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MOMENTUM ON THE JSE: THE INFLUENCE OF SIZE AND LIQUIDITY

by

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ABSTRACT

This study investigates the buy-and-hold returns to intermediate-term 'zero investment' momentum strategies on the Johannesburg Stock Exchange, using both equally-weighted and value-weighted portfolios. The results indicate that there is little evidence to support the prevalence of intermediate-term 'pure' price momentum in South Africa using 'zero investment' strategies. Furthermore, this study examines the influence of size and liquidity on momentum returns. Compared to 'pure' price 'zero investment' momentum strategies, this study finds stronger return continuation for 'zero investment' strategies among medium and large capitalisation stocks, as well as the most liquid stocks. Moreover, a detailed analysis into the loser and winner portfolios that constitute the 'zero investment' portfolio, reveals that, if one is open to abandoning the traditional 'zero investment' approach, the returns to size-sorted momentum strategies may be significantly enhanced by taking a long position in the small-size winner portfolio, and the returns to liquidity-sorted momentum strategies can likewise be enhanced by taking a long position in the high-volume winner portfolio.

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1. INTRODUCTION

1.1 BACKROUND

The Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965) marked the birth of asset pricing theory. The attraction of this particular model is that it offers powerful and intuitively pleasing predictions about how to measure risk and the relation between expected risk and return. After the development of the CAPM, numerous authors undertook the challenge of testing the validity of the CAPM, and thus that of the Efficient Market Hypothesis (EMH) by examining whether or not an investor can consistently earn above average risk-adjusted returns. The early empirical evidence suggested that both the CAPM and the EMH were generally valid and that an investor, more often than not, cannot consistently earn above average risk-adjusted returns (see eg., Fama, 1970; Black, Jensen and Scholes, 1972; and Fama and MacBeth, 1973).

In spite of these findings, equity investment managers and analysts continued to pursue stylised investment strategies with the primary objective of outperforming the market, which suggested that at the time, the two formidable theories of finance must have exhibited exploitable anomalies.

Since the late 1970's, further attempts to empirically verify the predictions of the CAPM have produced numerous inconsistencies with the theory. Amongst these inconsistencies is the evidence that variables such as the book-to-market ratios (B/M), market capitalisations (Size), and price-to-earnings ratios (P/E) are able to predict security returns beyond that explained by the risk factor beta (see eg., Basu, 1977; Banz, 1981; Fama and French, 1992; Van Rensburg and Robertson, 2003; and Basiewicz and Auret, 2009). One relatively recent and notable inconsistency that has attracted a large amount of interest amongst financial academics and practitioners alike, is momentum (see eg., Jegadeesh and Titman, 1993; Fraser and Page, 2000; Jegadeesh and Titman, 2001; Hart, Slagter and Van Dijk, 2003; Page, Britten and Auret, 2013). Momentum refers to an interdependence of time-series returns. More specifically, stocks with above (below) average returns in recent months tend to outperform (underperform) other stocks in the investable universe. 'Zero investment' momentum strategies attempt to exploit this aforementioned anomaly by purchasing stocks that outperformed a common benchmark (winners) and short-selling those that have underperformed a common benchmark (losers).

Equity market momentum studies are commonly categorised by way of a short-term, intermediate-term and long-term investment horizons. Short-term indicates an investment horizon of one week to one month (see eg.,Lehmann, 1990; Jegadeesh, 1990), intermediate-term indicates an investment horizon of three to 12 months – the most frequently researched – (see eg., Jegadeesh and Titman, 1993; Hong, Lim and Stein, 2000; Jegadeesh and Titman, 2001; Demir, Muthuswamy and Walter, 2004), and long-term usually indicates an investment horizon of three to five years, where contrarian profits are most commonly documented (see eg., De Bondt and Thaler, 1985; Jegadeesh and Titman, 2001).

This study aims to extend the analysis of momentum strategies on the Johannesburg Stock Exchange (JSE) and contribute to the literature as follows. First, a detailed analysis of intermediate-term momentum strategies is conducted over the period of 1st of January 2001 to the 31st of January 2011 (which includes all stocks listed on the JSE) to provide a comparison with similar studies in the USA, UK, Europe, Asia and Australia. Second, the influence of size and liquidity on all of the aforementioned momentum strategy returns is evaluated by way of portfolio sorts, to possibly disentangle confounding effects of the resultant returns. Third, a regression analysis is employed to separate the effects of intermediate-horizon momentum estimation returns, size and liquidity on excess stock performance.

To preview, this study finds little evidence to support the prevalence of intermediate-term 'pure' price momentum in South Africa using 'zero investment' strategies. Furthermore, compared to 'pure' price momentum 'zero investment' strategies, this study finds stronger return continuation for 'zero investment' strategies among medium and large capitalisation stocks, as well as the most liquid stocks. Moreover, a detailed analysis into the loser and winner portfolios that constitute the 'zero investment' portfolio, reveals that, if one is open to abandoning the traditional 'zero investment' approach, the returns to size-sorted momentum strategies may be significantly enhanced by taking a long position in the small-size winner portfolio, and the returns to liquidity-sorted momentum strategies can likewise be enhanced by taking a long position in the high-volume winner portfolio.

The remainder of this study is organised as follows. Section 2 presents a literature review. Section 3 describes the methodology. Section 4 presents and analyses the empirical results. Section 5 concludes.

2 LITERATURE REVIEW

2.1 MOMENTUM IN THE USA

Jegadeesh and Titman (1993) are amongst the first authors to highlight and advocate the momentum anomaly. These authors attempt to investigate the relative strength of momentum strategies (formed on data over the past 3-to-12 months) on NYSE and AMEX stocks over the period of 1965 to 1989. They conclude that strategies that buy past winners (companies that have performed well in the portfolio formation period) and sell past losers (companies that have performed poorly in the portfolio formation period) realise significant abnormal returns over the 1965 to 1989 period. Additional evidence indicates that the profitability of the momentum strategies is not due to their systematic risk. Furthermore, the returns of the zero-cost (winners minus losers) portfolio were examined in each of the 36 months after the portfolio formation date. With the exception of the first month, this portfolio realises positive returns in each of the 12 months after the formation date. However, the longer-term performance of these past winners and losers reveals that half of their excess returns in the year following the portfolio formation date dissipate within the following two years. This reversal re-enforces the earlier findings of De Bondt and Thaler (1985, 1987).

Carhart (1997) conducts further analysis into the persistence in mutual fund performance over the period of January 1962 to December 1993. He demonstrates that common factors in stock returns and investment expenses almost completely explain the persistence in equity mutual funds mean and risk-adjusted return. Furthermore, a major contribution by Carhart (1997), directly extends the Fama-French three-factor model by including a fourth common risk factor that accounts for the tendency of firms with positive (negative) past returns to produce positive (negative) future returns. This additional risk dimension is aptly named the price momentum factor (*MOM*) and it is constructed by taking the average return of a set of stocks with the best performance over the prior year minus the average return of stocks with the worst returns. Formally, the model he proposes is: $(R_{it} - RFR_t) = \alpha_i + b_{i1}(R_{mt} - RFR_t) + b_{i2}SMB_t + b_{i3}HML_t + b_{i4}MOM_t + e_{it}$.He demonstrates that the momentum variable inclusion into the Fama-French three-factor model can increase explanatory power by as much as 15%. Although this finding is somewhat enlightening, one must be aware that it is in contrast to that of Jegadeesh and Titman (1993), who indicate that the profitability of momentum strategies is as a result of an independent phenomenon, rather than being considered as compensation for systematic risk.

Conrad and Kaul (1998) present an analysis of trading strategies that rely on time-series patterns in security returns (momentum and contrarian) at eight different horizons (ranging between one week

and 36 months) over several different sub-periods during the 1926 to 1989 period, for all NYSE/AMEX securities. They show that less than 50% of the 120 strategies implemented yield statistically significant profits and, unconditionally, momentum and contrarian strategies are equally likely to be successful. Furthermore, they state that a momentum strategy is usually profitable at the intermediate horizon (3-to-12 months). However, the authors do point out that the source of the profitability of these trading strategies is a point of contention that requires further investigation. More specifically, Conrad and Kaul (1998) suggest that momentum strategies are profitable because initiating a momentum strategy amounts to buying, on average, high-mean risk securities and short-selling low-mean risk securities.

Hong, Lim and Stein (2000) set out to extend the earlier gradual-information-diffusion model of Hong and Stein (1999) in explaining momentum in stock returns over the intermediate-horizon. In other words, they search for evidence that momentum reflects the gradual diffusion of firm-specific information (i.e., stocks with slower information diffusion should exhibit more pronounced momentum). Their sample includes NYSE, AMEX, and Nasdaq stocks over the period of 1976 to 1996. The authors establish three key results. First, with respect to firm size, once one moves past the smallest capitilisation stocks (where thin market making capacity seems to be an issue), the profitability of momentum strategies declines sharply with market capitilisation. Second, holding firm size fixed, momentum strategies work better amongst stocks with low analyst coverage. Moreover, size and analyst coverage interact in a plausible fashion: The marginal importance of analyst coverage is greatest among small stocks. Finally, the effect of analyst coverage is more pronounced for stocks that are past losers rather than past winners. In conclusion, the authors suggest that these results are consistent with the hypothesis that firm-specific information, especially negative information, diffuses only gradually across the investing public, however, they do not claim that alternative interpretations of some or all the evidence cannot be put forth.

Lee and Swaminathan (2000) set out to investigate the usefulness of trading volume in predicting the cross-section of returns for various price momentum strategies on all firms listed on the NYSE and the AMEX during the period of January 1965 to December 1995, with at least two years of data prior to the portfolio formation date. The authors' findings establish several important regularities about the role of trading volume in predicting cross-sectional returns. First, they show that trading volume, as measured by the turnover ratio, is unlikely to be a proxy for liquidity, but rather that the information content of trading volume is related to market misperceptions of firms' future earnings prospects. Second, they show that firms with high (low) past turnover ratios exhibit many glamour (value) characteristics, earn lower (higher) future returns, and have consistently more negative

(positive) earnings surprises over the next eight quarters. Third, the returns to zero-cost momentum strategies are higher for high-volume firms than for low-volume firms. This result is both economically and statistically significant. Fourth, past trading volume also predicts both the magnitude and persistence of price momentum. Specifically, price momentum effects reverse over the next five years, and high (low) volume winners (losers) experience faster reversals. This finding represents an important conceptual shift in the literature as previous studies have generally viewed intermediate-horizon momentum and long-horizon momentum price reversal as two separate phenomena. The findings in this study show that trading volume provides an important link between these two effects. The implications of this study suggest that incorporating past volume into price momentum strategies appear to provide improved and economically significant gains.

2.2 MOMENTUM IN INTERNATIONAL MARKETS

Rouwenhorst (1998) attempts to address the concern, that the documented return continuation and reversal in the USA, may be as a result of an elaborate data snooping process, as many empirical researchers use the same or similar databases of stocks. Following a methodology similar to Jegadeesh and Titman (1993), he studies return patterns in an international context, using data for 12 European countries over the period of 1978 to 1995. The main finding of his study is that an internationally diversified zero-cost momentum strategy earns approximately 1% per month. Furthermore, there are two auxiliary findings. First, the return continuation is present in all 12 sample countries, lasts on average for about one year, and cannot be attributed to conventional measures of risk. Second, return continuation holds across all size deciles, although it is stronger for smaller firms than larger firms. Since the European evidence is remarkably similar and correlated to that of the USA, Rouwenhorst (1998) suggests that it is unlikely that the U.S. evidence is simply due to chance, and furthermore, it is possible that exposure to a common factor may drive the profitability of momentum returns.

Rouwenhorst (1999) aims to determine if emerging market returns are characterised by the same factors as those found in developed markets. He examines the cross section of returns in 20 emerging markets, using return data of 1750 stocks over the period of 1982 to 1997, by forming portfolios of stocks that are constructed by sorting stocks on observable firm characteristics or estimated risk exposures. He shows that the return factors in emerging markets are qualitatively similar to those in developed markets: small stocks outperform large stocks, value stocks outperform growth stocks and emerging market stocks exhibit momentum. There is no evidence to suggest that local market betas are associated with average returns. The low correlation between the country return factors suggests that the premiums have a strong local character. A Bayesian analysis

of the return premiums shows that the combined evidence of developed and emerging markets strongly favours the hypothesis that similar return factors are present around the world. Finally, the study documents the relationship between expected returns and share turnover, and examines the turnover characteristics of the local return factor portfolios. There is no evidence of a relation between expected returns and turnover in emerging markets, however, beta, size, momentum and value are positively cross-sectionally correlated with turnover in emerging markets. This suggests that the return premiums do not simply reflect a compensation for liquidity.

Liu, Strong and Xu (1999) examine intermediate-term momentum strategies on a large sample of UK stocks over the period of January 1977 to June 1998, following the approaches of both Lehmann (1990) and Jegadeesh and Titman (1993). Their analysis shows that significant momentum profits are available in the UK over the sample period. An analysis of sub-period results, seasonal effects, and the persistence of momentum profits confirms the robustness of the results. Furthermore, the authors go on to examine the sources of momentum profits by investigating the relation between momentum profits and factors known to be associated with differential average returns. These factors include: market capitilisation (size), stock price, the book-to-market ratio (B/M), and the cash earnings-to-price ratio (E/P). This particular analysis confirms the presence of size, price, book-to-market, and cash earnings-to-price effects in UK stock returns. However, after controlling for the aforementioned factors, the momentum profits remain intact. The authors suggest that their findings lend support towards behavioural explanations of the intermediate-term price momentum phenomenon rather than risk-based explanations, but they do unequivocally state that their tests cannot qualify as proper and robust tests of these behavioural theories.

Chan, Hameed and Tong (2000) set out to investigate the profitability of momentum strategies implemented on international stock market indices. The sample data covers 23 countries over the period of January 1980 to June 1995, except for Austria, South Africa and Indonesia – due to data collection constraints. Their results indicate statistically significant evidence of momentum profits. It is interesting to note that although the major source of momentum profits arises from price continuations in individual stock indices, the momentum profits could be enhanced from exploiting exchange rate information. Furthermore, the authors also show that when they implemented the momentum strategies on markets that experience increases in volume in the previous period, the momentum profits are higher. This indicates that return continuation is stronger following an increase in trading volume – consistent with the herding behaviour theory, in which investors tend

to follow the crowd in buying and selling securities. One may conclude that the aforementioned finding confirms the informational role of volume and its applicability in technical analysis.

Hameed and Kusnadi (2002) investigate momentum investment strategies in six emerging Asian stock markets over the period of 1979 to 1994 using a methodology similar to that of Jegadeesh and Titman (1993), as well as Rouwenhorst (1998). The authors show that their unrestricted momentum investment strategies over various estimation and holding periods (3-to-12 months) consistently produce positive but insignificant returns. When the authors construct a diversified country-neutral momentum portfolio (in an effort to reduce portfolio volatility), they show that this portfolio yields a small, but statistically significant positive return during the 1981 to 1994 period. However, when the authors control for size and turnover effects, these significant returns tend to dissipate. In line with their findings, Hameed and Kusnadi (2002) suggest that the factors which contribute to the momentum phenomenon in other markets may not be prevalent in the emerging Asian markets that were investigated in this study.

Hart, Slagter and Van Dijk (2003) examine the profitability of a broad range of stock selection strategies in 32 emerging markets over the period of 1985 to 1999. Their empirical results are fivefold. First, the value, momentum and earnings revisions strategies are most successful in generating significant excess returns, in contrast to stock selection strategies based on size, liquidity and mean reversion. Second, the authors state that the performance of stock selection strategies can be enhanced by selecting stocks on multiple of the aforementioned characteristics as well as by using the strategies for country selection, although the latter bears the cost of increased risk. Third, financial market liberalisations in emerging countries do not affect the performance of the strategies, as they show that all strategies generate significant excess returns in both liberalised and non-liberalised markets. Fourth, the apparent profitability of the selection strategies cannot be regarded as compensation for exposures to global market, B/M, size and momentum risk factors as the excess returns remain significant after adjusting for these factors. Fifth, the authors document that the strategies can be implemented successfully in practice by a large institutional investor, facing a lack of liquidity and substantial transaction costs.

Glaser and Weber (2003) set out to analyse the relationship between momentum and turnover for the German stock market over the period of June 1988 to July 2001, in order to provide an out-of-sample test of the results of Lee and Swaminathan (2000). Their main finding is that momentum strategies are more profitable among high-turnover stocks. In contrast to Lee and Swaminathan (2000), this result is mainly driven by the constituent winner portfolio, rather than the constituent

loser portfolio of the zero-cost momentum portfolio: high-turnover winners have higher returns than low-turnover winners, and low-turnover losers have higher returns than high-turnover losers, but the return differential is more pronounced for winner portfolios. Furthermore, the authors look at the influence of size, book-to-market(B/M), industry factors and seasonality on momentum returns. They suggest that according to their results, the momentum returns are, to some extent, due to size, book-to-market, and industry factors. Lastly, their results do indeed show a striking seasonality in the sense that momentum returns are negative in most January periods, and that all returns, except those of the zero-cost momentum portfolios, are above average in January.

Demir, Muthuswamy and Walter (2004) examine short and intermediate-term momentum returns for all Australian securities (excluding small and infrequently traded stocks to create a realistic and implementable strategy) that are approved for short-selling over the period of September 1990 to July 2001, or are included in the All Ordinaries Index over the period of July 1996 to July 2001, using daily price data. The main finding of this particular study is that short-term and intermediate-term momentum is prevalent in the Australian market, and it appears that the momentum profits are of a greater magnitude than those that were found previously in other markets. The authors show that return continuation is present and significant in both small and large firm samples (although small stocks do exhibit greater momentum), is robust to risk adjustment, and is not solely attributed to extreme decile performance. Furthermore, the returns to the zero-cost strategy cannot be explained by the 'liquidity effect'. Contrary to expectations, the relative strength strategy implemented on illiquid stocks yields lower (and in some cases negative) returns than when the strategy is applied to more liquid stocks

Wang and Chin (2004), in the same spirit as Lee and Swaminathan (2000), examine the informational role of the interaction between past returns and past trading volume in the prediction of cross-sectional returns over intermediate horizons (3 to 12-months), using a sample of A-shares traded on the Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE) over the period of July 1994 to December 2000. The authors document strong evidence of predictable patterns in cross-sectional returns. First, they show that low-volume stocks outperform high-volume stocks, consistent with the liquidity premium hypothesis (see eg., Amihud and Mendelson, 1986; Datar, Naik and Radcliffe, 1998; Brennan, Chordia and Subrahmanyam, 1998). Second, the difference in returns between low-and-high-volume stocks is larger for past winners than for past losers. Third, low-volume stocks experience significant return continuations, whereas high-volume winners experience strong reversals. In light of these findings, one can conclude that there are significant momentum profits present in low-volume stocks but not in high-volume stocks.

Furthermore, the results also hold true after risk adjustments relative to the Fama and French (1993) three factor model, and are robust to stock exchange as well as large stock sub-samples. Overall, these results are not entirely consistent with Lee and Swaminathan (2000), but appear to be more in line with behavioural finance models (see eg., Hong and Stein, 1999; and Baker and Stein, 2004).

Naughton, Truong and Veeraraghavan (2008) investigate the profitability of short, intermediate and long-term momentum strategies for equities listed on the Shanghai Stock Exchange over the period of 1995 to 2005. They also investigate the role of trading volume to examine whether there is any relationship between stock returns and past trading volume, using a similar approach to that of Lee and Swaminathan (2000). The authors show that there is evidence of substantial momentum profits over the period of 1995 to 2005, and that momentum is a pervasive feature of stock returns for the market investigated in this paper. Furthermore, the evidence suggests that past trading volume does not provide a strong link between momentum and value strategies. Lastly, around earnings announcements, the momentum strategies earn high short-term returns, although such returns are a relatively small component of the overall profits earned from a variety of monthly holding periods.

Brown, Yan Du, Ghon Rhee and Zhang (2008) set out to evaluate the returns to value and momentum strategies in four Asian markets over the period of 1990 to 2005, using two unique experiments. First, they analyse both value and momentum strategies in combination rather than separately. They create a long portfolio containing the stocks that are both value and winner stocks and a short portfolio containing the stocks that are both growth and loser stocks. Second, they put all sample stocks selected from Hong Kong, Korea, Singapore and Taiwan into one basket. Under this one-basket approach, they evaluate the respective returns to value and momentum strategies at the regional level rather than at the country level. The results suggest that the combination of value and momentum strategies does not provide a significant improvement over the value or the momentum strategy evaluated separately. One immediate conjecture is that value stocks and winner stocks do not move in tandem. Likewise, growth stocks and loser stocks may offset their effectiveness. Lastly, the value premia under the one-basket approach appears to be insignificant regardless of the weighting scheme used.

Bettman, Maher and Sault (2009) examine the profitability of intermediate-term momentum trading strategies for all stocks listed on the All Ordinaries Index within the Australian equity market over the period of January 1990 to December 2007, using daily price data. They extend the analysis of Jegadeesh and Titman (1993) with the inclusion of three innovations. First, they apply the Barber and Lyon (1997) matched sample methodology to measure momentum profits. Second, they

examine the robustness of momentum profits to short-selling restrictions and transaction costs in the form of bid-ask spreads. Third, they examine whether momentum profits are exploitable by investors by simulating the activity of an investor, whereby short-sale restrictions, liquidity constraints and transaction costs are accounted for. The authors show that momentum profits exist and are significant in the Australian equity market. Furthermore, they provide the first evidence that momentum profits in the Australian equity market are robust to short-selling restrictions, liquidity constraints, and bid-ask spread costs. Lastly, the culmination of these (realistic estimation) results suggests that statistically significant momentum profits can be achieved by an investor.

Fama and French (2012) look to reaffirm the presence of momentum and other anomalies in share returns. More specifically, they set out to achieve two goals. The first is to determine whether there are size, value and momentum patterns in average returns for 23 developed markets over the period of November 1989 to March 2011. The second is to examine how well asset pricing models such as the Fama and French (1993) model and the Carhart (1997) model capture the value and momentum patterns in international average returns and whether asset pricing seems to be integrated across the four regions (North America, Europe, Japan and Asia Pacific). The authors show that value premiums exist in all four of the regions that they examine (North America, Europe, Japan and Asia Pacific), and that there are strong momentum returns in all regions, except for Japan. Value premiums are larger for small stocks, except for Japan, and winner minus loser spreads in momentum returns also decrease from smaller to larger stocks. In Japan, there is no hint of momentum returns in any size group. Furthermore, integrated pricing across regions does not get strong support in the authors' tests. Lastly, for three regions (North America, Europe, Japan), local models that use local explanatory returns provide passable descriptions of local average returns for portfolios formed on size and value versus growth. Local models are less successful in tests on portfolios formed on size and momentum.

2.3 MOMENTUM IN SOUTH AFRICA

Fraser and Page (2000) aim to independently determine the validity of momentum and value strategies when applied to the industrial sector of the JSE, and then they seek to determine whether there is any interaction between these two strategies over the period of January 1973 to October 1997. First, they conclude that both value strategies (based on book-to-market and dividend yield), and momentum strategies (based on the past 12 months return), have the power, independently, to predict the return on a share one month into the future, and thereby earn superior returns. It must be noted, however, that the dividend yield measure is weaker than the book-to-market measure, with reference to the value strategy. Second, using univariate tests, they do not observe any correlation

(negative or positive) between the value and momentum strategies. Furthermore, using bivariate tests they show no relation or interaction between the two strategies. These findings are contrary to those of Asness (1997) who find that value strategies are strongest amongst loser shares and weakest amongst winner shares, and that momentum strategies are particularly strong amongst growth shares. The findings of Fraser and Page (2000) suggest that, at a practical level, each of these strategies could be used independently in the formation of investment portfolios.

Van Rensburg (2001) conducts a broad based study on firm specific style-based factors that could possibly explain the returns to JSE industrial shares over the period of February 1983 to March 1999 using a 'portfolio-based' approach. Amongst the many style-based factor portfolios, Van Rensburg (2001) constructs momentum portfolios by ranking shares in descending order based on their past performance into three equally-weighted portfolios, with portfolio 1 containing the top one third of shares (winners) and portfolio 3 containing the bottom one third of shares (losers). The portfolios are tested for different estimation and holding periods. Van Rensburg (2001) shows that the strategies based on past 3, 6, and, 12 month returns are profitable at the 5% level of significance, but that the 12 month strategy is the most successful for generating profit. In line with these findings, he concludes that momentum exists within the industrial sector of shares on the JSE.

Van Rensburg and Robertson (2003) continue Van Rensburg's (2001) strand of research on all JSE listed shares over the period of July 1990 to June 2000, by adopting the 'characteristics-based approach' supported by Daniel and Titman (1997) . The central concern of this paper is to discern the identity of the style-based factors that explain the cross-section of JSE returns using cross-sectional regression analysis. Amongst these style-based factors, the authors examine momentum as a possible explanatory variable describing the cross-section of JSE returns using a share's past 1, 6, and 12 month return. Unlike the findings of Fraser and Page (2000) and Van Rensburg (2001), whose analyses are confined to the industrial sector of the JSE, none of the measures of price momentum are significant when all JSE shares are considered for analysis.

Venter (2009) examines ultra-short-term (holding periods of at most a few hours) return predictability on the JSE based on intraday momentum and contrarian effects over the full tradable year of 2007, using mid-quote prices instead of transaction prices to avoid the bid-ask bounce effect. The authors' findings indicate some evidence in favour of significant return predictability when returns are calculated from mid-quote prices. However, when one considers more realistic bid-ask pricing assumptions that would be applicable from a trading point of view in calculating returns, the intraday momentum and contrarian effects largely disappear.

Page, Britten and Auret (2013) set out to investigate short and medium-term pure price momentum strategies, as well as the interaction between momentum and liquidity on the JSE over the period of January 1995 to December 2010. Firstly, the authors show that there is a significant momentum effect on the JSE, however, the magnitude of the profits declines in the latter half of the sample. More specifically, in the first sub-sample, momentum profits are higher than the second sub-sample by at least 1%per month. This result is possibly attributable to the financial market crisis experienced over the period of 2008 and 2009. Secondly, they find that high and medium liquidity momentum portfolios outperform the low liquidity momentum portfolios on an absolute return basis, and that illiquidity seems to have a significantly negative effect on momentum profits. These findings are in line with the behavioural decomposition of the momentum effect.

3 METHODOLOGY

3.1 DATA

The monthly closing share prices – adjusted for corporate events and dividends – are obtained from the Findata@Wits database. Monthly total returns are denominated in South African rands .The firm characteristics that are utilised include: market capitalisations and number of shares traded. These firm characteristics are sourced from the Findata@wits database. The market benchmark (FTSE/JSE All Share Index – J203) monthly closing prices are obtained from the McGregor BFA database. The sample period runs from the 1st of January 2001 to the 31st of January 2011 and includes all stocks listed on the JSE over the stipulated sample period.

3.2 PORTFOLIO CONSTRUCTION

In tests that use portfolio sorting, the individual returns in the portfolios can be equally-weighted or weighted according to the stock's market capitalisation. Value-weighted returns may be preferred as it decreases the impact of trading costs (Daniel and Titman, 1999). The equal-weighted returns may be preferable as firm specific events are less likely to influence the results. However, critics of momentum studies claim that equal-weighted portfolios do not accurately reflect implementable strategies as it places too much emphasis on returns of small stocks. Small stocks tend to be less liquid relative to larger stocks and therefore the resultant returns from equally-weighted portfolios may not be achievable without incurring significant transaction and market impact costs (Demir et al., 2004). Since there is no agreement amongst academics as to which weighting scheme is better (Basiewicz and Auret, 2009), this study will present the results of both weighting schemes.

Furthermore, the performance of all momentum strategies in this study are measured as the returns in excess of the market benchmark (FTSE/JSE All Share Index – J203) of a 'zero investment' strategy, which involves a long position in the winner portfolio and an offsetting short position in the loser portfolio (see eg., Jegadeesh and Titman, 1993; Fama and French, 1998; Rouwenhorst, 1999). The significance of the various 'zero investment' strategy returns in excess of the market index is examined using a *t*-statistic.

3.3 MOMENTUM TRADING STRATEGIES

Following a methodology similar to that of Demir et al. (2004), the momentum strategies used in this study involve constructing momentum portfolios in the following manner. At the end of each K-month (K = 3, 6, 9, and 12) estimation period, stocks are ranked in ascending order based on their buy-and-hold returns in excess of the market benchmark (FTSE/JSE All Share Index – J203)

return. More specifically, excess buy-and-hold returns of a given firm at time t is mathematically stated as:

$$r_t = \frac{Stock\ Price_t - Stock\ Price_{t-n}}{Stock\ Price_{t-n}} - \frac{Benchmark\ Price_t - Benchmark\ Price_{t-n}}{Benchmark\ Price_{t-n}} \quad \textbf{(1)}$$

Where $Price_t$ represents the price of the asset and market benchmark respectively at a given time, and $Price_{t-n}$ represents the price of the asset and market benchmark respectively at a given time minus n months ago.

The stocks are then assigned to 1 of the 10 (equally-weighted or value-weighted) relative strength portfolios, where portfolio P1 represents the loser portfolio with the stocks that have the lowest past K-month estimation period return, and portfolio P10 represents the winner portfolio with the stocks that have the highest K-month estimation period return. The portfolios are then held for a subsequent L-month (L = 3, 6, 9, and 12) prediction period. This provides a total of 16 momentum strategies that are examined.

Prediction period excess returns over the market benchmark (FTSE/JSE All Share Index – J203) are measured using buy-and-hold returns. Buy-and-hold returns are preferred for this specific study as they accurately reflect the actual return that investors receive from their investments. Since cumulative arithmetic and cumulative logarithmic returns cannot be realised by investors, it may be somewhat trivial to report these results, and thus it was decided to omit these results in favour of maintaining the pragmatic approach of this study.

Barber and Lyon (1997) in their analysis of the empirical power and specification of test statistics in event studies designed to detect long-run abnormal stock returns, state their preference for using buy-and-hold returns as a measure for calculating abnormal returns. They argue that the use of cumulative abnormal returns could conceivably lead to incorrect inferences. More specifically, they state that when the buy-and-hold abnormal return is less than 13% per annum, the cumulative abnormal return overstates the buy-and-hold returns by up to 5%. However, when the buy-and-hold return increases beyond 28% per annum, the cumulative abnormal returns are dramatically less than the annual buy-and-hold return. It must be noted, however, that both Kothari and Warner (1997) and Barber and Lyon (1997) outline some pitfalls associated with using the buy-and-hold returns. These include rebalancing and skewness biases, which result in negatively biased test statistics.

The decision to include a stock in the given strategy depends on whether the stock is listed for a sufficient period of time. For a company to be considered for the strategy, it needs to be listed for

all of the estimation period, plus 1-month in the prediction period. If we do not specify at least one month, a return cannot be calculated as data is provided in a monthly format. If a stock is partially on the list for the prediction period, the returns are calculated for the time it is on the list and the stock is assumed to be held as cash thereafter.

This study will examine all possible 3-month, 6-month, 9-month and 12-month estimation and prediction intervals. For example, a 3-3 strategy that starts in month 1 includes an estimation period of month 1 to month 3, and the prediction period of month 5 to month 7 (a 1-month lag between the end of the portfolio formation period and the beginning of the testing period is applied to avoid possible bid-ask bounce effects)[1]. The next 3-3 strategy includes an estimation period of month 4 to month 6, and the prediction period of month 8 to month 10.

3.4 ROBUSTNESS CHECKS

3.4.1 Size

The apparent superiority of momentum strategies in the international arena might be attributable to the 'size effect'. The 'size effect' refers to the observation that small capitalisation firms have on average higher returns (absolute and risk-adjusted) than large capitalisation firms (see eg., Banz, 1981; Reinganum 1981a; Fama and French 1992; Fama and French, 2012)

To examine whether the profitability of momentum strategies is confined to smaller stocks, size-neutral momentum portfolios are created by sorting stocks according to size, measured by market capitalisation at the beginning of the L-month prediction period (t – 1). This involves creating relative strength portfolios based on past 3, 6, 9, and 12 month returns as in section 3.3. Once the relative strength portfolios have been created, they are sorted further into thirds based on size. More specifically, stocks are assigned to 1 of the 10 (equally-weighted or value-weighted) relative strength portfolios, where portfolio P1 represents the loser portfolio with the stocks that have the lowest past K-month estimation period return, and portfolio P10 represents the winner portfolio with the stocks that have the highest K-month estimation period return. Then within each relative-strength portfolio stocks are ranked into thirds in ascending order based on market capitalisation with portfolio S1 representing stocks with the smallest market capitalisation and portfolio S3 representing stocks with the highest market capitalisation.

[1] The bid-ask bounce effect refers to an observation whereby the month-end closing prices of winner securities are likely to be at the at the ask-price, while the month-end closing prices of the loser securities are likely to be at the bid-price. If the bid-ask bounce effect is not accounted for, it can induce a systematic bias into the data, which can adversely affect the analysis and consequential results.

3.4.2 Liquidity

Liquidity is generally described as the ability to trade large quantities quickly at low cost with little price impact (Liu, 2006). In recent years, the concept of liquidity has gained importance as being a priced variable inherent in the cross-section of returns (see eg., Amihud and Mendelson, 1986; Datar, et al., 1998; Amihud, 2002; Pastor and Stambaugh, 2003; Liu, 2006).

If past K-month winners are on average less liquid than past K-month losers, then the reported premiums in an emerging market such as South Africa may simply be a compensation for their relative liquidity. To disentangle the potential confounding influence of liquidity, this study will utilise raw trading volume – indicated by number of trades executed – as a measure of liquidity.

In contrast to Demir et al. (2004) who use average daily volume to proxy for liquidity, this study utilises monthly trading volume at the beginning of the L-month prediction period (t - 1). The design of this particular liquidity proxy is similar in nature to that of Rouwenhorst (1999) and Hart et al. (2003) who examine liquidity in an emerging market context.

The liquidity-neutral momentum portfolios are created by sorting stocks according to liquidity, using an analogous method to the size-neutral portfolios created in section 3.4.1.

3.5 REGRESSION ANALYSIS

To separate the effects of intermediate-horizon momentum estimation returns, size and liquidity on excess stock performance, regression analysis is employed. More specifically, the following estimation is used:

$$(\boldsymbol{R_i - R_m})_{\boldsymbol{L}} = \boldsymbol{\alpha} + \boldsymbol{\lambda}\, \boldsymbol{return_{Ki}} + \boldsymbol{\gamma}\, \mathbf{log}(\boldsymbol{size})_i + \boldsymbol{\phi liquidity_i} \qquad \textbf{(2)}$$

Where $(R_i - R_m)_L$ is the prediction period abnormal return, $return_{Ki}$ is the abnormal lag return for estimation periods of equal length to the prediction period to ensure tractability (i.e., K=3/L=3, K=6/L=6, K=9/L=9 and K=12/L=12), $\log(size)_i$ is the logarithm of market capitalisation at the beginning of the L-month prediction period (t – 1), and $liquidity_i$ is the monthly trading volume at the beginning of the L-month prediction period (t – 1).

4 EMPIRICAL RESULTS

This section presents and examines the findings of the empirical investigation. In section 4.1 the returns to various intermediate-term momentum strategies, and possible size and liquidity based explanations for these returns are discussed. In section 4.2 the results of the multivariate regression are presented and analysed.

4.1 MOMENTUM TRADING STRATEGY RETURNS

Table 1 summarizes the results from the 'zero investment' momentum portfolios for each of the 16 strategies. There are two panels, which report buy-and-hold returns to the equally-weighted portfolios (Panel A) and value-weighted portfolios (Panel B).

Table 1: Returns to the 'zero investment' momentum portfolios

	L = 3			L = 6			L = 9			L = 12		
	Return	Average monthly return	*t*-statistic	Return	Average monthly return	*t*-statistic	Return	Average monthly return	*t*-statistic	Return	Average monthly return	*t*-statistic
Panel A: buy-hold returns to the equally-weighted portfolios												
K = 3	3.42	**1.14**	*(1.31)*	1.00	**0.17**	*(0.19)*	4.07	**0.45**	*(0.58)*	8.00	**0.67**	*(1.00)*
K = 6	-0.89	**-0.30**	*(-0.30)*	4.55	**0.76**	*(0.78)*	14.43	**1.60**	*(1.72)*	3.92	**0.33**	*(0.40)*
K = 9	3.76	**1.25**	*(0.62)*	1.19	**0.20**	*(0.11)*	-0.15	**-0.02**	*(-0.02)*	8.14	**0.68**	*(1.05)*
K = 12	1.88	**0.63**	*(0.53)*	-4.28	**-0.71**	*(-0.58)*	-4.94	**-0.55**	*(-0.60)*	-9.88	**-0.82**	*(-1.07)*
Panel B: buy-hold returns to the value-weighted portfolios												
K = 3	3.34	**1.11**	*(1.32)*	2.54	**0.42**	*(0.49)*	6.52	**0.72**	*(1.07)*	6.08	**0.51**	*(0.98)*
K = 6	0.06	**0.02**	*(0.02)*	2.20	**0.37**	*(0.29)*	7.75	**0.86**	*(0.82)*	5.89	**0.49**	*(0.57)*
K = 9	3.07	**1.02**	*(0.40)*	5.32	**0.89**	*(0.67)*	8.57	**0.95**	*(0.96)*	7.91	**0.66**	*(0.94)*
K = 12	2.90	**0.97**	*(0.58)*	5.45	**0.91**	*(0.70)*	3.68	**0.41**	*(0.33)*	-12.58	**-1.05**	*(-0.73)*

The 'zero investment' momentum portfolios are constructed in the following manner: at the end of each K-month period, all the stocks are ranked in ascending order based on their K-month buy-and-hold returns (K = 3, 6, 9, and 12). The stocks are then assigned to 1 of 10 relative strength portfolios (equal and value-weighted), where 1 represents the loser portfolio (i.e., the stocks with the lowest past K-month performance) and 10 represents the winner portfolio (i.e., the stocks with the highest past K-month performance). Acknowledging there is a 1 month lag between the end of the portfolio formation period and the beginning of the testing period to avoid possible bid-ask spread and lead-lag effects, these portfolios are then held for a subsequent L-months (L = 3, 6, 9, and 12). This results in a total of 16 momentum strategies in operation. The total L-month returns to the momentum portfolios (winner – loser) are reported and all the numbers are in percentages. All returns are returns in excess of the market benchmark (FTSE/JSE All Share Index – J203). The *t*-statistic is marked with a '*', '**', '***' to indicate the significance of the return at the 10%, 5% and 1% level respectively.

Panel A of Table 1 shows that the highest monthly return to the equally-weighted 'zero investment' portfolios is obtained by the strategy that ranks stocks based on their returns over the previous 6 months and then holds this portfolio for 9 months (K = 6, L = 9), while the lowest monthly return is obtained by the strategy that ranks stocks based on the previous 12 month's returns and maintains this position for 12 months (K = 12, L = 12). These strategies yield 1.60% and -0.82% per month respectively.

Critics of momentum studies claim that equally-weighted portfolios are not an accurate depiction of implementable trading strategies, due to the emphasis that this weighting-method places on the returns of small stocks. Since small market capitalisation stocks tend to be less liquid compared to large capitalisation stocks, the assumed position in these stocks arising from an equally-weighted

portfolio cannot be achieved without inflicting significant transaction and market impact costs (Demir et al., 2004). To examine this criticism, value-weighted 'zero investment' momentum portfolios are constructed.

Panel B of Table 1 shows that the highest monthly return to the value-weighted 'zero investment' portfolios is obtained by the strategy that ranks stocks based on their returns over the previous 3 months and then holds this portfolio for 3 months (K = 3, L = 3), while the lowest monthly return is obtained by the strategy that ranks stocks based on the previous 12 month's returns and maintains this position for 12 months (K = 12, L = 12). These strategies yield 1.11% and -1.05% per month respectively.

It is interesting to note that when value-weighted portfolios are constructed, the momentum returns remain and become more uniformly positive compared with the returns to equally-weighted portfolios. However, all 16 momentum strategies yield statistically insignificant returns for both weighting schemes. This finding is in line with those of Van Rensburg and Robertson (2003).

To provide a comparison of these results to those of previous momentum studies, it is necessary to concentrate on a K = 6, L = 6 strategy using equally-weighted portfolios as other authors have done. In developed markets, Jegadeesh and Titman (1993) report (significant) profits of around 0.95% per month in the US, Rouwenhorst (1998) reports (significant) profits of around 1.16% per month for European countries, Liu et al. (1999) report (significant) profits of around 1.30% per month for the UK, and Demir et al. (2004) report (significant) profits of 1.76% per month for Australia. In emerging markets, Rouwenhorst (1999) reports (significant) profits of around 0.39% per month across 20 countries, and Hameed and Kusnadi (2002) report (insignificant) profits of around 0.53% per month for six emerging Asian markets.

This study reveals that a similar strategy (K = 6, L = 6) on JSE securities yields (insignificant) profits of 0.76% per month using equally-weighted portfolios. These profits are lower than those found in developed markets but somewhat higher than the profits realised in emerging markets. It must be noted that one should not place too much emphasis on the significance of the results, since the standard deviations of returns in emerging markets is large (Rouwenhorst, 1999). This diminishes signal-to-noise properties in security returns.

Table 2: Sell-side and buy-side returns to 'zero investment' momentum portfolios

	L = 3		L = 6		L = 9		L = 12	
	Sell-side return	Buy-side return	Sell-side return	Buy-side return	Sell-side return	Buy-side return	Sell-side return	Buy-side return
Panel A: buy-hold returns to the equally-weighted portfolios								
K = 3	-0.18	3.59	-6.35	7.34	-8.27	12.34	-9.57	17.57
t-statistic	*(-0.09)*	*(1.87)**	*(-1.42)*	*(2.35)***	*(-1.58)*	*(2.68)***	*(-1.79)**	*(2.71)***
K = 6	-3.91	3.02	-4.11	8.66	-2.70	17.12	-16.44	20.36
t-statistic	*(-1.31)*	*(1.64)*	*(-0.90)*	*(1.92)**	*(-0.50)*	*(2.54)***	*(-1.78)**	*(3.16)****
K = 9	0.99	2.77	-6.96	8.15	-12.04	11.89	-9.58	17.72
t-statistic	*(0.28)*	*(0.65)*	*(-1.17)*	*(1.06)*	*(-1.98)**	*(1.83)*	*(-1.71)*	*(2.08)**
K = 12	-1.80	3.68	-6.22	1.94	-10.21	5.27	-19.71	9.83
t-statistic	*(-0.49)*	*(1.86)**	*(-1.06)*	*(0.45)*	*(-1.51)*	*(0.99)*	*(-2.05)**	*(1.44)*
Average	-1.22	3.26	-5.91	6.52	-8.30	11.66	-13.83	16.37
Panel B: buy-hold returns to the value-weighted portfolios								
K = 3	1.94	1.40	3.02	-0.48	4.98	1.54	6.40	-0.32
t-statistic	*(1.00)*	*(0.86)*	*(0.75)*	*(-0.15)*	*(1.03)*	*(0.41)*	*(1.29)*	*(-0.08)*
K = 6	-1.34	1.40	4.62	-2.42	6.51	1.24	5.22	0.66
t-statistic	*(-0.41)*	*(0.58)*	*(0.78)*	*(-0.58)*	*(0.97)*	*(0.23)*	*(0.72)*	*(0.12)*
K = 9	1.54	1.53	1.00	4.32	3.22	5.34	2.22	5.69
t-statistic	*(0.43)*	*(0.33)*	*(0.22)*	*(1.03)*	*(0.54)*	*(1.29)*	*(0.40)*	*(1.06)*
K = 12	2.92	-0.02	9.65	-4.20	7.62	-3.95	-8.97	-3.61
t-statistic	*(0.63)*	*(-0.01)*	*(2.73)***	*(-0.71)*	*(1.74)*	*(-0.49)*	*(-1.05)*	*(-0.37)*
Average	1.27	1.08	4.57	-0.69	5.58	1.04	1.22	0.61

The sell-side and buy-side momentum portfolios which constitute the 'zero investment' momentum portfolio are constructed in the following manner: at the end of each K-month period, all the stocks are ranked in ascending order based on their K-month buy-and-hold returns (K = 3, 6, 9, and 12). The stocks are then assigned to 1 of 10 relative strength portfolios (equal and value-weighted), where 1 represents the sell-side portfolio (i.e., the stocks with the lowest past K-month performance) and 10 represents the buy-side portfolio (i.e., the stocks with the highest past K-month performance). Acknowledging there is a 1 month lag between the end of the portfolio formation period and the beginning of the testing period to avoid possible bid-ask spread and lead-lag effects, these portfolios are then held for a subsequent L-months (L = 3, 6, 9, and 12). This results in a total of 32 momentum portfolios in operation. The total L-month returns to the sell-side and the buy-side momentum portfolios are reported and all the numbers are in percentages. Average return represents the specified L-month prediction period return to each momentum strategy for all K-month estimation periods. The average return figure is utilised as an indicator to identify whether any return data patterns exist within the sell-side and buy-side momentum portfolios. All returns are returns in excess of the market benchmark (FTSE/JSE All Share Index – J203). The *t*-statistic is marked with a '*', '**', '***' to indicate the significance of the return at the 10%, 5% and 1% level respectively.

Table 2 shows the results to the sell-side and buy-side portfolios that constitute the 'zero-investment' momentum portfolio. Given the constraints that many investors face, such as shorting stocks with low momentum and the larger transaction costs that are associated with small stocks that tend to be less liquid, as well as, the relatively higher risks associated with shorting than going long, these results allow one to obtain a clearer picture with regards to the "symmetry" of the returns of the 'zero investment' constituent portfolios. This in turn, allows one to gauge the practicality of implementing a 'zero investment' momentum strategy, or alternatively, whether it is more feasible to focus on a momentum strategy that takes either only short positions or only long positions.

Panel A of Table 2 shows that the returns to most of the equally-weighted investment strategies are asymmetric, and predominantly from the buy-side constituent portfolio. What is interesting to note, is that the sell-side constituent portfolio in 15 out of the 16 momentum strategies, actually reduces the magnitude of the profits to the equally-weighted investment strategies. This finding, which suggests that it may be more profitable to focus on a momentum strategy that only takes long positions, will be welcomed with open arms by investment managers as they don't have to subject themselves to the heightened risks and constraints (legal and/or otherwise stipulated by the firm-specific investment committee) associated with short-selling in the pursuit of alpha. These risks include: infinite losses, margin trading fees, and short squeezes (when stock prices rise, short sellers rush to cover their positions, which effectively drives prices up even further, increasing short sellers losses) amongst others.

Before one gets too excited at the prospect of a long-only momentum strategy, it is necessary to evaluate if this finding extends through to value-weighted portfolios, in an effort to accommodate the aforementioned criticism that was levelled against equally-weighted portfolios.

Panel B of Table 2 shows that the returns to most of the value-weighted portfolios come from the sell-side constituent portfolio, but they are less asymmetric than those of the equally-weighted portfolios. Unfortunately, this finding suggests that, while this weighting scheme is subject to relatively lower transaction and market impact costs, more often than not, investment managers will refrain from implementing such a strategy. This is due to the fact that the relative risks associated with obtaining alpha are too high in the case of value-weighted portfolios, with the majority of the returns being realised by the sell-side portfolio.

4.1.1 Size

Table 3 shows the influence of firm size on momentum returns. 'Zero investment' momentum portfolio returns are presented for each size segment and for all K-month/L-month strategies.

The results indicate that for all the equally-weighted strategies considered, 10 out of 16 momentum strategies show significant returns in at least one of their relative size segments. These results suggest that size may have a pervasive effect on momentum strategies. Furthermore, if one takes a look at the results for value-weighted strategies, it is evident that the results are qualitatively similar (and even more consistent) to those of the equally-weighted strategies, which indicates that the observed results are robust to differential portfolio weighting schemes.

Table 3: Momentum returns to size-sorted portfolios

		L = 3			L = 6			L = 9			L = 12		
	Size segment	Return	Average monthly return	*t*-statistic	Return	Average monthly return	*t*-statistic	Return	Average monthly return	*t*-statistic	Return	Average monthly return	*t*-statistic
Panel A: buy-hold returns to the equally-weighted portfolios													
K = 3	S1	-2.54	**-0.85**	*(-0.51)*	-14.08	**-2.35**	*(-1.15)*	-15.10	**-1.68**	*(-0.82)*	-6.66	**-0.56**	*(-0.28)*
	S2	4.46	**1.49**	*(0.86)*	6.55	**1.09**	*(0.92)*	13.45	**1.49**	*(1.84)**	16.71	**1.39**	*(2.04)***
	S3	6.27	**2.09**	*(1.92)**	6.94	**1.16**	*(1.55)*	8.91	**0.99**	*(1.69)**	11.05	**0.92**	*(2.10)***
K = 6	S1	-9.09	**-3.03**	*(-2.14)***	2.21	**0.37**	*(0.17)*	9.99	**1.11**	*(0.53)*	-22.13	**-1.84**	*(-0.72)*
	S2	4.02	**1.34**	*(0.71)*	9.20	**1.53**	*(1.30)*	23.40	**2.60**	*(2.16)***	25.28	**2.11**	*(2.03)**
	S3	1.59	**0.53**	*(0.23)*	2.58	**0.43**	*(0.29)*	10.36	**1.15**	*(1.23)*	7.85	**0.65**	*(0.90)*
K = 9	S1	1.21	**0.40**	*(0.10)*	-2.65	**-0.44**	*(-0.12)*	-18.22	**-2.02**	*(-1.07)*	5.13	**0.43**	*(0.22)*
	S2	2.59	**0.86**	*(0.45)*	-5.02	**-0.84**	*(-0.41)*	3.62	**0.40**	*(0.19)*	9.49	**0.79**	*(0.62)*
	S3	7.22	**2.41**	*(1.45)*	10.37	**1.73**	*(1.63)*	12.83	**1.43**	*(1.45)*	9.98	**0.83**	*(1.04)*
K = 12	S1	-15.18	**-5.06**	*(-2.35)***	-38.12	**-6.35**	*(-2.52)***	-46.04	**-5.12**	*(-3.00)***	-49.98	**-4.16**	*(-2.49)***
	S2	16.62	**5.54**	*(4.22)****	10.12	**1.69**	*(0.97)*	14.07	**1.56**	*(0.80)*	14.85	**1.24**	*(0.86)*
	S3	17.54	**5.85**	*(1.68)*	16.15	**2.69**	*(1.97)**	17.65	**1.96**	*(1.25)*	8.05	**0.67**	*(0.43)*
	Average S1	-6.40	**-2.13**		-13.16	**-2.19**		-17.34	**-1.93**		-18.41	**-1.53**	
	Average S2	6.92	**2.31**		5.21	**0.87**		13.63	**1.51**		16.58	**1.38**	
	Average S3	8.16	**2.72**		9.01	**1.50**		12.44	**1.38**		9.23	**0.77**	
Panel B: buy-hold returns to the value-weighted portfolios													
K = 3	S1	3.87	**1.29**	*(0.75)*	-12.97	**-2.16**	*(-1.22)*	-16.33	**-1.81**	*(-1.07)*	-11.54	**-0.96**	*(-0.69)*
	S2	5.18	**1.73**	*(1.03)*	6.27	**1.04**	*(1.00)*	16.06	**1.78**	*(2.40)***	18.28	**1.52**	*(2.35)***
	S3	3.43	**1.14**	*(1.21)*	1.16	**0.19**	*(0.22)*	4.27	**0.47**	*(0.68)*	4.33	**0.36**	*(0.65)*
K = 6	S1	-3.28	**-1.09**	*(-0.87)*	0.87	**0.15**	*(0.08)*	10.68	**1.19**	*(0.69)*	-19.17	**-1.60**	*(-0.70)*
	S2	-3.96	**-1.32**	*(-0.34)*	7.06	**1.18**	*(0.63)*	19.46	**2.16**	*(1.29)*	17.43	**1.45**	*(0.96)*
	S3	-0.38	**-0.13**	*(-0.09)*	1.53	**0.25**	*(0.20)*	6.75	**0.75**	*(0.69)*	4.78	**0.40**	*(0.45)*
K = 9	S1	-6.28	**-2.09**	*(-1.08)*	-16.51	**-2.75**	*(-2.29)***	-26.53	**-2.95**	*(-2.22)***	-13.85	**-1.15**	*(-0.83)*
	S2	2.22	**0.74**	*(0.36)*	-5.52	**-0.92**	*(-0.49)*	4.98	**0.55**	*(0.36)*	10.98	**0.91**	*(0.94)*
	S3	3.79	**1.26**	*(0.48)*	6.10	**1.02**	*(0.75)*	8.65	**0.96**	*(0.92)*	8.36	**0.70**	*(0.93)*
K = 12	S1	-5.72	**-1.91**	*(-1.07)*	-28.15	**-4.69**	*(-2.18)**	-24.49	**-2.72**	*(-2.20)**	-26.32	**-2.19**	*(-1.82)*
	S2	6.05	**2.02**	*(0.68)*	13.61	**2.27**	*(1.41)*	17.42	**1.94**	*(1.21)*	17.69	**1.47**	*(1.16)*
	S3	6.65	**2.22**	*(0.85)*	5.71	**0.95**	*(0.64)*	3.67	**0.41**	*(0.28)*	-12.87	**-1.07**	*(-0.65)*
	Average S1	-2.85	**-0.95**		-14.19	**-2.36**		-14.17	**-1.57**		-17.72	**-1.48**	
	Average S2	2.37	**0.79**		5.35	**0.89**		14.48	**1.61**		16.09	**1.34**	
	Average S3	3.37	**1.12**		3.63	**0.60**		5.84	**0.65**		1.15	**0.10**	

At the end of each estimation period, all stocks are ranked in ascending order based on their past K-month (estimation period) buy-and-hold returns (K = 3, 6, 9, and 12). The stocks are then assigned to 1 of 10 relative strength portfolios (equal and value-weighted), where 1 represents the loser portfolio (i.e., the stocks with the lowest past K-month performance) and 10 represents the winner portfolio (i.e., the stocks with the highest past K-month performance). The stocks within each decile are split further into thirds (S1, S2, and S3) based on market capitalisation at the beginning of the L-month prediction period (t – 1). The S1, S2, and S3 portfolios within each decile refer to stocks from smallest to largest market capitilisation respectively. This results in 3 portfolios to examine for each K-month/L-month strategy. The 'zero investment' portfolio buy-and-hold return to each size sub-group is presented. Essentially the 'zero investment' S1 portfolio involves buying the smallest group of best performing stocks in decile 10, and going short in the smallest group of worst performing stocks in decile 1. Average return represents the specified L-month prediction period return to each size sub-group (i.e., S1, S2, and S3) for all K-month estimation periods. The average return figure is utilised as an indicator to identify whether any return data patterns exist within the size sorted portfolios. All the returns are reported in percentages and are returns in excess of the market benchmark (FTSE/JSE All Share Index – J203). The *t*-statistic is marked with a '*', '**', '***' to indicate the significance of the return at the 10%, 5% and 1% level respectively.

More importantly, if one takes a collective look at the results, a few patterns emerge. Firstly, over the shorter intermediate holding horizon (i.e., L = 3), the magnitude of the average monthly return to the 'zero-investment' strategy is generally greatest for the S3 (largest stocks) segment, and smallest (generally negative) for the S1 (smallest stocks) segment. Secondly, as one starts to look at longer intermediate holding horizons (i.e., L = 6, 9, and 12), the magnitude of the average monthly return to the 'zero investment' strategy is generally greatest for the S2 (medium size stocks) segment, and smallest (generally negative) for the S1 (smallest stocks) segment.

For example, the most successful equally-weighted strategy (i.e., K = 6, L = 9 as in section 5.1) yields an average monthly return of 1.11% for S1 stocks, 2.60% for S2 stocks, and 1.15% for S3 stocks. As this study provides a more comprehensive investigation of all common intermediate-horizon momentum strategies, it is difficult to take these results in entirety, and compare them with previous literature. For this reason, one needs to look at the equally-weighted K = 6, L = 6 benchmark strategy used by much of the previous literature to provide a comparison of the results. The K = 6, L = 6 momentum strategy yields an average monthly return of 0.37% for S1 stocks, 1.53% for S2 stocks, and 0.43% for S3 stocks. These results are in line with those of Liu et al. (1999), and Hong et al. (2000), but in contrast to the results of Demir et al. (2004) who found that the momentum effect for 'zero investment' strategies are strongest in smaller stocks.

One may be surprised to note that the 'size effect', as outlined in section 3.4.1, which is a pervasive feature of stock markets around the world (including that of the JSE), is not prevalent in the aforementioned 'zero investment' momentum strategies. As, this result may be contrary to one's expectations, a closer examination of the constituent portfolio returns is necessary, to provide a reasonable explanation for this counterintuitive return pattern.

Table 4 presents the results of momentum returns to equally-weighted size-sorted loser and winner portfolios, which constitute the 'zero investment' momentum portfolios. A closer examination reveals that in general, across all momentum strategies, the return differential (the absolute difference between small size stocks and large size stocks) to the constituent loser portfolio is larger (except for the K = 6/L = 3 momentum strategy) than the return differential to the constituent winner portfolio, which together constitute the 'zero-investment' momentum portfolio. In other words, small-size losers have higher returns than large-size losers, and small-size winners have higher returns than large-size winners, but this relationship is significantly more pronounced for losers.

This means that small size losers strongly rebound in most of the holding periods relative to large size losers, and small size winners continue the momentum effect compared to large size winners. These findings suggest that, for the most part, the 'size effect' is prevalent in the loser and winner portfolios that constitute the "zero investment' momentum strategies. Furthermore, it is evident that, in general, medium-size losers continue to show lower returns than small-size losers, and medium-size winners continue the momentum effect, but to a lesser extent than small-size winners (except for K = 12/L = 3, 6, 9, and 12).

Table 4: Momentum returns to size-sorted loser and winner portfolios which constitute the 'zero investment' momentum portfolios

		L = 3						L = 6						L = 9						L = 12					
		Loser portfolio			Winner Portfolio			Loser portfolio			Winner Portfolio			Loser portfolio			Winner Portfolio			Loser portfolio			Winner Portfolio		
		Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*
Buy-hold returns to the equally-weighted portfolios																									
K = 3	S1	6.56	**2.19**	*(2.19)***	4.02	**1.34**	*(1.12)*	25.18	**4.20**	*(2.50)***	11.10	**1.85**	*(1.56)*	38.23	**4.25**	*(2.92)****	23.13	**2.57**	*(1.86)**	42.08	**3.51**	*(2.97)****	35.42	**2.95**	*(1.89)**
	S2	-1.64	**-0.55**	*(-0.45)*	2.82	**0.94**	*(0.79)*	-0.56	**-0.09**	*(-0.11)*	5.99	**1.00**	*(1.22)*	-6.45	**-0.72**	*(-1.20)*	7.00	**0.78**	*(1.39)*	-6.11	**-0.51**	*(-1.10)*	10.60	**0.88**	*(1.70)**
	S3	-1.94	**-0.65**	*(-0.74)*	4.34	**1.45**	*(2.56)***	-1.33	**-0.22**	*(-0.34)*	5.60	**0.93**	*(1.97)**	-1.52	**-0.17**	*(-0.30)*	7.39	**0.82**	*(2.35)***	-1.09	**-0.09**	*(-0.21)*	9.96	**0.83**	*(2.50)***
	Absolute return differential (S1 -S3)	8.50	**2.83**	*(2.26)***	*0.31*	**0.10**	*(0.09)*	26.51	**4.42**	*(2.45)***	5.49	**0.92**	*(0.74)*	39.76	**4.42**	*(2.78)****	15.75	**1.75**	*(1.25)*	43.16	**3.60**	*(2.77)****	25.46	**2.12**	*(1.29)*
K = 6	S1	8.00	**2.67**	*(1.68)*	*-1.09*	**-0.36**	*(-0.38)*	13.55	**2.26**	*(2.04)**	15.75	**2.63**	*(1.60)*	14.14	**1.57**	*(1.47)*	24.12	**2.68**	*(1.48)*	50.51	**4.21**	*(1.93)**	28.38	**2.37**	*(1.68)*
	S2	1.54	**0.51**	*(0.29)*	*5.56*	**1.85**	*(1.97)**	-1.35	**-0.22**	*(-0.21)*	7.85	**1.31**	*(1.74)**	-3.24	**-0.36**	*(-0.42)*	20.16	**2.24**	*(2.89)***	0.97	**0.08**	*(0.10)*	26.25	**2.19**	*(3.20)****
	S3	2.75	**0.92**	*(0.50)*	*4.35*	**1.45**	*(1.16)*	0.28	**0.05**	*(0.03)*	2.85	**0.48**	*(0.87)*	-2.60	**-0.29**	*(-0.32)*	7.76	**0.86**	*(1.71)*	-1.47	**-0.12**	*(-0.19)*	6.38	**0.53**	*(1.25)*
	Absolute return differential (S1 -S3)	5.25	**1.75**	*(0.86)*	*5.43*	**1.81**	*(1.16)*	13.27	**2.21**	*(1.24)*	12.90	**2.15**	*(1.37)*	16.74	**1.86**	*(1.32)*	16.36	**1.82**	*(1.07)*	51.98	**4.33**	*(1.81)**	22.00	**1.83**	*(1.25)*
K = 9	S1	3.73	**1.24**	*(0.85)*	*4.95*	**1.65**	*(0.45)*	15.74	**2.62**	*(2.17)**	13.09	**2.18**	*(0.69)*	24.92	**2.77**	*(2.13)***	6.70	**0.74**	*(0.54)*	21.79	**1.82**	*(1.66)*	26.92	**2.24**	*(1.24)*
	S2	-3.10	**-1.03**	*(-0.55)*	*-0.52*	**-0.17**	*(-0.19)*	8.06	**1.34**	*(0.64)*	3.04	**0.51**	*(0.62)*	12.40	**1.38**	*(0.86)*	16.02	**1.78**	*(1.62)*	4.44	**0.37**	*(0.39)*	13.92	**1.16**	*(1.54)*
	S3	-3.24	**-1.08**	*(-1.05)*	*3.98*	**1.33**	*(0.92)*	-2.01	**-0.34**	*(-0.43)*	8.36	**1.39**	*(1.97)**	0.10	**0.01**	*(0.01)*	12.94	**1.44**	*(2.65)***	3.30	**0.28**	*(0.35)*	13.28	**1.11**	*(2.21)***
	Absolute return differential (S1 -S3)	6.98	**2.33**	*(1.63)*	*0.97*	**0.32**	*(0.08)*	17.76	**2.96**	*(2.49)***	4.73	**0.79**	*(0.26)*	24.82	**2.76**	*(1.82)**	6.24	**0.69**	*(0.48)*	18.49	**1.54**	*(1.17)*	13.64	**1.14**	*(0.61)*
K = 12	S1	10.51	**3.50**	*(1.73)*	*-4.67*	**-1.56**	*(-1.91)**	30.24	**5.04**	*(2.11)**	-7.89	**-1.31**	*(-1.98)**	35.60	**3.96**	*(2.34)***	-10.44	**-1.16**	*(-3.85)****	48.69	**4.06**	*(2.06)**	-1.28	**-0.11**	*(-0.12)*
	S2	-1.49	**-0.50**	*(-0.16)*	*15.13*	**5.04**	*(1.49)*	-1.01	**-0.17**	*(-0.15)*	9.11	**1.52**	*(1.35)*	4.66	**0.52**	*(0.32)*	18.73	**2.08**	*(2.19)**	7.93	**0.66**	*(0.52)*	22.78	**1.90**	*(2.29)**
	S3	-7.19	**-2.40**	*(-1.18)*	*10.34*	**3.45**	*(1.83)*	-11.84	**-1.97**	*(-1.79)*	4.31	**0.72**	*(0.98)*	-10.60	**-1.18**	*(-1.08)*	7.05	**0.78**	*(0.86)*	-0.24	**-0.02**	*(-0.02)*	7.81	**0.65**	*(0.70)*
	Absolute return differential (S1 -S3)	17.70	**5.90**	*(2.91)***	*15.02*	**5.01**	*(2.18)**	42.07	**7.01**	*(3.45)****	12.20	**2.03**	*(2.31)***	46.21	**5.13**	*(3.88)****	17.49	**1.94**	*(2.07)**	48.93	**4.08**	*(2.27)**	9.09	**0.76**	*(0.50)*

At the end of each estimation period, all stocks are ranked in ascending order based on their past K-month (estimation period) buy-and-hold returns (K = 3, 6, 9, and 12). The stocks are then assigned to 1 of 10 relative strength portfolios (equal and value-weighted), where 1 represents the loser portfolio (i.e., the stocks with the lowest past K-month performance) and 10 represents the winner portfolio (i.e., the stocks with the highest past K-month performance). The stocks within each decile are split further into thirds (S1, S2, and S3) based on market capitalisation at the beginning of the L-month prediction period (t – 1). The S1, S2, and S3 portfolios within each decile refer to stocks from smallest to largest market capitalisation respectively. This results in 6 portfolios to examine for each K-month/L-month strategy. The buy-and-hold returns to the winner and loser portfolios, which constitute the 'zero investment' momentum portfolio, are presented for each size sub-group. The absolute return differential (S1-S3) represents the absolute difference between the small stocks and the large stocks. All the returns are reported in percentages and are returns in excess of the market benchmark (FTSE/JSE All Share Index – J203). The *t*-statistic is marked with a '*', '**', '***' to indicate the significance of the return at the 10%, 5% and 1% level respectively.

The combination of these aforementioned observations drive this counterintuitive result, in which the medium or large-size stocks 'zero investment' momentum strategies outperform the small-size stocks 'zero investment' momentum strategies. The momentum returns to value-weighted size-sorted loser and winner portfolios, which constitute the 'zero investment' momentum portfolios are qualitatively similar and therefore are not reported, although it is important to note that medium size winners have a tendency to outperform small-size winners in the value-weighted portfolios.

To put these findings into context, it is necessary to look at the equally-weighted K = 6, L = 6 benchmark strategy used by much of the previous literature to provide a comparison of the results. Focusing on the K = 6, L = 6 strategy in this study, Table 4 shows that small-size losers have an average monthly return of 2.26% compared to large-size losers which have an average monthly return of 0.28%, and small-size winners have an average monthly return 2.63% compared to large-size winners which have an average monthly return of 0.48%. These findings suggest that one may be able to enhance his/her momentum strategy by focusing on taking a long position in the small-size winner portfolio. However, in accordance with the results, it is necessary to highlight the fact that, in general, small-size loser portfolios exhibit more pronounced positive returns than small-size winner portfolios, which suggests that such strategies may be also be useful in generating positive and significant alpha. In line with this finding, one may be inclined to infer that strategies of a contrarian nature, are more profitable in the intermediate-horizon, but unfortunately, the current analysis does not allow one to distinguish whether this result is driven by the 'size effect' or by sources of a contrarian nature (i.e., return reversal), and therefore it would be incorrect to make such inferences[2].

4.1.2 Liquidity

The liquidity results are presented in Table 5, which use monthly trading volume of the stock at the beginning of the prediction period (t – 1) as a proxy for liquidity.

The results indicate that for all the equally-weighted strategies considered, 7 out of 16 momentum strategies show significant returns in at least one of their relative liquidity segments. These results suggest that liquidity, more than likely, does not have a pervasive effect on the momentum strategies examined in this study, although one must not be blind-sighted by the fact that the effects of liquidity may be masked by other factors such as firm size (due to the high correlation of firm size and trading volume). Furthermore, if one takes a look at the results for value-weighted

[2] However, in unreported results, it is evident that in general, loser portfolio stocks have smaller market capitalisations than winner portfolio stocks, which would motivate one to suggest that the 'size effect' drives this result, nonetheless, without further analysis this suggestion is little more than speculation.

strategies (which inadvertently controls for firm size), it is evident that the results are far less significant and consistent to those of the equally-weighted strategies.

Table 5: Momentum returns to liquidity-sorted portfolios

		L = 3			L = 6			L = 9			L = 12		
	Volume segment	Return	Average monthly return	*t*-statistic	Return	Average monthly return	*t*-statistic	Return	Average monthly return	*t*-statistic	Return	Average monthly return	*t*-statistic
Panel A: buy-hold returns to the equally-weighted portfolios													
K = 3	V1	-7.09	**-2.36**	*(-1.44)*	-13.80	**-2.30**	*(-1.95)**	-9.35	**-1.04**	*(-1.51)*	-12.03	**-1.00**	*(-1.87)**
	V2	2.12	**0.71**	*(0.57)*	-2.47	**-0.41**	*(-0.24)*	-3.95	**-0.44**	*(-0.24)*	6.10	**0.51**	*(0.28)*
	V3	13.90	**4.63**	*(2.37)***	14.33	**2.39**	*(1.41)*	19.64	**2.18**	*(1.63)*	26.62	**2.22**	*(2.61)***
K = 6	V1	-6.66	**-2.22**	*(-1.29)*	-7.83	**-1.31**	*(-1.11)*	-1.45	**-0.16**	*(-0.18)*	-8.82	**-0.73**	*(-0.61)*
	V2	-1.08	**-0.36**	*(-0.2)*	2.66	**0.44**	*(0.29)*	6.65	**0.74**	*(0.57)*	-12.42	**-1.04**	*(-0.63)*
	V3	4.50	**1.50**	*(0.72)*	19.22	**3.20**	*(1.82)**	38.91	**4.32**	*(2.03)**	32.49	**2.71**	*(2.31)***
K = 9	V1	-1.70	**-0.57**	*(-0.24)*	-10.39	**-1.73**	*(-0.87)*	-13.30	**-1.48**	*(-0.81)*	-13.66	**-1.14**	*(-0.97)*
	V2	-2.52	**-0.84**	*(-0.34)*	-4.77	**-0.80**	*(-0.72)*	-6.49	**-0.72**	*(-0.66)*	-2.29	**-0.19**	*(-0.23)*
	V3	15.54	**5.18**	*(1.28)*	19.22	**3.20**	*(0.78)*	20.05	**2.23**	*(0.95)*	41.11	**3.43**	*(1.67)*
K = 12	V1	-2.36	**-0.79**	*(-0.25)*	-18.28	**-3.05**	*(-1.57)*	-12.86	**-1.43**	*(-0.85)*	-20.18	**-1.68**	*(-1.05)*
	V2	6.33	**2.11**	*(0.61)*	-8.65	**-1.44**	*(-0.67)*	-18.30	**-2.03**	*(-0.79)*	-32.16	**-2.68**	*(-1.05)*
	V3	10.87	**3.62**	*(3.81)****	12.40	**2.07**	*(1.65)*	12.30	**1.37**	*(1.02)*	18.45	**1.54**	*(1.39)*
	Average V1	-4.45	**-1.48**		-12.58	**-2.10**		-9.24	**-1.03**		-13.67	**-1.14**	
	Average V2	1.21	**0.40**		-3.31	**-0.55**		-5.52	**-0.61**		-10.19	**-0.85**	
	Average V3	11.20	**3.73**		16.29	**2.72**		22.73	**2.53**		29.67	**2.47**	
Panel B: buy-hold returns to the value-weighted portfolios													
K = 3	V1	-0.81	**-0.27**	*(-0.14)*	0.92	**0.15**	*(0.14)*	5.26	**0.58**	*(0.89)*	5.94	**0.49**	*(0.92)*
	V2	2.52	**0.84**	*(0.55)*	8.06	**1.34**	*(1.20)*	12.27	**1.36**	*(1.65)*	15.49	**1.29**	*(1.66)*
	V3	2.25	**0.75**	*(0.78)*	-2.40	**-0.40**	*(-0.40)*	2.66	**0.30**	*(0.36)*	4.40	**0.37**	*(0.55)*
K = 6	V1	-0.86	**-0.29**	*(-0.17)*	-2.01	**-0.34**	*(-0.26)*	11.31	**1.26**	*(1.06)*	5.99	**0.50**	*(0.54)*
	V2	-4.55	**-1.52**	*(-0.63)*	3.30	**0.55**	*(0.39)*	10.53	**1.17**	*(0.96)*	9.17	**0.76**	*(0.74)*
	V3	0.18	**0.06**	*(0.04)*	3.82	**0.64**	*(0.46)*	12.86	**1.43**	*(1.02)*	9.20	**0.77**	*(0.68)*
K = 9	V1	2.31	**0.77**	*(0.24)*	7.96	**1.33**	*(0.59)*	12.69	**1.41**	*(0.97)*	8.57	**0.71**	*(0.49)*
	V2	7.60	**2.53**	*(1.31)*	7.61	**1.27**	*(1.06)*	6.79	**0.75**	*(0.54)*	15.57	**1.30**	*(1.41)*
	V3	2.56	**0.85**	*(0.26)*	7.08	**1.18**	*(0.79)*	12.61	**1.40**	*(1.44)*	7.52	**0.63**	*(0.81)*
K = 12	V1	7.71	**2.57**	*(0.53)*	4.58	**0.76**	*(0.37)*	23.32	**2.59**	*(1.58)*	12.21	**1.02**	*(0.57)*
	V2	6.40	**2.13**	*(0.43)*	2.66	**0.44**	*(0.25)*	13.44	**1.49**	*(1.02)*	19.49	**1.62**	*(1.35)*
	V3	5.74	**1.91**	*(3.35)****	3.69	**0.62**	*(0.37)*	-1.12	**-0.12**	*(-0.07)*	-18.70	**-1.56**	*(-0.84)*
	Average V1	2.09	**0.70**		2.86	**0.48**		13.14	**1.46**		8.18	**0.68**	
	Average V2	2.99	**1.00**		5.41	**0.90**		10.76	**1.20**		14.93	**1.24**	
	Average V3	2.68	**0.89**		3.05	**0.51**		6.75	**0.75**		0.60	**0.05**	

At the end of each estimation period, all stocks are ranked in ascending order based on their past K-month (estimation period) buy-and-hold returns (K = 3, 6, 9, and 12). The stocks are then assigned to 1 of 10 relative strength portfolios (equal and value-weighted), where 1 represents the loser portfolio (i.e., the stocks with the lowest past K-month performance) and 10 represents the winner portfolio (i.e., the stocks with the highest past K-month performance). The stocks within each decile are split further into thirds (V1, V2, and V3) based on monthly trading volume at the beginning of the L-month prediction period (t – 1). The V1, V2, and V3 portfolios within each decile refer to stocks from smallest to largest monthly trading volume respectively. This results in 3 portfolios to examine for each K-month/L-month strategy. The 'zero investment' portfolio buy-and-hold return to each volume sub-group is presented. Essentially the 'zero investment' V1 portfolio involves buying the best performing stocks in decile 10 with the lowest volume, and going short in the worst performing stocks in decile 1 with the lowest volume. Average return represents the specified L-month prediction period return to each volume sub-group (i.e., V1, V2, and V3) for all K-month estimation periods. The average return figure is utilised as an indicator to identify whether any return data patterns exist within the liquidity sorted portfolios. All the returns are reported in percentages and are returns in excess of the market benchmark (FTSE/JSE All Share Index – J203). The *t*-statistic is marked with a '*', '**', '***' to indicate the significance of the return at the 10%, 5% and 1% level respectively.

Nonetheless, if one takes a collective look at the equally-weighted results, a noticeable pattern emerges. The high-volume 'zero investment' momentum strategies consistently produce superior returns to those of medium or low-volume 'zero investment' momentum strategies. These results are consistent with those of Lee and Swaminathan (2000), Hameed and Kusnadi (2002), Glaser and Weber (2003), and Page et.al (2013), but in contrast to those of Demir et al. (2004), and Wang and Chin (2004). Furthermore, if one looks at the value-weighted portfolios, it is very difficult to

discern any noticeable patterns in the returns, besides the observation that low and even medium-volume momentum strategies exhibit returns that are more in line (although not entirely consistent) with the liquidity hypothesis, which states that more illiquid (low volume) stocks should earn higher expected returns than liquid (high volume) stocks (Amihud and Mendelson, 1986).

However, it must be noted that, taking the results in their entirety, there appears to be no systematic effect of liquidity on price momentum for value-weighted strategies, and any claim to the contrary would be unfounded. Unfortunately, since the previous literature on value-weighted momentum portfolios (including liquidity sorts) is scarce or non-existent, the investigation will proceed to analyse the results to the equally-weighted momentum portfolios (which are in abundance), so that one can undertake a comparative analysis of these results to those of previous literature.

Since it is difficult to understand why a 'zero investment' momentum portfolio of high-volume stocks should be less liquid than a 'zero investment' momentum portfolio of low volume stocks, a closer examination of the constituent portfolio returns is necessary, to provide a reasonable explanation for this counterintuitive return pattern.

Table 6 presents the results of momentum returns to equally-weighted liquidity-sorted loser and winner portfolios, which constitute the 'zero investment' momentum portfolios. A closer examination reveals that in general, across all momentum strategies, the return differential (the absolute difference between low-volume stocks and high volume stocks) to the constituent loser portfolio is lower (but only slightly, except for all K = 12/L = 3, 6, 9, and 12 momentum strategies) than the return differential to the constituent winner portfolio, which together constitute the 'zero-investment' momentum portfolio. In other words, low-volume losers have higher returns than high-volume losers, and low-volume winners have lower returns than high-volume winners, but this relationship is more pronounced for winners. This means that low-volume losers strongly rebound in most of the holding periods relative to high volume losers, and high-volume winners continue the momentum effect compared to low-volume winners. These findings suggest that, for the most part, the returns to the loser portfolios reflect an illiquidity premium, which is consistent with the liquidity hypothesis of Amihud and Mendelson (1986); however, the same cannot be said for the winner portfolios. Furthermore, it is evident that, in general, medium-volume losers also rebound in most of the holding periods, but to a greater extent than low-volume losers, and medium-volume winners continue the momentum effect, but to a lesser extent than high-volume winners.

Table 6: Momentum returns to liquidity-sorted loser and winner portfolios which constitute the 'zero investment' momentum portfolios

		L = 3						L = 6						L = 9						L = 12					
		Loser portfolio			Winner Portfolio			Loser portfolio			Winner Portfolio			Loser portfolio			Winner Portfolio			Loser portfolio			Winner Portfolio		
		Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*	Return	Average monthly return	*t-statistic*
Buy-hold returns to the equally-weighted portfolios																									
K = 3	V1	5.39	**1.80**	*(1.38)*	-1.70	**-0.57**	*(-0.71)*	13.40	**2.23**	*(2.02)**	-0.41	**-0.07**	*(-0.13)*	8.02	**0.89**	*(1.34)*	-1.33	**-0.15**	*(-0.39)*	12.02	**1.00**	*(1.88)**	-0.01	**0.00**	*(0.00)*
	V2	2.17	**0.72**	*(0.72)*	4.29	**1.43**	*(1.81)**	12.94	**2.16**	*(1.30)*	10.47	**1.75**	*(2.65)***	28.13	**3.13**	*(2.10)***	24.17	**2.69**	*(2.45)***	29.06	**2.42**	*(2.31)***	35.16	**2.93**	*(2.07)***
	V3	-5.79	**-1.93**	*(-2.59)***	8.11	**2.70**	*(1.64)*	-2.45	**-0.41**	*(-0.41)*	11.89	**1.98**	*(1.64)*	-5.47	**-0.61**	*(-0.86)*	14.17	**1.57**	*(1.52)*	-5.58	**-0.47**	*(-0.99)*	21.04	**1.75**	*(2.66)***
	Absolute return differential (V1 -V3)	11.17	**3.72**	*(2.38)***	*9.82*	**3.27**	*(1.72)**	15.84	**2.64**	*(1.67)*	12.29	**2.05**	*(1.53)*	13.50	**1.50**	*(1.43)*	15.50	**1.72**	*(1.58)*	17.61	**1.47**	*(1.95)**	21.05	**1.75**	*(2.48)***
K = 6	V1	7.28	**2.43**	*(1.38)*	*0.62*	**0.21**	*(0.27)*	9.07	**1.51**	*(1.19)*	1.23	**0.21**	*(0.32)*	7.71	**0.86**	*(0.81)*	6.26	**0.70**	*(1.27)*	18.01	**1.50**	*(1.23)*	9.19	**0.77**	*(1.35)*
	V2	5.61	**1.87**	*(1.14)*	*4.52*	**1.51**	*(1.48)*	8.29	**1.38**	*(1.18)*	10.95	**1.82**	*(1.76)**	9.83	**1.09**	*(1.18)*	16.48	**1.83**	*(1.91)**	30.79	**2.57**	*(1.69)*	18.37	**1.53**	*(1.91)**
	V3	-0.62	**-0.21**	*(-0.12)*	*3.88*	**1.29**	*(1.11)*	-4.96	**-0.83**	*(-0.88)*	14.26	**2.38**	*(1.58)*	-9.27	**-1.03**	*(-1.42)*	29.65	**3.29**	*(1.78)**	1.36	**0.11**	*(0.20)*	33.86	**2.82**	*(3.04)****
	Absolute return differential (V1 -V3)	7.90	**2.63**	*(1.05)*	*3.25*	**1.08**	*(0.69)*	14.02	**2.34**	*(1.65)*	13.02	**2.17**	*(1.54)*	16.98	**1.89**	*(1.54)*	23.38	**2.60**	*(1.40)*	16.64	**1.39**	*(1.09)*	24.66	**2.06**	*(2.31)***
K = 9	V1	0.24	**0.08**	*(0.04)*	*-1.47*	**-0.49**	*(-0.39)*	10.58	**1.76**	*(0.96)*	0.19	**0.03**	*(0.04)*	17.43	**1.94**	*(1.12)*	4.14	**0.46**	*(0.71)*	18.89	**1.57**	*(1.44)*	5.22	**0.44**	*(0.91)*
	V2	0.94	**0.31**	*(0.16)*	*-1.58*	**-0.53**	*(-0.45)*	5.69	**0.95**	*(0.87)*	0.92	**0.15**	*(0.17)*	12.46	**1.38**	*(1.20)*	5.97	**0.66**	*(0.85)*	9.14	**0.76**	*(0.95)*	6.85	**0.57**	*(0.84)*
	V3	-4.49	**-1.50**	*(-1.06)*	*11.05*	**3.68**	*(1.05)*	3.81	**0.64**	*(0.32)*	23.03	**3.84**	*(1.15)*	4.90	**0.54**	*(0.37)*	24.95	**2.77**	*(1.67)*	0.03	**0.00**	*(0.00)*	41.14	**3.43**	*(1.88)**
	Absolute return differential (V1 -V3)	4.72	**1.57**	*(0.65)*	*12.52*	**4.17**	*(1.19)*	6.77	**1.13**	*(0.42)*	22.84	**3.81**	*(1.23)*	12.53	**1.39**	*(0.56)*	20.81	**2.31**	*(1.38)*	18.86	**1.57**	*(1.00)*	35.92	**2.99**	*(1.65)*
K = 12	V1	8.79	**2.93**	*(1.16)*	*6.43*	**2.14**	*(2.00)**	19.33	**3.22**	*(1.79)*	1.05	**0.18**	*(0.23)*	16.27	**1.81**	*(1.08)*	3.41	**0.38**	*(0.77)*	24.19	**2.02**	*(1.40)*	4.01	**0.33**	*(0.64)*
	V2	1.49	**0.50**	*(0.18)*	*7.83*	**2.61**	*(2.24)**	14.78	**2.46**	*(1.16)*	6.13	**1.02**	*(1.06)*	30.99	**3.44**	*(1.51)*	12.70	**1.41**	*(1.60)*	43.30	**3.61**	*(1.68)*	11.14	**0.93**	*(1.09)*
	V3	-5.93	**-1.98**	*(-0.71)*	*4.94*	**1.65**	*(0.59)*	-13.37	**-2.23**	*(-2.63)***	-0.97	**-0.16**	*(-0.14)*	-12.15	**-1.35**	*(-1.21)*	0.14	**0.02**	*(0.01)*	-3.76	**-0.31**	*(-0.31)*	14.70	**1.22**	*(1.26)*
	Absolute return differential (V1 -V3)	14.72	**4.91**	*(1.33)*	*1.49*	**0.50**	*(0.19)*	32.70	**5.45**	*(2.80)***	2.02	**0.34**	*(0.33)*	28.42	**3.16**	*(1.57)*	3.27	**0.36**	*(0.31)*	27.95	**2.33**	*(1.45)*	10.69	**0.89**	*(1.26)*

At the end of each estimation period, all stocks are ranked in ascending order based on their past K-month (estimation period) buy-and-hold returns (K = 3, 6, 9, and 12). The stocks are then assigned to 1 of 10 relative strength portfolios (equal and value-weighted), where 1 represents the loser portfolio (i.e., the stocks with the lowest past K-month performance) and 10 represents the winner portfolio (i.e., the stocks with the highest past K-month performance). The stocks within each decile are split further into thirds (V1, V2, and V3) based on monthly trading volume at the beginning of the L-month prediction period (t – 1). The V1, V2, and V3 portfolios within each decile refer to stocks from smallest to largest monthly trading volume respectively. This results in 6 portfolios to examine for each K-month/L-month strategy. The buy-and-hold returns to the winner and loser portfolios, which constitute the 'zero investment' momentum portfolio, are presented for each volume sub-group. The absolute return differential (V1-V3) represents the absolute difference between low-volume stocks and high volume stocks. All the returns are reported in percentages and are returns in excess of the market benchmark (FTSE/JSE All Share Index – J203). The *t*-statistic is marked with a '*', '**', '***' to indicate the significance of the return at the 10%, 5% and 1% level respectively.

The combination of these aforementioned observations drive this counterintuitive result, in which high-volume 'zero investment' momentum strategies outperform low and medium-volume 'zero investment' momentum strategies.

To put these findings into context, it is necessary to look at the equally-weighted K = 6, L = 6 benchmark strategy used by much of the previous literature to provide a comparison of the results. Focusing on the K = 6, L = 6 strategy in this study, Table 6 shows that low-volume losers have an average monthly return of 1.51% compared to high-volume losers which have an average monthly return of -0.83%, and high-volume winners have an average monthly return 2.38% compared to low-volume winners which have an average monthly return of 0.21%. These findings suggest that one may be able to enhance his/her momentum strategy by taking a long position in the high-volume winner portfolio.

These results are consistent with Glaser and Weber (2003), who also found similar results for both the loser and winner portfolio, but in contrast to Lee and Swaminathan (2000) who found that the loser portfolio return differential was more pronounced than that of the winner portfolio return differential, and that high-volume winners generally underperformed low-volume winners.

4.2 REGRESSION RESULTS

Finally, we examine the influence of estimation period excess returns, size, and liquidity on prediction period excess returns in the same regression for all stocks that are included in decile 1 (loser portfolio) and decile 10 (winner portfolio). This allows one to observe which of these variables contributes most to the observed prediction period excess returns.

Table 7: Regression estimates for equation (2)

Period	Intercept	*t*-statistic	Return $_{Ki}$	*t*-statistic	(Log)Size	*t*-statistic	Volume	*t*-statistic	R-squared	F-statistic	Number of observations
3-3	0.086	*(3.33)***	0.001	*(0.10)*	-0.029	*(-2.78)***	1.97E-10	*(0.48)*	0.004	*(2.62)***	2017
6-6	0.204	*(3.82)***	0.029	*(1.85)**	-0.068	*(-3.15)***	2.06E-10	*(0.27)*	0.013	*(4.43)****	1011
9-9	0.325	*(3.55)***	0.033	*(1.53)*	-0.098	*(-2.56)***	9.72E-10	*(0.52)*	0.013	*(2.94)***	688
12-12	0.539	*(4.06)***	-0.004	*(-0.35)*	-0.162	*(-3.06)****	-9.95E-10	*(-0.27)*	0.024	*(3.73)***	454

Coefficient estimates are obtained from pooled OLS regressions using monthly stock price data. The dependent variable is the prediction period excess (buy-and-hold) return and the independent variables are the estimation period excess (buy-and-hold) return, logarithm of market capitalisation at the beginning of the L-month prediction period (t – 1), and monthly trading volume at the beginning of the L-month prediction period (t – 1). Excess returns are defined as the return on a stock minus the return on the market benchmark (FTSE/JSE All Share Index – J203). The estimated regression can be expressed as: $(R_i - R_m)_L = \alpha + \lambda\, return_{Ki} + \gamma \log(size)_i + \phi liquidity_i$. To keep tractability, equal estimation and prediction period (i.e., K = L) returns have been computed. Only stocks within the extreme decile portfolios (i.e., decile 1 extreme losers and decile 10 extreme winners) which have data for each variable (dependent and independent) were included in the regressions. Number of observations used to estimate each regression is given in the last column. The *t*-statistic is marked with a '*', '**', '***' to indicate the significance of the return at the 10%, 5% and 1% level respectively. The F-statistic is marked with a '*', '**', '***' to indicate the overall significance of the equation at the 10%, 5% and 1% level respectively.

It is important to note, that the primary objective of this section is to examine if the aforementioned factors can explain the observed prediction period excess returns in the extreme decile winner and loser portfolios, which most commonly constitute a 'zero investment' momentum portfolio (see eg., Jegadeesh and Titman, 1993; Rouwenhorst, 1998; Liu et al., 1999; Hameed and Kusnadi, 2002; Demir et al., 2004), rather than setting out to find a model that prescribes the expected returns for all stocks on the JSE.

Table 7 shows that for most strategies examined, the lagged return variable ($Return_{Ki}$) is positive (except for the K = 12, L = 12, which is negative). Moreover, the lagged return variable ($Return_{Ki}$) is insignificant in most cases, except for the K = 6, L = 6 strategy, which is significant at the 10% level. These results indicate that, more often than not, the momentum effect is subsumed by the 'size effect'.

There are several other aspects worth noting. Firstly, if the model can explain the prediction period excess return to each stock, the intercept would be statistically insignificant from zero. Unfortunately, looking at the intercept term, one will notice that it is positive and statistically significant at the 1% level, which means that this is a poor model for explaining prediction period excess returns. Secondly, if one looks at the size variable $Log(Size)$, it is evident that the 'size effect', as outlined in section 3.4.1, is a prevalent and significant feature for all stocks (on an individual share basis) within extreme loser and winner decile portfolios, for all strategies considered. Although this finding is in line with previous literature (see eg., Banz, 1981; Reinganum 1981a; Fama and French 1992; Van Rensburg, 2003; Basiewicz and Auret, 2009 Fama and French, 2012), and that of the loser and winner portfolios that constitute the 'zero investment' portfolios, one must reiterate that, in line with the findings of section 4.1.1, this effect disappears when one considers 'zero investment' momentum strategies. Lastly, when we computed F-tests for each regression (in order to test the overall significance of the equation), the results revealed that the F-tests strongly reject the hypothesis that all the coefficients are equal to zero.

In summary, one can see that the momentum effect is not significant, which confirms the earlier findings in section 4.1. Furthermore, firm size seems to be the variable that has the most power to explain prediction period excess returns. This finding implies that one may be able to create more successful trading strategies by creating portfolios conditioned on 'pure' firm size rather than 'pure' momentum.

5 CONCLUSION

This study examines the returns to intermediate-term 'zero investment' momentum strategies across all stocks on the JSE over the period of 1st of January 2001 to the 31st of January 2011, as well as the influence of size and liquidity on momentum returns. Unlike studies in the USA, UK, Europe, and Australia, this study finds little evidence to support the prevalence of intermediate-term 'pure' price momentum in South Africa. When one applies 'pure' price 'zero investment' momentum strategies, which consist of taking short positions in past losers and long positions in past winners, over various intermediate-term horizons ranging from three to 12 months, the strategies consistently produce insignificant profits.

When 'zero investment' strategies are conditioned on past returns and then sorted according to size, this study finds two patterns that emerge in both the equally-weighted and value-weighted 'zero investment' portfolios. Firstly, it is evident that return continuation over the shorter intermediate holding horizon (i.e., L = 3), is generally strongest for the largest stocks, and weakest (generally negative) for the smallest stocks. Secondly, as one starts to look at longer intermediate holding horizons (i.e., L = 6, 9, and 12), the return continuation is generally greatest for medium size stocks, and weakest (generally negative) for the smallest stocks. Moreover, if one undertakes a more detailed analysis into the loser and winner portfolios that constitute the 'zero investment' portfolios, it is evident that the returns to momentum strategies may be significantly enhanced by taking a long position in the small-size winner portfolio.

Furthermore, when equally-weighted 'zero investment' strategies are conditioned on past returns and then sorted according to liquidity, it is evident that return continuation is generally strongest for the most liquid stocks. When value-weighted 'zero investment' strategies are considered, there appears to be no systematic effect of liquidity on price momentum. However, analogous to the detailed analysis conducted for the size-sorted portfolios, it is possible to significantly enhance the returns to momentum strategies by taking a long position in the high-volume winner portfolio.

This study has several implications for investment management. Since weak evidence for 'pure' price 'zero investment' momentum strategies is documented, it is unlikely that these momentum profits will be robust to transaction costs, which in turn questions the feasibility of constructing 'zero investment' trading strategies based on 'pure' price momentum. However, if it is possible to find sub-groups of stocks that show higher momentum returns than the average stock, momentum strategies may be significantly profitable, even after accounting for transaction costs. Fortunately, compared to 'pure' price 'zero investment' momentum strategies, clear evidence exists of higher

return continuation for ‘zero investment’ strategies among medium and large capitalisation stocks, as well as the most liquid stocks. An even more interesting observation is that if one is willing to abandon the traditional ‘zero investment’ approach, the returns to size-sorted momentum strategies may be significantly enhanced by taking a long position the small-size winner portfolio, and the returns to liquidity-sorted momentum strategies can likewise be enhanced by taking a long position in the high-volume winner portfolio.

Further analysis should extend to examine how common market frictions will impact the returns of ‘pure’ momentum strategies, as well as those momentum strategies conditioned on firm size and liquidity in order to assess the practicality of implementing such strategies. This would require one to include the dynamics of the trading process into the portfolio formation and realisation strategies. Furthermore, it would be helpful to distinguish between firm-specific and industry-specific momentum effects, as this would shed more light on the source of these momentum profits. These topics are left for further research.

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