on the JSE. In total, the data set consisted of 1350 shares (listed and delisted over the sample period) before any filtering, of which 44, at a particular point in time, were included in the final portfolios. It is crucial to note that the inclusion of delisted firms is done to prevent any look-ahead bias. Whilst this may seem counterintuitive, the following scenario is assumed to hold. At a point in time, the investor (or portfolio manager) has access to public information regarding those firms currently listed. Based on this dynamic sample, he makes his selection of shares via the fusion strategy. Thus, he does not know in advance which shares will be either suspended or delisted. Once the portfolio is formed, should delisting or suspension occur, the share is immediately removed from the portfolio and assigned a -100% return.

2.2. Value investing. All value strategies select those shares that have low fundamentals relative to price. The shares are then sorted and grouped in descending order. This study uses book-to-market (B/M) ratios as the value indicator as Auret and Sinclaire (2006) find this proxy to be a highly significant variable in identifying value shares listed on the JSE. From the sample, those firms with negative B/M ratios[2] were excluded. Thus, each month, the value quartile (top 25 percent) and growth quartile (bottom 25 percent) are formed.

2.3. Fundamental investing. The Piotroski score (Piotroski, 2000) relies on examining historical financial statement information to filter out financially sound firms from their counterparts. The variables are then converted to binary signals – if the firm's ratio surpasses the benchmark, it takes on a value of either 0 or 1 (dependent upon the variable in question). The binary signals are then aggregated. The aggregate score ranges from 0 to 9 where 0 indicates a financially unsound firm and 9 indicates a financially sound firm. The fundamental signals chosen are related to: profitability, financial

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[1] FinData@Wits is a database compiled internally by the University of the Witwatersrand.
[2] A share can have a negative B/M ratio if the firm has experienced a series of financial losses.

leverage, liquidity and operating efficiency. Piotroski (2000) stresses that these signals were chosen from both academic and practitioner circles and that they do not purport to represent the only signals to indicate the financial soundness of a firm[1].

Whilst this approach seems relatively efficient, the effect of any signal on the share's price may be ambiguous. Therefore, an *ex ante* implication must be stated. Each signal is conditioned on the premise that the firm is financially distressed to some degree. Myers and Majluf (1984) describe how an increase in leverage can be considered a negative signal whereas Harris and Raviv (1990) find that an increase in leverage can be considered a positive signal. Thus, the extent of these signals may not be uniform across firms with high B/M values. This ultimately will reduce the power of the Piotroski score to differentiate between financially sound and financially unsound firms.

As the Piotroski score is an aggregate measure of performance, it presents a simplified investment strategy when using fundamentals. However, given this simplicity, two complications arise. First, the conversion of information into binary signals does ultimately lead to a loss of that information. Thus, potentially valuable information can be overlooked. Second, there is no theoretical justification for the above model. It is an *ad hoc* approach to selecting those firms that are fundamentally stable. Each of the signals will now be discussed followed by the composite score.

2.3.1. Profitability. The profitability of a firm provides information about the firm's ability to generate funds internally. A positive earnings trend suggests an improvement of the firm's ability to generate cash in the future. Similarly, a negative earnings trend is suggestive of future performance deterioration.

The Piotroski score uses four performance measures on profitability:

1. *ROA*: The return on assets of a firm, defined as net income before extraordinary items as a percentage of average assets for the year.
2. *CFO*: Cash flow from operations as a percentage of average assets for the year.
3. *ΔROA*: The difference between the current year's *ROA* and the previous year's *ROA*.

If *ROA, CFO* and *ΔROA* are positive, their respective dummy variables take on a value of 1, and 0 otherwise. The benchmarks of zero profit and zero cash flow were chosen by Piotroski (2000) as

they are independent of industry level, market level and time specification[2]. Sloan (1996) finds that firms that have positive accrual adjustments (profits that are greater than cash flow from operations) actually convey a negative signal to investors, whereas a negative accrual adjustment conveys a positive signal. This result could have possibly gained credence from the Free Cash Flow Hypothesis of Jensen (1986). Amongst value firms (firms with high B/M values) this relationship becomes important in managing earnings, where the incentive to do so is strong (Sweeney, 1994). As such, the relationship between cash flow and earnings is considered.

4. *Accrual*[3]: The variable *Accrual* is defined as the current year's net income less extraordinary items and less cash flow from operations as a percentage of average assets for the year. The associated dummy variable is assigned a value of 1 if *Accrual* is positive (*CFO > ROA*) and 0 otherwise.

2.3.2. Leverage, liquidity and source of funds. Since most value firms are financially constrained, it is logical to examine their capital structure and ability to meet future obligations. Further if these financially constrained firms were to increase leverage via external financing or decreasing liquidity, it has a negative impact on the firm's management of financial risk (financial risk is thus greater):

1. Δ*Lever* captures changes in long term capital structure. It is the change in the historical ratio of long term debt to average total assets. An increase in the ratio is seen as a negative signal. Myers and Majluf (1984) and Miller and Rock (1985) argue that the use of external financing conveys a signal that the firm is unable to generate sufficient internal funds. An increase in long term debt is also likely to place further constraints on the firm's financial flexibility. Thus, the associated dummy variable takes on a value of 1, if Δ*Lever* is negative and 0 otherwise.
2. Δ*Liquid* measures the change in liquidity. It is defined as the difference between the current year's current ratio (current assets as a percentage of current liabilities) to the previous year's current ratio. A positive change implies a positive signal and consequently has a value of 1 for the dummy variable. A negative change has a value of 0 for the dummy variable.

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[1] Various statistical methodologies, such as factor analysis, can be used to determine the optimal choice of signals to be used.

[2] Zero profit or zero cash flow can occur at any point in time, irrespective of industry-wide profit levels or market-wide profit levels. These benchmarks are thus independent and also easy to implement.
[3] Piotroski's (2000) definition of accrual includes depreciation, where depreciation is considered a negative accrual.

3. *Eq_offer* is simply a dummy variable which takes on the value of 1 if the firm did not issue equity in the prior year and 0 otherwise. As discussed in Myers and Majluf (1984), the use of external financing (debt, hybrid securities or common equity) signals a firm's inability to generate sufficient cash flow to meet obligations.

2.3.3. Operating efficiency. The last two measures used are components included in a DuPont[1] model.

1. Δ*Margin* is defined as the firm's current gross margin ratio (gross margin as a percentage of total sales) less the prior year's gross margin ratio. If the associated change is positive, the dummy variable takes on a value of 1 and 0 otherwise. The associated positive change could indicate an increase in the firm's product price or a decrease in operating or input costs.
2. Δ*Turn* is defined as the firm's current year's asset turnover ratio (total sales as a percentage of average total assets for the year) less the prior year's asset turnover ratio. An improvement in this ratio signifies greater productivity of assets and has a value of 1 for the dummy variable; and 0 otherwise.

2.3.4. Composite score. Thus, the nine dummy variables in equation form are:

$$F_{Score} = F_{ROA} + F_{\Delta ROA} + F_{CFO} + F_{ACCRUAL} +$$
$$+ F_{\Delta MARGIN} + F_{\Delta TURN} + F_{\Delta LEVER} + \qquad (1)$$
$$+ F_{\Delta LIQUID} + EQOFFER.$$

A fundamental investment strategy will rely on selecting firms with high F_{Scores}. This differs from the probability models and data fitting models of Ou and Penman (1989) and Holthausen and Larcker (1992). The Piotroski Score is straightforward to implement and can be recalculated with little effort.

As the F_{Score} is an aggregate measure of performance, it presents a simplified investment strategy when using fundamentals. However, given this simplicity, two complications arise. First, the conversion of information into binary signals does ultimately lead to a loss of that information. Thus, potentially valuable information can be overlooked. Second, there is no theoretical justification for the above model. It is an *ad hoc* approach to selecting those firms that are fundamentally stable[2].

Once the Piotroski scores are calculated, those firms that have scores greater than or equal to 7 are selected to implement a momentum strategy. It is hypothesised that these firms will have strong subsequent performance. The choice of the cut-off score represents the highest tercile of firms – in other words, the top 33% of value firms. Thus, out of the sub-population of value firms (some of which may be financially distressed), the Piotroski score selects those which possess strong historical financial soundness.

2.4. Momentum investing. Using those shares that pass both of the above screening criteria (the value screen and Piotroski screen), a momentum strategy is implemented. This study uses a $J = 12$, $K = 12$ momentum strategy. The original approach is described as per Jegadeesh and Titman (1993). Historic share returns are calculated each month for a 12 month horizon – in other words, on a rolling 12 month horizon. The shares are then sorted based on these historic returns, in ascending order, into quintiles. The bottom quintile is referred to as the loser portfolio and the top quintile is referred to as the winner portfolio. Typically one would long the top quintile and short the bottom quintile. Given that historic 12 month returns are calculated monthly, the sorting procedure is also conducted monthly. Thus, each month the top quintile is bought. As the portfolio in month t is held for a period of 12 months, the overall portfolio will consist of the winner portfolio for the current month, as well as the winner portfolios for the previous 11 months – the overall portfolio will consist of 12 buy-and-hold returns. The return of this overall portfolio is the equally weighted average of the monthly winner and loser portfolios

It can be deduced that the longer the holding period, the lower the transaction costs. However, the drawback with extending the holding period is that opportunities to rebalance the portfolio (especially in a volatile market) will be missed. It then becomes a typical economic conundrum of weighing the (transaction) costs with the benefit of realising (potentially) greater returns.

2.5. Performance-based measurement. In addition to statistical testing, the portfolio manager would be more interested in specific performance ratios. This study employs three such ratios. The Treynor (Treynor, 1965) and Sharpe (Sharpe, 1966) ratios are used to determine exposure (if any) to unsystematic and total risk; and the Sortino ratio (Sortino and Price, 1994) is used as a ranking criterion. Unlike the first two ratios, the Sortino ratio evaluates return per unit of downside risk (defined by semi-deviation). This ratio is often overlooked by analysts yet has important behavioral implications for the investor − volatility in returns is arguably more important when returns are negative than when they are positive. These ratios are calculated on a rolling window period using a minimum return period of 12 months. The risk-free rate used in this study is 3-month T-bill rate.

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[1] The DuPont model decomposes Return on Equity (ROE) into profitability, financial leverage and operational efficiency.
[2] Alternative measures would be the use of Altman's *z*-statistic (Altman, 1968), the historical change in profitability or a decomposition of ROA.

3. Results

3.1. Portfolio returns. Using those shares that passed all screening criteria, the 12-month momentum strategy is examined. Transaction costs of 1% per share in the cross-sectional average are imposed. Throughout this study, these returns are referred to as the "fusion strategy" returns. An apparent caveat in this calculation lies in the feasibility of these returns in a real world scenario. Thus far, these transaction returns inherently ignore the amount of funds available to the investor – the investor could very well invest large amounts of money into each share and be highly leveraged. Further, the intricacies of short selling on the JSE are arguably not feasible for the typical investor. According to the JSE Equities Rules (JSE, 2009, p. 66), short sales are only allowed if the investor has an equivalent amount of borrowing in place. Thus, we present the results of the long and short fusion strategy here, with the results of the long only strategy in the Appendix.

The performance of the fusion strategy is now compared to several benchmarks. The benchmarks selected can be categorized into active and passive. The passive benchmarks used were the All Share Index (ALSI) (JSE code: J203) and the Small Cap Index (JSE code: J202). The ALSI can be considered representative of the South African market for share trading (barring any finer points on its efficiency or the extent of this representativeness). From the perspective of the average investor, the ALSI represents the market. The first screening criterion for the fusion strategy selects those shares that are inexpensive based on their B/M values – some of which could have small capitalization values. This is the primary motivation for selecting the Small Cap Index as the other passive benchmark. In a South African context, the ALSI is dominated by large capitalization firms. If the fusion strategy primarily selects small capitalisation firms, it is logical to compare performance against a suitable index. The active benchmarks were selected from the universe

of unit trusts. Those unit trusts that are advertised as "moderate to high risk", invest only in domestic equity and follow a semblance of a typical value strategy were selected to be compared with the fusion strategy. The benchmarks chosen were the: Absa Select Equity Fund (Fund A), Stanlib Value Fund (Fund B) and the Investment Solutions Multi-Manager Equity Fund (Fund C). As unit trusts are actively managed instruments, the Total Expense Ratio (TER)[1] as well as management fees were considered in performance comparison. In total, the fusion strategy is compared against two passive benchmarks and four active benchmarks[2]. An important caveat in the comparison relates to the data points used in the testing. The passive benchmarks contain data for at least 15 years whilst the active benchmarks (ranging in data points) contain data for at least 4 years.

Assuming returns to be normally distributed, Table 1 below shows the descriptive statistics of the fusion strategy. The mean return of the fusion strategy is 5.59% per month. Whilst this is impressive, the high standard deviation shows that the strategy is quite volatile (indeed the highest when compared to its benchmarks), also given by the large range between maximum and minimum returns. Lastly, it can be seen that all of the active benchmarks possess lower betas than the ALSI, indicative of good defensive strategies (which inherently implies good diversification according to Modern Portfolio Theory (MPT) of Markowitz (1952a)). The fusion strategy has a low beta of 0.07, indicative of a lack of a relationship between market movements with the strategy. Further, by using a simple statistical measure, the coefficient of variation (CV). For this measure, a lower value indicates less variability around the mean return. The CV indicates that the fusion strategy offers the highest risk per mean unit of return, while Fund A offers the best return per unit of variability. In other words, an investor seeking stable returns would invest in Fund A, while an investor seeking higher returns (with higher volatility) would invest in the fusion strategy.

Table 1. Descriptive statistics with the fusion strategy

	ALSI	Small Cap	Fund A	Fund B	Fund C	Fusion
Mean (%)	0.79	0.75	1.19	1.04	0.88	5.59
Standard deviation (%)	1.32	1.63	1.45	1.72	1.54	13.00
Maximum (%)	2.87	3.28%	2.98	2.64	2.67	11.40
Minimum (%)	-2.56	-2.73	-1.58	-2.70	-2.08	-14.00
Observations	165	165	61	64	64	253
β (Beta)*	1.00	0.84	0.84	1.00	0.90	0.07
Coefficient of variation	1.67	2.17	1.22	1.65	1.75	2.33

Note: * $\beta = \dfrac{cov\,ar(i,j)}{\sigma(i) \times \sigma(j)}$. Calculations for beta used the ALSI as the market proxy and restricted the number of observations to the minimum present in both data series.

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[1] TER is a measure of the total cost of the fund to an investor. It includes a variety of administrative costs.
[2] Details on the active benchmarks are obtainable upon request.

Figure 1 below plots the returns over the sample period of the fusion strategy. The results are quite interesting as the strategy seems to perform well over financial anomalies (the technology bubble during 2000 to 2001 and surprisingly during the financial recession of 2007 to 2009). The performance of the strategy, in light of it's extremely low beta point towards a good diversified portfolio. We further examine this point below.
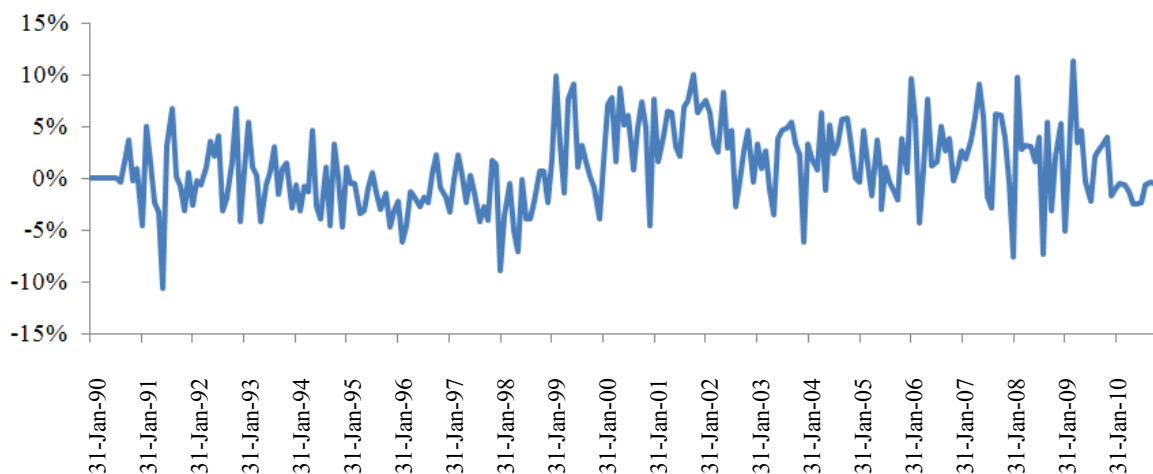

Fig. 1. Fusion strategy returns

3.2. Risk-adjusted performance. Upon examination of Table 2 below, the majority of Treynor ratios are lower than their corresponding Sharpe ratios, with the exception of Fund B (with its associated fusion strategy comparison) and the Small Cap index only. This implies that the fusion strategy and the benchmarks have relatively good levels of diversification. The large negative values for the Sharpe ratio of Fund B (as well as the fusion strategy) could be explained by the measurement period used for the fund. Returns to Fund B were calculated with the initial data point beginning in January 2008. At the onset of a global recession, the returns to Fund B were particularly low.

The fusion strategy performs better than the Small Cap Index under the Sharpe ratio and better than the ALSI under the Treynor ratio. In the parlance of portfolio management language, the fusion strategy provides greater returns per unit of total risk (given by σ) than the Small Cap Index and better returns per unit of systematic risk than the ALSI. The results for the active benchmarks are somewhat mixed. Two funds (Fund A and Fund D) perform better than the fusion strategy, Fund B is outperformed by the fusion strategy and Fund C has mixed results when considering the Sharpe and Treynor ratios.

Attention is now turned to the Sortino ratio below. This ratio provides a measure of return per unit of downside risk. A higher Sortino ratio is indicative of better managed investment portfolio. In contrast to the mixed results presented earlier, performance according to the Sortino ratio is more in favor of the fusion strategy. The strategy has higher Sortino ratios for all

benchmarks except Fund A[1]. The fusion strategy offers better capital preservation than the benchmarks used. This is particularly appealing to investors who wish to seek a form of assurance in financial returns (as counter-factual as the analogy may seem).

Table 2. Sharpe and Treynor ratios using returns from the fusion strategy and fusion fund

	Sample Period	Sharpe Ratio	Treynor Ratio	Sortino Ratio
Fusion	1995-2010	0.18	0.01	0.11
ALSI		0.08	0.00	0.02
Fusion	1995-2010	0.18	0.01	0.14
Small Cap		0.08	0.00	0.01
Fusion	2000-2010	0.28	0.01	0.26
Fund A		0.32	0.01	0.83
Fusion	2003-2010	0.28	0.01	0.26
Fund C		0.10	0.00	-2.02
Fusion	2003-2010	0.28	0.01	0.26
Fund D		0.21	0.01	-0.47

Robustness tests were conducted to determine if the results of the fusion strategy (fund) can be attributed to either the business cycle, calendar effects or the level of transaction costs. Details of these tests are obtainable from the authors upon request.

3.3. Statistical tests and caveats. To add robustness to our results, we employ a simple two sample unequal variance *t*-test to determine whether the returns of the fusion strategy are statistically different from zero. Indeed, the results of the test indicate that the null of a zero difference are rejected − the fusion strategy returns are statistically significantly different from zero at the 1% level of significance.

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[1] This also serves as an indirect validation of the superior performance of Fund A, given by the accolades this fund has earned.

Table 3. *T*-test results for a hypothesised mean difference of zero

T stat	4.44
P(T ≤ t)	0.00

Further, we determine if the returns of the fusion strategy are linear or non-linear. The BDS test (Brock, Dechert & Scheinkman, 1987) for non-linearity was used and the results are shown in Table 4 below. The BDS test divides the data distribution into quartiles and provides the test statistic in the upper panel of the table. The *p*-values are provided in the lower panel. The results of the BDS test show that the fusion strategy exhibits non-linear behaviour as the null hypothesis of linearity is rejected at all common levels of significance.

Table 4. BDS test for non-linearity

FUSION	25th percentile 3.2112	Median 6.4223	75th percentile 9.6335	99th percentile 12.8447
Lag = 2	21.2865	13.3288	7.1935	4.5292
Lag = 3	21.1055	12.5540	6.1080	4.2917
FUSION	25th percentile 3.2112	Median 6.4223	75th percentile 9.6335	99th percentile 12.8447
Lag = 2	0	0	0	0
Lag = 3	0	0	0	0

Of the statistical caveats that can be levelled against this study, perhaps the greatest is that of the small sample period used. However, according to McCloskey (1985), it is not strictly necessary for a result to be both statistically significant and economically significant. Indeed, as the returns of the fusion strategy are arguably economically significant for the typical investor, it is a minor issue that the number of shares included in the strategy are small. Further, while a diversification argument can be raised, it is the very aim of the strategy to pick particular shares in an attempt to earn above-average returns.

Conclusion

The fusion strategy developed in this study utilized three screening criteria – a value, fundamental and momentum screen. Returns were calculated net of transaction costs, initially set to 1% per month, and were compared against two passive benchmarks and four active benchmarks.

On a nominal basis, the fusion strategy outperformed all active and benchmarks chosen, with a monthly return of 5.79% after costs. On a risk adjusted basis, the results were mixed. By the use of Sharpe and Treynor measures, the fusion strategy performed better against some benchmarks and worse than others. However, the Sortino ratio shows that the fusion strategy outperforms all benchmarks chosen, except Fund A. The performance of the fusion strategy was also found to not be induced by either a sector rotation strategy or the existence of the January effect. Sensitivity of the level of transaction costs was also investigated. The level of transaction costs that results in a break-even return for the fusion strategy was found to be at least 6.50% per month. This amount is economically significant. Thus, notwithstanding the significant influence of transaction costs, the results are promising.

Given the richness of the database used, future promising avenues of research would be to investigate the timing of the share purchases and sales, so as to maximize returns while minimizing risk. Indeed, a mean-variance approach can be adopted, leading to a fund being created from the fusion strategy and other assets. Given the non-linearity in returns, one could pursue a theoretical investigation as to the link between the strategy's performance and market efficiency.

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Appendix

We present the results of the long only fusion strategy, as a typical investor on the JSE will not be able to short sell equity.

Table A1 shows that the returns of the long only strategy are an average of 1.07% a month. This is considerably lower than the returns of the long-short fusion strategy, primarily due to the volatility of short selling equity. The beta of the strategy is somewhat higher (0.12) indicating that a long only strategy offers slightly more co-movement to the JSE compared to a long-short fusions strategy.

Table A1. Descriptive statistics with the fusion strategy

	ALSI	Small Cap	Fund A	Fund B	Fund C	Fusion
Mean (%)	0.79	0.75	1.19	1.04	0.88	1.07
Standard deviation (%)	1.32	1.63	1.45	1.72	1.54	3.82
Maximum (%)	2.87	3.28%	2.98	2.64	2.67	11.40
Minimum (%)	-2.56	-2.73	-1.58	-2.70	-2.08	-10.63
Observations	165	165	61	64	64	253
β (Beta)*	1.00	0.84	0.84	1.00	0.90	0.12
Coefficient of variation	1.67	2.17	1.22	1.65	1.75	3.57

Note: $* \beta = \dfrac{covar(i,j)}{\sigma(i) \times \sigma(j)}$. Calculations for beta used the ALSI as the market proxy and restricted the number of observations to the

minimum present in both data series.

A plot of returns in Figure A1 indicates that the long only fusion strategy seems to follow the business cycle. The strategy did not perform well over the financial recession of 1998 to 1999 and 2008 to 2009.
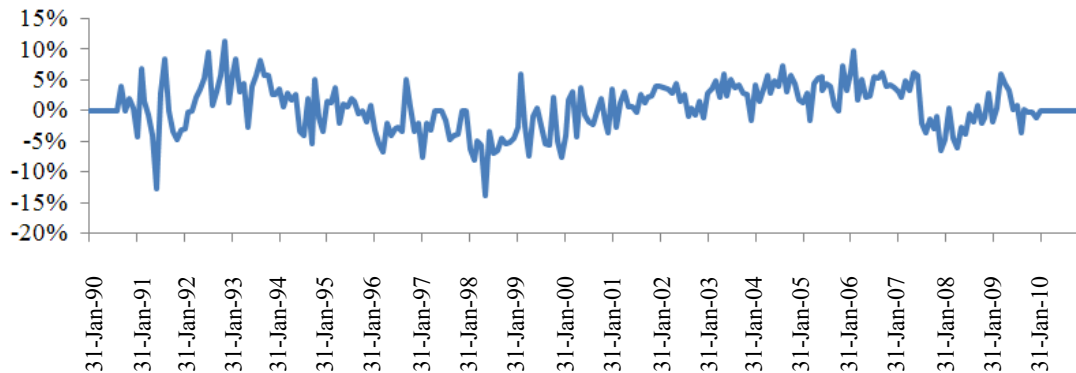

Fig. A1. Fusion strategy returns

The performance ratios in Table A2 below show that the long only fusion strategy offers less return per unit of systematic risk than both passive and active benchmarks. The results of the Treynor ratio are more in favor of the long only strategy, with the fusion strategy performing better than Funds A, C and D. Similarly to the long-short fusion strategy, the Sortino ratio shows that the long only strategy outperforms all benchmarks chosen, with the exception of Fund A.

Table A2. Sharpe, Treynor and Sortino ratio comparison across benchmarks

	Sharpe ratio	Treynor ratio	Sortino ratio
Fusion	-0.37	0.02	0.17
ALSI	0.01	0.00	-0.40
Fusion	-0.37	0.02	0.17

Table A2 (cont.). Sharpe, Treynor and Sortino ratio comparison across benchmarks

	Sharpe ratio	Treynor ratio	Sortino ratio
Small Cap	-0.16	0.03	-0.68
Fusion	2.92	0.15	0.55
Fund A	3.90	0.03	0.57
Fusion	0.97	0.05	0.17
Fund B	-4.11	-0.09	-10.01
Fusion	2.90	0.15	0.54
Fund C	4.09	-0.03	0.27
Fusion	2.90	0.15	0.54
Fund D	4.62	0.02	0.24

In summary, we show that the long only fusion strategy can be considered a viable option for the typical investor, as the monthly returns are still favorable compared to chosen benchmarks, and the return per unit of downside risk outperforms all chosen benchmarks, with the exception of Fund A.