



A Momentum Trading Strategy On the Johannesburg Stock Exchange

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50% research report

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Abstract

This research report documents an example of evidence of investor overreaction in the marketplace, with overreaction to short-term information found to be exploitable via price corrections in order to generate market-beating returns. An efficient market should render any consistent abnormal returns unattainable. Hence any technical analysis allowing an investor to obtain such returns would indicate a degree of market inefficiency.

Three signal generation strategies are employed to test for momentum and price corrections in the market, namely using a stock's price and moving average, ranking stocks based on prior returns, and allocating stocks as overbought and oversold. The strategies are employed on data comprising the top 60 stocks on the JSE as at August 2012. The period tested runs from January 1998 to August 2012.

Signal generation by means of price and moving average encompasses trade signals being generated by a stock's price moving above or below a variable moving average. Returns to this strategy tend to be maximized when employing a short-term (20-day) moving average, with an annualised above market return of 14,9% achievable.

Using the returns of a stock in an immediately preceding formation period as a ranking criterion to classify stocks into a portfolio is found to be a superior method to generate trading signals. A portfolio of the best performing stocks in a preceding period ("the winner portfolio") is found to be able to outperform the market. Given a minimum formation period of 50 days, price continuation is achieved after holding the portfolio for at least 30 days, with annualized market excess returns greater than 10% achieved at longer formation and holding periods. A portfolio of the worst performing stocks in the same period ("the loser portfolio") is able to outperform the winner portfolio, and is capable of achieving returns of 20% in excess of the market, given a formation period as low as 10 days, while closing the investment position after no more than 10 days.

Using a stock's change in price with respect to the price level of a variable moving average as an indication of being overbought or oversold is found to be a good indicator of subsequent price correction. Price continuation for the overbought portfolio is achieved at holding periods greater than 25 days, given a minimum formation period (moving average) of 100 days. Annualized market outperformance of up to 7,4% is achieved at longer formation and holding periods. The oversold portfolio exhibits market excess returns of 24,3% for a 10-day formation period (moving average), closing out the investment position within 5 days.

While all three of the strategies employed have their own merits and demerits, that of ranking shares based on prior returns is indicative of the highest annualized achievable returns, given the range of formation and holding periods examined. Nevertheless, all three strategies advocate for buying the loser portfolio and short selling the winner portfolio at low formation periods, closing out the trade within 5 to 10 days.

The results documented in this report hence indicate the presence of investor overreaction in the market and support prior findings on the existence of momentum in the marketplace.

Declaration

I, Frederick Nicholas Eloff, hereby declare that the work contained herein is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree at this or any other University. I empower the University to reproduce this thesis for the purpose of research, either the whole or any portion of the contents, in any manner whatsoever.

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1. Introduction

- i) The aim of this research report is to present a concise and integrated analysis on whether an active momentum trading strategy is able to generate returns which are in excess of those exhibited by a passive buy-and-hold alternative in the market place. Several strategies are employed, with a distinct focus on moving averages, short-term market overreaction to new information, and long-term reversion. An emphasis is placed on investigating both momentum in the market place, as well as the existence of price corrections, ultimately exploiting short term and long term market inefficiency.

- ii) This research report is organized as follows:
Chapter 2 presents an overview of prior literature, which has been conducted on various aspects of momentum trading strategies on both the JSE and internationally. The review first examines different approaches which have been adopted to test momentum strategies and the profitability thereof. A review of successful trend following and momentum strategy testing, as well as price reversals and mean reversion in the South African and International market place is then explored, after which prior work on specific filters and trend isolation is examined.

- iii) Chapter 3 provides a detailed account of both the data acquired and utilized, as well as the methodology adopted in employing various simulations in this research report. Chapter 4 presents the results obtained, while chapter 5 summarizes and concludes, with suggestions for further research following.

2. A Review of Prior Research

2.1 A review of International and South African Literature on the application and profitability of momentum trading strategies

Momentum trading by means of moving averages has been in existence in an attempt to forecast trend direction for a number of years. For example, Gartley employed moving average analysis as early as the 1930's (Park and Irwin, 2005). Over the ensuing time period, a variety of methods have been developed in an attempt to successfully predict the direction of a trend and profit from identified trends.

Richard Donchian, considered by many as the father of trend following, initiated trading rules in the 1930's, employing a short and long term average to generate buy and sell signals in the belief that commodity futures prices changed through long sustained moves over time (Costa, 2004). Accurately predicting the direction of a sustained move in price over time allows for signal generation that is capable of identifying arbitrage opportunities. Many of the technical rules followed today are adapted from his earlier work, most notably the 5 and 20 day moving average rule. It is hypothesized that these lengths were chosen as they represented the amount of trading days in a week and a month respectively. Further, not only did Donchian's rule stipulate that the 5 day moving average had to cross over the 20 day moving average to generate a signal, but that the closing price on the day the signal was generated had to exceed (fall short by) a minimum of 1 standard deviation of the previous day's closing price. Employing these criteria ensure signals are only generated by a minimum magnitude of price changes, and make the rule self-adjusting as price changes increase or decrease in magnitude.

Joubert and Mason (1991) identify 3 most commonly observed strategies used to employ moving average trend following. The first method is to use the moving average itself in order to identify the trend, interpreting an upward movement in the average as a buy signal, and a downward movement as a sell signal. This method proved useful at a time when calculations were performed manually, owing to the fact that reversal points in the average were easily identifiable. The next method is to combine the moving average and price such that a buy signal is generated whenever

the price breaks through from below to above the moving average and conversely, a sell signal is generated when the price falls from above to below the moving average. The reasoning behind this is that a moving average will always lag behind the price while it maintains a firm trend, as a reversal in the trend will only begin to materialize once the price deviates in either direction sufficiently from the average. Hence we experience a time lag, which is directly proportional to the length of the average, as shorter moving averages adjust more rapidly to price changes and vice versa. Resultantly, the sensitivity of the indicator can be refined by means of adjusting the time period of the average, so as to adjust the amount of “noise” which is filtered out, with the aim of successfully forecasting the underlying trend.

Joubert and Mason (1991) note the existence of a trade-off between the amount of time (lag) from the moment of the actual reversal in the trend to the time of the signal, and false signals, which arise when “noise” results in a signal being generated, yet the original trend resumes shortly thereafter. The incidence of these false signals is often referred to as ‘whiplash’.

The third strategy arose in an attempt to mitigate this trade off by means of using two moving averages as opposed to the combination of moving average and price. Here a signal is generated as above when the shorter moving average crosses the longer moving average, and termed the Dual Moving Average Crossover method.

Joubert and Mason (1991) also document the introduction of momentum oscillators. While a momentum chart of the price is used to depict the rate of change of the price, any “noise” evident in the price distorts the momentum chart. In other words, a “noisy” price chart will result in a “noisy” momentum chart. However, a momentum chart of the moving average of the price allows one to observe an otherwise unobservable underlying trend (effectively eliminating some noise) to generate buy and sell signals. Mathematically, when the rate of change of a variable is zero, that variable is at a maximum/minimum. Using a momentum chart in this manner allows one to generate buy and sell signals when the zero base line is crossed as the price reaches its maxima and minima. Hence a reversal in the trend is more certain.

Joubert and Mason (1991) note that in practice, using methods such as those described above to reduce the effects of noise may introduce delays in the momentum oscillator, as owing to the nature of moving averages, the average trails behind the direction of the price. Empirical findings have led to a strategy devised so as to use these lags to one's advantage. If one generates a warning signal by means of a band (which is a pre-specified distance from the baseline) when the momentum reverses direction, instead of waiting for the momentum to cross the base line, it is implicitly assumed that the price will soon reach its maximum or minimum, and also change direction. In this way false signals, as well as lag can be mitigated, effectively reducing the need for a trade off.

In light of the application of these technical tools one must question the profitability of such techniques and whether investors still stand to profit adequately for the risk assumed in employing these techniques. Pukthuanthong-le, Levich, and Thomas, in their 2006 paper "Do foreign exchange markets still trend?" explore the progression of technical analysis by means of moving averages on 6 major currency futures contracts which have been trading since 1970, as well as more recent contracts on "exotic" currencies. Their findings indicate that most modern financial markets are indeed weak-form efficient, and resultantly should render any forecasting of future price changes based on past information impossible. However, for several extended periods, major spot currency exchange rates and their associated futures prices were anomalies that produced profits when momentum strategies and trend analysis were applied to them. Though their study is focused primarily on trend following profitability in foreign exchange markets, many of the methods and findings are applicable to this paper, namely in that the existence of momentum as referenced in chapter 5 of this research report.

Pukthuanthong-le *et al.* (2006), using futures data, employed three moving averages to produce trading signals (where a signal of +1 represents a long position in the currency, and -1 a short position). The first compares the 5-day moving average with the 20-day moving average, the second compares the 1-day moving average with the 5-day moving average, and the last compares the 20-day moving average to the 200-day moving average, in order to pick up long swings in exchange rates. They employ a method of buying when the short-term average rises above the long-term average

and holding that position until the signal changes. Returns are annualized and expressed in excess of US T-bills, so as to be considered in the context of normal risk premiums.

Daily returns are taken as the difference of the natural log of futures prices, multiplied by the signal varying between +1 and -1, depending on the values of the individual rules.

The relative risk and return metrics in this research report have been expressed so as to be in line with returns and volatility on the JSE, as elaborated on in the methodology and results. Levich and Thomas (2006) express the returns of a portfolio as an equally weighted average of all six currencies and experience lower volatility as a result of imperfect correlation among the six currencies. Similarly, an equally weighted index of stock returns is generated as a benchmark in this research report. They find that trend following models performed very well until 1995. The equally weighted portfolio of currencies produced a return of 10.26 percent above T-bills, which with volatility of 12 percent, translates into an information ratio of 0.86. Information ratios of a similar magnitude are achieved for certain momentum trading strategies employed in this research report.

After 1995, profits for all currencies declined and more than half were negative, results “*even worse than could be expected from chance alone*”. Overall, looking at an equally weighted portfolio, the post-1995 performance of trend following rules was found to be poor. An equally weighted portfolio of currencies using trending rules lost money during 1995-1999 and again during 2000-2006. Diminishing profits to a technical trading rule in subsequent time periods is in line with the findings of Park and Irwin (2005), as discussed below.

Levich and Thomas (2006) hypothesize two possible causes for diminishing returns from this method of trend following. One is that “*traders have adjusted to exchange rate trends, altering their strategies to reflect the popularity of trend following. Resultantly, profits may have vanished because traders, anticipating a trend, all try to initiate their positions simultaneously, resulting in a step function response in the currency to news, rather than a smooth, trending response. In such a scenario, only*

the first and quickest traders would make money.” Their second hypothesis was that the “dumb money,” which had never previously recognized exchange rate trends and had systematically lost money in these markets, finally caught on to the profitable trading strategy, with prices adjusting quickly so as to diminish returns to the strategy as it was employed by more and more market participants. In either event, they conclude that in 1995-1999 and certainly by the post-2000 period, it was no longer possible to earn profits using moving average trend following trading rules in the major dollar currencies.

The authors go on to examine the effectiveness of employing the same moving average techniques on newly liquid “exotic” currencies, referring predominantly to emerging market currencies. This is found to be profitable, but for how long this will remain the case was questionable.

The authors conclude that their data suggests that it has taken 20 years before trend following profits were substantially eliminated in the major currencies, however, the lack of profits in these relatively simple models has not deterred many foreign exchange traders from continuing to employ technical analysis. They hypothesized that a possible explanation was that traders may have begun to employ more sophisticated technical models, based on more complex relationships or applied at higher frequencies, “*minute-by-minute or second-by-second*”. Another explanation is that successful traders may have moved to what they deemed exotic currencies, as explained above. Levich and Thomas (2006) note that it may take far less time for the exotics to become weak-form efficient relative to major dollar currencies, also noting there is weak evidence that they are already producing less return from trend trading than they once did. Finally, they note however, that the recent trading profits for exotic currencies are still attractive.

The findings of their paper raise some interesting considerations for this one. Though this research report has been carried out on the JSE, with fewer tradable securities than on many other international markets, it remains to be seen whether trend isolation and momentum trading proves profitable in the local market.

Park and Irwin (2005), examine the profitability of momentum trading in the context

of agricultural futures. The opening page conveniently summarizes: *“Academics tend to be skeptical about technical analysis based on the belief that markets are efficient, at least with respect to historical prices. In efficient markets (Fama), any attempt to make economic profits by exploiting currently available information, such as past prices, is futile. This view is summed up in an oft-quoted passage by Samuelson, who argued that ‘...there is no way of making an expected profit by extrapolating past changes in the futures price, by chart or any other esoteric devices of magic or mathematics. The market quotation already contains in itself all that can be known about the future and in that sense has discounted future contingencies as much as is humanly possible’.*”

While the success of momentum trading on agricultural futures falls out of the scope of this study, some inferences on the reasoning behind the skepticism on technical trading and its profitability in practice are worth noting. Park and Irwin (2005) note numerous empirical studies which have investigated the profitability of technical trading rules and also that many find evidence of positive technical trading profits. For example, Lukac and Brorsen (1990) find that during the time period spanning 1978 to 1984, four technical trading systems, including the dual moving average crossover method and the price channel, yield statistically significant monthly portfolio net returns ranging from 1.89% to 2.78%, which they note do not appear to be compensation for bearing systematic risk.

Park and Irwin (2005) document that such findings *“potentially represent a serious challenge to the efficient markets hypothesis and our understanding of price behavior in speculative markets.”* They also note, however, the existence of, and reason for skepticism about technical trading profits reported in many previous studies.

They cite data snooping as a primary concern that drives much of the skepticism, however they note that such data snooping biases may be properly accounted for through recently introduced statistical procedures. A variety of measures have been taken in this research report to avoid a collection of biases, as elaborated on in the data and methodology section.

Park and Irwin (2005) generate two moving average systems: the Simple Moving

Average with Percentage Price Band (MAB), which includes a band that must be exceeded for successful signal generation, as explained above, and the Dual Moving Average Crossover (DMAC). They note an advantage of the dual moving average method over, for example, the simple moving average method, (as described in the beginning of this review) namely that “... *the (dual) moving average method is one of the few technical trading procedures that is statistically well defined, because it generates trading signals by depending only on data available at the present time.... As market participants, such as brokers, money managers or advisers, and individual investors, were known to extensively use the Dual Moving Average Crossover system, many academics have tested this system since the early 1990s.*”

Furthermore, Park and Irwin (2005) reference the benchmark which momentum strategies have historically been tested by, in order to test the efficient markets hypothesis. They reference the buy-and-hold strategy, which for some time has been employed as a benchmark for the stock market in which a general up-trend in asset prices is observed. They question the validity of this as a benchmark in testing conducted within the futures market, owing to specific characteristics exhibited therein, but this is out of the scope of this research report. For the purposes of testing momentum strategies in equity markets, a buy-and-hold strategy is a suitable benchmark, as one is testing the effectiveness of a technical, actively managed strategy against a passive alternative.

The results of their paper indicate that throughout the earlier out-of-sample period (1978-1984), technical trading rules generated statistically significant economic profits in 6 out of 12 futures markets. However, the replication of the strategies, when employed on new data, show that the earlier successful performance of the technical trading rules was unable to persist in the later sample period, 1985-2003. Hence the substantial trading profits in the earlier sample period were no longer available in subsequent time periods. This is somewhat consistent with findings of Levich and Thomas (2006), as noted above.

They hypothesized three possible explanations for the disappearance of technical trading profits in the 1985-2003 period: Data snooping biases (or selection bias) in previous studies, structural changes in futures markets, and the inherently self-

destructive nature of technical trading strategies. Stated alternatively, when first introduced, forecasting techniques in their initial application may produce economic profits. However, once these models gain popularity amongst professionals within the industry, the information they are able to extrapolate is more likely to be impounded in prices, and thus their initial profitability may disappear. This reasoning is similar to that referenced by Levich and Thomas (2006), above. Park and Irwin (2005) note the findings of Schwert (2003) “that a wide variety of market anomalies in the stock market, such as the size effect and value effect, tend to have eroded after the academic papers that brought them to attention were published”.

Campbell (2007), tests the profit generating ability of several simple moving average rules against a buy-and hold strategy on the JSE over the period 1988-2007, after numerous suggestions that technical trading systems were capable of outperforming the market. The data series, spanning 20 years of daily returns on the JSE, is broken down and tested in four non-overlapping sub-periods (of 5 years each). Aside from the primary objective of profitability within momentum trading strategies, secondary aims of the paper included evaluating whether a particular technical rule or moving average length examined outperforms the selected alternatives. The results of the paper show that excess returns over a buy-and-hold strategy are indeed possible using technical analysis, even in the presence of transactional costs. Some clarification is required, however.

The paper sets out to test three simple trading rules; namely the Variable Moving Average (VMA) rule, where one varies both the short and long term moving averages in order to isolate trends in a time series, Fixed Moving Average (FMA), where moving average lengths are not varied, and Trading range break out rules, where buy and sell signals are emitted when the price moves above (below) the recent (specified in number of days) maximum (minimum) with the intention of replicating an original study performed by Brock, Lakonishok, and Lebaron (1997). Campbell (2007) uses a different data set (being the JSE), in a more recent time period (1988-2007), in an attempt to avoid data snooping. Though the trading break-out rule is not be tested in this research report, the findings on the profitability of all 3 rules present an opportunity for further research on a different data set; namely using individual share data on the 60 largest shares on the JSE (By market capitalization as at August 2012),

over a more recent time period, where Campbell's study is conducted on an index. The 20-year data series used by Campbell (2007) shows an overall upward trend over the sample, with an exponential upward trend in the final period, 2002-2007. Further, The introduction of a band is applied so as to eliminate whiplash signals (false signals being generated, as discussed earlier in this review) as highlighted by Brock *et al.* (1997).

Upon testing the following ten Moving Average rules [(1,50,0); (1,50,0.01); (1,150,0); (1,150,0.01); (5,150,0); (5,150,0.01); (1,200,0); (1,200,0.01); (2,200,0) and (2,200,0.01)], results varied, particularly before and after transaction costs were introduced. The actual execution of a buy or sell trade is assumed to occur the day after a signal is generated, resulting in a 1-day time lag between signal generation and trade execution. Campbell notes that this makes the model more realistic as it would be impossible in reality to execute a trade on the same day a signal is generated, owing to the fact that the signal is based on that day's closing price. After defining buy and sell returns and transaction costs, and stating several assumptions about the history of these in the context of the South African market place, the following hypotheses were tested:

The null hypothesis (H_0), that excess returns generated by technical trading rules over and above a buy-and-hold trading strategy are zero, is tested against the alternative (H_1); that the excess returns generated by technical trading rules over and above a buy-and-hold strategy are greater than zero.

T-statistics are calculated for three separate technical analysis excess returns signals measured: Excess returns achieved through technical analysis buy signals; excess returns achieved through technical analysis sell signals, and excess returns achieved through both buy and sell signals.

In summary, the following findings by Campbell (2007) are most relevant: The number of buy signals are found to be far greater than the number of sell signals generated, with all ten Variable Moving Average tests in the paper found to show positive buy-signal and total annual excess returns over a buy-and-hold strategy. All of the buy signal-return and 8 of the total-return t-tests reject the null hypothesis at the

90% significance level. However, sell-signals produce below average profits, with only 3 of 10 tests with positive excess returns. Further, none of the sell signal-return tests reject the null hypothesis. The VMA (1,50,0) rule yields the highest returns before transaction costs are considered, but shows the worst profit margin once transaction costs are taken into account. In fact, all tests except the abovementioned rule yield positive excess returns when accounting for transaction costs.

Campbell (2007) notes that while this research does provide some evidence in favour of the forecasting ability of simple technical trading rules on the JSE, the t-tests employed are unable to confirm the statistical significance of the results conclusively, owing to the null hypothesis not being rejected for all tests.

For the sample period in which the analysis is undertaken, and once averaged over all 26 rules (that is 10 rules for Variable and Fixed Moving averages each, as specified above, and 6 rules for Trading Range Break-out technical analysis), the excess return (over and above a buy and hold strategy) before accounting for trading costs achieved by technical trading is found to be 4.6% per annum. It is noted that this is a significant improvement in return (above the passive strategy) as the average annual buy-and-hold return for the period on the JSE is 16.3% in total. However, excess returns achieved by simple technical trading rules once transaction costs have been accounted for is found to be on average only 1.5% per annum.

Campbell (2007) notes positive excess returns (before trading costs) are observed in all sub-periods tested except for the period 1997-2002, which is the sub-period in which the greatest price volatility is experienced, resulting in more of a sideways rather than upward price trend. The recent volatility exhibited in the JSE over the last 5 years, evident primarily as a result of the global financial crisis, combined with record highs recently achieved on the JSE at the time of writing this research report, makes for an interesting time period in which it is undertaken.

Campbell (2007) documents that the period 1993 to 2002 exhibits negative returns when compared to a buy-and-hold strategy after accounting for transaction costs. This is somewhat consistent with the findings of Levich and Thomas (2006) and Park and Irwin (2005) above. Resultantly, Campbell concludes that excess profits are more

attainable in positively trending markets, rather than highly volatile markets or bear markets, and that these excess profits are not always capable of being achieved using simple technical rules after considering the transaction costs associated with such trades.

Results also show that the shorter the time length of moving average employed, the higher the resulting pre- and post transaction cost technical trading returns. The paper finds the VMA (1,50,0) rule yields the highest pre-trading cost excess return of 12.5% while the TRB (1,50,0) rule yields the highest post trading cost profit of 5.9% over a simple buy-and-hold strategy.

The incorporation of a 1% tolerance band, as discussed earlier in this literature review, is found to reduce the number of trades, as could reasonably be expected when attempting to reduce the incidence of false signals, but is not found to consistently improve returns after the consideration of trading costs. In many cases the incorporation of such a band yields worse results than the alternative of not incorporating a band into the rule. Overall, the VMA trading rules are found to outperform the other rule categories tested before transaction costs, however there is no clear “superior” rule once trading costs are taken into account. Campbell (2007) finds that buy signals are found to consistently generate higher returns than sell signals.

This poses some interesting questions for the results obtained in this research report, given a different time period and individual shares, rather than an index. With reference to the Efficient Market Hypothesis, Campbell (2007) notes that any indication that excess returns are possible through technical trading rules is considered an indication of market inefficiency. While the research documented by Campbell (2007) shows that excess returns over a naive buy-and-hold strategy are attainable on the JSE through employing simple technical trading rules, the statistical significance of the results obtained are termed “inconclusive”. However, the evidence in the paper demonstrates that technical trading rules and their application does *“have forecasting ability, is intriguing and remains an interesting and unresolved issue for further research.”*

Employing a somewhat different approach, Muller (1999), ranks stocks according to their prior performance at a given point in time. Following a predetermined formation period in which ranking criteria is employed, one is able to classify stocks in to both a ‘winner’ and ‘loser’ portfolio, which can subsequently be invested in for varying holding periods. The paper explores the existence of price momentum and price reversals, based on the idea that investors who believe in price momentum would back the winner portfolio, where the loser portfolio would be backed by investors supporting overreaction theory and expecting prices to revert to some intrinsic mean.

The non-rational type of investor behavior exploited is that of investors consistently over-weighting recent information, while “under-weighting long-term base data” (De Bondt and Thaler, 1985).

To elaborate, assume that when negative information becomes available to the market, investors panic and over-react, driving share prices significantly below their mean fundamental values (as established by expected future earnings and other fundamental explanatory factors of share prices). This event can be considered as the short-term horizon. Over time, share prices tend to recover by regressing to their means via a price correction. This can be thought of as the long term, where no new information necessarily enters the market, but prices regress to their means.

With reference to the Winner and Loser portfolio as mentioned above, Muller (1999), citing findings from Dreman and Berry (1995), notes that investor overreaction to new information, coupled with simultaneous disregard of long-term trends, results in regression to the mean turning the average winner into a loser and vice versa. Further, as the reversal tends to develop with some delay, a profitable opportunity presents itself. This is suitably described by Muller (1999) as the market first overreacting to short-term news, while underreacting while awaiting new short-term news of a different nature.

The “fads hypothesis”, as referred to by Muller (1999), asserts that share prices may overreact to relevant news. This was documented after Poterba and Summers (1998), found suggestions of “pronounced negative long-term serial correlation”, while prior research had suggested evidence of short-term positive serial correlation in share

prices. Bodie, Kane and Marcus (1996), with reference to the “fads hypothesis” find that overreaction can lead to “positive serial correlation over short time horizons”, while a correction of such overreaction would lead to good performance after poor performance and vice versa. The implication for long-term market inefficiency is that any mean reversion would imply that a run of positive returns is expected to eventually be followed by a run of negative returns, leading to negative serial correlation over longer investment horizons, post short-term positive serial correlation (momentum). This paper finds evidence of both short-term momentum, as well as negative (positive) long-term serial correlation in the winner (loser) portfolio, as inferred by findings referenced above.

Muller (1999) hypothesizes that if investors could invest in (sell short) stocks immediately after negative (Positive) over-reaction, they may be able to lock in market beating returns. If successful, this strategy would then imply that markets are weak form inefficient in the long term. Muller (1999) does in fact infer increasing market inefficiency over longer holding periods, evidenced by increasing returns to buying the loser portfolio and extending the holding period.

Muller (1999) refers primarily to two prior studies carried out to examine investor overreaction as described above. The first, conducted by O’Shaughnessy (1996) set both the formation, as well as the holding period at 1 year, and ran both a winner and a loser portfolio (comprising of 50 stocks each) in parallel over 42 years. The study proposed a trend following strategy, where the winner portfolio yielded 14,45% per annum, compared to a mere 2,54% for the loser strategy.

In strong contradiction, De Bondt and Thaler (1985, 1987) found stocks with the worst performance during the formation period exhibited abnormally good subsequent performance and vice versa.

Muller (1999) draws attention to the fact that the fundamental difference between the two papers is that while O’Shaughnessy kept both the formation and holding period constant at 1 year, DeBondt and Thaler calculated optimal formation and holding periods while holding other variables constant. This draws attention to the importance surrounding the optimization process and the impact on portfolio return from varying

both formation and holding periods.

In employing his own trading strategy, Muller (1999) tested the following two propositions: That optimized winner portfolios outperform the market, and that optimized loser portfolios outperform optimized winner portfolios. These are formed on the basis that a winner portfolio would typically be supported by investors betting on price momentum, where the loser portfolio would typically be backed by investors in support of short-term overreaction and long term mean reversion, as discussed previously. He also notes that both propositions rely on the assumption that the means which prices regress to do not move as the strategy is based on theory underpinning mean reversion.

Muller (1999) undertakes a rigorous methodology in order to mitigate any biases which may arise from employing the strategy. One of the primary criticisms of De Bondt and Thaler (1985,1987) related to the start and end of the investment horizon and resultant market timing issues which affected performance. Muller (1999) notes that Ball, Kothari, and Shanken (1995) find that the reversal effect as referenced by De Bondt and Thaler (1985, 1987) is substantially diminished if portfolios are grouped based on past performance periods ending in mid-year, rather than December. The importance of varying the start date of the formation period is highlighted here. For this reason Muller employs latin-hypercube sampling to randomly (but with even distribution) select starting dates for varying formation and holding periods over the investment horizon.

From a sample of the top 200 shares on the JSE ranked by market capitalization as at February 1998, a base of market returns is established by simulating every combination of formation period, holding period, and start date, while setting portfolio size to 200 and ignoring winning and losing portfolios. The portfolio was first limited to either 30 or 60 shares, while the optimal formation and holding periods were calculated for both winner and loser portfolios by running every combination of formation and holding period from 60 to 1400 days in steps of 70 days. For both the winner and loser portfolio, optimal formation and holding periods produced significantly higher excess returns for the 30-share portfolio, as opposed to the 60-share portfolio.

The formation and holding period was then set to these optimal values and the portfolio size varied from 1 to 200 shares in steps of 1 in order to optimize the portfolio size and yield maximum portfolio return. This also explored the effect of different risk return trade-offs, where the highest annualized market excess return of 85,3% for the winner portfolio, and 26,7% for the loser portfolio was achieved by limiting the portfolio size to a single share. Naturally the portfolio comprising only one share exhibited significant variation in returns. Alternatively, when extending the portfolio size across the spectrum to include all 200 shares, market excess return dropped to zero, as the portfolio became the market of all 200 available assets. However, variation in returns was significantly reduced. This opened the discussion on the optimal portfolio size, given an optimal formation and holding period derived from a simulation with a set number of shares. Muller (1999) hypothesized that the optimal portfolio comprised between 20 and 40 shares, given the variation in returns as shares were added/removed from the portfolio for a given formation and holding period, as observed in two-dimensional graphs.

By setting the formation period and holding period to their prior optimal values, varying the start date, alternating between winner and loser strategies, and varying the portfolio size from 1 to 200 in steps of 1, out/underperformance of the market was observed in three dimensional schematics once resultant returns had been standardized and annualized.

Muller (1999) observed that the optimal formation and holding period for the loser portfolio exhibited excess returns which were greater than those from the winner portfolio. Additionally, relative to the winner portfolio, significantly higher mean positive market-excess returns for the loser portfolio are documented. The findings in this research report are similar and provide support for both of these observations.

When employing both a difference in means test, as well as a test in the proportion positive of market-excess returns, Muller (1999) found that observing the winner portfolio against the loser portfolio resulted in a statistically significant difference in means/proportion positive, while changing the number of shares in the portfolio was significant only for the loser portfolio, but not for the winner portfolio. Stated

alternatively, there is a significant difference in results when alternating between the winner and the loser portfolio, which is not necessarily the case when changing the number of shares in the portfolio for a constant strategy.

From his results, Muller (1999) concluded that he had certainly presented a case supporting investor overreaction on the Johannesburg Stock Exchange. Highlights from his findings include that loser strategy portfolios yielded higher excess market returns with increasing holding period, whereas winner strategy portfolios yielded lower excess market returns with increasing the holding period. To an extent this supports the idea that winner portfolios exhibited momentum in the short term (deemed as a holding period less than 600 days in this research report, beyond which returns diminished significantly), while loser portfolios exhibited mean reversion in that excess returns were observed for holding periods greater than 400 days. The findings in this research report support those referenced above, with an altered definition of short and long-term.

Further, the optimized winner portfolio outperformed the market by as much as 15% per annum, while the optimized loser strategy portfolio outperformed the market by almost 20% per annum, confirming both the proposition that (i) optimised winner portfolios outperform the market, and (ii) optimised loser portfolios outperform optimised winner portfolios.

Muller and ward (2012) find that portfolios constructed on the basis of univariate ranked style characteristics exhibit significant effects over the period 1985-2011. Amongst other variables, momentum is cited as the best style of all those examined, and a factor to which significant and persistent excess returns can be attributed. Muller and ward (2012) find that a 12 month formation period and 3 month holding period persistently outperformed the ALSI by around 9% per annum, and acknowledge that there is evidence that momentum strategies work best over even shorter holding periods. Venter (2009) undertakes to test the profitability of intraday momentum. While this is out of the scope of this report as the minimum formation and holding period is limited to 5 days, Venter (2009), finds significant return predictability to be present when returns are calculated from mid-quote prices. However, this is not the case when using bid-ask pricing assumptions on an intraday

basis.

Jegadeesh and Titman (1993), find that strategies which buy stocks that have performed well in the past and sell stocks which have performed poorly in the past generate significant positive returns over 3-12 month holding periods. The profitability of these strategies is documented as not being due to their systematic risk or delayed stock price reaction to common factors. It is also noted, however, that part of the abnormal returns generated in the first year after portfolio formation dissipates in the following two years. Jegadeesh and Titman (2001), evaluate various explanations for the profitability of momentum strategies documented in Jegadeesh and Titman (1993), finding evidence of momentum profits continuing into the 1990's, suggesting that original results were not a product of data snooping bias. Further, Jegadeesh and Titman (2011), find evidence providing support for behavioural models which propose that momentum profits are due to delayed overreactions that are eventually reversed. Jegadeesh and Titman (2001), also find that positive momentum returns are sometimes associated with post holding period reversals.

These findings bear particular significance to this research report, which aims to conduct further research into optimal formation and holding periods, as well as excess market returns achievable in order to determine the presence, if any, of short and long-term momentum in the market place. Evidence of these trends would indicate market inefficiency on the Johannesburg Stock Exchange.

The implications of market efficiency on the JSE pose some interesting ideas for this research report, as evidence of market efficiency should render technical momentum trading unprofitable. The evidence suggests mixed results, and this research report aims to shed some light on the profitability of technical momentum trading on the JSE. Further, several studies have explored more advanced filters and trading rules beyond simple moving averages and momentum strategies, and the profits associated therewith. This is elaborated on in the ensuing section.

2.2 A review of the Literature on Filters and Trend Isolation

In their 2009 paper “A momentum trading strategy based on the low frequency component of the exchange rate”, Richard D.F. Harris and Fatih Yilmaz employ both kernel regression, as well as using the Hodrick and Prescott filter, developed by R. Hodrick and E. Prescott in 1997, to recover the non-linear trend in the monthly exchange rate and use short term momentum in this trend to generate buy and sell signals. The filter isolates a low frequency non-linear trend from a time-series, the smoothness of which is determined by a pre-specified smoothing parameter.

Harris and Yilmaz (2009) note that the low frequency momentum trading strategy offers greater directional accuracy, higher returns and Sharpe ratios, lower maximum drawdown and less frequent trading (hence fewer transaction costs) than traditional moving average rules. They also note that unlike traditional moving average rules, the performance of the low frequency momentum trading strategy is found to be relatively robust across different time periods, and that the low frequency momentum trading strategy is also robust to the choice of smoothing parameter (in the case of the HP filter).

The origin of their model for directional forecasts of the spot exchange rate separates the rate into a regular and irregular component. Specifically, they assume that the spot rate, S_t , has the following decomposition:

$$S_t = S_t^* + v_t,$$

Where S_t^* is “a low frequency, non-linear regular component (which may comprise both long-run trend and medium-run cycle components) and v_t is a high-frequency, serially uncorrelated (though possibly heteroscedastic)” process with

$$E[v_t] = 0 \quad \text{and} \quad E[v_t^2] = \sigma_v^2 < \infty$$

The paper assumes that the success of momentum-based trading strategies comes from predictability in the low frequency component, S_t^* , and even more so in forecasting changes in the direction of this trend. The Hodrick and Prescott filter

essentially minimizes the sum of squared deviations between the observed series and the unobserved low frequency component that is to be recovered, while penalizing variation in the low frequency component. Mathematically, the HP filter consists of two terms, which, when applied to time series data, estimates the non-linear trend as represented below:

$$S_t^* = \underset{\{S_t^*\}_{t=1}^T}{\text{Argmin}(t)} \left[\sum_{t=1}^T (S_t - S_t^*)^2 + \lambda \sum_{t=2}^{T-1} [(S_{t+1}^* - S_t^*) - (S_t^* - S_{t-1}^*)]^2 \right]$$

Where $\text{Argmin}(t)$ denotes the t th observation of the series that minimizes the objective function. The first term above penalises deviations of the observed series from the low frequency trend, while the second term penalises variation in the trend using its second derivative and a smoothing parameter, lambda. While there is no ‘correct’ value for the smoothing parameter, lambda, Harris and Yilmaz (2009) note that a common choice in the prior literature concerning applications of the filter is to multiply the squared frequency of the data by 100. When $\lambda = 0$, the trend is equal to the original series, as the second term falls away, while as lambda approaches infinity, the isolated trend converges towards a linear trend, resulting in severe delays in the detection of turning points in the exchange rate.

Harris and Yilmaz (2009) document that a number of studies have demonstrated that moving average rules are able to systematically generate returns in the foreign exchange market which are in excess of a simple buy-and-hold strategy. Further, while opinions diverge over the source of these excess returns, they have found that evidence suggests they are not simply compensation for transaction costs or risk.

In the context of their paper on trend trading on foreign exchange rates, they contextualize the success of momentum trading strategies as hinging on the extraction of a non-linear trend, forecast from the spot exchange rate as elaborated on above. *“The success of such strategies is limited by the fact that the spot exchange rate comprises a substantial ‘noise’ component, which makes identification of any trend particularly difficult.”* As an illustrative example, they note the following: A two-period moving average rule indicates a positive trend if the current month’s spot rate

is higher than the previous month's spot rate, and conversely a negative trend if it is lower. However, this logical deduction fails to take into account that while an increase in the exchange rate can be synonymous with the existence of a positive trend, it may also be consistent with a zero or even negative trend, that is concealed by noise in either the current month's exchange rate or last month's exchange rate, or both.

In a similar fashion to the trade-off between the amount of lag and false signals, as referenced above by Joubert and Mason (1991), Harris and Yilmaz (2009) note that while increasing the number of lags used in the moving average rule successfully diminishes the impact of the irregular component (as defined below) within the spot exchange rate, such an approach also hinders the sensitivity of the rule to cyclical turning points, which in turn constricts its usefulness as a trading indicator.

Harris and Yilmaz (2009) further note the problematic nature of the choice of moving average horizon, owing to the fact that moving average rules are "*not formally derived from the time-series properties of the exchange rate*", or, in application to this research report, equity returns. An implication of this is that fruitful application of the rule necessitates subjective adjustment of the moving average period, while using in sample data.

From this stems the motivation for an alternative, somewhat more thorough approach: namely the identification of the non-linear trend from the spot exchange rate. They achieve this by developing a low frequency momentum trading strategy that is based on a breakdown of the spot exchange rate into both its regular and irregular components. Furthermore, they use short-term momentum in the (unobservable) low frequency trend element of the exchange rate to generate directional forecasts of the spot exchange rate. In order to decompose the spot exchange rate into its regular and irregular components, they employ two approaches. Primarily they use the high-pass filter of Hodrick and Prescott (1997), which isolates a low frequency non-linear trend from a time-series, the smoothness of which is determined by a pre-specified smoothing parameter. The second approach is that of using kernel regression, which approximates the local trend of a time-series as a weighted average of the sample data. For the purposes of this review, their application of the Hodrick and Prescott filter is examined.

Using the HP filter, they apply this low frequency trading strategy to nine major currencies measured against the USD, and to an equally weighted portfolio (EWP) of these currencies, using monthly data over the period 1993–2008.

They measure the success of their strategy through the directional accuracy (for which they test the null hypothesis that the directional forecasts are random), annualized return, annualized Sharpe ratio and maximum drawdown, against a pre-specified benchmark for the full sample.

The results obtained when using the HP filter prove to be very promising, and are summarized as follows:

*“It is clear that the HP strategies offer a very substantial improvement over the MA strategies, across all four measures and for almost all of the currencies. For the EWP, the HP strategies offer better directional accuracy than any of the MA rules, significantly higher annualized returns and Sharpe ratios, and almost invariably lower maximum drawdown. The differences are substantial: the highest annual return for the EWP offered by the MA strategies is 2.32% (using the MA(2,6) rule), while the **lowest** annualized return offered by the HP strategies is 4.36%. The difference in Sharpe ratios between the HP strategies and the MA strategies is even more striking. For individual currencies, the HP strategies outperform the MA strategies in almost all cases... Perhaps the most striking feature of the HP strategy is its insensitivity to the choice of smoothing parameter...”*

Harris and Yilmaz note that while it appears that the success of simple moving average strategies have diminished over time, (which is consistent with the findings of Levich and Thomas, 2006), they observe less evidence that the performance of either the Hodrick and Prescott filter or the kernel regression strategy have diminished over time. On the contrary, with particular reference to an equally weighted portfolio, and for many of the individual currencies, they find that the Sharpe ratio of the HP filter and kernel regression strategies has actually risen between sample periods.

Finally, in addition to their findings above, they note that unlike the Moving Average

rules, the performance of the low frequency momentum trading strategy is relatively stable over different sample periods, as well as being robust to the choice of smoothing parameter over a wide range of values. After the incorporation of “*reasonable*” transaction costs, they find that the relative performance of the low frequency trading strategy is even greater.

This paper draws attention to the fact that while traditional moving average trading rules have been documented as producing diminishing returns over time, there is scope for profitable momentum trading using more advanced filters and technical trading rules. The profitability of momentum trading strategies on the JSE over a 15-year period, the last third of which falls within the global financial crises, is examined in this research report. The methodology employed and data utilized is described in the following section.

3. Data and methodology

3.1 Data

Daily returns for the top 60 stocks on the Johannesburg Stock Exchange (ranked by market capitalization) were obtained from Datastream for the period January 1998 to August 2012. Dividends and transaction costs were ignored in employing the different strategies in order to first test the effectiveness of the strategies. Descriptive statistics surrounding the returns generated by simulations imposed on the data are documented in the relevant sections. The list of stocks can be found in appendix 1.

3.2 Research propositions

Through the implementation of three trading signal generation strategies, evidence of price anomalies in the form of both price momentum and price corrections is investigated for the abovementioned time period.

The first strategy (price and moving average) uses a stock's price and moving average to generate a trade signal when the price crosses over a selected variable moving average length. In this instance a stock is allocated to the winner (loser) portfolio if its price is above (below) a given moving average at the start of the holding period, where the average has formed over the formation period. Buying or selling a stock when its price crosses over a variable moving average is consistent with following a momentum trading strategy in the belief that capturing both upward and downward swings in the stock price can achieve market outperformance. While simple moving average rules may achieve outperformance, they do not necessarily identify the relative proportion by which stocks have been pushed unsustainably above or below their intrinsic values, and may be subject to the incidence of false signals.

Employing a more sophisticated signal generation technique (ranking stocks based on prior returns), a universe of investible assets, which in this instance represents "the market", can be divided into two portfolios; one which contains the best performing stocks, according to some ranking criteria, and one containing stocks which have exhibited the worst performance, ranked by the same criteria, over the preceding period (the formation period). At a given point in time, the ranking of stocks based on past performance would enable one to classify them into both winner and loser portfolios. The second strategy thus allocates stocks with the highest (lowest) cumulative returns within a specified quantile to the winner (loser) portfolio for the holding period.

While measuring stocks based on their return enables one to rank them over a given formation period, another consideration is using the proportionate levels of stocks being overbought and oversold in the market place. The third strategy (ranking stocks as overbought or oversold) thus encompasses measuring the difference in the level of price and moving average, relative to the moving average, in order to group stocks

into (overbought) winner and (oversold) loser portfolios. The theory underpinning this method is that the price would need to be consistently higher (lower) than the moving average in order to be ranked in a given percentile and hence be included in the winner (loser) portfolio with the relative distance between the daily price level and the price level of a variable moving average dictating the ranking criteria.

With reference to the above strategies, an investor betting on price momentum would typically buy the winner portfolio in expectation of continued favourable performance, where an investor following a contrarian strategy, betting on a price reversal or reversion to an intrinsic value would typically buy the loser portfolio. One must consider both the relative performance of the two portfolios, as well as the time period in which reversals and momentum is evidenced. In light of this, both the formation period over which stocks are ranked, as well as the holding period over which stocks are held must be considered.

Post the portfolio parameters being established, maximum returns to each strategy are obtained as a function of the optimal formation period and holding period for both the winner and loser portfolio. The risk/return trade-off within optimal formation and holding periods is examined as a function of the relative market outperformance of a portfolio of stocks against the volatility of returns when adjusting the number of stocks in the portfolio.

With reference to the process described above, this research report aims to investigate the following propositions:

1. An optimal winner portfolio, comprised of stocks selected as a function of some ranking criteria, will achieve returns in excess of the market.
2. An optimal loser portfolio, comprised of the worst ranked stocks from the same criteria as the winner portfolio, will outperform an optimal winner portfolio within certain investment horizons.

Identification of investor overreaction through these methods is undertaken, with excess market returns obtained over the investment horizon implying a certain degree of market inefficiency (as the presence of abnormal returns in itself is a rejection of

weak-form market efficiency). It must be noted that all returns are expressed as being in positive or negative excess of the market, which is represented by an equally weighted index of the returns of the universe of stocks observed over the time period examined in this research report. Resultantly, documented positive and negative price reversals and price continuations are expressed in relation to the market, and do not necessarily infer that stocks have generated profits or losses in absolute terms. Stated alternatively, a downward price reversal implies that a portfolio has generated negative returns in relation to the market, which is not necessarily indicative of a loss-generating portfolio when measured by absolute returns.

In light of the prior literature documented above, and inferences drawn from past research, the ensuing section of the research report is conducted as follows: The methodology by which the abovementioned trading strategies are employed is documented, after which results and conclusions are presented.

3.3 Research Methodology

For the purposes of increased liquidity, the universe of investible assets representing the market is limited to the top 60 stocks on the Johannesburg Stock Exchange as at August 2012 (appendix 1), with daily returns spanning back to January 1998. Only the stocks still in existence at the end of the data period were known, resulting in any stocks which delisted over the period being excluded from the sample. This would imply that the sample suffered from survivorship bias, as the top 60 stocks on the exchange were in existence at the end of the period under observation, having exhibited the best performance, as well as being the largest, and hence less likely to be de-listed than smaller stocks. While an investor does not have knowledge on which stocks will de-list over the investment horizon, the model used to run the simulation selects stocks in the portfolio based on prior performance. If a stock were to delist, it would be excluded from the ranking process in the subsequent formation period, and the universe of investible assets would shrink by 1 stock, with the equally weighted market return adjusting accordingly. Similarly, if a new stock were to list on the exchange, it may or may not be included in the next simulation, depending on performance, and the universe of assets will increase by 1 stock, with the equally weighted return adjusting accordingly. Given that the simulation formulates a portfolio of stocks with a set ranking criteria, and that performance is measured relative to an equally weighted index of returns (which itself is comprised only of assets available at that time), stocks listing or delisting in the period under review should not materially impact the model in terms of performance relative to a benchmark. However, as alluded to above, performing analysis on stocks known to be in existence at the end of the observation period does incur a certain degree of look-ahead bias.

Prices for the active strategy are not adjusted for dividend returns in this research report (i.e. raw closing prices are used). The frequent trading of the active strategy would often result in a stock not being held on the day it goes ex-dividend, and this is a risk inherent in active trading. Adjusted prices are used for the equally weighted index return, given that a passive buy-and-hold strategy would benefit from capital appreciation, as well as dividend yield.

Transaction costs such as brokerage and taxes are ignored in this research report. A 5-day trading week is assumed and data has been adjusted for weekends. It is assumed that any stocks which may have listed after the start of the period under observation will only become part of both the active and passive investor's available universe of assets upon listing, and the weighted average of returns is adjusted accordingly. Owing to the fact that the same trading rules are not being formulated and tested on the same data set, and hence that the rules are effectively being tested out of sample, any data snooping bias has been eliminated

A series of computer models were developed to generate the equally weighted index, and to simulate the three core strategies elaborated on below. These calculated the return to each strategy employing varying formation periods, holding periods, and moving averages, and optimizing these parameters.

3.3.1. Price and Moving Average

The first strategy tested in order to explore the existence of momentum in the market by means of a simple price and moving average combination is that of a signal being generated when the price of a stock rises above or falls below a variable moving average.

In the context of the research propositions referenced previously, the “winner” portfolio is comprised of stocks which exhibit prices which are above a selected variable moving average at the beginning of the investment holding period. Similarly, the “loser” portfolio is comprised of stocks which exhibit prices which are below a selected variable moving average at the beginning of the investment holding period.

A signal to allocate a stock to the winner portfolio if its price level is above the level of the moving average is generated, while a signal to allocate a stock to the loser portfolio if its price level is below the level of the moving average is generated. Portfolios are then bought and held for the investment holding period. At the end of any given holding period, shares are automatically re-allocated based on their price being above or below the selected moving average and a new portfolio of shares is established. Returns to the active strategy are hence calculated as the cumulative daily returns for the period(s) over which the stocks are held.

The daily absolute return for such a trade is calculated as the difference of the natural logarithm of the closing price on day (t) and the closing price from the prior trading day, namely ($t-1$).

Allowing for returns to be defined in this manner, and denoting R_t as the daily return obtained, P_t as the price at the close of day t , and P_{t-1} as the price at the close of the preceding day, one can express the daily return obtained from holding a stock as:

$$R_t = \ln\left(\frac{P_t}{P_{t-1}}\right)$$

The program looped the moving average from 5 to 50 days in increments of 5 days, beyond which it increased to 300 days in increments of 50 days. This enables one to see the effect of employing both short-term and longer-term moving averages. The holding period is set to 5 days, after which new equally weighted winner and loser portfolios are established based on signal generation at this new point in time. This process loops through the entire period under observation, with absolute returns to the portfolios annualized.

An equally weighted return for all 60 stocks under observation is calculated and annualized for the period under observation. This return is subtracted from absolute returns in order to determine performance of the strategy relative to the market.

3.3.2. Ranking Stocks based on prior returns

As elaborated on in the following section, while simple moving average rules may achieve outperformance, they do not necessarily identify the relative proportion by which stocks have been pushed unsustainably above or below their intrinsic values, as signals are generated merely by the stock price crossing over a variable moving average. With the intention of employing a more advanced momentum trading strategy and in a similar manner to that employed by Muller (1999), shares are ranked based on prior returns before being allocated to either a “winner” or “loser” portfolio.

The investible universe of assets (“the market”) is again the top 60 shares on the JSE as at August 2012, spanning the same period of daily returns.

Following noteworthy observations referenced by Muller (1999) with regards to the importance of the starting point of the formation period in the calendar year, the following methodology is employed: While Muller (1999) used Latin Hypercube sampling (a statistical process used to generate a sample of parameter values from a multidimensional distribution) in order to randomly select 30 dates across the investment horizon at which the formation period initiated (with returns averaged), this research report explores the effect of rolling the formation and holding period continuously throughout the investment horizon. The daily returns to individual shares are recorded over the formation period, allowing shares to be ranked based on the cumulative return they exhibit over the pre-specified period. The number of best (worst) performing shares included in the winner (loser) portfolio relative to the number of shares in the market is specified by the quantile, which is set to the third decile (30%) for the first round of simulations. At the end of a given formation period, shares are bought on an equal value basis (on the assumption that any number of shares can be bought or sold) and held for the investment holding period. At the end of one formation period (beginning of a holding period) shares are again cumulatively ranked over the course of the next period so that at the end of any given holding period, shares are automatically re-ranked and a new portfolio of shares is established.

As with the methodology undertaken by Muller (1999), this process also avoids the criticism of Ball, Kothari, and Shanken (1995) that De Bondt & Thaler (1985) only

ranked shares according to prior performance at the end of each calendar year, and that any documented price reversal effect may be an illusion, given the cyclical nature of returns of certain shares over a calendar year. Further, this method also avoids the restriction associated with the process employed by Muller (1999) when using Latin Hypercube sampling with given formation and holding period specifications, whereby start dates for simulated portfolios are limited to the middle third of the investment horizon.

In the first simulation, the number of stocks in the portfolio is restricted to the top and bottom 30% quantile (third decile) of the universe of 60 available stocks, while both formation and holding period are allowed to vary. These parameters are varied first from 10 to 250 days in steps of 10 days in order to capture very short-term swings in the market. Subsequently, the formation period is allowed to vary from 25 to 850 days and the holding period is allowed to vary from 25 to 250 days, both in steps of 25 days, to capture the effect of longer formation and holding periods.

Muller (1999), employed formation and holding periods ranging from 60 to 1400 days, hypothesizing that an investor betting on price momentum would buy the winner portfolio, and that an investor betting on a contrarian strategy underpinned by mean reversion would buy the loser portfolio. This research report further seeks to examine the returns achievable when employing very short-term formation and holding periods to exploit investor irrationality in the market and resultant short-term corrections via price reversals.

The returns associated with the first simulation are annualized and expressed in percentage terms. In order to calculate market outperformance, the same equally weighted index used to represent “the market” for the first strategy is again employed. Market returns are then subtracted from absolute returns to determine excess returns.

Results for the first simulation are discussed in the relevant section and a maximum return with an associated formation and holding period is noted. The impact of extending the formation period beyond 250 days is then explored.

Given the implication of changing the quantile (number of shares) in the winner and loser portfolio on both excess returns and variation in returns, the simulation is rerun with the same formation and holding period ranges, but with shares in the portfolios now restricted to the second decile.

In order to examine returns on a risk-adjusted basis, the optimal formation and holding periods associated with maximum achievable returns as observed for both the winner and loser portfolios at the second decile are held constant. The number of stocks in the portfolio is then allowed to vary from 10% to 100% of the market in steps of 5%. The results are graphed and information ratios are elaborated on.

The statistically significant difference in results when changing the strategy from winner to loser, against the difference observed when changing the number of shares in the portfolio is examined and elaborated on in appendix 8.

3.3.3. Ranking Stocks as Overbought or Oversold

While the first strategy explored in this research report examined a simple price and moving average technique, the final strategy combines a more advanced price and moving average technique with the second strategy of ranking shares based on prior performance.

The same parameters in terms of formation period, holding period, and quantile ranking are used to run the simulation. However, a share's performance over the formation period is measured as and ranked by the difference between the price and the moving average, divided by the moving average. The theory underpinning the simulation is that the relative proportion by which a share's price exceeds (falls below) its moving average is a good indicator of shares being overbought or oversold, which should in turn be a good indicator of a price reversal. Further, varying the moving average and holding period allows one to observe these reversals in both the short-term and longer-term.

4. Analysis of Results

4.1 Price and Moving Average

The results from the first strategy employed - that of generating a buy signal for the winner and loser portfolio when the price of a stock is above or below a variable moving average - are summarized and tabulated in the heat map below.

4.1.1: Winner Portfolio: Excess market return by moving average length

(Appendix 2.1)

The heat map below contains annualized market excess returns (equally weighted index as market) to the winner portfolio by selected moving average lengths for a 5-day holding period. Moving vertically down the table increases the moving average length.

		Holding Period (Days)	
		5	
Moving Average (Days)	MA/HP		
	5	-7,4%	
	10	-12,7%	
	15	-11,8%	
	20	-12,8%	
	25	-11,2%	
	30	-11,3%	
	35	-11,3%	
	40	-9,1%	
	45	-8,2%	
	50	-7,0%	
	100	-4,8%	
	150	-3,6%	
	200	-0,9%	
	250	-1,3%	
	300	-2,4%	
		Max	-0,9%
		Min	-12,8%
		Proportion positive	0,0%
		Median	-8,2%
		Mean	-7,7%
		Std Dev	4,2%

The equally weighted return for an index comprising the 60 stocks as specified in appendix 1 for the period 1 January 1998 through August 2012 is calculated as an annualized 20,04%. This return is subtracted from absolute returns in order to express annualized returns in the context of market outperformance. Moving vertically down

the heat map above increases the moving average length, with corresponding returns alongside. Given a 5-day holding period, an investor buying stocks at a price level above their 5-day moving average would underperform the market by 7,4% on an annualized basis, with none of the moving average lengths employed indicative of market outperformance. While there appears to be a general improvement in returns as one employs longer moving averages (with a peak at the 200-day moving average of 0,9% below market), an investor buying the winner portfolio when following this signal generation technique is more likely to underperform the market. This is evidenced by a mean return across the simulations examined of 7,7% below market. However, it must be noted that the 200-day moving average simulation, while below market, is still indicative of a 19,2% annualized absolute return. While the employment of longer moving averages and holding periods may achieve positive price continuation (relative to the market), an investor seeking to maximize returns is more likely to short-sell stocks which exhibit a price higher than their short-term moving average, closing out the trade within a few days. The highest returns following this strategy are achievable when employing a 20-day moving average, indicative of annualised excess returns of 12,8% when short selling the winner portfolio.

Price and Moving Average

4.1.2: Loser Portfolio: Excess market return by moving average length

(Appendix 2.2)

The heat map below contains annualized market excess returns (equally weighted index as market) to the loser portfolio by selected moving average lengths for a 5-day holding period. Moving vertically down the table increases the moving average length.

		Holding Period (Days)	
		MA/HP	5
Moving Average (Days)	5		8,8%
	10		11,6%
	15		11,8%
	20		14,3%
	25		14,9%
	30		13,3%
	35		13,7%
	40		12,8%
	45		11,8%
	50		12,2%
	100		10,6%
	150		8,2%
	200		2,7%
	250		6,3%
	300		5,2%
		□ Max	14,9%
		□ Min	2,7%
		□ Proportion positive	100,0%
		□ Median	11,8%
		□ Mean	10,6%
		□ Std Dev	3,6%

The loser portfolio exhibits a pattern of returns in stark contrast to those from the winner portfolio. Buying the loser portfolio at short-term moving averages and exercising a 5-day holding period is indicative of annualized market outperformance of up to 14,9%, with every observation in the heat map above indicative of positive market outperformance. The median and mean return, as well as the proportion positive (the percentage of observations which exhibit positive market outperformance) is significantly higher than for the winner portfolio above. As one increases the length of the moving average, returns to this strategy first increase, peaking at a 25-day moving average before diminishing (although not in a linear fashion).

Preliminary results indicate that stocks which exhibit a price level below a variable moving average may have been pushed unsustainably below some intrinsic value, with a price correction leading to positive market outperformance in the subsequent investment holding period. For the winner portfolio, stocks which exhibit a price level above a variable moving average may have been pushed unsustainably above some intrinsic value, with a price correction leading to market underperformance in the subsequent investment holding period. At longer moving averages, the effect of this correction diminishes, indicative of the fact that a correction may have occurred in the market prior to an investment position being taken and that the price level has moved closer to an intrinsic value. It must be noted, however, that such conclusions cannot be drawn with much accuracy, given that the relative proportion by which stocks have moved above or below a moving average has not been factored into this simulation, as signals are generated merely by the stock price crossing over a variable moving average. Further, the incidence of false signals as referenced previously will erode returns over time.

The observations above call for a more sophisticated ranking criteria and signal generation strategy. An emphasis is placed on the relative proportion by which stocks have deviated from some intrinsic value (price per share) in subsequent sections. Nevertheless, it is documented that an investor seeking to maximize returns while employing this method would short-sell the winner portfolio or buy the loser portfolio while employing moving averages of 20 and 25 days respectively, closing out the trade within several days.

4.2 Ranking Stocks based on Prior Returns

In a similar methodology to that undertaken by Muller (1999), a more advanced signal generation trading strategy is implemented. The simulation is employed from 1 January 1998 through to the end of the data set, and the strategy is again run against an equally weighted index of the returns of the 60 shares as specified in appendix 1.

At the outset, a base of parameters is defined as described below. These are refined in the process of establishing optimal formation and holding periods, exploring short and long-term price reversals and continuations, and considering returns to a strategy on a risk-adjusted basis.

In the first round of simulations in testing the strategy, the formation and holding period are allowed to vary first from 10 to 250 in steps of 10 days. This allows one to capture very short-term swings in the market. Thereafter, the formation period is allowed to vary from 25 to 850 days and the holding period is allowed to vary from 25 to 250 days, both in steps of 25 days, to capture the effect of longer formation and holding periods. The universe of investible stocks is limited to the top 60, and the top and bottom quantile specified at the third decile (30%). By allocating the formation period to rows and the holding period to columns, with resultant returns captured in corresponding cells, a heat map is generated which allows one to observe areas of general outperformance. This is calculated for both the winner and the loser portfolios, with results in the heat maps below and available in the appendices.

4.2.1.1:

Ranking Stocks Based on Prior Returns at the 30% quantile

4.2.1.1.1:

Winner Portfolio: Formation and Holding Period up to 250 days (30% quantile)
(Appendix 3.1)

The heat map below contains annualized market excess returns (equally weighted index as market) to the winner portfolio.

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

□ Max **7,6%**
 Min **-16,7%**
 Proportion positive **79,8%**
 Median **1,9%**
 Mean **1,7%**
 Std Dev **2,5%**

fp/hp	Holding Period (Days)																								
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250
10	-16,7%	-7,3%	-3,0%	-2,6%	-1,3%	1,8%	-0,6%	1,3%	0,2%	-1,6%	-1,9%	0,7%	-1,4%	-1,8%	0,9%	-0,2%	-0,3%	0,6%	3,5%	-1,2%	0,6%	0,2%	-1,0%	-0,5%	1,6%
20	-12,2%	-9,3%	-3,3%	-2,3%	-3,6%	-1,1%	1,5%	1,5%	4,6%	-2,9%	-0,5%	-1,8%	0,9%	1,0%	-5,0%	2,7%	3,9%	3,1%	1,9%	-2,3%	-0,2%	2,9%	4,3%	-1,0%	-0,1%
30	-11,3%	-5,5%	-3,8%	-0,9%	-0,8%	1,8%	3,6%	1,4%	2,9%	-0,4%	0,6%	-1,0%	-2,7%	0,2%	-1,4%	2,1%	5,4%	2,8%	3,6%	-0,8%	-0,5%	2,0%	2,0%	1,6%	2,0%
40	-9,1%	-2,9%	-1,0%	0,9%	1,5%	2,8%	3,6%	3,3%	3,6%	-1,0%	0,8%	0,1%	-2,8%	1,7%	0,7%	4,8%	2,1%	6,3%	2,8%	0,0%	-0,8%	1,8%	0,9%	2,7%	1,1%
50	-7,2%	-2,6%	1,2%	3,1%	3,8%	3,7%	2,3%	3,9%	3,9%	1,4%	-0,2%	-1,1%	0,8%	-2,7%	0,1%	5,6%	3,1%	7,6%	-1,2%	0,5%	-2,3%	1,5%	3,8%	3,9%	2,1%
60	-4,3%	-1,4%	1,6%	2,8%	5,4%	5,0%	2,9%	3,6%	3,8%	4,7%	0,3%	0,7%	3,5%	-2,7%	0,3%	1,8%	0,4%	7,1%	1,5%	-0,3%	-0,3%	2,0%	3,4%	5,2%	3,3%
70	-0,8%	1,6%	3,4%	4,2%	5,5%	5,4%	3,4%	0,6%	3,4%	0,6%	-0,4%	4,1%	4,0%	0,3%	-1,1%	-1,0%	-0,4%	6,8%	-1,6%	0,7%	0,2%	3,8%	0,5%	5,8%	1,2%
80	-0,7%	2,1%	3,5%	3,8%	3,2%	2,8%	1,7%	3,8%	2,5%	0,5%	3,2%	3,7%	4,1%	-0,2%	-3,3%	1,0%	1,3%	5,7%	-2,2%	1,4%	-1,1%	3,5%	1,3%	5,8%	0,4%
90	-0,6%	0,6%	2,8%	3,4%	1,9%	3,0%	2,1%	0,9%	3,4%	0,9%	4,3%	2,7%	3,4%	1,7%	-5,6%	-2,8%	2,5%	6,8%	-2,2%	2,7%	-1,0%	0,9%	-0,2%	4,4%	-0,4%
100	-2,8%	1,7%	1,8%	1,5%	0,9%	1,4%	2,7%	-1,4%	0,4%	0,4%	4,3%	0,6%	2,1%	0,9%	-3,9%	-2,5%	2,0%	3,5%	-1,3%	0,3%	1,5%	-1,5%	1,2%	1,8%	-0,2%
110	-0,3%	1,8%	1,3%	3,9%	4,0%	2,5%	3,2%	1,6%	-0,1%	4,3%	2,9%	1,5%	2,6%	2,9%	0,5%	-0,1%	1,8%	2,8%	0,7%	3,9%	0,3%	-0,9%	3,6%	2,8%	1,1%
120	-1,1%	1,3%	1,9%	2,0%	1,4%	2,1%	0,0%	2,0%	-0,2%	2,4%	4,7%	1,3%	2,8%	1,4%	1,3%	-0,9%	-1,2%	2,8%	0,5%	0,4%	0,5%	-1,6%	3,8%	1,3%	2,3%
130	-0,3%	1,1%	1,6%	2,0%	2,0%	3,9%	1,3%	1,7%	2,0%	2,9%	4,0%	1,7%	3,6%	2,6%	3,7%	0,6%	0,2%	2,6%	2,0%	3,0%	1,2%	-0,8%	4,6%	2,3%	4,1%
140	-0,4%	0,4%	0,9%	3,8%	1,6%	1,8%	0,1%	3,6%	3,8%	0,3%	2,6%	2,1%	4,0%	2,3%	3,0%	-1,4%	1,9%	2,2%	0,3%	2,1%	2,0%	0,8%	1,5%	2,7%	4,0%
150	-2,5%	0,2%	1,0%	2,0%	2,0%	2,5%	1,9%	1,4%	0,2%	0,5%	0,9%	-0,8%	-0,8%	1,7%	4,5%	0,1%	1,9%	-1,0%	1,9%	1,9%	2,5%	0,5%	3,9%	1,3%	2,5%
160	-0,6%	2,4%	2,3%	2,3%	4,3%	1,4%	2,2%	2,2%	2,4%	1,5%	-1,2%	-0,8%	-2,3%	2,2%	4,8%	0,0%	4,1%	0,5%	2,2%	2,9%	2,0%	1,1%	3,2%	1,0%	5,7%
170	-0,6%	1,2%	1,8%	1,2%	3,9%	1,9%	1,6%	1,7%	0,8%	1,5%	-0,3%	-0,5%	-1,4%	0,6%	2,8%	0,9%	3,5%	-0,4%	5,3%	2,7%	2,3%	2,8%	3,1%	1,4%	4,3%
180	-0,6%	3,0%	2,2%	3,6%	2,5%	2,9%	2,9%	2,1%	2,1%	0,0%	1,2%	2,2%	0,8%	0,6%	2,9%	3,5%	3,6%	0,4%	5,2%	2,5%	2,1%	4,3%	1,8%	4,6%	4,8%
190	-2,5%	0,6%	1,2%	2,9%	2,9%	2,9%	-1,4%	2,9%	1,5%	3,3%	4,6%	3,4%	3,7%	-2,3%	3,3%	3,7%	4,8%	1,7%	6,4%	0,6%	3,8%	6,4%	1,8%	3,5%	3,0%
200	-1,6%	1,1%	0,9%	3,6%	4,2%	2,8%	4,2%	1,8%	1,8%	3,9%	4,8%	4,1%	5,5%	-1,1%	2,8%	3,7%	4,6%	2,8%	7,3%	1,9%	2,5%	4,8%	2,6%	3,3%	3,9%
210	-1,9%	1,5%	0,8%	2,5%	4,5%	1,9%	1,0%	4,0%	1,8%	3,3%	3,4%	3,3%	4,6%	-1,1%	2,1%	4,1%	4,2%	1,4%	6,0%	2,6%	2,8%	1,5%	2,9%	5,1%	
220	-1,0%	1,9%	3,3%	2,7%	5,7%	2,6%	3,1%	1,5%	1,5%	4,4%	2,3%	2,7%	3,1%	1,4%	4,5%	2,3%	3,7%	1,7%	5,0%	2,7%	4,3%	3,8%	1,7%	1,9%	3,7%
230	-1,2%	0,8%	1,0%	2,2%	4,2%	2,8%	1,9%	1,9%	1,9%	3,7%	3,4%	3,1%	2,0%	1,9%	2,9%	3,3%	1,1%	4,2%	3,7%	2,0%	3,7%	4,6%	-0,3%	1,7%	2,1%
240	-1,8%	0,1%	2,4%	2,5%	3,6%	3,2%	1,8%	0,3%	0,6%	2,7%	4,0%	3,2%	4,0%	1,3%	-1,4%	2,2%	1,9%	4,2%	4,2%	1,7%	3,7%	4,9%	2,1%	1,7%	2,8%
250	0,7%	2,3%	4,6%	3,5%	3,4%	4,8%	3,1%	2,5%	3,4%	2,6%	3,0%	4,2%	4,1%	4,1%	-0,8%	3,8%	2,8%	6,3%	3,1%	0,9%	5,4%	5,5%	3,7%	2,4%	2,8%

Formation Period (Days)

Annualized returns expressed in terms of market outperformance range from 16,7% below market (for a formation and holding period of 10 days) to 7,6% above market (for a formation period of 50 days and holding period of 180 days), with a median return of 1,9% and mean return of 1,7% (with associated standard deviation of 2,5%) when both formation and holding period are restrained to a maximum of 250 days. The total proportion of positive (greater than or equal to market) observations is 79,8%.

For very short formation and holding periods, shares tend to significantly underperform the market. A short-term downward price reversal is observable, indicative of the fact that shares have been overbought in the formation period immediately preceding the holding period. As the holding period increases, the portfolio slowly begins exhibiting returns in-line with the market, with peaks occurring at 180 days. Returns increase from being significantly below market for extremely short holding periods to being in excess of the market as one increases both formation and holding period. Increasing the formation period prior to holding a stock tends to mitigate the extent of market underperformance (the downward price reversal effect decreases), *ceteris paribus*. In other words, stocks which have outperformed over longer formation periods are less likely to experience market underperformance (short term price reversals) in subsequent holding periods than stocks which may experience market underperformance post a shorter formation period.

While downward price reversals post shorter formation periods are evident, a price continuation given longer holding periods is achievable. Given a formation period of no less than 50 days, price continuation is achieved at a holding period of 30 days, with all but one stock exhibiting positive excess returns for an 80-day holding period (across all formation periods). For holding periods longer than 100 days, there appears to be a less marked price continuation (particularly for shorter formation periods). Given a 250-day formation period, returns are in excess of the market for all but one of the 25 holding periods examined. (The effect of increasing the formation period beyond 250 days is elaborated on in subsequent sections). Areas of return in excess of 5% of the market are observable for 180-day and 190-day formation periods (with corresponding 40 to 90-day and 170 to 220-day formation period ranges), presenting weak evidence of mid to long-term price momentum post achieving price

continuation. However, peaks in excess-return are only partially supported by surrounding points of similar return.

Overall there appears to be a more significant impact on return from an increasing formation period, rather than an increasing holding period, particularly when the holding period is below 60 days. This partially supports Muller (1991), who found that varying the formation period had an impact on return at holding periods of less than 60 days. However, in contradiction to Muller's findings that formation period has very little impact at longer holding periods, this research report finds that excess returns achievable from both price reversals, as well as price continuation, are significantly affected for both winner and loser portfolios when increasing the formation period, *ceteris paribus*.

Ranking Stocks based on Prior Returns at the 30% quantile

4.2.1.2:

Loser Portfolio: Formation and Holding Period up to 250 days (30% quantile)

(Appendix 3.2)

The heat map below contains annualized market excess returns (equally weighted index as market) to the loser portfolio.

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

□ Max **15,3%**
 □ Min **-3,8%**
 □ Proportion positive **66,9%**
 □ Median **0,7%**
 □ Mean **1,0%**
 □ Std Dev **2,2%**

□	fp/hp	Holding Period (Days)																									
		10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	
10	15,3%	7,7%	7,0%	2,9%	2,9%	3,7%	0,0%	-1,2%	1,4%	1,7%	3,4%	0,2%	5,6%	1,6%	1,7%	0,7%	2,2%	0,0%	-3,2%	0,0%	0,2%	3,2%	3,0%	-2,3%	-1,4%	0,6%	3,3%
20	14,1%	8,8%	6,1%	4,5%	3,1%	1,5%	-0,1%	2,0%	-3,0%	1,2%	2,9%	3,5%	0,4%	1,1%	3,4%	-0,3%	-0,3%	-3,2%	-0,3%	0,9%	2,0%	3,7%	-1,4%	-3,0%	3,5%	0,4%	
30	14,9%	7,6%	5,7%	4,5%	0,8%	-0,4%	-1,0%	1,8%	-2,0%	3,3%	3,2%	2,5%	5,3%	0,5%	2,6%	-0,1%	-1,2%	-3,8%	-2,0%	-2,0%	3,9%	3,9%	-2,1%	-0,2%	-0,6%	-0,8%	
40	9,3%	6,4%	2,9%	1,0%	0,6%	-0,9%	-1,5%	-1,4%	-0,2%	4,4%	3,1%	1,7%	4,2%	1,5%	1,2%	-1,1%	-1,6%	-3,2%	-3,2%	3,6%	3,0%	2,4%	-0,1%	-0,6%	0,4%	0,7%	
50	9,2%	3,5%	3,4%	0,0%	0,5%	0,9%	-0,5%	0,3%	1,0%	2,8%	2,1%	4,1%	0,2%	5,4%	3,1%	-1,4%	-1,9%	-2,6%	1,3%	1,2%	1,2%	4,7%	1,6%	-1,0%	0,6%	0,5%	
60	8,6%	4,1%	1,8%	2,5%	1,0%	0,0%	-0,1%	-0,2%	-0,6%	-1,8%	3,7%	3,3%	0,9%	3,7%	1,4%	-0,2%	-0,9%	-2,0%	3,2%	1,8%	1,8%	3,0%	1,8%	-1,1%	-0,1%	-0,3%	
70	5,8%	2,5%	-0,2%	2,1%	0,6%	-1,4%	2,3%	2,4%	-0,3%	0,7%	1,6%	0,9%	0,5%	4,4%	1,2%	1,1%	0,7%	-2,2%	2,8%	1,9%	2,4%	2,4%	-0,7%	-2,1%	-1,2%	0,2%	
80	5,2%	4,1%	1,1%	1,0%	0,5%	1,1%	1,7%	-1,1%	2,7%	1,6%	-0,8%	-0,8%	-1,0%	4,4%	5,2%	-0,8%	2,0%	-0,5%	4,0%	0,4%	3,5%	-1,5%	-1,7%	-2,1%	0,9%	0,9%	
90	5,0%	2,2%	0,4%	-0,6%	1,3%	-1,4%	-0,6%	-1,3%	0,9%	1,4%	-3,3%	-3,4%	-0,9%	1,6%	6,1%	-1,1%	-2,4%	-2,5%	2,4%	0,7%	1,4%	-1,5%	0,4%	-3,7%	2,2%	2,2%	
100	4,7%	3,2%	0,9%	-0,5%	1,8%	0,2%	-0,3%	-1,1%	1,7%	3,0%	-3,0%	-2,7%	-0,9%	-1,3%	5,4%	1,1%	-1,8%	-0,1%	2,2%	1,3%	1,6%	-0,6%	0,8%	0,5%	2,9%	2,9%	
110	5,8%	1,5%	3,0%	-0,2%	0,0%	1,9%	0,9%	-1,0%	0,9%	1,9%	-1,8%	0,3%	-1,5%	1,0%	0,9%	1,1%	-1,4%	1,1%	1,4%	1,9%	0,3%	1,8%	-1,6%	1,9%	3,4%	3,4%	
120	5,7%	2,6%	1,6%	-1,7%	-0,1%	0,0%	3,6%	-1,7%	0,8%	-0,6%	-1,8%	1,7%	-1,9%	0,7%	-0,4%	1,6%	-0,4%	-1,0%	-0,6%	1,1%	1,1%	0,5%	1,2%	-0,2%	1,8%	1,8%	
130	4,9%	3,0%	0,1%	0,6%	0,2%	-0,2%	1,2%	0,0%	0,1%	0,4%	-1,6%	0,9%	-0,8%	1,3%	-0,8%	5,2%	-0,3%	0,6%	0,2%	1,6%	-0,1%	1,0%	1,0%	-1,3%	0,4%	0,6%	
140	4,3%	0,5%	1,6%	0,9%	1,5%	-0,8%	0,5%	0,2%	-0,9%	3,0%	0,8%	-0,4%	2,1%	1,9%	0,2%	4,2%	-0,2%	0,9%	0,3%	2,6%	0,9%	1,6%	1,6%	-2,5%	1,8%	0,5%	
150	4,1%	2,2%	1,5%	1,8%	1,3%	-0,3%	0,2%	3,0%	0,5%	1,0%	1,9%	0,2%	-0,6%	1,3%	-0,5%	3,0%	3,0%	1,5%	1,5%	0,7%	-1,6%	3,1%	-3,0%	2,6%	0,5%		
160	6,2%	2,8%	1,7%	0,5%	-0,2%	0,8%	-0,5%	2,8%	0,6%	-0,6%	1,4%	0,2%	2,2%	0,9%	-1,0%	2,6%	-0,6%	0,6%	-3,2%	-1,3%	-1,3%	1,2%	0,0%	-3,0%	2,6%	0,5%	
170	4,5%	1,4%	1,7%	0,4%	0,6%	2,3%	1,1%	1,9%	2,5%	-0,8%	1,7%	0,0%	1,4%	1,4%	0,0%	1,8%	0,8%	3,4%	3,4%	-2,7%	-1,9%	-1,0%	0,5%	-0,1%	1,3%	0,5%	
180	3,7%	1,3%	0,3%	-0,2%	-2,2%	1,7%	0,2%	0,5%	-0,6%	-0,2%	0,7%	0,3%	-1,3%	0,4%	-1,6%	-0,6%	-1,0%	2,1%	2,1%	-1,9%	-0,7%	-0,9%	1,0%	1,4%	0,3%	0,3%	
190	3,5%	1,3%	1,9%	0,7%	2,5%	0,6%	2,8%	0,7%	0,6%	1,5%	-1,1%	-0,9%	-2,0%	2,9%	-0,2%	0,4%	1,2%	1,2%	-2,5%	1,6%	1,6%	-1,2%	-1,2%	0,1%	1,4%	1,4%	
200	4,6%	3,4%	1,0%	2,1%	0,8%	-0,2%	0,2%	1,3%	-0,6%	1,3%	-1,7%	-0,8%	-1,2%	2,7%	0,1%	-1,6%	-0,8%	-0,2%	-2,5%	1,2%	1,2%	-1,3%	-0,8%	1,2%	0,8%	1,4%	
210	5,6%	3,2%	2,1%	1,2%	0,3%	-0,7%	0,8%	0,1%	0,4%	0,2%	1,2%	-0,8%	-1,5%	1,8%	0,6%	-1,0%	-0,8%	0,2%	-0,7%	0,6%	0,6%	0,3%	0,1%	2,2%	1,3%	2,2%	
220	4,6%	2,5%	2,0%	-0,2%	1,1%	1,5%	0,4%	-0,2%	1,7%	1,2%	0,5%	0,9%	0,7%	1,8%	0,6%	-1,0%	1,1%	2,9%	0,6%	0,7%	1,9%	0,2%	-0,4%	1,7%	0,2%	0,2%	
230	5,1%	1,8%	2,1%	0,2%	0,3%	-0,1%	-0,6%	0,6%	0,0%	0,0%	0,6%	3,2%	0,4%	-0,6%	1,8%	1,1%	2,4%	0,6%	0,5%	2,0%	-0,7%	0,6%	1,7%	4,9%	2,2%	2,2%	
240	3,4%	2,1%	0,3%	0,5%	0,8%	0,4%	0,3%	2,1%	0,1%	2,3%	-1,4%	2,6%	0,9%	0,8%	3,2%	0,8%	3,0%	-0,4%	-2,2%	3,2%	-1,0%	-0,4%	1,4%	3,7%	1,2%	1,2%	
250	3,4%	1,4%	1,0%	-0,7%	-0,9%	-0,8%	0,0%	-1,3%	0,7%	-0,6%	-0,3%	-0,4%	0,7%	0,3%	2,5%	-0,6%	2,7%	-0,1%	2,5%	-0,5%	0,6%	-0,1%	-1,4%	0,9%	0,6%	-0,6%	

Formation Period (Days)

For the loser portfolio, also restrained to 250 days in terms of holding and formation period, returns range from 3,8% below market (for a formation period of 30 days and holding period of 180 days) to 15,3% above market (for a formation and holding period of 10 days), with a median return of 0,7% and mean return of 1,0% above market. This equates to 1,2% and 0,7% lower than the winner portfolio respectively, with an associated standard deviation in returns of 2,2%. Despite being able to achieve a higher maximum return, the total proportion of positive observations is almost 13% lower than for the winner portfolio, at 66,9%.

As can be expected, price movements for the loser portfolio exhibit a different pattern to that observed when buying the winner portfolio. Where returns to buying the winner portfolio post shorter formation periods were below market, (owing to a downward price reversal), the most significant market outperformance is achieved for the loser portfolio at very short-term holding periods, with optimal returns achieved at a 10-day formation and holding period. From the magnitude of returns in the 10-day holding period range, there appears to be a more exacerbated short-term upward price reversal (relative to the winner portfolio downward price reversal), as investors appear to have overreacted proportionately more to negative information in the short term. As with the winner portfolio, the extent of the price reversal decreases with an increasing formation period. In other words, stocks which have underperformed over longer formation periods are less likely to experience short-term upward price corrections in subsequent holding periods to the same extent as stocks which may have experienced significant downward price pressure over a shorter formation period. Alternatively stated, and in-line with the heat map above, returns to buying the loser portfolio are maximized at extremely short-term formation and holding periods, where a strong upward price correction is evident.

For the loser portfolio, price continuation desirable for a short strategy is achieved at a 60-day holding period, across a range of formation periods. For an investor willing to hold a long position in the loser portfolio, there is weak evidence of a mid to long-term price reversal post price continuation for a holding period of 140 to 160 days. In this range there are areas of return in excess of 4% of the market for cells moving diagonally down from 140-day to 160-day holding periods (with corresponding 50 to 80-day and 90 to 170-day formation period ranges). However, it is again noted that

peaks in excess-return are only partially supported by surrounding points of similar return (raising suspicion of outliers). The same observation applies for patches of return achievable following a short strategy in the loser portfolio, where negative price continuation surfaces at 180 and 190 day holding periods. It is unlikely, however, that an investor would hold a short position through losses incurred as a result of upward price reversals when following a short strategy over longer holding periods.

It would appear that excess returns are achievable for both strategies; buying the winner portfolio after longer formation periods and exercising longer holding periods, and buying the loser portfolio after very short-term formation periods and exercising shorter holding periods to exploit short term upward price corrections. Returns to shorting the loser portfolio are achievable via price continuation across a range of formation periods, however these are significantly lower than indicative returns achievable from exploiting upward short-term price reversals. Hence returns to shorting the loser portfolio are maximized at very short term formation and holding periods, where as returns to buying the winner portfolio seem to be maximized when buying stocks which have exhibited market outperformance for longer formation periods (which have normalized post being overbought and undergoing a price reversal), at a holding period of between 180 and 200 days. An alternative strategy is that of short-selling the winner portfolio post very low formation periods and closing out the trade at very low holding periods, prior to price continuation.

The proportionately larger upward price reversal in the loser portfolio relative to the downward price reversal in the winner portfolio (across the 10 day holding period range) presents evidence of loss aversion in the market, where investors have overreacted proportionately more to negative information over positive information, pushing losers further below their intrinsic value relative to winners being pushed above their intrinsic value.

4.2.2 Increasing the Formation Period (30% quantile)

While both the formation and holding period were purposely limited to 250 days on the assumption that no rational investor would hold a stock for any longer when attempting to exploit momentum in the market place, it would appear from the results above that benefits to increasing the formation period could be attained for the winner portfolio across the spectrum of holding periods. While increasing the formation period beyond 250 days is explored for both the winner and the loser portfolio in the subsequent section, the effect of increasing the holding period beyond 250 days remains unreported for reasons stated above.

In examining investment periods beyond which one would not expect a rational investor to hold stocks while attempting to exploit momentum in the market place, the holding period is limited to a maximum of 250 days, as it is unlikely that an investor exploiting momentum will hold stocks for more than 1 trading year.

Ranking Stocks based on Prior Returns at the 30% quantile

4.2.2.1:

Winner Portfolio: Formation Period up to 850 days;

Holding Period up to 250 days (30% quantile)

(Appendix 3.3)

The heat map below contains annualized market excess returns (equally weighted index as market) to the winner portfolio.

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

		Holding Period (Days)									
		25	50	75	100	125	150	175	200	225	250
Formation Period (Days)	fp/hp										
	25	-5,2%	-2,0%	-2,8%	-3,3%	-1,0%	-3,6%	-0,8%	-1,5%	-4,8%	-0,8%
	50	0,5%	3,8%	2,2%	1,4%	3,7%	0,1%	-1,0%	0,5%	-1,0%	2,1%
	75	3,6%	4,9%	1,8%	0,4%	1,3%	-1,4%	-3,5%	0,3%	-0,5%	-0,9%
	100	1,8%	0,9%	0,9%	0,4%	-0,3%	-3,9%	-1,1%	0,3%	0,0%	-0,2%
	125	1,0%	0,8%	2,4%	1,4%	0,6%	2,7%	1,0%	0,5%	5,0%	2,6%
	150	1,6%	2,0%	2,0%	0,5%	1,2%	4,5%	5,2%	1,9%	5,4%	2,5%
	175	3,0%	3,0%	0,4%	0,3%	3,6%	2,8%	4,1%	2,4%	3,8%	4,4%
	200	3,3%	4,2%	3,4%	3,9%	1,8%	2,8%	3,0%	1,9%	3,0%	3,9%
	225	3,1%	6,1%	3,5%	3,3%	-1,0%	1,2%	2,5%	2,9%	3,5%	2,3%
	250	3,5%	3,4%	1,2%	2,6%	2,9%	-0,8%	0,5%	0,9%	-2,4%	2,8%
	275	2,4%	3,3%	3,8%	3,6%	2,1%	4,4%	3,4%	2,5%	-0,4%	1,4%
	300	4,8%	3,7%	3,8%	2,1%	3,6%	5,7%	0,9%	2,3%	-0,5%	2,5%
	325	4,9%	3,4%	2,8%	3,7%	4,2%	4,8%	4,3%	2,7%	0,3%	2,9%
	350	2,3%	3,7%	3,6%	2,7%	0,4%	1,5%	3,0%	2,6%	2,6%	1,3%
	375	5,0%	3,7%	5,6%	3,9%	2,2%	1,3%	2,5%	2,7%	4,8%	1,2%
	400	4,0%	5,3%	3,0%	4,9%	2,5%	0,8%	2,9%	4,9%	2,4%	2,2%
	425	3,9%	3,1%	3,0%	2,4%	2,8%	3,2%	1,2%	1,8%	2,4%	3,5%
	450	4,3%	4,3%	4,2%	2,5%	1,7%	4,7%	0,8%	0,7%	2,8%	3,4%
	475	2,4%	2,8%	1,7%	1,6%	2,5%	2,2%	-0,1%	0,7%	-0,9%	2,2%
	500	2,6%	2,8%	3,3%	3,4%	0,9%	2,2%	3,6%	2,4%	-0,8%	0,5%
	525	2,5%	2,4%	3,2%	2,0%	0,7%	-0,4%	2,5%	-0,5%	0,4%	-0,3%
	550	3,1%	3,3%	2,7%	1,5%	2,0%	-1,0%	1,6%	0,9%	1,5%	0,2%
	575	2,3%	2,0%	2,2%	0,1%	1,2%	0,9%	0,7%	0,5%	2,9%	-1,6%
	600	2,3%	1,5%	2,2%	0,9%	0,1%	1,9%	-2,4%	0,7%	1,1%	-0,8%
625	1,2%	0,8%	-0,2%	0,4%	-0,9%	0,9%	-1,3%	-1,0%	0,7%	-2,7%	
650	0,8%	1,1%	1,3%	1,2%	-0,7%	-0,1%	-1,2%	-1,6%	0,4%	-1,2%	
675	0,5%	-0,1%	1,4%	-0,6%	-0,3%	-0,7%	0,8%	-0,5%	1,0%	0,6%	
700	0,8%	0,6%	-0,7%	0,7%	0,7%	-0,6%	0,1%	-0,6%	-3,1%	0,1%	
725	1,2%	0,2%	1,2%	0,9%	0,2%	0,6%	0,1%	-3,1%	-3,0%	-0,6%	
750	0,8%	0,2%	0,8%	0,4%	-0,7%	-0,6%	1,0%	-0,7%	-2,1%	-2,6%	
775	0,1%	1,0%	-0,4%	-0,3%	-1,0%	-0,4%	-1,4%	-0,8%	-1,6%	-1,9%	
800	-0,8%	-0,2%	-0,9%	0,6%	-0,6%	-1,7%	-2,4%	0,2%	-1,1%	-2,1%	
825	-0,7%	-0,4%	-0,3%	-2,2%	-1,6%	-1,9%	-4,2%	-2,1%	0,0%	-2,9%	
850	-0,6%	-0,4%	-0,7%	-1,4%	-1,5%	-1,4%	-0,2%	-4,6%	-0,7%	-2,9%	

Max	6,1%
Min	-5,2%
Proportion positive	71,2%
Median	1,1%
Mean	1,2%
ST Dev	2,1%

Once the formation period is extended to 850 days, implications for both the winner and the loser portfolio emerge. For the extended heat map above, a median market excess return of 1,1% and mean excess return of 1,2% is achieved. These are both lower than the same strategy with formation period limited to 250 days, while the total proportion of positive observations is 71,2%. This is almost 9% less than the same simulation with formation period limited to 250 days, and the reduction is primarily due to general market underperformance across the holding period range for formation periods in excess of 600 days.

The winner portfolio, as referenced when formation period was limited to 250 days, experiences a downward price reversal which is exacerbated at shorter formation periods, and fails to achieve price continuation across the spectrum of holding periods for a 25-day formation period. For formation periods greater than 25 days, price continuation is observed; however at formation periods below 125 days there appears to be a price reversal after holding stocks for 100 to 125 days, which can be interpreted as stocks being unable to achieve sustained price continuation at formation periods below 125 days. In order to achieve price continuation across the range of holding periods, a minimum formation period of 125 days is hence required. Given an increasing formation period, strong price continuation is observed, particularly at shorter holding periods. The winner portfolio exhibits excess market returns through price continuation across almost the entire range of holding periods up to a formation period of around 600 days. This appears to be a distinct watermark, beyond which a long-term downward price reversal occurs. Stocks which have consistently outperformed over longer formation periods (600 days or more) tend to exhibit a downward price reversal, with the winner portfolio failing to achieve price continuation across the range of holding periods for formation periods greater than 800 days. Returns to this strategy are hence maximized by buying the winner portfolio in a formation period range of 125 to 600 days and holding the stock for no more than 100 days.

Ranking Stocks based on Prior Returns at the 30% quantile

4.2.2.2:

Loser Portfolio: Formation Period up to 850 days;

Holding Period up to 250 days (30% quantile)

(Appendix 3.4)

The heat map below contains annualized market excess returns (equally weighted index as market) to the loser portfolio.

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

		Holding Period (Days)									
		25	50	75	100	125	150	175	200	225	250
Formation Period (Days)	fp/hp										
	25	6,6%	-0,1%	2,1%	4,1%	1,0%	4,8%	3,8%	2,2%	5,6%	-0,8%
	50	1,9%	0,5%	-0,2%	2,8%	-1,1%	3,1%	5,0%	1,2%	0,8%	0,5%
	75	1,6%	1,0%	-0,9%	0,7%	0,3%	4,7%	2,8%	1,2%	1,7%	2,8%
	100	1,8%	1,8%	0,2%	3,0%	3,5%	5,4%	2,1%	1,3%	3,3%	2,9%
	125	0,7%	0,6%	0,1%	0,3%	-0,8%	0,4%	2,6%	1,4%	2,0%	0,8%
	150	1,9%	1,3%	-0,1%	1,0%	-1,0%	-0,5%	1,2%	0,7%	-2,0%	0,5%
	175	0,1%	-2,2%	-0,9%	-1,3%	-0,4%	-1,9%	1,7%	-1,9%	-0,3%	-1,0%
	200	1,5%	0,8%	-0,5%	1,3%	-0,2%	-0,2%	2,3%	1,2%	1,0%	1,4%
	225	0,8%	-1,7%	-0,6%	-1,2%	0,8%	-0,2%	2,4%	1,0%	0,6%	0,6%
	250	0,5%	-0,9%	0,2%	-0,6%	-0,1%	2,5%	4,6%	-0,5%	4,4%	-0,6%
	275	1,1%	-0,6%	2,4%	1,8%	2,5%	3,1%	3,8%	1,5%	5,3%	0,6%
	300	2,8%	2,7%	3,7%	2,7%	4,6%	1,5%	2,8%	-0,8%	5,6%	3,4%
	325	3,2%	2,4%	2,6%	1,9%	2,9%	0,8%	1,2%	-0,3%	4,2%	2,6%
	350	2,2%	1,2%	1,8%	4,1%	4,1%	2,2%	2,2%	2,8%	2,6%	3,6%
	375	3,9%	2,0%	4,2%	1,6%	3,8%	3,3%	3,3%	1,7%	3,1%	3,8%
	400	4,3%	3,4%	4,2%	1,5%	3,1%	5,4%	3,5%	2,2%	3,2%	3,1%
	425	4,5%	2,6%	2,7%	2,1%	2,7%	4,4%	4,6%	4,2%	3,7%	4,6%
	450	5,0%	3,4%	4,2%	4,2%	4,8%	4,0%	4,7%	4,9%	3,8%	5,7%
	475	5,8%	4,1%	4,6%	3,3%	7,0%	4,9%	6,4%	4,0%	5,7%	7,7%
	500	5,0%	3,7%	4,1%	4,2%	6,8%	3,6%	5,5%	5,5%	5,3%	5,8%
	525	5,2%	4,3%	4,6%	5,1%	4,5%	3,7%	4,4%	5,2%	6,4%	4,9%
	550	5,0%	5,3%	6,2%	6,5%	4,7%	5,8%	3,7%	5,1%	7,3%	4,5%
	575	7,3%	6,2%	6,0%	4,5%	5,7%	4,8%	6,0%	5,0%	6,2%	4,8%
	600	7,2%	6,6%	5,6%	6,1%	5,8%	3,7%	4,9%	5,5%	5,4%	4,9%
625	6,9%	5,4%	4,7%	4,6%	5,6%	4,8%	4,8%	5,4%	6,8%	3,5%	
650	6,4%	5,4%	4,4%	5,1%	4,6%	6,1%	6,0%	6,0%	6,6%	3,2%	
675	6,0%	5,0%	6,5%	4,1%	3,2%	6,7%	6,0%	5,6%	7,5%	3,1%	
700	6,7%	6,1%	6,0%	7,2%	6,9%	8,2%	4,6%	7,6%	4,4%	6,7%	
725	7,4%	6,5%	5,8%	6,2%	8,3%	7,1%	5,7%	3,6%	4,5%	7,7%	
750	7,3%	6,0%	7,7%	7,3%	6,1%	4,3%	7,1%	4,2%	6,4%	4,2%	
775	6,9%	6,6%	5,7%	6,7%	5,3%	5,7%	5,6%	5,8%	5,9%	5,6%	
800	6,6%	6,6%	5,1%	7,0%	4,2%	5,4%	4,9%	6,4%	5,2%	5,3%	
825	7,0%	7,8%	6,9%	4,2%	4,7%	5,1%	3,8%	5,9%	5,6%	3,6%	
850	7,2%	5,8%	6,2%	4,6%	5,9%	5,0%	3,7%	5,4%	6,2%	5,1%	

Max	8,3%
Min	-2,2%
Proportion positive	90,3%
Median	4,1%
Mean	3,7%
ST Dev	2,4%

As referenced before, the loser portfolio exhibits a short-term upward price reversal, the effect of which diminishes with longer formation periods. In the heat map above, (downward) price continuation is achieved at formation periods between 175 and 275 days, given a holding period of at least 50 days. The median and mean market excess return of 4,1% and 3,7% is substantially higher than the same simulation with formation period limited to 250 days, while the total proportion of positive observations increases to 90,3%. This is over 20% more than the same simulation with formation period limited to 250 days, and the increase is primarily due to positive market outperformance across the holding period range for formation periods in excess of 325 days.

In the prior loser portfolio simulation (section 4.2.1.2), the loser portfolio exhibited diminishing returns with increasing formation periods. Further, returns for holding periods above 60 days were significantly lower than returns for holding periods below 60 days, particularly for very short formation periods (given a diminishing price reversal effect for increased formation periods, and stocks exhibiting downward price continuation for increased holding periods). In the revised heat map above, the 250-day formation period appears to be a turning point at which returns to the loser portfolio have bottomed out for the range of holding periods examined. It appears that returns to buying the loser portfolio, which are found to be maximized at very short formation and holding periods, tend to increase again at longer formation periods (across the spectrum of holding periods).

This is a mirror image of returns achievable when buying the winner portfolio for long-term formation and holding periods, and appears to support evidence of a long-term upward price reversal for the loser portfolio as referenced by Muller (1999). Muller (1999) finds positive excess market returns for the loser portfolio for formation and holding periods beyond 400 days, which this research report confirms in unreported data. However the holding period is limited to 250 days for reasons stated above.

Overall, formation periods greater than 600 days indicate below market returns for the winner portfolio, which experiences a long term downward price reversal, without achieving price continuation. On the other hand, formation periods beyond 300 days

tend to be a very good performance indicator for the loser portfolio, which outperforms both in the very short term, and in the long term, owing to short and long term upward price reversals.

4.2.3. Reducing the Number of Stocks in the Portfolio to the 20% quantile

While the results of prior simulations have indicated optimal formation and holding periods for a given number of stocks in the portfolio, changing the number of stocks bears an impact on both the risk, as well as the achievable return on the portfolio. In the simulation below, the quantile restriction specifying the number of stocks selected from the investible universe of assets is reduced from the third to the second decile. The effect on the standard deviation of returns and resultant information ratios extracted is examined in section 4.2.5.

Ranking Stocks based on Prior Returns at the 20% quantile

4.2.3.1:

Winner Portfolio: Formation and Holding Period up to 250 days (20% quantile)
(Appendix 4.1)

The heat map below contains annualized market excess returns (equally weighted index as market) to the winner portfolio.

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

fp/hp	Holding Period (Days)																									Max	Min	Proportion positive	Median	Mean	Std Dev
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250						
10	-21.1%	-8.5%	-2.3%	-4.6%	-1.5%	2.1%	1.6%	-0.1%	1.0%	-0.1%	-3.8%	1.5%	-1.3%	-1.5%	3.1%	0.5%	-4.3%	1.9%	3.4%	-1.5%	3.3%	0.3%	-0.4%	0.2%	1.6%						
20	-12.7%	-9.1%	-2.8%	-1.6%	-2.3%	-1.1%	0.8%	0.9%	4.9%	-1.4%	0.3%	-1.6%	0.8%	0.6%	-3.8%	2.2%	3.7%	4.6%	2.7%	-0.8%	0.2%	2.2%	7.6%	-0.6%	0.7%						
30	-12.9%	-5.2%	-4.4%	0.6%	-0.3%	1.8%	4.6%	1.5%	3.3%	0.6%	0.4%	-2.4%	-4.8%	1.4%	-1.4%	3.1%	5.3%	2.7%	4.4%	1.1%	-1.9%	1.5%	4.5%	-0.2%	2.4%						
40	-11.8%	-2.6%	-0.7%	2.3%	2.3%	3.5%	6.2%	6.2%	5.2%	0.2%	-1.3%	-2.1%	-6.3%	2.9%	1.0%	5.0%	5.4%	6.8%	0.7%	2.6%	-1.3%	3.3%	2.1%	3.2%	1.3%						
50	-6.9%	-1.9%	0.9%	3.6%	4.2%	4.6%	4.3%	4.6%	5.1%	2.4%	1.5%	-2.5%	-0.1%	-2.9%	-0.1%	5.8%	2.4%	9.0%	-1.5%	1.7%	-3.0%	1.0%	5.5%	5.1%	-0.6%						
60	-3.5%	-1.5%	1.7%	2.4%	7.1%	3.6%	3.6%	3.3%	4.8%	4.2%	1.6%	-0.7%	2.0%	-0.1%	1.5%	4.1%	0.0%	8.3%	-2.7%	2.2%	-3.0%	3.6%	2.7%	6.7%	2.1%						
70	1.5%	4.0%	6.6%	7.1%	6.6%	6.9%	4.7%	3.3%	7.7%	0.7%	-1.4%	4.4%	5.7%	0.2%	-0.2%	0.3%	1.7%	9.4%	-3.7%	2.6%	-0.3%	3.6%	2.7%	8.9%	1.6%						
80	1.7%	5.5%	6.8%	7.8%	6.4%	5.5%	5.2%	7.3%	5.9%	1.8%	6.0%	6.4%	4.6%	2.1%	-2.6%	2.7%	3.7%	9.8%	-3.2%	3.4%	2.1%	7.3%	3.9%	8.9%	1.2%						
90	3.0%	3.3%	6.3%	5.5%	4.1%	5.4%	4.8%	3.4%	6.4%	1.6%	8.3%	5.0%	6.2%	1.8%	-6.2%	-0.6%	5.9%	9.8%	-2.1%	4.5%	1.0%	3.4%	3.9%	8.0%	-0.8%						
100	-1.3%	4.1%	4.0%	5.0%	2.3%	5.1%	3.8%	1.9%	4.5%	3.0%	6.8%	4.1%	5.4%	2.3%	-2.5%	-1.6%	6.3%	8.4%	0.8%	4.5%	3.3%	2.9%	3.1%	4.1%	0.7%						
110	2.5%	5.4%	3.9%	6.5%	7.9%	4.6%	5.4%	5.0%	2.6%	8.0%	5.3%	4.6%	4.4%	5.1%	1.5%	0.4%	1.2%	6.0%	1.8%	8.8%	1.0%	1.2%	3.2%	5.1%	1.4%						
120	1.6%	3.5%	4.4%	3.8%	2.5%	5.1%	2.5%	4.1%	3.1%	3.9%	6.8%	3.5%	6.4%	4.5%	3.4%	1.4%	0.4%	7.5%	2.2%	1.3%	0.9%	0.8%	2.4%	4.0%	2.7%						
130	3.0%	3.4%	3.6%	3.6%	2.9%	6.5%	3.8%	3.8%	5.4%	2.5%	7.0%	4.1%	5.9%	4.2%	5.4%	-0.5%	-0.5%	5.2%	1.4%	3.0%	1.2%	2.1%	5.2%	4.5%	6.3%						
140	0.9%	2.3%	1.3%	4.6%	4.4%	3.0%	2.1%	5.6%	4.3%	2.1%	3.9%	2.9%	4.6%	4.3%	3.1%	-2.0%	4.1%	4.7%	0.7%	4.5%	2.5%	1.8%	3.3%	4.2%	5.7%						
150	0.2%	3.6%	4.3%	5.1%	7.0%	4.6%	3.8%	0.3%	2.6%	3.7%	8.0%	0.2%	2.9%	4.4%	7.7%	-1.2%	2.5%	2.5%	3.6%	3.8%	3.7%	2.6%	6.7%	1.7%	4.3%						
160	0.8%	3.5%	5.6%	3.1%	9.4%	5.3%	6.1%	4.5%	5.1%	7.5%	0.7%	3.0%	1.1%	5.4%	9.7%	1.8%	3.7%	2.8%	5.3%	5.3%	4.8%	3.1%	5.6%	3.9%	7.7%						
170	2.7%	3.7%	4.7%	4.7%	6.9%	5.2%	7.5%	4.7%	3.0%	3.2%	2.4%	0.1%	0.5%	5.9%	5.4%	3.5%	5.3%	0.4%	7.8%	2.8%	5.2%	5.3%	5.4%	1.5%	6.0%						
180	2.2%	4.1%	4.5%	4.8%	4.5%	6.9%	4.2%	2.0%	3.6%	2.6%	4.2%	3.7%	2.0%	3.2%	2.0%	5.0%	6.0%	3.6%	9.0%	4.3%	4.7%	8.6%	2.7%	6.7%	5.7%						
190	0.6%	3.6%	5.3%	4.7%	5.7%	7.3%	0.1%	4.2%	3.5%	3.8%	7.6%	5.9%	7.2%	0.3%	7.0%	6.4%	6.1%	4.0%	3.6%	2.0%	5.4%	9.4%	5.4%	6.6%	6.3%						
200	1.9%	4.1%	3.5%	4.7%	6.6%	4.5%	5.0%	7.1%	5.0%	5.8%	7.3%	5.1%	7.2%	2.2%	5.9%	7.8%	7.1%	5.4%	7.0%	4.5%	5.1%	7.3%	4.8%	6.1%	6.3%						
210	1.0%	4.0%	4.4%	4.4%	8.6%	6.2%	3.4%	5.8%	5.4%	7.4%	6.5%	5.2%	6.1%	2.4%	6.1%	8.3%	5.8%	4.7%	9.0%	6.2%	5.2%	7.7%	1.6%	4.0%	7.4%						
220	2.1%	6.4%	4.1%	3.8%	7.9%	4.6%	7.0%	3.7%	5.6%	7.0%	6.7%	3.1%	5.0%	4.7%	6.7%	5.0%	6.3%	5.0%	10.3%	5.1%	7.3%	6.9%	4.3%	3.0%	6.5%						
230	2.0%	3.5%	2.3%	5.1%	8.7%	3.6%	5.8%	4.3%	5.1%	8.5%	6.1%	3.7%	5.2%	7.0%	6.0%	6.4%	4.1%	6.2%	7.2%	6.2%	6.9%	6.4%	2.0%	3.6%	4.0%						
240	2.2%	4.1%	5.6%	6.0%	7.0%	5.7%	6.0%	2.3%	4.5%	6.4%	6.6%	4.8%	5.5%	4.7%	2.1%	4.7%	3.9%	6.3%	6.9%	4.1%	6.6%	8.4%	4.8%	2.5%	5.6%						
250	3.2%	4.2%	7.7%	6.8%	6.8%	8.5%	7.6%	5.4%	8.9%	5.7%	5.5%	7.6%	5.7%	7.5%	2.8%	5.8%	5.1%	10.2%	2.9%	4.3%	9.0%	8.8%	6.3%	5.6%	6.0%						

Formation Period (Days)

The same price movements as exhibited in section 4.2.1.1 are identifiable, with maximum and minimum returns more accentuated, and price continuation achievable at shorter holding periods. Variability of returns associated with decreasing the number of shares in the portfolio has increased, with the standard deviation of returns up 0,9% compared to the same simulation at the third decile. Annualized returns expressed in terms of market outperformance range from 21,1% below market (for a formation and holding period of 10 days) to 10,7% above market (for a formation period of 200 days and holding period of 190 days). A median return of 4% and mean return of 3,5% (above market) are exhibited for this simulation. The total proportion of positive observations is 88,3%. Relative to the same simulation at the third decile, this translates into a minimum return which is 4,4% lower, and a maximum return, median, mean, and proportion positive which is 3,1%; 2,1%; 1,8% and 8,5% higher respectively. Preliminary results indicate that higher returns are achievable at a lower quantile, which is expected as the selection process by which stocks are ranked has become more stringent.

For short-term holding periods, shares significantly underperform the market for formation periods below 60 days. Buying the winner portfolio for a 10-day holding period post a 10-day formation period exhibits an absolute annualized return of -1% (more than 20% below that of the market). The indication in section 4.2.1.1 that winners have been overbought appears to result in an even more accentuated downward price reversal at the second decile for very short-term trades. However, price continuation is reached at far lower holding periods than the same strategy at the third decile, with multiple positive excess returns achieved for holding periods as low as 10 days (given a formation period greater than 60 days), and upward price momentum evident for holding periods greater than 30 days. At a 120-day formation period, returns are in excess of the market for all of the 25 holding periods examined. (The effect of increasing the formation period beyond 250 days at the second decile is elaborated on in subsequent sections). In similarity to the same simulation at the third decile, there are areas of return in excess of 7% of the market for 180-day and 190-day holding periods (with corresponding 50 to 100-day and 170 to 230-day formation period ranges), presenting weak evidence of mid to long-term price momentum post achieving price continuation. However, peaks in excess-return are only partially supported by surrounding points of similar return (raising suspicion of outliers).

Overall, price continuation is a more common theme than with the same simulation at the third decile. However, the extent of the short-term price reversal has been accentuated by placing a more stringent selection criterion on the portfolio constituents. While an investor buying the winner portfolio and exercising longer formation and holding periods is likely to achieve price continuation and above-market returns, an alternative strategy to maximise returns would be to short-sell winners at or below 10-day formation periods, closing out the trade within 10 days. The increase in returns and proportion of positive observations are discussed in subsequent sections on a risk-adjusted basis.

Ranking Stocks based on Prior Returns at the 20% quantile

4.2.3.2:

Loser Portfolio: Formation and Holding Period up to 250 days (20% quantile)
(Appendix 4.2)

The heat map below contains annualized market excess returns (equally weighted index as market) to the loser portfolio.

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

□ Max **20,0%**
 □ Min **-5,8%**
 □ Proportion positive **66,2%**
 □ Median **0,9%**
 □ Mean **1,2%**
 □ Std Dev **2,8%**

fpl/hp	Holding Period (Days)																								
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250
10	20,0%	9,8%	8,8%	3,0%	4,5%	0,2%	1,0%	-1,6%	0,8%	0,7%	1,9%	1,2%	5,3%	3,6%	3,7%	-0,9%	2,5%	2,8%	-0,7%	2,3%	2,2%	-3,5%	-2,8%	1,2%	2,4%
20	15,2%	9,8%	7,9%	6,8%	5,4%	0,8%	0,1%	2,6%	-3,7%	5,3%	4,1%	4,3%	-0,1%	0,5%	6,8%	1,4%	1,3%	-4,3%	3,1%	2,7%	3,6%	-2,0%	-3,2%	4,2%	3,3%
30	17,1%	7,9%	7,4%	1,9%	0,5%	-1,5%	-1,8%	1,8%	-1,4%	4,3%	2,7%	1,7%	7,1%	2,0%	4,7%	-2,2%	-2,6%	-4,4%	-2,8%	0,4%	7,0%	-1,3%	-0,5%	-1,1%	-0,2%
40	13,2%	9,4%	4,7%	2,0%	3,2%	-1,5%	-2,7%	1,3%	-1,2%	6,8%	3,6%	2,9%	3,6%	0,7%	3,4%	-1,0%	-2,1%	-3,1%	1,9%	3,2%	4,1%	-0,6%	1,7%	-0,9%	0,2%
50	13,3%	7,8%	5,0%	3,6%	2,3%	2,0%	1,9%	2,3%	2,8%	4,1%	3,2%	4,2%	0,1%	6,7%	4,3%	-1,3%	-3,8%	-2,8%	3,2%	0,5%	7,0%	0,4%	0,1%	0,1%	1,5%
60	11,7%	5,8%	2,9%	3,5%	1,5%	1,2%	0,5%	0,5%	1,2%	-1,7%	5,2%	3,1%	1,3%	5,2%	3,1%	-0,1%	-2,1%	0,0%	2,2%	-1,1%	5,6%	2,0%	-0,1%	0,4%	2,6%
70	8,0%	3,5%	0,9%	2,6%	1,5%	-1,2%	2,8%	1,8%	0,3%	1,5%	1,5%	2,1%	1,0%	4,9%	0,9%	2,0%	0,7%	-0,4%	5,5%	1,1%	3,4%	-1,3%	-2,4%	-1,5%	3,5%
80	8,2%	4,4%	1,6%	0,3%	-0,6%	-0,3%	4,1%	-1,4%	1,8%	1,3%	0,4%	-3,4%	1,4%	6,4%	1,0%	-1,1%	1,4%	-1,5%	3,4%	1,2%	5,6%	-1,4%	-0,5%	-2,6%	3,1%
90	6,2%	1,7%	-0,1%	-0,5%	2,0%	-1,2%	-0,5%	-3,1%	1,0%	2,0%	-5,8%	-2,8%	-0,1%	2,6%	7,3%	-4,0%	-2,7%	-1,4%	1,9%	1,9%	3,4%	-2,9%	2,0%	-2,9%	3,9%
100	5,5%	3,8%	0,4%	-0,5%	-0,6%	-1,0%	-1,6%	-1,2%	0,5%	2,1%	-5,3%	-1,8%	-0,9%	-0,8%	1,5%	-0,1%	-2,7%	0,7%	-0,3%	0,6%	0,8%	-1,7%	2,3%	0,4%	2,0%
110	7,9%	3,1%	3,6%	-0,2%	1,5%	2,2%	-0,5%	-3,0%	1,4%	2,7%	-4,7%	0,5%	-2,0%	0,6%	0,4%	1,3%	-1,4%	-0,7%	2,0%	3,1%	-2,0%	-0,7%	-2,7%	3,1%	-0,1%
120	4,6%	-0,3%	1,1%	-2,5%	-0,4%	-0,5%	4,4%	-1,9%	0,6%	-0,9%	0,5%	3,4%	-1,2%	0,3%	-4,4%	1,2%	-1,8%	0,8%	-3,8%	1,6%	-1,3%	3,5%	-0,7%	0,9%	-1,1%
130	4,9%	2,2%	0,1%	-1,8%	-2,6%	-0,3%	0,8%	-0,4%	-1,7%	0,8%	0,3%	-1,4%	-1,6%	-1,2%	-0,7%	5,1%	-1,8%	-1,9%	-0,8%	1,4%	-3,0%	1,2%	-1,2%	0,9%	-3,7%
140	4,4%	0,3%	0,4%	-1,1%	0,2%	-2,9%	0,9%	-1,7%	-3,9%	1,4%	0,4%	-2,2%	-1,4%	0,7%	-1,2%	1,3%	-1,3%	-1,7%	-0,1%	1,4%	-2,2%	2,4%	-1,9%	-0,6%	-2,1%
150	5,7%	3,1%	1,7%	1,4%	2,2%	-1,9%	-1,6%	4,2%	-0,3%	0,9%	-0,5%	-1,1%	-1,5%	1,8%	0,2%	2,8%	-2,3%	1,5%	-1,2%	0,5%	-0,1%	2,6%	-2,6%	0,0%	0,3%
160	5,2%	2,4%	1,1%	-0,3%	-2,5%	0,1%	-2,6%	2,3%	-2,1%	-1,3%	0,5%	-0,4%	0,6%	-1,0%	-2,0%	3,4%	-1,3%	-1,7%	-2,1%	-2,2%	-2,3%	1,7%	1,2%	3,1%	0,4%
170	3,1%	1,9%	2,0%	-0,3%	-0,4%	1,8%	0,3%	0,0%	1,0%	-0,5%	1,5%	0,2%	1,3%	3,0%	1,2%	0,0%	-3,1%	3,8%	-2,7%	-1,8%	-0,6%	0,9%	2,7%	1,6%	0,1%
180	4,4%	2,5%	2,1%	0,7%	0,8%	3,3%	2,5%	1,1%	1,3%	1,1%	0,5%	0,0%	-0,8%	3,9%	0,3%	0,0%	-0,4%	2,8%	0,2%	1,0%	-0,2%	1,2%	4,1%	0,2%	1,9%
190	4,3%	3,9%	3,9%	1,5%	3,3%	1,7%	4,9%	-0,2%	0,5%	1,4%	-0,5%	-0,9%	-0,6%	3,0%	0,7%	-0,3%	-1,2%	0,3%	0,9%	2,0%	-2,3%	-0,5%	3,4%	0,1%	2,6%
200	5,5%	4,2%	1,4%	2,2%	1,3%	0,2%	1,6%	1,3%	1,4%	1,2%	-1,2%	-0,6%	-0,5%	3,0%	0,7%	-0,1%	0,2%	-0,4%	1,0%	1,2%	0,7%	-0,2%	3,0%	1,5%	-1,4%
210	5,6%	4,8%	2,2%	0,9%	-0,1%	-1,2%	-1,5%	0,3%	0,2%	-0,2%	-2,2%	-0,4%	0,8%	0,8%	1,8%	-0,2%	0,2%	0,2%	1,1%	0,1%	-0,2%	-0,4%	1,8%	4,2%	-1,7%
220	5,6%	4,7%	2,7%	1,7%	1,9%	2,3%	-0,7%	0,5%	1,1%	1,4%	-1,3%	1,5%	0,5%	0,9%	1,5%	-1,0%	1,0%	2,4%	-0,8%	1,3%	1,0%	0,4%	0,8%	3,8%	3,1%
230	4,6%	3,4%	2,8%	0,9%	-0,5%	0,6%	-4,7%	2,3%	-0,1%	1,7%	-0,7%	4,2%	2,4%	0,2%	2,2%	3,2%	2,9%	0,6%	-0,8%	2,3%	0,0%	1,9%	3,5%	5,9%	-0,5%
240	5,2%	5,1%	1,7%	2,8%	0,3%	2,1%	0,7%	2,9%	2,2%	3,3%	0,7%	4,9%	2,9%	1,4%	4,6%	2,4%	4,8%	1,8%	1,9%	4,4%	0,5%	2,0%	2,3%	6,6%	0,5%
250	4,4%	1,4%	2,6%	-1,3%	0,3%	-1,4%	0,5%	-1,3%	0,6%	1,0%	-0,2%	-0,5%	1,7%	1,4%	2,5%	0,1%	5,0%	0,2%	1,9%	0,6%	2,1%	1,9%	0,3%	2,2%	1,6%

Formation Period (Days)

Relative to the winner portfolio, the metrics above translate into a minimum and maximum return which are 15,3% and 9,3% higher respectively, yet a proportion positive, median and mean which are all lower. As with simulations at the third decile, though both the minimum and maximum return outperform that of the winner portfolio, it would appear that the average return to buying the winner portfolio outperforms that of buying the loser portfolio at the second decile, given a 250-day formation period limitation. This is elaborated on in the ensuing section.

Relative to the same loser portfolio simulation at the third decile, preliminary results indicate that a higher return, median, and mean are achievable (with a higher standard deviation), which is expected as the selection process by which stocks are ranked has become more stringent.

In a similar manner to the observed relationship between the winner and loser portfolio at the third decile, there is an upward short-term price reversal exhibited by the loser portfolio, as opposed to the downward price reversal observed when buying the winner portfolio. The most significant market outperformance is achieved for this strategy at very short-term holding periods, with optimal returns achieved at a 10-day formation and holding period. As documented previously, stocks which have underperformed over longer formation periods are less likely to experience upward price reversals in subsequent holding periods to the same extent as stocks which have underperformed over shorter formation periods, and tend to reach (downward) price continuation at lower holding periods.

Investors buying the winner portfolio (betting on price continuation) will realize higher returns after longer formation periods and while exercising longer holding periods, ensuring price continuation and momentum (which appears to be maximized at a holding period of between 180 and 200 days). Alternatively, short-selling the winner portfolio at very low formation periods and closing out one's position at very low holding periods would enable an investor to lock in market-beating returns through the downward price reversal. Investors backing the loser portfolio will maximize returns doing so post very short-term formation periods and exercising shorter holding periods to take advantage of upward short-term price reversals. Again, the proportionately larger upward price reversal in the loser portfolio relative to the

downward price reversal in the winner portfolio presents evidence of loss aversion in the market, where investors have overreacted proportionately more to negative information over positive information, pushing losers further below their intrinsic value relative to winners exceeding their intrinsic value. This is not necessarily evident from a single return, but rather from the sum of returns for formation periods up to 60 days, given a 10-day holding period.

4.2.4: Increasing the Formation period (20%Q)

Ranking Stocks based on Prior Returns at the 20% quantile

4.2.4.1:

Winner Portfolio: Formation Period up to 850 days;

Holding Period up to 250 days (20% quantile)

(Appendix 4.3)

The heat map below contains annualized market excess returns (equally weighted index as market) to the winner portfolio.

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

fp/hp		Holding Period (Days)									
		25	50	75	100	125	150	175	200	225	250
25	25	-5,0%	-4,4%	-3,7%	-2,6%	-0,4%	-5,5%	-3,8%	-1,9%	-6,5%	-3,5%
50	25	-0,5%	4,2%	4,3%	2,4%	4,3%	-0,1%	-2,1%	1,7%	-0,5%	-0,6%
75	25	5,8%	7,1%	2,9%	2,2%	2,4%	-3,1%	-5,5%	4,1%	-2,9%	0,0%
100	25	3,7%	2,3%	2,1%	3,0%	-0,1%	-2,5%	-2,2%	4,5%	3,2%	0,7%
125	25	3,7%	2,2%	4,8%	2,3%	0,3%	4,9%	2,0%	2,6%	6,2%	3,7%
150	25	2,3%	7,0%	4,6%	3,7%	1,3%	7,7%	7,4%	3,8%	8,9%	4,3%
175	25	5,3%	6,0%	2,4%	3,2%	5,4%	6,5%	7,5%	3,4%	7,1%	6,3%
200	25	5,5%	6,6%	5,4%	5,8%	6,0%	5,9%	5,9%	4,5%	6,2%	6,3%
225	25	4,7%	7,3%	2,6%	7,0%	1,2%	3,1%	4,2%	4,8%	6,1%	4,8%
250	25	5,7%	6,8%	4,0%	5,7%	5,5%	2,8%	2,8%	4,3%	1,5%	6,0%
275	25	3,8%	6,6%	6,9%	6,2%	3,0%	7,7%	5,2%	6,0%	1,0%	2,2%
300	25	5,8%	5,2%	8,0%	6,8%	4,3%	10,4%	4,3%	4,8%	2,0%	2,3%
325	25	4,5%	5,9%	4,7%	4,1%	1,8%	3,3%	5,1%	3,7%	4,2%	1,8%
350	25	5,3%	6,4%	6,3%	5,3%	2,9%	6,2%	5,7%	4,6%	6,9%	3,3%
375	25	5,6%	5,7%	6,0%	5,7%	2,9%	2,2%	4,9%	5,0%	2,9%	3,6%
400	25	3,7%	5,7%	3,8%	7,2%	5,2%	1,2%	4,3%	8,1%	5,9%	5,0%
425	25	6,0%	5,4%	5,1%	5,1%	5,2%	5,0%	0,8%	4,3%	5,2%	6,6%
450	25	4,1%	5,3%	5,3%	1,6%	4,6%	7,3%	1,7%	-0,1%	3,5%	6,4%
475	25	2,7%	4,4%	2,0%	3,1%	4,3%	3,5%	1,3%	2,8%	-0,4%	6,6%
500	25	4,7%	5,9%	3,8%	6,6%	2,3%	4,0%	6,5%	4,9%	0,8%	3,6%
525	25	6,8%	5,6%	7,0%	4,1%	2,5%	2,0%	5,7%	1,2%	2,8%	3,3%
550	25	6,5%	7,1%	4,7%	4,6%	5,2%	1,5%	4,6%	4,1%	5,2%	3,1%
575	25	7,1%	6,0%	5,1%	2,1%	4,1%	2,7%	3,7%	2,0%	6,0%	-0,7%
600	25	7,1%	6,2%	5,8%	6,1%	2,2%	5,2%	0,9%	4,8%	5,9%	-1,0%
625	25	5,8%	5,6%	1,7%	4,2%	1,0%	1,4%	1,3%	1,3%	2,4%	-1,9%
650	25	4,9%	4,2%	2,8%	3,7%	2,0%	2,0%	1,4%	0,1%	4,0%	-0,6%
675	25	4,2%	4,4%	4,2%	3,6%	1,3%	1,7%	4,8%	1,9%	4,7%	1,0%
700	25	3,7%	3,1%	2,5%	4,4%	1,9%	1,0%	3,1%	2,3%	-1,5%	1,8%
725	25	5,1%	4,3%	2,4%	3,0%	5,2%	3,8%	5,1%	-0,6%	0,4%	2,3%
750	25	3,8%	3,8%	4,0%	2,9%	1,9%	3,8%	5,1%	1,6%	1,3%	-1,0%
775	25	3,2%	3,0%	1,6%	0,5%	1,5%	1,7%	0,8%	0,2%	0,3%	-2,1%
800	25	1,2%	2,2%	1,0%	2,8%	1,3%	0,3%	0,0%	3,7%	1,8%	-1,3%
825	25	2,5%	1,8%	3,1%	0,3%	0,7%	-0,9%	-1,4%	-0,6%	4,0%	-0,9%
850	25	2,4%	2,4%	1,3%	0,4%	0,6%	-0,3%	-0,5%	-3,8%	1,4%	-1,1%

Max	10,4%
Min	-6,5%
Proportion positive	87,9%
Median	3,7%
Mean	3,2%
ST Dev	2,7%

As expected, the same price movements as exhibited in section 4.2.2.1 are identifiable, with maximum and minimum returns more accentuated. Again the downward price reversal at a 25-day formation period is observable and the portfolio fails to achieve price continuation across the spectrum of holding periods for such a formation period. For formation periods greater than 25 days, price continuation is observed. However, at formation periods below 125 days there appears to be a price reversal after holding stocks for more than 125 days, which can be interpreted as stocks being unable to achieve sustained price continuation at formation periods below 125 days. In order to achieve sustained price continuation across the range of holding periods, a minimum formation period of 125 days is therefore required, with an increasing formation period resulting in strong price continuation, particularly at shorter holding periods. The long-term downward price reversal in the winner portfolio is evident in this simulation, but with returns generally higher. Further, the effect of restricting the quantile specification from the third to the second decile has shifted the price reversal further out to a longer formation period. Given a 25-day holding period, returns to the winner portfolio appear to be maximized at around 600 days, beyond which diminishing returns are exhibited. At the third decile this occurred at a formation period of around 400 days. Unlike the same simulation at the third decile, price continuation is still achieved at formation periods beyond 600 days (but of a diminishing magnitude). At an 850-day formation period the winner portfolio begins to exhibit returns below that of the market at certain holding periods.

The variability of returns associated with decreasing the number of shares in the portfolio has increased marginally, with standard deviation of returns up 0,6% to 2,7% compared to the same simulation at the third decile. Annualized returns expressed in terms of market outperformance range from 6,5% below market to 10,4% above market. Relative to the same simulation at the third decile, mean return has increased, with a general increase in proportion positive. This is primarily attributable to the long-term downward price reversal having shifted further out, as well as a general increase in return.

This increase is to be expected at a lower quantile, and the winner portfolio exhibits excess market returns through price continuation across almost the entire range of holding periods up to a formation period of around 800 days, beyond which a long-

term downward price reversal occurs. Stocks which have consistently outperformed over longer formation periods (800 days or more) tend to exhibit a downward price reversal, turning the average winner into the average loser in subsequent periods. Returns to this strategy are more likely to be maximized by buying the winner portfolio in a formation period range of 125 to 600 days.

Ranking Stocks based on Prior Returns at the 20% quantile

4.2.4.2:

Loser Portfolio: Formation Period up to 850 days;

Holding Period up to 250 days (20% quantile)

(Appendix 4.4)

The heat map below contains annualized market excess returns (equally weighted index as market) to the loser portfolio.

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

		Holding Period (Days)																				
		25	50	75	100	125	150	175	200	225	250											
Formation Period (Days)	fp/hp																					
	25	7,3%	0,3%	2,0%	3,6%	2,7%	4,4%	3,3%	1,4%	6,0%	1,1%											
	50	3,8%	2,3%	1,1%	4,1%	-2,4%	4,3%	6,9%	0,5%	2,1%	1,5%											
	75	3,2%	1,2%	0,1%	2,6%	-2,2%	3,6%	1,7%	1,3%	1,5%	3,4%											
	100	1,6%	-0,6%	-2,1%	2,1%	2,6%	1,5%	1,8%	0,6%	1,3%	2,0%											
	125	-2,0%	-2,3%	-1,6%	-0,2%	-1,0%	-1,3%	1,6%	1,6%	-0,4%	-1,3%											
	150	0,0%	2,2%	-0,3%	0,9%	-0,6%	-0,2%	2,1%	0,5%	-1,8%	0,3%											
	175	2,2%	-1,6%	-0,4%	-0,9%	-1,8%	-0,2%	1,4%	-1,3%	1,0%	-1,7%											
	200	1,8%	1,3%	-2,4%	1,2%	-2,2%	0,7%	0,4%	1,2%	1,8%	-1,4%											
	225	3,0%	-0,2%	0,6%	1,3%	3,1%	3,8%	3,1%	2,1%	2,5%	4,6%											
	250	2,1%	0,3%	0,1%	1,0%	2,7%	2,5%	3,7%	0,6%	6,4%	1,6%											
	275	2,4%	0,6%	2,0%	1,0%	3,8%	2,2%	3,2%	0,3%	6,9%	3,4%											
	300	5,7%	3,4%	5,2%	4,5%	5,4%	3,4%	3,6%	1,6%	7,5%	5,6%											
	325	5,4%	3,4%	4,1%	5,4%	5,9%	5,2%	4,9%	3,8%	6,8%	5,4%											
	350	2,2%	0,4%	1,5%	1,0%	1,4%	1,4%	1,5%	5,5%	2,4%	5,6%											
	375	5,3%	3,2%	5,1%	4,2%	2,6%	6,0%	4,6%	5,3%	5,1%	7,4%											
	400	6,1%	4,9%	5,0%	1,6%	3,5%	6,8%	6,0%	4,5%	3,8%	6,0%											
	425	5,4%	3,1%	3,8%	2,4%	5,3%	6,0%	7,3%	5,9%	4,1%	6,3%											
	450	6,4%	4,9%	7,2%	5,2%	8,9%	6,7%	8,0%	7,6%	5,2%	10,9%											
	475	5,4%	4,9%	5,2%	4,6%	9,8%	6,4%	9,5%	7,7%	6,7%	11,0%											
	500	6,7%	5,4%	4,9%	7,5%	10,7%	6,5%	7,9%	8,9%	8,7%	9,0%											
	525	7,4%	6,1%	7,7%	7,6%	7,3%	6,3%	8,2%	9,2%	9,2%	8,2%											
	550	8,3%	8,2%	10,4%	9,9%	8,8%	7,4%	7,1%	8,5%	10,1%	9,0%											
	575	13,2%	11,5%	9,3%	9,0%	9,5%	7,4%	10,4%	7,9%	9,5%	10,1%											
	600	13,2%	11,4%	11,2%	10,2%	8,9%	8,8%	8,3%	9,0%	9,1%	10,0%											
625	10,9%	9,1%	6,5%	8,8%	10,6%	7,5%	8,6%	10,5%	10,2%	7,7%												
650	9,4%	8,1%	7,1%	8,7%	8,1%	10,2%	10,6%	10,1%	9,9%	6,7%												
675	9,5%	8,7%	11,0%	7,8%	8,4%	12,7%	10,8%	10,4%	13,7%	7,9%												
700	9,4%	8,6%	8,3%	10,2%	13,7%	11,2%	9,9%	12,0%	9,1%	11,2%												
725	10,9%	10,4%	7,9%	10,7%	14,5%	11,6%	9,4%	9,3%	7,6%	13,1%												
750	10,9%	10,8%	11,7%	11,9%	12,3%	9,1%	11,1%	9,4%	9,8%	10,2%												
775	11,2%	10,4%	10,4%	9,3%	11,3%	11,5%	10,6%	9,3%	10,2%	10,2%												
800	10,7%	10,3%	8,7%	10,0%	9,5%	10,7%	8,2%	10,5%	9,1%	10,9%												
825	10,2%	11,3%	10,6%	7,3%	9,7%	10,0%	7,9%	10,5%	8,3%	10,1%												
850	11,6%	9,7%	10,2%	8,6%	10,2%	11,0%	8,3%	10,1%	10,0%	10,8%												

Max	14,5%
Min	-2,4%
Proportion positive	91,8%
Median	6,2%
Mean	5,9%
ST Dev	4,1%

The output for this simulation is somewhat more accentuated than in section 4.2.2.2, with the long-term upward price reversal even more observable. As referenced before, the loser portfolio exhibits a short-term upward price reversal, which diminishes with longer formation periods. The 250-day formation period referenced at the third decile is again a point beyond which a long-term upward price reversal is exhibited. The long term reversal is more accentuated than before, with an annualized excess market return of 14,5% achieved for a 725-day formation period, when held for 125 days.

Relative to the same strategy at the third decile, the maximum achievable return has increased significantly, with a general increase in proportion positive, median, and mean.

Returns to this strategy are more likely to be maximized by buying the loser portfolio at formation periods greater than 600 days and holding the stock for up to 250 days; capturing price momentum post an upward price reversal of the loser portfolio.

4.2.5. Risk-adjusted Returns

While the results of prior simulations have indicated optimal formation and holding periods for a given number of stocks in the portfolio, changing the number of stocks bears an impact on both the risk, as well as the achievable return on the portfolio. In the results above, the quantile restriction specifying the number of stocks selected from the investible universe of assets is reduced from the third to the second decile, with the impact of changing the formation and holding period documented accordingly. The risk-adjusted returns and resultant information ratios are examined below.

Information ratios

4.2.5.1:

Winner Portfolio: Formation and Holding Period up to 250 days (30% quantile)

(Appendix 5.1)

The heat map below contains information ratios corresponding to the returns in the heat map in section 4.2.1.1 (Ranking Stocks based on Prior Returns at the 30% quantile).

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

fp/hp	Holding Period (Days)																								
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250
10	-1,77	-0,80	-0,32	-0,30	-0,16	0,20	-0,06	0,14	0,02	-0,19	-0,21	0,07	-0,15	-0,18	0,11	-0,02	-0,03	0,07	0,37	-0,14	0,07	0,02	-0,12	-0,05	0,19
20	-1,27	-0,99	-0,36	-0,24	-0,39	-0,12	0,17	0,15	0,47	-0,30	-0,06	-0,18	0,09	0,12	-0,52	0,30	0,42	0,32	0,19	-0,25	-0,02	0,29	0,53	-0,10	-0,01
30	-1,16	-0,58	-0,40	-0,09	-0,08	0,18	0,39	0,14	0,30	-0,05	0,05	-0,27	0,02	0,02	-0,15	0,22	0,57	0,29	0,38	-0,08	-0,06	0,23	0,23	0,16	0,22
40	-0,92	-0,29	-0,10	0,09	0,15	0,28	0,38	0,40	0,37	-0,10	0,09	0,01	-0,28	0,19	0,07	0,49	0,21	0,68	0,28	0,00	-0,08	0,20	0,10	0,27	0,10
50	-0,72	-0,26	0,12	0,32	0,38	0,37	0,23	0,41	0,38	0,14	-0,03	-0,12	0,08	-0,28	0,01	0,58	0,32	0,78	-0,12	0,05	-0,21	0,16	0,43	0,41	0,22
60	-0,43	-0,14	0,17	0,29	0,56	0,52	0,30	0,38	0,39	0,49	0,03	0,36	-0,11	-0,11	0,03	0,19	0,04	0,76	0,14	-0,02	-0,03	0,20	0,38	0,54	0,33
70	-0,08	0,16	0,34	0,42	0,55	0,55	0,36	0,07	0,34	0,06	-0,05	0,42	0,42	0,03	-0,11	-0,10	-0,03	0,71	-0,15	0,06	0,02	0,37	0,06	0,58	0,12
80	-0,07	0,21	0,35	0,38	0,33	0,28	0,18	0,39	0,25	0,05	0,34	0,39	0,41	-0,02	-0,33	0,10	0,12	0,59	-0,20	0,13	-0,11	0,35	0,15	0,62	0,04
90	-0,05	0,06	0,28	0,36	0,19	0,30	0,23	0,09	0,33	0,09	0,46	0,28	0,33	0,18	-0,55	-0,27	0,24	0,69	-0,20	0,25	-0,10	0,08	-0,02	0,46	-0,04
100	-0,27	0,17	0,17	0,15	0,09	0,14	0,28	-0,14	0,01	0,04	0,43	0,06	0,20	0,10	-0,39	-0,25	0,20	0,32	-0,12	0,03	0,14	-0,04	0,12	0,17	-0,02
110	-0,03	0,18	0,12	0,39	0,41	0,26	0,33	0,16	-0,01	0,44	0,28	0,16	0,25	0,30	0,05	-0,01	0,18	0,21	0,06	0,37	0,03	-0,08	0,37	0,27	0,10
120	-0,11	0,11	0,18	0,20	0,14	0,21	0,00	0,20	-0,02	0,24	0,47	0,13	0,28	0,14	0,13	-0,09	-0,12	0,26	0,05	0,03	0,04	-0,14	0,39	0,13	0,22
130	-0,03	0,10	0,15	0,20	0,20	0,38	0,13	0,17	0,20	0,28	0,40	0,17	0,37	0,27	0,39	0,05	0,02	0,25	0,18	0,26	0,10	-0,07	0,45	0,22	0,36
140	-0,09	0,03	0,09	0,37	0,15	0,18	0,01	0,34	0,37	0,03	0,24	0,21	0,41	0,24	0,29	-0,13	0,12	0,21	0,03	0,19	0,18	0,07	0,14	0,25	0,37
150	-0,25	0,02	0,10	0,19	0,19	0,25	0,19	0,13	0,02	0,05	0,08	-0,08	-0,08	0,17	0,42	0,00	0,18	-0,09	0,17	0,17	0,23	-0,05	0,38	0,12	0,23
160	-0,06	0,23	0,22	0,22	0,43	0,14	0,22	0,20	0,23	0,41	-0,12	-0,07	-0,22	0,23	0,46	0,00	0,36	0,05	0,19	0,28	0,18	0,09	0,30	0,09	0,54
170	-0,06	0,12	0,18	0,12	0,38	0,18	0,16	0,17	0,08	0,15	-0,03	-0,05	-0,14	0,26	0,25	0,09	0,31	-0,04	0,46	0,27	0,21	0,25	0,29	0,13	0,42
180	-0,06	0,29	0,22	0,35	0,24	0,28	0,01	0,14	0,20	0,00	0,11	0,20	0,08	0,06	0,27	0,34	0,33	0,04	0,46	0,25	0,20	0,38	0,16	0,41	0,46
190	-0,24	0,06	0,11	0,28	0,27	0,28	-0,13	0,29	0,14	0,31	0,42	0,31	0,36	-0,21	0,30	0,36	0,44	0,15	0,57	0,06	0,35	0,57	0,17	0,32	0,28
200	-0,16	0,10	0,09	0,34	0,40	0,26	0,13	0,40	0,17	0,38	0,45	0,38	0,53	-0,11	0,26	0,35	0,41	0,25	0,66	0,18	0,23	0,44	0,23	0,28	0,35
210	-0,19	0,15	0,07	0,24	0,44	0,18	0,09	0,39	0,17	0,32	0,32	0,32	0,42	-0,10	0,19	0,39	0,38	0,13	0,57	0,26	0,23	0,47	0,13	0,26	0,46
220	-0,10	0,19	0,32	0,26	0,54	0,25	0,23	0,29	0,15	0,40	0,22	0,26	0,28	0,12	0,41	0,21	0,33	0,16	0,49	0,25	0,39	0,36	0,15	0,16	0,34
230	-0,11	0,08	0,10	0,21	0,41	0,26	0,18	0,17	0,17	0,34	0,32	0,29	0,18	0,17	0,27	0,30	0,09	0,39	0,36	0,19	0,34	0,43	-0,03	0,10	0,19
240	-0,17	0,01	0,22	0,24	0,33	0,31	0,17	0,03	0,05	0,25	0,38	0,29	0,36	0,11	-0,13	0,21	0,16	0,34	0,38	0,16	0,34	0,46	0,14	0,10	0,26
250	0,06	0,22	0,43	0,33	0,32	0,45	0,29	0,23	0,32	0,24	0,29	0,40	0,38	0,35	-0,07	0,34	0,23	0,56	0,28	0,08	0,47	0,53	0,33	0,19	0,24

Formation Period (Days)

The information ratios above are specified as the ratio of the daily market excess return to the standard deviation of the daily difference between the return to the portfolio and the market return, expressed annually. This performance measure has been employed as opposed to the Sharpe ratio; given that this research report considers returns to an active strategy over and above that of a passive buy-and-hold alternative, rather than a risk-free alternative return measure.

In similarity to the pattern of returns observed in section 4.2.1.1, excess returns and associated positive information ratios are generally exhibited for longer formation periods, given the reduced probability of market underperformance (exhibited as a result of short-term downward price reversals occurring at lower formation periods). Further, given the increase in excess returns associated with longer holding periods as stocks tend to achieve price continuation, information ratios tend to increase with increasing holding periods, *ceteris paribus*. The mean information ratio of 0,16, while positive, is not notably high. Maximum and minimum information ratios of 0,78 and negative 1,77 are generated by the same formation and holding periods associated with the maximum and minimum returns in section 4.2.1.1. An information ratio greater than 0,5 can be regarded as a demonstration of skill, rather than luck, depending on the investment period under observation. Information ratios greater than 0,5 in this instance can be generated by an investor employing a number of different formation and holding period combinations, although the divide between skill and luck would become more apparent after numerous investment periods.

Information Ratios

4.2.5.2:

Loser Portfolio: Formation and Holding Period up to 250 days (30% quantile)
(Appendix 5.2)

The heat map below contains information ratios corresponding to the returns in the heat map in section 4.2.1.2 (Ranking Stocks based on Prior Returns at the 30% quantile).

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

dp/hp	Holding Period (Days)																									Max	Min	Proportion positive	Median	Mean
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250					
10	1,62	0,84	0,77	0,33	0,43	-0,05	0,00	-0,13	0,15	0,20	0,34	0,02	0,59	0,18	0,20	0,08	0,26	0,00	0,02	0,37	0,34	-0,23	-0,14	0,07	0,38					
20	1,44	0,89	0,61	0,45	0,32	0,15	-0,01	0,20	-0,32	0,13	0,30	0,34	0,04	0,12	0,34	-0,03	-0,03	-0,33	0,09	0,19	0,36	-0,14	-0,30	0,39	0,04					
30	1,48	0,76	0,56	0,46	0,08	-0,04	-0,10	0,19	-0,21	0,34	0,32	0,24	0,53	0,05	0,26	-0,01	-0,14	-0,39	-0,21	-0,02	0,37	0,21	-0,02	-0,07	-0,08					
40	0,90	0,63	0,29	0,10	0,06	-0,08	-0,14	-0,15	-0,02	0,45	0,31	0,17	0,42	0,15	0,12	-0,11	-0,18	-0,32	0,34	0,30	0,24	-0,01	-0,06	0,05	0,08					
50	0,88	0,33	0,33	0,00	0,05	0,08	-0,05	0,03	0,10	0,28	0,21	0,41	0,02	0,51	0,30	-0,14	-0,19	-0,25	0,13	0,12	0,47	0,15	-0,10	0,06	0,06					
60	0,82	0,40	0,18	0,25	0,10	0,00	-0,01	-0,02	-0,05	-0,19	0,39	0,34	0,09	0,37	0,14	-0,02	-0,09	-0,19	0,31	0,18	0,28	0,18	-0,10	-0,01	-0,03					
70	0,55	0,24	-0,02	0,20	0,06	-0,14	0,22	0,24	-0,03	0,07	0,17	0,09	0,06	0,45	0,11	0,11	0,07	-0,21	0,27	0,19	0,24	-0,07	-0,20	-0,14	0,02					
80	0,49	0,39	0,11	0,09	0,05	0,11	0,17	-0,11	0,26	0,16	-0,09	-0,08	-0,10	0,48	0,49	-0,08	0,21	-0,05	0,40	0,04	0,35	-0,16	-0,16	-0,24	0,10					
90	0,47	0,20	0,04	-0,06	0,12	-0,13	-0,06	-0,13	0,09	0,14	-0,34	-0,34	-0,09	0,18	0,57	-0,11	-0,25	-0,23	-0,23	0,24	0,07	0,14	-0,15	-0,40	0,22					
100	0,44	0,30	0,08	-0,05	0,18	0,02	-0,03	-0,10	0,16	0,29	-0,29	-0,26	-0,08	-0,13	0,53	0,11	-0,18	-0,01	0,22	0,13	0,15	-0,05	0,07	0,05	0,31					
110	0,54	0,14	0,28	-0,02	0,00	0,18	0,08	-0,10	0,09	0,18	-0,17	0,03	-0,15	0,10	0,10	0,11	-0,15	0,10	0,14	0,19	0,03	0,16	-0,15	0,18	0,34					
120	0,53	0,24	0,15	-0,16	-0,01	0,00	0,33	-0,16	0,08	-0,06	-0,17	0,16	-0,19	0,07	-0,04	0,16	-0,08	-0,10	-0,06	0,11	0,05	0,11	-0,02	-0,02	0,16					
130	0,53	0,24	0,15	-0,16	-0,01	0,00	0,34	-0,16	0,08	-0,06	-0,17	0,16	-0,19	0,07	-0,04	0,15	-0,08	-0,10	-0,06	0,11	0,05	0,12	-0,02	-0,02	0,17					
140	0,39	0,04	0,15	0,08	0,14	-0,07	0,04	0,02	-0,09	0,28	0,07	-0,04	0,20	0,17	0,02	0,39	-0,02	0,08	0,03	0,25	0,08	0,15	-0,24	0,16	0,05					
150	0,37	0,20	0,13	0,16	0,12	-0,03	0,02	0,27	0,04	0,10	0,17	0,12	-0,06	0,13	-0,05	0,28	0,02	0,14	-0,02	0,07	-0,16	0,30	-0,29	0,23	0,05					
160	0,56	0,25	0,15	0,05	-0,02	0,07	-0,04	0,26	0,06	-0,06	0,13	0,02	0,21	0,09	-0,10	0,25	-0,05	0,24	-0,30	-0,12	-0,02	0,12	0,00	0,19	-0,05					
170	0,41	0,13	0,15	0,03	0,05	0,22	0,10	0,18	0,22	-0,08	0,16	0,00	0,13	0,13	0,00	0,18	0,08	0,31	-0,26	-0,19	-0,09	0,05	-0,01	0,12	-0,04					
180	0,33	0,12	0,02	-0,02	-0,20	0,16	0,02	0,05	-0,05	-0,02	0,07	0,03	-0,13	0,04	-0,15	-0,06	-0,09	0,20	-0,18	-0,07	-0,08	0,10	0,13	0,03	0,02					
190	0,31	0,12	0,17	0,06	0,23	0,05	0,26	0,07	0,05	0,15	-0,11	-0,09	-0,19	0,26	-0,02	0,04	-0,11	0,11	-0,24	0,17	0,01	-0,12	0,01	0,01	0,14					
200	0,42	0,30	0,10	0,19	0,08	-0,02	0,02	0,12	-0,05	0,13	-0,16	-0,07	-0,14	0,11	-0,02	0,12	-0,09	-0,11	-0,14	0,12	-0,12	-0,08	0,11	0,08	0,13					
210	0,51	0,30	0,19	0,11	0,03	-0,07	0,07	0,01	0,04	0,02	-0,11	-0,12	-0,11	0,25	0,01	-0,16	-0,07	0,02	-0,07	0,06	0,03	0,01	0,20	0,12	-0,22					
220	0,42	0,23	0,18	-0,02	0,10	0,14	0,04	-0,02	0,16	0,11	0,05	0,08	0,06	0,17	0,06	-0,09	0,10	0,27	0,06	0,06	0,18	0,02	-0,04	0,15	0,02					
230	0,46	0,16	0,19	0,02	0,03	-0,01	-0,06	0,06	0,00	0,00	0,06	0,30	0,04	-0,06	0,16	0,09	0,23	0,06	0,05	0,18	-0,07	0,06	0,15	0,44	0,20					
240	0,31	0,19	0,03	0,05	0,08	0,04	0,03	0,19	0,01	0,21	-0,13	0,24	0,08	0,07	0,29	0,07	0,27	-0,03	-0,02	0,29	-0,10	-0,04	0,13	0,33	0,10					
250	0,31	0,13	0,09	-0,07	-0,09	-0,08	0,00	-0,12	0,06	-0,06	-0,03	-0,04	0,06	0,02	0,22	-0,05	0,24	-0,01	0,23	-0,05	0,06	-0,01	-0,13	0,08	-0,06					

In similarity to the pattern of returns exhibited in section 4.2.1.2, excess returns and associated positive information ratios are generally exhibited for shorter formation periods, given prior findings that the loser portfolio tends to outperform the market at lower formation periods (as a result of short-term upward price reversals). Further, given the increase in excess returns associated with shorter holding periods (prior to stocks in the loser portfolio achieving downward price continuation), information ratios tend to be maximised when employing short-term formation and holding periods, *ceteris paribus*. While positive, the mean information ratio of 0,1 and proportion positive of 66,1% are below that of the winner portfolio and not an overly convincing performance measure (although this is largely attributable to the formation period range under observation, given that the loser portfolio exhibited increases in both mean and proportion positive when increasing the formation period to 850 days in prior sections). While the maximum information ratio of 1,62 is generated by the same formation and holding periods associated with the maximum returns in section 4.2.1.2, this is not the case with the minimum information ratio of negative 0,4. Both the maximum and minimum information ratios achieved are higher than those for the winner portfolio, with the maximum achievable ratio of 1,62 more than double that of the winner portfolio. Nevertheless, an investor measuring returns on a risk-adjusted basis would employ the same strategy as an investor seeking total return (as is the case with the winner portfolio).

Information Ratios

4.2.5.3:

Winner Portfolio: Formation and Holding Period up to 250 days (20% quantile)
(Appendix 5.3)

The heat map below contains information ratios corresponding to the returns in the heat map in section 4.2.3.1 (Ranking Stocks based on Prior Returns at the 20% quantile).

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

fp/hp	Holding Period (Days)																									Max 0,77	Min -1,66	Proportion positive 88,3%	Median 0,29	Mean 0,26
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250					
10	-1,66	-0,67	-0,19	-0,38	-0,13	0,17	0,13	0,00	0,08	0,08	-0,01	-0,35	0,12	-0,11	-0,12	0,28	0,04	-0,37	0,15	0,25	-0,14	0,28	0,02	-0,04	0,02	0,13				
20	-1,00	-0,74	-0,23	-0,13	-0,20	-0,09	0,07	0,07	0,37	0,37	-0,12	0,02	-0,12	0,06	0,05	-0,32	0,18	0,29	0,37	0,22	-0,06	0,01	0,18	0,75	-0,05	0,06				
30	-0,98	-0,40	-0,35	0,05	-0,03	0,14	0,38	0,11	0,25	0,25	0,05	0,04	-0,18	-0,36	0,12	-0,12	0,24	0,42	0,22	0,35	0,08	-0,16	0,13	0,40	-0,02	0,19				
40	-0,90	-0,20	-0,05	0,17	0,17	0,27	0,50	0,47	0,40	0,40	0,01	-0,11	-0,16	-0,48	0,24	0,08	0,39	0,40	0,57	0,05	0,18	-0,10	0,26	0,19	0,24	0,10				
50	-0,52	-0,14	0,07	0,27	0,31	0,35	0,33	0,36	0,39	0,18	0,12	0,12	-0,19	0,00	-0,23	-0,01	0,44	0,19	0,73	-0,11	0,12	-0,21	0,08	0,50	0,38	-0,05				
60	-0,26	-0,12	0,13	0,19	0,55	0,29	0,28	0,26	0,38	0,34	0,13	-0,06	0,15	-0,01	-0,01	0,12	0,31	0,00	0,69	-0,20	0,15	-0,22	0,27	0,23	0,51	0,16				
70	0,11	0,30	0,50	0,54	0,51	0,53	0,37	0,26	0,59	0,05	-0,11	0,35	0,44	0,02	-0,01	0,02	0,12	0,12	0,75	-0,26	0,18	-0,02	0,26	0,23	0,67	0,12				
80	0,12	0,41	0,50	0,59	0,50	0,42	0,42	0,56	0,45	0,14	0,49	0,50	0,35	0,17	-0,20	0,19	0,28	0,42	0,77	-0,22	0,23	0,15	0,53	0,33	0,69	0,09				
90	0,22	0,25	0,48	0,43	0,32	0,42	0,40	0,27	0,49	0,12	0,66	0,41	0,45	0,15	-0,46	-0,04	0,42	0,75	0,75	-0,14	0,30	0,07	0,23	0,08	0,62	-0,06				
100	-0,09	0,31	0,29	0,38	0,18	0,38	0,31	0,15	0,33	0,23	0,52	0,33	0,39	0,19	-0,19	-0,11	0,46	0,60	0,06	0,06	0,31	0,23	0,20	0,25	0,30	0,05				
110	0,19	0,41	0,29	0,48	0,59	0,35	0,41	0,38	0,20	0,59	0,40	0,35	0,32	0,40	0,12	0,03	0,09	0,43	0,12	0,59	0,07	0,23	0,08	0,26	0,37	0,10				
120	0,12	0,27	0,33	0,29	0,19	0,39	0,19	0,31	0,25	0,28	0,52	0,28	0,47	0,35	0,27	0,10	0,03	0,55	0,15	0,09	0,06	0,06	0,05	0,19	0,29	0,18				
130	0,22	0,25	0,27	0,27	0,22	0,48	0,29	0,28	0,42	0,18	0,53	0,32	0,45	0,33	0,42	-0,04	-0,04	0,38	0,10	0,20	0,08	0,15	0,15	0,39	0,33	0,41				
140	0,07	0,17	0,10	0,34	0,33	0,23	0,16	0,40	0,33	0,15	0,29	0,21	0,35	0,34	0,24	-0,14	0,29	0,33	0,05	0,30	0,16	0,12	0,24	0,24	0,30	0,37				
150	0,02	0,26	0,32	0,37	0,52	0,35	0,29	0,02	0,19	0,27	0,28	0,02	0,21	0,34	0,57	-0,08	0,16	0,18	0,18	0,23	0,26	0,25	0,18	0,48	0,12	0,28				
160	0,06	0,26	0,41	0,24	0,70	0,40	0,47	0,33	0,37	0,56	0,05	0,21	0,08	0,42	0,71	0,13	0,26	0,20	0,35	0,39	0,32	0,20	0,39	0,28	0,28	0,56				
170	0,20	0,28	0,35	0,36	0,52	0,39	0,55	0,36	0,22	0,24	0,17	0,01	0,03	0,44	0,40	0,26	0,37	0,03	0,51	0,22	0,36	0,37	0,39	0,11	0,45	0,45				
180	0,17	0,31	0,34	0,36	0,33	0,51	0,31	0,15	0,26	0,19	0,29	0,26	0,15	0,24	0,15	0,38	0,42	0,25	0,60	0,31	0,34	0,56	0,20	0,48	0,42	0,42				
190	0,04	0,27	0,38	0,35	0,41	0,54	0,00	0,31	0,24	0,27	0,53	0,41	0,51	0,02	0,50	0,47	0,42	0,27	0,50	0,15	0,38	0,62	0,38	0,47	0,44	0,44				
200	0,14	0,30	0,26	0,35	0,48	0,33	0,35	0,53	0,36	0,42	0,52	0,38	0,51	0,15	0,42	0,55	0,49	0,38	0,75	0,34	0,34	0,35	0,49	0,32	0,42	0,43				
210	0,07	0,29	0,32	0,32	0,63	0,45	0,25	0,43	0,40	0,53	0,46	0,37	0,43	0,16	0,44	0,58	0,40	0,34	0,66	0,46	0,46	0,37	0,52	0,11	0,26	0,50				
220	0,15	0,46	0,30	0,28	0,57	0,34	0,51	0,27	0,41	0,48	0,42	0,23	0,34	0,33	0,47	0,34	0,42	0,35	0,75	0,36	0,36	0,51	0,49	0,29	0,19	0,46				
230	0,15	0,25	0,17	0,37	0,63	0,26	0,43	0,30	0,37	0,59	0,45	0,26	0,34	0,48	0,42	0,43	0,26	0,45	0,52	0,44	0,44	0,50	0,46	0,13	0,23	0,29				
240	0,16	0,30	0,39	0,44	0,49	0,41	0,43	0,16	0,32	0,45	0,48	0,34	0,38	0,32	0,15	0,33	0,25	0,45	0,47	0,28	0,28	0,47	0,33	0,15	0,39	0,39				
250	0,22	0,30	0,54	0,48	0,49	0,60	0,53	0,37	0,60	0,40	0,40	0,54	0,38	0,50	0,19	0,39	0,33	0,71	0,20	0,28	0,62	0,63	0,44	0,35	0,40	0,40				

Once again, excess returns and associated positive information ratios are generally exhibited for longer formation periods, and tend to be maximised when employing longer formation and holding periods, *ceteris paribus*.

When comparing returns for the winner portfolio at the second and third decile, the winner portfolio at the second decile exhibits more accentuated returns. Given a more stringent selection criteria, one would expect these augmented returns. While the increased volatility of returns from holding fewer stocks in the portfolio appears to be outweighed by the relative increase in return overall, resulting in higher ratios, the maximum ratio of 0,77 falls just below the 0,78 achieved by the winner portfolio at the third decile. The mean information ratio of 0,26 and proportion positive of 88,3% both compare favourably to the mean of 0,16 and proportion positive of 79,8% achieved for the winner portfolio at the third decile. While the minimum information ratio of negative 1,66 is again generated by the same formation and holding periods associated with the minimum returns in section 4.2.3.1, this is not the case with the maximum information ratio of 0,77. Nevertheless, the low formation and holding period associated with the minimum ratio and longer formation and holding period associated with the maximum ratio are sensible, given the findings on the winner portfolio above, and an investor considering returns on a risk-adjusted basis would employ the same strategy as an investor seeking absolute returns.

Information Ratios

4.2.5.4:

Loser Portfolio: Formation and Holding Period up to 250 days (20% quantile) (Appendix 5.4)

The heat map below contains information ratios corresponding to the returns in the heat map in section 4.2.3.2 (Ranking Stocks based on Prior Returns at the 20% quantile).

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

fp/hp	Holding Period (Days)																									Max 1,65	Min -0,46	Proportion positive 67,7%	Median 0,07	Mean 0,10
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250					
10	1,65	0,80	0,76	0,27	0,39	0,02	0,08	-0,14	0,07	0,15	0,10	0,45	0,30	0,33	-0,08	0,22	0,24	-0,07	0,20	0,18	-0,29	-0,23	0,11	0,21	0,21					
20	1,19	0,78	0,63	0,54	0,42	0,06	0,01	0,21	-0,31	0,31	0,33	-0,01	0,03	0,52	0,11	0,11	-0,34	0,24	0,20	0,27	-0,15	-0,24	0,37	0,28						
30	1,29	0,61	0,57	0,15	0,04	-0,11	-0,14	0,14	-0,12	0,33	0,20	0,13	0,56	0,36	-0,17	-0,23	-0,34	-0,22	0,03	0,50	-0,10	-0,04	-0,09	-0,01						
40	0,99	0,73	0,37	0,16	0,26	-0,11	-0,21	0,11	-0,09	0,55	0,27	0,23	0,29	0,06	0,27	-0,18	-0,24	0,14	0,25	0,31	-0,05	0,12	-0,08	0,02						
50	0,99	0,59	0,37	0,27	0,18	0,15	0,14	0,18	0,22	0,32	0,25	0,33	0,01	0,50	0,33	-0,10	-0,30	0,24	0,04	0,54	0,03	0,01	0,01	0,12						
60	0,87	0,44	0,22	0,27	0,12	0,09	0,04	0,04	0,09	-0,14	0,40	0,26	0,10	0,41	0,24	-0,01	-0,18	0,00	0,16	0,40	0,16	-0,01	0,04	0,20						
70	0,60	0,26	0,07	0,20	0,11	-0,09	0,20	0,14	0,02	0,12	0,12	0,17	0,08	0,38	0,07	0,16	0,06	-0,03	0,41	0,08	0,25	-0,10	-0,14	0,27						
80	0,60	0,33	0,12	0,02	-0,04	-0,02	0,30	-0,11	0,13	0,10	0,04	-0,28	0,11	0,50	0,07	-0,08	0,11	-0,11	0,27	0,09	0,42	-0,12	-0,23	0,23						
90	0,46	0,13	0,00	-0,04	0,15	-0,09	-0,04	-0,24	0,07	0,15	-0,46	-0,22	-0,01	0,21	0,55	-0,30	-0,23	-0,10	0,15	0,15	0,26	-0,23	0,14	0,29						
100	0,40	0,28	0,03	-0,04	-0,05	-0,07	-0,12	-0,09	0,04	0,16	-0,40	-0,14	-0,07	-0,06	0,12	-0,01	-0,21	0,05	-0,02	0,05	0,06	-0,13	0,15	0,15						
110	0,58	0,22	0,26	-0,01	0,11	0,16	-0,04	-0,22	0,11	0,21	-0,35	0,04	-0,16	0,05	0,03	0,10	-0,11	-0,05	0,15	0,24	-0,15	-0,06	0,20	0,15						
120	0,33	-0,03	0,08	-0,18	-0,03	-0,04	0,31	-0,14	0,05	-0,07	0,03	0,25	-0,09	0,02	-0,19	0,09	-0,14	0,03	-0,30	0,12	-0,10	0,25	-0,05	0,07						
130	0,35	0,16	0,00	-0,13	-0,19	-0,02	0,06	-0,03	-0,13	0,05	0,02	-0,11	-0,13	-0,09	-0,06	0,36	-0,14	-0,15	-0,07	0,11	-0,21	0,09	-0,09	-0,28						
140	0,32	0,02	0,03	-0,08	0,01	-0,21	0,06	-0,12	-0,30	0,10	0,03	-0,16	-0,11	0,05	-0,09	0,10	-0,09	-0,13	0,00	0,01	-0,16	0,18	-0,14	-0,16						
150	0,41	0,22	0,12	0,10	0,16	-0,13	-0,12	0,30	-0,02	0,07	-0,03	-0,08	-0,11	0,13	-0,02	0,20	-0,17	0,10	-0,09	0,04	0,00	0,20	-0,20	0,02						
160	0,37	0,17	0,08	-0,02	-0,18	0,01	-0,19	0,17	-0,16	-0,10	0,03	-0,03	0,04	-0,08	-0,15	0,25	-0,10	-0,13	-0,15	-0,18	-0,17	0,13	0,09	0,22						
170	0,22	0,13	0,14	-0,02	-0,03	0,13	0,02	0,00	0,07	-0,04	0,11	0,02	0,10	0,20	0,08	-0,01	-0,22	0,27	-0,21	-0,14	-0,04	0,07	0,19	0,11						
180	0,31	0,18	0,15	0,05	0,06	0,24	0,18	0,08	0,09	0,08	0,03	0,00	-0,06	0,27	0,02	0,00	-0,03	0,20	0,02	0,08	-0,02	0,09	0,29	0,02						
190	0,04	0,26	0,37	0,33	0,39	0,53	0,00	0,30	0,24	0,28	0,56	0,43	0,55	0,02	0,49	0,46	0,43	0,28	0,53	0,15	0,40	0,70	0,38	0,47						
200	0,39	0,29	0,11	0,16	0,10	0,01	0,11	0,09	0,10	0,08	-0,09	-0,04	-0,04	0,22	0,05	-0,01	0,01	-0,03	0,07	0,10	0,05	-0,02	0,21	0,11						
210	0,39	0,34	0,16	0,07	-0,01	-0,08	-0,11	0,02	0,02	-0,01	-0,16	-0,03	0,06	0,04	0,13	-0,01	0,01	0,01	0,08	0,01	-0,02	-0,03	0,13	0,31						
220	0,39	0,34	0,19	0,12	0,14	0,16	-0,05	0,04	0,08	0,10	-0,09	0,10	0,03	0,06	0,10	-0,07	0,07	0,17	-0,06	0,10	0,07	0,03	0,06	0,27						
230	0,33	0,24	0,20	0,06	-0,04	0,05	-0,12	0,16	-0,01	0,12	-0,05	0,30	0,17	0,02	0,16	0,22	0,20	0,04	-0,06	0,17	0,00	0,14	0,24	0,42						
240	0,36	0,36	0,12	0,19	0,02	0,15	0,05	0,20	0,15	0,24	0,05	0,34	0,21	0,10	0,32	0,17	0,33	0,13	0,13	0,31	0,04	0,14	0,16	0,46						
250	0,31	0,10	0,18	-0,09	0,02	-0,10	0,03	-0,09	0,04	0,07	-0,01	-0,04	0,12	0,10	0,17	0,01	0,35	0,01	0,13	0,04	0,15	0,13	0,02	0,15						

In similarity to the pattern of returns exhibited in section 4.2.3.2, excess returns and associated positive information ratios are generally exhibited for shorter formation periods, and tend to be maximised when employing very short-term formation and holding periods, *ceteris paribus*. While positive, the mean information ratio of 0,1 and proportion positive of 67,7% are only slightly above that of the loser portfolio at the third decile. Maximum and minimum information ratios of 1,65 and negative 0,46 are generated by the same formation and holding periods associated with the maximum and minimum returns to the strategy, and above those of the loser portfolio at the third decile. An investor measuring returns on a risk-adjusted basis would employ the same strategy as an investor seeking total return. As is the case previously when comparing portfolios on returns alone, the results in this section advocate for decreasing the number of stocks in the portfolio to the second decile.

4.2.6 Effect of portfolio size on optimal strategy

The ratios above demonstrate the effect on risk-adjusted returns when reducing the number of stocks in the portfolio. In order to document the effect of portfolio size on a given formation and holding period combination, the formation and holding period associated with optimal returns to both the winner and loser portfolio at the second decile are held constant, while varying the number of shares included in the portfolio from 10% to 100% of the market.

Effect of Portfolio Size on Optimal Winner Portfolio:

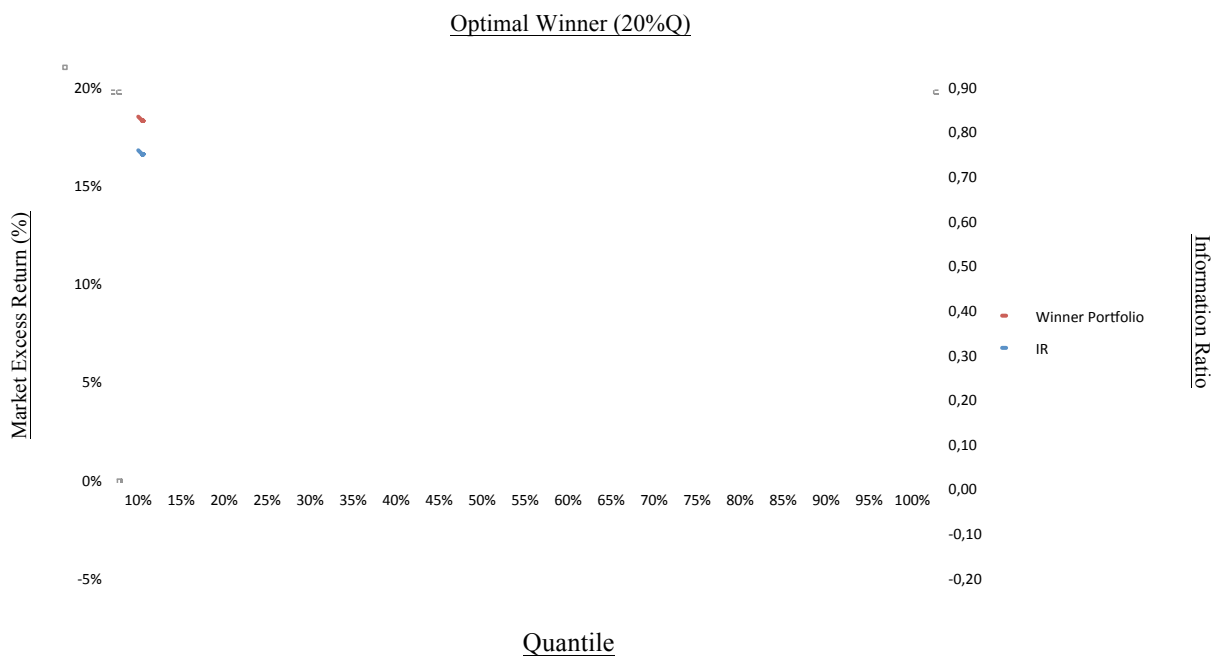
Information Ratios and Market Excess returns (with market as equally weighted index)

Ranking Stocks Based on Prior Returns:

4.2.6.1

Formation Period 200 days; Holding Period 190 days

(Appendix 6.1)



The optimal winner portfolio exhibited a 10,7% annualised above market return at a formation and holding period of 200 and 190 days respectively. Setting the formation period and holding period to these optimal values, reducing the portfolio size down to the 10% quantile, and increasing the number of stocks allocated to the portfolio in increments of 5% is graphed above. The data points are recorded in appendix 6.1.

As could be expected, an excess market return of 0% is exhibited when including all 60 shares in the portfolio at the 100% quantile, with returns falling below market between the 80% and 100% quantile. Reducing the number of shares in the portfolio to the 10% quantile produced a market excess return of 18%. While there is no visible

downside risk associated with the increased volatility in returns on the left hand side of the graph, increasing variation in returns is evident as each share has significantly more influence on portfolio price fluctuation, relative to a portfolio comprising more stocks. The information ratios pertaining to each return point are also graphed and marked on the right hand y-axis. While increasing returns associated with decreasing the quantile generally produces higher information ratios, it can be seen that the relationship is not necessarily linear, particularly at quantiles below 20% or above 80%. The optimal range of attainable information ratios as one moves left across the graph reaches a maximum in an indicative range in the 20% to 30% quantiles before becoming volatile. The relative trade-off consideration to an investor of the increased volatility of returns when reducing the number of stocks in the portfolio against diminishing returns on the right of the graph is partly dictated by risk appetite, with an optimal range as indicated above.

Effect of Portfolio Size on Optimal Loser Portfolio:

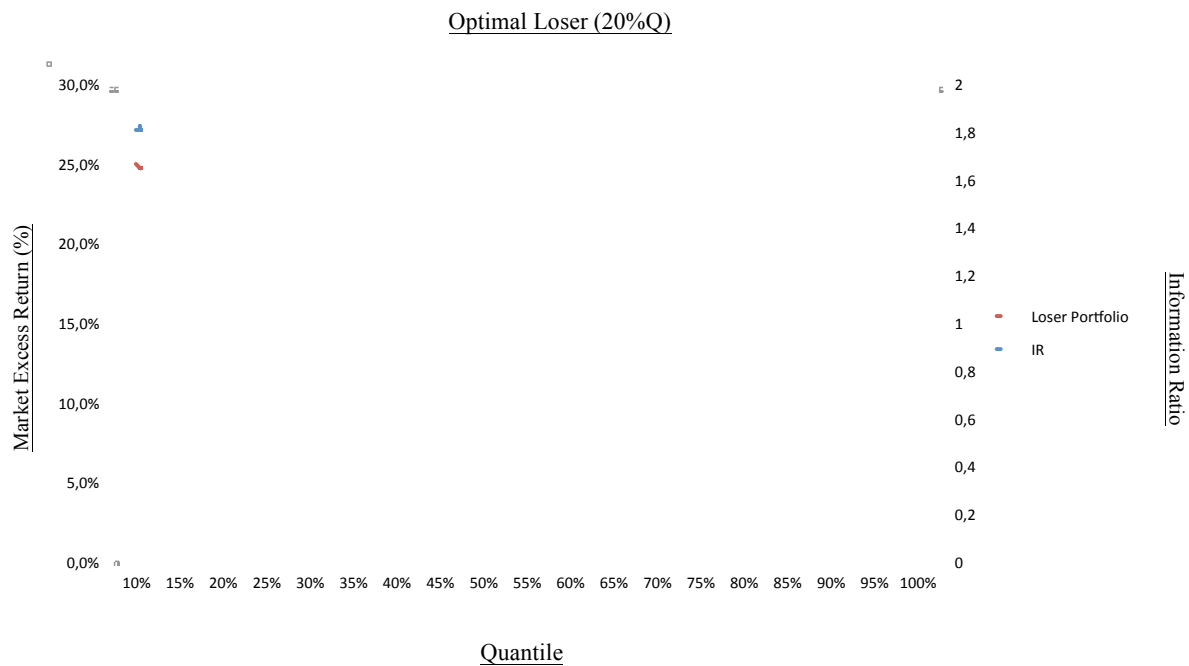
Information Ratios and Market Excess returns (with market as equally weighted index)

Ranking Stocks Based on Prior Returns:

4.2.6.2

Formation Period 10 days; Holding Period 10 days

(Appendix 6.2)



The optimal loser strategy at the second decile exhibited a 20% annualised above market return at a formation and holding period of 10 days respectively.

An excess market return of 0% is correctly exhibited at the 100% quantile. Reducing the number of shares in the portfolio to the 10% quantile produced a market excess return of 25%. Unlike the pattern exhibited with the winner portfolio above, there is a far less marked correlation between information ratios and return when increasing the quantile specification. As one adds more stocks to the portfolio, the decrease in return is almost equally offset by a proportionate decrease in the variability of returns, with the resultant information ratios remaining in a range of between 1,6 and 1,8 for quantile restrictions between 20% and 80%. In similarity to the winner portfolio,

however, at a quantile restriction below 20% or above 80% there is a significant change (in this instance a sharp decrease) in the information ratio obtainable. For the loser portfolio, market excess return never falls below zero. While the proportion positive of the loser portfolio falls significantly below that of the winner portfolio at the second decile (for the combinations of formation and holding period tested earlier in this research report), the optimal loser outperforms the optimal winner in every quantile specification in the graph above.

Given an optimal quantile range of 20% to 30%, the results prior to and within this section present an argument for a portfolio comprised of shares in the 20% rather than the 30% quantile, owing primarily to higher achievable returns and information ratios. Further, given a 60 share universe, a portfolio comprising shares at the 20% quantile will generally contain 12 shares, resulting in an 8,3% allocation of the portfolio to one particular share, on average. Given the restriction of a maximum of 10% of the portfolio to be invested in one stock on many institutional investors, it is unlikely that such investors would reduce the chosen quantile below 20% for a 60-share universe. Given these findings, the final strategy is tested only at the second decile.

4.3. Ranking Stocks as Overbought or Oversold

The first strategy explored in this research report examined a simple price and moving average simulation, which has been documented to suffer from the incidence of false signals, particularly at lower moving averages. Further, the relative proportion by which stocks have deviated from some intrinsic value was not accounted for in the simple preliminary model, with maximum achievable returns obtained in section 4.1 more than 5% below those exhibited by a model using more sophisticated ranking criteria in section 4.2. The strategy below combines a more advanced price and moving average technique with the methodology undertaken in section 4.2; that of ranking shares based on prior performance.

The same ranking and performance measures in terms of formation period and holding period are used to run the simulation, however a stock's performance over the formation period is measured as the change in price relative to the price level of a moving average in that period:

$$[(\text{Price-Moving Average Value}) / \text{Moving Average Value}]$$

The theory underpinning the simulation is that the relative proportion by which a share's price exceeds (falls below) its moving average within a pre-specified period is a good indicator of shares being overbought or oversold, which should in turn be a good indicator of a price correction. Further, varying the moving average and holding period allows one to observe these reversals in both the short term and longer term. Given the observations of both short-term and medium to long-term price reversals in prior findings, the effectiveness of this method as a ranking technique over the formation period is explored.

Overbought and oversold shares tend to exhibit price corrections in relatively short-term holding periods after a given formation period, as prices quickly regress to an intrinsic value. Resultantly, the holding period is limited to 50 days and varied in steps of 5 days. As in section 4.1, in order for one to see the effect of employing both short-term and longer-term moving averages, the range of moving averages moves in 5 day increments between 5 and 50 days, after which it extends to 300 days in steps of

50 days. While this extended formation period range provides data comparable with observations in section 4.1, longer moving averages tend to become relatively flat, reducing the effectiveness of an overbought or oversold indicator. Resultantly, the formation period range is restricted to 300 days. Following the argument for a 20% quantile selection parameter throughout section 4.2, the quantile is set to the second decile for the simulations below.

Ranking Stocks as Overbought or Oversold

4.3.1:

Winner Portfolio: Formation Period up to 300 days;

Holding Period up to 50 days (20% quantile)

(Appendix 7.1)

The heat map below contains annualized market excess returns (equally weighted index as market) to the winner portfolio.

Moving vertically down the table increases the moving average length (formation period), while moving horizontally across the table increases the holding period.

		Holding Period (Days)									
		5	10	15	20	25	30	35	40	45	50
Moving Average (Days)	fp/hp										
	5	-16,4%	-10,5%	-3,8%	-3,0%	-5,2%	1,1%	0,2%	-2,3%	-1,6%	-4,6%
	10	-25,2%	-15,6%	-8,0%	-12,2%	-9,4%	-0,7%	-5,8%	-4,9%	-0,9%	-6,0%
	15	-25,4%	-16,8%	-13,0%	-8,7%	-3,0%	-6,8%	-3,9%	-3,8%	-6,5%	0,8%
	20	-25,7%	-18,3%	-10,7%	-10,4%	-3,9%	-8,8%	-4,1%	-5,8%	-7,5%	-2,4%
	25	-25,6%	-15,8%	-10,9%	-7,6%	-7,6%	-4,2%	-3,1%	-2,3%	-0,8%	-4,3%
	30	-24,3%	-17,4%	-11,9%	-11,0%	-7,0%	-9,2%	-0,9%	-3,1%	-4,4%	-1,5%
	35	-23,4%	-15,4%	-10,1%	-7,8%	-11,0%	-6,5%	-5,9%	-3,5%	-2,6%	-3,3%
	40	-21,0%	-14,7%	-9,7%	-9,6%	-1,9%	-5,7%	-5,3%	-4,7%	-2,4%	0,7%
	45	-22,4%	-14,4%	-10,3%	-9,2%	-4,9%	-5,7%	-7,1%	-4,3%	2,3%	3,2%
	50	-21,8%	-13,8%	-7,3%	-7,8%	-4,9%	-4,7%	-3,4%	-1,7%	1,2%	1,6%
	100	-10,2%	-5,9%	-4,1%	-2,0%	0,1%	1,5%	4,9%	0,7%	4,9%	4,8%
	150	-6,3%	-3,2%	-0,6%	-0,1%	1,8%	2,4%	-1,1%	3,5%	4,1%	5,7%
	200	-3,2%	-0,3%	2,4%	2,0%	3,9%	3,2%	5,6%	4,5%	5,2%	7,4%
	250	-3,0%	-0,2%	0,2%	3,3%	4,8%	4,2%	4,8%	5,4%	6,1%	7,1%
	300	-2,2%	-0,1%	2,4%	5,3%	4,6%	5,0%	6,1%	5,4%	4,5%	7,1%

Max	7,4%
Min	-25,7%
Proportion positive	28,7%
Median	-3,8%
Mean	-4,6%
Std Dev	7,7%

In a similar fashion to the pattern exhibited throughout section 4.2, returns to buying the winner portfolio at low formation and holding periods after stocks have been ranked (as the most overbought in the preceding formation period) are significantly below market. A downward price reversal is observable, and again returns which are the most below market are at lower holding periods. The worst returns to the strategy are at moving average lengths (formation periods) between 10 and 35 days. The simulation yielded a return as low as 25,7% below market for a moving average of 20 days, with a corresponding 5-day holding period. The extent of the price reversal diminishes with longer holding periods, with price continuation achieved at relatively lower holding periods as the formation period increases. The proportion positive of cells is very low at 28,7%, demonstrating the general market underperformance associated with buying an overbought portfolio and exercising holding periods of 50 days or less. As previously observed in prior sections, increasing both the formation and holding period increases returns to the strategy, with a more pronounced effect on returns from increasing the formation period, particularly at shorter holding periods. Stated alternatively, stocks which have been overbought over a longer formation period (moving average), tend to exhibit proportionately smaller price corrections, *ceteris paribus*. This supports similar findings on the formation period in section 4.2, and to an extent on moving average lengths in section 4.1.

With reference to the returns to the winner portfolio in section 4.2.3.1 (appendix 4.1), the downward price reversal persists through longer formation periods as one increases the moving average length. A 250-day moving average is incapable of achieving price continuation if held for 10 days, whereas appendix 4.1 demonstrates a 3,2% market excess annualized return for the same parameters. While there are notable benefits to short-selling the winner portfolio at lower formation and holding periods, price continuation and subsequent momentum is certainly attainable at moving averages equal to or greater than 100 days; holding the investment position for 25 days or longer.

Ranking Stocks as Overbought or Oversold

4.3.2:

Loser Portfolio: Formation Period up to 300 days;

Holding Period up to 50 days (20% quantile)

(Appendix 7.2)

The heat map below contains annualized market excess returns (equally weighted index as market) to the Loser portfolio.

Moving vertically down the table increases the moving average length (formation period), while moving horizontally across the table increases the holding period.

		Holding Period (Days)									
		5	10	15	20	25	30	35	40	45	50
Moving Average (Days)	fp/hp										
	5	21,3%	12,2%	7,5%	5,5%	9,0%	3,7%	5,1%	5,8%	3,2%	6,3%
	10	24,3%	15,4%	11,1%	14,2%	8,8%	6,6%	9,2%	5,1%	2,7%	8,3%
	15	22,6%	15,4%	11,4%	11,8%	4,3%	5,6%	6,1%	7,7%	6,1%	0,9%
	20	21,9%	14,9%	8,7%	8,1%	4,3%	6,0%	2,2%	3,3%	4,4%	-0,8%
	25	21,9%	16,2%	14,1%	8,0%	8,1%	9,9%	2,0%	2,2%	5,4%	3,1%
	30	23,0%	17,0%	13,9%	15,5%	10,2%	7,1%	2,1%	5,7%	5,4%	8,5%
	35	22,6%	15,4%	10,2%	10,5%	7,7%	5,4%	8,4%	4,7%	5,2%	2,5%
	40	18,9%	15,2%	13,4%	8,8%	5,5%	7,0%	6,2%	2,6%	5,4%	4,3%
	45	18,1%	14,4%	13,2%	7,8%	6,3%	5,6%	6,0%	3,4%	1,2%	2,7%
	50	16,9%	14,0%	9,1%	9,5%	6,8%	2,5%	4,3%	4,9%	1,0%	-0,7%
	100	13,8%	7,9%	6,0%	1,3%	2,9%	2,0%	-0,9%	-0,8%	-1,4%	-1,0%
	150	10,8%	8,0%	5,5%	4,9%	1,8%	1,5%	3,1%	-0,9%	0,0%	0,9%
	200	9,2%	8,3%	6,0%	5,6%	3,8%	3,3%	2,7%	4,1%	3,6%	3,3%
	250	6,0%	4,8%	4,0%	3,4%	2,2%	3,0%	1,3%	4,1%	3,3%	0,5%
	300	5,1%	4,7%	3,7%	3,4%	1,6%	1,3%	0,7%	0,4%	0,5%	-0,2%

Max	24,3%
Min	-1,4%
Proportion positive	94,7%
Median	5,6%
Mean	7,0%
Std Dev	5,7%

In contrast to the winner portfolio above, returns to buying the loser portfolio after stocks have been ranked (as the most oversold in the preceding formation period), are highly positive. An upward price correction is observable, and in similarity to section 4.2, the returns which are the most above market are at lower holding periods. The best returns to the strategy are at moving average lengths (formation periods) between 10 and 35 days. The strategy yielded a return as high as 24,3% above market for a moving average of 10 days, with a corresponding 5-day holding period. As with the winner portfolio, the extent of the price reversal diminishes with longer holding periods. An investor buying the loser portfolio would maximize returns to the strategy while employing shorter formation periods and closing out the position in a relatively short space of time, capturing the full extent of the price reversal. In stark contrast to the winner portfolio, the proportion positive of observations is 94,7%, demonstrating the general market outperformance associated with buying an oversold portfolio and exercising holding periods below 50 days. In contrast to the findings in section 4.2, where a proportionately larger upward price reversal in the loser portfolio relative to the downward price reversal in the winner portfolio was observed, the opposite tends to occur when employing this ranking method. In this instance this is evident from both the magnitude of individual returns, as well as from the sum of returns for formation periods up to 100 days, given a 10-day holding period.

Increasing both the formation and holding period decreases returns to the strategy, with a more pronounced effect on returns from increasing the formation period, particularly at shorter holding periods. Stocks which have been oversold over a longer formation period (moving average), tend to exhibit proportionately smaller price corrections, *ceteris paribus*.

The above results advocate using this method as a signal generation technique in order to lock in to market-excess returns by buying oversold stocks, with indicative profits of a similar (and in some instances larger) magnitude emanating from short selling overbought stocks.

The effect of increasing both the formation and holding period in section 4.2 and 4.3 suggests investors should consider their ability to hold an investment position when executing a trade. While winners and losers have demonstrated price continuation

(given a long enough holding period), an investor would not likely hold a loss-generating stock over an extended holding period in the hope of price continuation. Similarly, it is unlikely that an investor would short sell a stock from the loser portfolios exhibited in these sections and hold the position in anticipation of downward price continuation, given the significant losses that would amount over the initial holding period.

Given these observations, the results in section 4.2 and 4.3 tend to indicate that while winners are able to outperform the market (given a sufficient holding period), an investor buying the loser portfolio and closing out the position within a few days would generate significantly higher returns. An investor following the same strategy while short selling the winner portfolio (as determined by either favourable prior performance or as a result of being overbought) would generate returns of a similar magnitude (and in some instances even higher). In fact, employing the optimal short-term formation and holding periods from the loser portfolios when short selling the winner portfolios in section 4.2 and 4.3 would generate a superior return. Results in section 4.1 advocate for buying the loser portfolio and short selling the winner portfolio at low moving averages, closing out the investment position within several days. These findings are central to the contrarian investment strategy evidenced in this research report, and are supported throughout subsequent sections.

5. Interpretation of Results and Conclusion

5.1 Interpretation of results

The results documented in this research report present a convincing account of momentum trading and investor overreaction in the market place.

A simple investment strategy involving price and moving average to generate trading signals is found to be capable of producing market excess returns of up to 14,9% per annum. The loser portfolio tended to outperform the winner portfolio, while the winner portfolio was incapable of outperforming the market in any of the 15 simulations tested. While this strategy is relatively easy to implement, it has been documented to suffer from the incidence of false signals, and does not take into account the relative proportion by which a stock has deviated from some intrinsic value. Nevertheless, findings that an investor would maximise returns by buying the loser portfolio or short selling the winner portfolio at low moving averages, closing out the trade in several days, are supported in this section.

The investment strategy of buying portfolios of the best and the worst performing stocks over preceding formation periods and holding these portfolios for varying time periods is found to be capable of generating returns in excess of 20% of the market on an annualized basis.

When ranking stocks based on prior performance, a portfolio of the best performing stocks in a preceding period (“the winner portfolio”) is able to outperform the market. A short-term downward price correction is exhibited by this portfolio post favourable performance in the formation period, and is exacerbated at lower formation periods. Given a minimum formation period of 50 days, price continuation is achieved after holding the portfolio for at least 30 days, with annualized market excess returns greater than 10% achieved at longer formation and holding periods.

A portfolio of the worst performing stocks in the same period (“the loser portfolio”) is able to outperform the winner portfolio, exhibiting a sharp upward short-term price correction post poor performance in the formation period. This portfolio is capable of achieving returns 20% in excess of the market, given a formation period as low as 10

days, while closing the investment position after no more than 10 days. This is indicative of outperformance of the winner portfolio by almost 10% in nominal terms (though it must be noted that short-selling the winner portfolio at low formation and holding periods would generate returns of a similar magnitude, and in some instances an even higher return). In the long-term, the winner portfolio is found to exhibit a downward price reversal, generating diminishing performance across the range of holding periods examined for formation periods greater than 400 to 600 days, depending on the quantile restriction. Returns to the winner portfolio fall below those of the market at formation periods greater than 600 to 800 days, depending on the quantile restriction. Conversely, the loser portfolio exhibits a long-term upward price reversal, exhibiting upward price momentum across the range of holding periods examined for formation periods greater than 250 days.

The existence of price reversals often occurs as a result of stocks being overbought or over sold, which the method of ranking shares as described in section 4.3 is an indicator of. The results from this simulation strongly support those in prior sections; advocating for buying the loser portfolio and short-selling the winner portfolio while exercising short-term formation and holding periods.

The effect of changing the number of shares in the portfolio explored in this research report indicates that, even on a risk-adjusted basis, a portfolio ranking restriction on stocks at the second decile would outperform a portfolio at the third decile. However, increased risk associated with fewer stocks, as well as an institutional restriction of no more than 10% of the portfolio invested in 1 stock precludes an investor from employing a decile which is too restrictive. When considering whether to engage the winner or loser portfolio against changing the number of stocks in the actual portfolio, the results in appendix 8 indicate that an investor is more likely to experience a significant difference in returns when alternating between buying the winner and loser portfolio, rather than changing the number of stocks in the portfolio for a given strategy. The results for both the difference in proportions test, as well as for the difference in means test support the findings of Muller (1999).

While prior papers documented in the literature review in section 2 present findings specified by formation and holding periods spanning several years, there has been a

distinct focus in this research report on limiting the holding period to a maximum of 250 days, for reasons elaborated on previously. With this in mind, the implications on market outperformance for both the winner and loser portfolio as referenced above need to be qualified in terms of time-specific formation and holding investment periods, as discussed in the conclusion of this research report.

While it must be noted that the inclusion of transaction costs will mitigate the extent of returns observed, section 4.2 of this research report presents a convincing case of market inefficiency through both price reversals and price momentum patterns, while section 4.3 documents the effect of using a share's price and moving average relationship as an indication of being overbought or oversold, conditions synonymous with price corrections via reversals. Returns to buying an oversold portfolio or short selling an overbought portfolio exceeded the market return by more than 20% on an annualized basis, while similar returns are obtainable for the shortest formation and holding periods examined when ranking stocks based on prior returns. There is a strong indication that an investor would maximize return by either buying or short-selling a stock and quickly closing out the investment position to try to capture a price correction in the short term, rather than trying to hold a stock through to price continuation.

5.2 Conclusion

This research report documents an interesting example of evidence of investor overreaction in the marketplace. The winner portfolio is found to exhibit negative excess returns associated with shorter formation and holding periods, while returns to the loser portfolio are maximized at shorter formation and holding periods. Given a sufficient holding period, the winner portfolio is able to outperform the market through price continuation. Both in the short term, with price reversals evidenced, as well as the long-term, where the loser portfolio experiences an upward price reversal and vice-versa for the winner portfolio, the loser portfolio tends to dominate the winner portfolio. Thus both research propositions as specified in section 3.2 are confirmed.

A simple price and moving average strategy is capable of achieving excess returns of up to 14,9% per annum. However, while simple moving average rules may achieve outperformance, they do not necessarily identify price corrections when stocks have been pushed unsustainably above or below their intrinsic values, as signals are generated merely by the stock price crossing over a variable moving average. This calls for a more sophisticated method. Ranking shares based either on prior returns, or being overbought or oversold in the formation period provides for more sophisticated signal generation techniques, and these tend to exhibit increased market outperformance.

When ranking shares based on prior returns, short-term investor overreaction is found to drive the prices of losers in preceding periods to levels far below their intrinsic value. The subsequent upward price reversal in short term holding periods is able to generate returns which outperformed the market by more than 20% on an annualized basis. In the context of one trading year (250 days), an increasing formation period tends to diminish the effect of the price reversal, as losers which have exhibited consistently poor performance over longer formation periods are less likely to experience the same extent of unsustainable downward price pressure, given the adjustment in the market over extended time periods. An increasing holding period within a 250-day trading period tends to achieve downward price continuation within 30 to 50 days (depending on the formation period) as the price reversal eases out.

Similarly, short-term investor overreaction is found to drive the prices of winners in preceding periods to levels far above their intrinsic value. The subsequent downward price reversal in short term holding periods is able to generate returns which underperformed the market by as much as 21% on an annualized basis. In the context of one trading year (250 days), an increasing formation period tends to diminish the effect of the price reversal, as winners which have exhibited consistently good performance over longer formation periods are less likely to experience the same extent of unsustainable upward price pressure, given the adjustment in the market over extended time periods. An increasing holding period within a 250-day trading period tends to achieve price continuation within 30 to 50 days, depending on the formation period.

The price reversals for the winner and loser portfolio are not necessarily of equal magnitude. When ranking shares based on prior returns, the proportionately larger upward price reversal in the loser portfolio relative to the downward price reversal in the winner portfolio presents evidence of loss aversion in the market, where investors have overreacted proportionately more to negative information over positive information, pushing losers further below their intrinsic value relative to winners exceeding their intrinsic value. This is not necessarily evidenced from a single return but rather from the sum of returns for formation periods up to 60 days, given a 10-day holding period in section 4.2. This is not observed in section 4.3. When ranking shares based on being overbought or oversold, the winner portfolio tends to experience a proportionately larger downward price reversal relative to the upward price reversal in the loser portfolio.

Increasing the formation period beyond 250 days reveals a distinct 400 to 600-day high-water mark for the winner portfolio (depending on the quantile restriction); beyond which winners exhibit diminishing performance across the spectrum of holding periods, with returns turning negative in relation to the market as a result of a long-term downward price reversal. While the winner is able to achieve sustained price continuation post a short-term downward price reversal, this does not appear to be the case with a long-term price reversal at the third decile (given a 250-day holding period). The 250 day formation period tends to be a point at which returns to the loser

portfolio have bottomed out, beyond which returns across the range of holding periods are in excess of the market as a result of a long-term upward price correction.

An investor betting on price continuation and momentum would be happier buying the winner portfolio at formation periods of between 200 and 600 days, while exercising a holding period in the region of 180 days, while an investor backing a contrarian strategy would maximise returns by buying losers (or short selling winners) after formation periods as low as 5 days, closing out the trade after no more than 10 days.

The existence of price reversals often occurs as a result of stocks being overbought or oversold, which the method of ranking shares as described in section 4.3 is an indicator of. Using a stock's change in price with respect to the price level of a variable moving average as an indication of being overbought or oversold is found to be a good indicator of subsequent price correction. As found when ranking stocks based on prior returns, the winner portfolio, identified as comprising those stocks with the highest proportionate change in price with respect to the price level of a variable moving average, exhibits a short-term downward price reversal post the formation period. Price continuation is achieved at holding periods greater than 25 days, given a minimum formation period (moving average) of 100 days. Annualized market outperformance of up to 7,4% is achieved at longer formation and holding periods. The loser portfolio, identified as comprising those stocks with the greatest negative proportionate change in price with respect to the price level of a variable moving average, exhibits a short-term upward price reversal post the formation period. Annualized market excess returns of 24,3% are achieved with a 10-day formation period (moving average), closing out the investment position within 5 days. These results indicate that an investor would maximize returns by either buying the (oversold) loser portfolio, or short selling the (overbought) winner portfolio at low formation periods, and closing out the investment position at very low holding periods. Both of these strategies are indicative of returns greater than 20% above the market.

While the three core strategies explored in this research report are defined by various parameters, each presents evidence of market inefficiency through abnormal returns, obtainable via price corrections in the market.

A simple price and moving average strategy requires a less sophisticated signal generation technique, and (given no quantile specification), contains more stocks in the winner or loser portfolio during simulation, resulting in less variation in daily returns for a specified moving average and holding period length. In unreported data, the daily standard deviation of returns to this strategy for individual moving average and holding period lengths (when annualised) is circa 4% lower on average than that exhibited in winner and loser portfolios at the second decile in section 4.2. The ranking of shares based on prior returns is an effective method to obtain above market returns via either the identification of price corrections, or through price continuation. Ranking shares as overbought or oversold is also found to be an effective method of identifying price corrections, with market outperformance in excess of 23% achieved on an annualised basis.

While all three of the strategies employed have their own merits and demerits, ranking shares with a quantile specification restriction either as overbought/oversold, or based on prior returns, is able to generate returns far higher than those from the simple price and moving average method. At a 10-day moving average and 5-day holding period, returns to the loser portfolio in section 4.3 (overbought/oversold) are more than 12% higher than those in section 4.1 (price and moving average) for the same parameters, and more than 9% higher than the maximum achievable return in section 4.1 (achieved at a 25-day moving average). While the lowest holding period tested for the loser portfolio in section 4.2 (ranking shares based on prior returns) is 10 days, a 10-day formation and holding period for the loser portfolio at the second decile generates returns more than 4% higher than those exhibited in section 4.3 for the same parameters. Given the findings on a decreasing holding period in section 4, one would expect the loser portfolio in section 4.2 to outperform the loser portfolio in section 4.3 at a 10-day formation period and 5-day holding period by implication. This is confirmed in unreported data, with a 26,7% market excess return achieved for these parameters. This is 2,5% higher than the return exhibited for the same formation and holding period in section 4.3. Hence by comparison, ranking stocks based on

prior returns is found to generate higher returns than ranking stocks as overbought/oversold, which in turn is found to generate higher returns than employing a simple price and moving average strategy.

Nevertheless, all three strategies advocate for buying the loser portfolio and short selling the winner portfolio at low formation periods, closing out the trade within no more than 10 days. The simulations explored in section 4.2 and 4.3 also demonstrate the positive market excess return achieved through longer-term price continuation, though to a lesser magnitude than those returns achieved when exploiting short-term price corrections.

An investor seeking an optimal strategy would maximize returns by simultaneously buying the oversold (loser) portfolio and short selling the overbought (winner) portfolio at formation periods as low as 5 days, closing out the trade within 5 to 10 days.

While the findings in this research report certainly present a strong case for investor over-reaction in the market place, any technical trading strategy requires continual adjustment and augmentation, given the ever-increasing flow of information and technological advances in the market place.

Future research in this area would benefit from incorporating transaction costs, given the suggested high frequency trading proposed as an optimal investment strategy. High frequency trading costs will certainly decrease returns to the strategy, while further refinement in the ranking criteria of stocks may prove insightful. While prior research draws attention to the effectiveness of advanced trend isolators, such as the Hodrick and Prescott filter, the smoothing parameter may need to be refined. Multiplying the squared frequency of the data in this research report by 100 would result in a smoothing parameter value (λ) in excess of 6 million (assuming 250 trading days in 1 year). In this instance, at such high λ values, the isolated trend would converge towards a linear trend, resulting in severe delays in the detection of turning points in price. However, the application of the filter on lower frequency data may well yield better results.

The consideration of industry or sector-specific factors on stocks prior to ranking and portfolio allocation may enable investors to identify stocks which have been pushed the most above or below their intrinsic value. While returns generated in the simulations in this research report indicate significant market outperformance, it is uncertain whether the optimised parameters in these simulations are accurate predictors of future market movements. To this end, testing the simulations on differing time periods can provide further insight in this regard. Over and above these observations, risk-aversion, transaction costs, as well as the ability to hold an investment position when employing the strategies simulated in this research report must be considered, along with the tradability of shares within the portfolio at any given time.

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Appendix 1:**Top 60 shares by Market Capitalization as at August 2012**

Stock	Market Capitalisation	Stock	Market Capitalisation
SAB	R 625 180 800 301	IPL	R 42 839 454 370
BIL	R 523 814 035 175	MSM	R 36 783 108 842
AGL	R 331 336 528 299	CSO	R 39 323 055 029
MTN	R 295 940 646 233	HAR	R 29 449 943 465
CFR	R 271 440 000 000	ARI	R 31 583 228 712
SOL	R 233 946 636 788	TFG	R 32 467 262 535
NPN	R 201 506 513 640	DSY	R 34 139 199 455
SBK	R 176 788 425 498	MPC	R 34 127 130 801
KIO	R 154 588 139 520	MMI	R 30 554 773 215
FSR	R 154 761 499 363	REI	R 30 272 928 687
VOD	R 159 181 318 920	INP	R 30 811 735 504
AMS	R 112 980 529 321	MDC	R 28 538 796 169
ANG	R 100 663 269 839	ABL	R 26 135 694 000
OML	R 109 211 042 180	LBH	R 26 276 239 865
ASA	R 102 165 378 617	MNP	R 27 458 594 990
SHP	R 96 422 222 945	NTC	R 25 534 001 348
NED	R 93 889 255 835	RDF	R 26 557 187 942
IMP	R 84 017 964 660	TSH	R 23 063 936 766
GFI	R 73 702 105 546	SNT	R 21 470 420 418
SLM	R 77 658 000 000	PIK	R 21 344 052 972
REM	R 69 231 206 643	SPP	R 21 356 978 026
BVT	R 66 857 925 516	ACL	R 18 097 536 559
APN	R 65 265 399 874	AVI	R 19 844 409 420
EXX	R 53 515 215 137	LON	R 15 695 813 229
RMH	R 51 329 529 006	BAW	R 16 396 549 933
TBS	R 52 923 464 482	NPK	R 18 840 473 829
TRU	R 43 987 404 977	CPL	R 17 532 220 304
WHL	R 50 230 073 280	HYP	R 17 868 817 922
GRT	R 47 812 709 581	PPC	R 15 592 131 895
SHF	R 46 490 054 307	RLO	R 14 253 268 657
		Total	R 5 301 046 240 342

Appendix 2:

Price and Moving Average

Appendix 2.1:

Winner Portfolio: Excess market return by moving average Length

The heat map below contains annualized market excess returns (equally weighted index as market) to the winner portfolio by selected moving average lengths for a 5-day holding period. Moving vertically down the table increases the moving average length.

		<u>Holding Period (Days)</u>	
		5	
<u>Moving Average (Days)</u>	MA/HP		
	5	-7,4%	
	10	-12,7%	
	15	-11,8%	
	20	-12,8%	
	25	-11,2%	
	30	-11,3%	
	35	-11,3%	
	40	-9,1%	
	45	-8,2%	
	50	-7,0%	
	100	-4,8%	
	150	-3,6%	
	200	-0,9%	
	250	-1,3%	
	300	-2,4%	
		Max	-0,9%
		Min	-12,8%
		Proportion positive	0,0%
		Median	-8,2%
		Mean	-7,7%
		Std Dev	4,2%

Appendix 2.2:

Loser Portfolio: Excess market return by moving average Length

The heat map below contains annualized market excess returns (equally weighted index as market) to the loser portfolio by selected moving average lengths for a 5-day holding period. Moving vertically down the table increases the moving average length.

		Holding Period (Days)		
		5		
Moving Average (Days)	MA/HP			
	5	8,8%		
	10	11,6%		
	15	11,8%		
	20	14,3%		
	25	14,9%		
	30	13,3%		
	35	13,7%		
	40	12,8%		
	45	11,8%		
	50	12,2%		
	100	10,6%		
	150	8,2%	□ Max	14,9%
	200	2,7%	Min	2,7%
	250	6,3%	Proportion positive	100,0%
	300	5,2%	Median	11,8%
			Mean	10,6%
		Std Dev	3,6%	

Appendix 3:

Ranking shares based on prior returns at the 30% quantile

Appendix 3.1:

Winner Portfolio: Formation and Holding Period up to 250 days (30% quantile)

The heat map below contains percentage returns in excess of the market (relative to the equally weighted index).

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

Max 7,6%
 Min -16,7%
 Proportion positive 79,8%
 Median 1,9%
 Mean 1,7%
 Std Dev 2,5%

fp/hp	Holding Period (Days)																								
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250
10	-16,7%	-7,3%	-3,0%	-2,6%	-1,3%	1,8%	-0,6%	1,3%	0,2%	-1,6%	-1,9%	0,7%	-1,4%	-1,8%	0,9%	-0,2%	-0,3%	0,6%	3,5%	-1,2%	0,6%	0,2%	-1,0%	-0,5%	1,6%
20	-12,2%	-9,3%	-3,4%	-2,3%	-3,6%	-1,1%	1,5%	1,5%	4,6%	-2,9%	-0,5%	-1,8%	1,0%	0,9%	-5,0%	2,7%	3,9%	3,1%	1,9%	-2,3%	-0,2%	2,9%	4,3%	-1,0%	-0,1%
30	-11,3%	-5,5%	-3,8%	-0,9%	-0,8%	1,8%	3,6%	1,4%	2,9%	-0,4%	0,4%	-1,0%	-2,7%	0,2%	-1,4%	2,1%	5,8%	2,8%	3,6%	-0,8%	-0,5%	2,0%	2,0%	1,6%	2,0%
40	-9,1%	-2,9%	-1,0%	0,9%	1,5%	2,8%	3,6%	3,9%	3,6%	-1,0%	0,8%	1,7%	-2,8%	1,7%	0,7%	4,8%	2,1%	6,3%	2,8%	0,0%	-0,8%	1,8%	0,9%	2,7%	1,1%
50	-7,2%	-2,6%	1,2%	3,1%	3,8%	3,7%	2,3%	3,9%	3,9%	1,4%	-0,2%	-1,1%	0,8%	-2,7%	0,1%	5,6%	3,1%	7,6%	-1,2%	0,5%	-2,3%	1,5%	3,8%	3,9%	2,1%
60	-4,3%	-1,4%	1,6%	2,8%	5,4%	5,0%	2,9%	3,6%	3,8%	4,7%	0,3%	0,7%	3,5%	-1,1%	0,3%	1,8%	0,4%	7,1%	1,5%	-0,3%	-0,3%	2,0%	3,4%	5,2%	3,3%
70	-0,8%	1,6%	3,4%	4,2%	5,5%	5,4%	3,4%	3,4%	3,4%	0,6%	-0,4%	4,1%	4,0%	0,3%	-1,1%	1,0%	-0,4%	6,8%	-1,6%	0,7%	0,2%	3,8%	0,5%	5,8%	1,2%
80	-0,7%	2,1%	3,5%	3,8%	3,2%	2,8%	1,7%	3,8%	2,5%	0,5%	3,2%	3,7%	4,1%	-0,2%	-3,3%	1,0%	1,3%	5,7%	1,1%	1,4%	-1,1%	3,5%	1,3%	5,8%	0,8%
90	-0,6%	0,6%	2,8%	3,4%	1,9%	3,0%	2,1%	0,9%	3,4%	0,9%	4,3%	2,7%	3,4%	1,7%	-5,6%	-2,8%	2,5%	6,8%	-2,2%	2,7%	-1,0%	0,9%	-0,2%	4,4%	-0,4%
100	-2,8%	1,7%	1,8%	1,5%	0,9%	1,4%	2,7%	-1,4%	0,1%	0,4%	4,3%	0,6%	2,1%	0,9%	-3,9%	-2,5%	2,0%	3,5%	-1,3%	0,3%	1,5%	-0,5%	1,2%	1,8%	-0,2%
110	-0,3%	1,8%	1,3%	3,9%	4,0%	2,5%	3,2%	1,6%	-0,1%	4,3%	2,9%	1,5%	2,6%	2,9%	0,5%	-0,1%	1,8%	2,3%	0,7%	3,9%	0,3%	0,9%	3,6%	2,8%	1,1%
120	-1,1%	1,1%	1,9%	2,0%	1,4%	2,1%	0,0%	2,0%	-0,2%	2,4%	4,7%	1,3%	2,8%	1,4%	1,3%	-0,9%	-1,2%	2,8%	0,5%	0,6%	0,5%	-1,6%	3,8%	1,3%	2,3%
130	-0,3%	1,1%	1,6%	2,0%	2,0%	3,9%	1,3%	1,7%	2,0%	2,9%	4,0%	1,7%	3,6%	2,6%	3,7%	0,6%	0,2%	2,6%	2,0%	3,0%	1,2%	-0,8%	4,6%	2,3%	4,1%
140	-1,0%	0,4%	0,9%	3,8%	1,6%	1,8%	0,1%	3,6%	3,8%	0,3%	2,6%	2,1%	4,0%	2,3%	4,5%	-1,4%	1,2%	2,2%	0,3%	2,1%	2,0%	0,8%	1,5%	2,7%	4,0%
150	-2,5%	0,2%	1,0%	2,0%	2,0%	2,5%	1,9%	1,4%	0,2%	0,5%	0,9%	-0,8%	-0,8%	1,7%	4,5%	0,1%	1,9%	-1,0%	1,9%	1,9%	2,5%	-0,5%	3,9%	1,3%	2,5%
160	-0,6%	2,4%	2,3%	2,3%	4,3%	1,4%	2,2%	2,2%	2,4%	4,2%	-1,2%	-0,8%	-2,3%	2,2%	4,8%	0,0%	4,1%	0,5%	4,1%	2,9%	2,0%	1,1%	3,2%	1,0%	5,7%
170	-0,6%	1,2%	1,8%	1,2%	3,9%	1,9%	1,6%	1,7%	0,8%	1,5%	-0,3%	-0,5%	-1,4%	0,6%	2,8%	0,9%	3,5%	-0,4%	5,3%	2,7%	2,3%	2,8%	3,1%	1,4%	4,3%
180	-0,6%	3,0%	2,2%	3,6%	2,5%	2,9%	2,9%	1,4%	2,1%	0,0%	1,2%	2,2%	0,8%	0,6%	2,9%	3,5%	3,6%	4,4%	5,2%	2,5%	2,1%	4,3%	1,8%	4,6%	4,8%
190	-2,5%	0,6%	1,2%	2,9%	2,9%	2,9%	-1,4%	2,9%	1,5%	3,3%	4,6%	3,4%	3,7%	-2,3%	3,3%	3,7%	4,8%	1,7%	6,4%	0,6%	3,8%	6,4%	1,8%	3,5%	3,0%
200	-1,6%	1,1%	0,9%	3,6%	4,2%	2,8%	1,4%	4,2%	1,8%	3,9%	4,8%	4,1%	5,5%	-1,2%	2,8%	3,7%	4,8%	2,8%	7,3%	1,9%	2,5%	4,8%	2,6%	3,3%	3,8%
210	-1,9%	1,5%	0,8%	2,5%	4,5%	1,9%	1,0%	4,0%	1,8%	3,3%	3,4%	3,3%	4,6%	-1,1%	2,1%	4,1%	4,2%	1,4%	6,0%	2,6%	2,5%	5,2%	1,5%	2,9%	5,1%
220	-1,0%	1,9%	3,3%	2,7%	5,7%	2,6%	2,4%	3,1%	1,5%	4,4%	2,3%	2,7%	3,1%	1,4%	4,5%	2,3%	3,7%	1,7%	5,0%	2,7%	4,3%	3,8%	1,7%	1,9%	3,7%
230	-1,2%	0,8%	1,0%	2,2%	4,2%	2,8%	1,9%	1,9%	1,9%	3,7%	4,0%	3,1%	2,0%	1,9%	2,9%	3,3%	1,1%	4,2%	3,7%	2,0%	3,7%	4,6%	-0,3%	1,2%	2,8%
240	-1,8%	0,1%	2,4%	2,5%	3,6%	3,2%	1,8%	0,3%	0,6%	2,7%	4,0%	3,2%	4,0%	1,3%	-1,4%	2,4%	1,1%	3,7%	4,2%	1,7%	3,7%	4,9%	2,1%	1,7%	2,1%
250	0,7%	2,3%	4,6%	3,5%	3,4%	4,8%	3,1%	2,5%	3,4%	2,6%	3,0%	4,2%	4,1%	4,1%	-0,8%	3,8%	2,8%	6,3%	3,1%	0,9%	5,4%	5,5%	3,7%	2,4%	2,8%

Appendix 3.2:

Losier Portfolio: Formation and Holding Period up to 250 days (30% quantile)

The heat map below contains percentage returns in excess of the market (relative to the equally weighted index).

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

Max 15,3%
 Min -3,8%
 Proportion positive 66,9%
 Median 0,7%
 Mean 1,0%
 Std Dev 2,2%

fp/hp	Holding Period (Days)																									
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	
10	7,7%	2,9%	3,7%	2,9%	3,7%	-0,5%	0,0%	-1,2%	1,4%	1,7%	3,4%	0,2%	5,6%	1,6%	1,7%	0,7%	2,2%	0,0%	0,2%	3,2%	3,0%	-2,3%	-1,4%	-0,4%	0,6%	3,3%
20	14,1%	8,8%	6,1%	4,5%	3,1%	1,5%	-0,1%	2,0%	-3,0%	1,2%	2,9%	3,5%	0,4%	1,1%	3,4%	0,7%	-0,3%	-3,2%	0,9%	2,0%	3,7%	-1,4%	-3,0%	-3,5%	0,4%	0,4%
30	14,8%	7,6%	5,7%	4,5%	0,8%	-0,4%	-1,0%	1,8%	-2,0%	3,3%	3,2%	2,5%	5,3%	0,5%	2,6%	-0,1%	-1,2%	-3,8%	-2,0%	3,9%	3,9%	2,1%	-0,2%	-0,6%	-0,8%	0,4%
40	9,3%	6,4%	2,9%	1,0%	0,6%	-0,9%	-1,5%	-1,4%	-0,2%	4,4%	3,1%	1,7%	4,2%	1,5%	1,2%	-1,1%	-1,6%	-3,2%	3,6%	3,0%	2,4%	-0,1%	-0,6%	0,4%	0,7%	0,7%
50	9,3%	3,5%	3,4%	0,0%	0,5%	0,9%	-0,5%	0,3%	1,0%	2,8%	2,1%	4,1%	0,2%	5,4%	3,1%	-1,4%	-1,9%	-2,6%	1,3%	1,2%	4,7%	1,6%	-1,0%	0,6%	0,5%	0,5%
60	8,6%	4,1%	1,8%	2,5%	1,0%	0,0%	-0,1%	-0,2%	-0,6%	-1,8%	3,7%	3,3%	0,9%	3,7%	1,4%	-0,2%	-0,9%	-2,0%	3,2%	1,8%	3,0%	1,8%	-1,1%	-0,1%	-0,3%	0,2%
70	5,8%	2,5%	-0,2%	2,1%	0,6%	-1,4%	2,3%	2,4%	-0,3%	0,7%	1,6%	-0,8%	0,5%	4,4%	1,2%	1,1%	0,7%	-2,2%	2,8%	1,9%	2,4%	-0,7%	-1,1%	-1,2%	0,2%	0,2%
80	5,2%	4,1%	1,1%	1,0%	0,5%	1,1%	1,7%	-1,1%	2,7%	1,6%	-0,8%	-0,8%	-1,0%	4,4%	5,2%	-0,8%	2,0%	-0,5%	4,0%	0,4%	3,5%	-1,5%	-1,7%	-2,1%	0,9%	0,9%
90	5,0%	2,2%	0,4%	-0,6%	1,3%	-1,4%	-0,6%	-1,3%	0,9%	1,4%	-3,3%	-3,4%	-0,9%	1,6%	6,1%	-1,1%	-2,4%	-2,5%	2,4%	0,7%	1,4%	-1,5%	0,4%	-3,7%	2,2%	2,2%
100	4,7%	3,2%	0,9%	-0,5%	1,8%	0,2%	-0,3%	-1,1%	1,7%	3,0%	-3,0%	-2,7%	-0,8%	-1,3%	5,4%	1,1%	-1,8%	-0,1%	2,2%	1,3%	1,6%	-0,6%	0,8%	0,5%	2,9%	2,9%
110	5,8%	1,5%	3,0%	-0,2%	0,8%	1,9%	0,9%	-1,0%	0,9%	1,9%	-1,8%	0,3%	-1,5%	1,0%	0,9%	1,1%	-1,4%	1,1%	1,4%	1,9%	0,3%	1,8%	-1,6%	1,9%	3,4%	3,4%
120	5,7%	2,6%	1,6%	-1,7%	-0,1%	0,0%	3,6%	-1,7%	0,8%	-0,6%	-1,8%	1,7%	-1,5%	0,7%	-0,4%	1,6%	-0,8%	-1,0%	-0,6%	1,1%	0,5%	1,2%	-0,2%	-0,2%	1,8%	1,8%
130	4,9%	3,0%	0,1%	0,6%	0,2%	-0,2%	1,2%	0,0%	0,1%	0,4%	-1,6%	0,9%	-0,8%	1,3%	-0,8%	5,2%	-0,3%	0,6%	0,2%	1,6%	-0,1%	1,0%	-1,3%	0,4%	0,6%	0,6%
140	4,3%	0,5%	1,6%	0,9%	1,5%	-0,8%	0,5%	0,2%	-0,8%	3,0%	0,8%	-0,4%	2,1%	1,9%	0,2%	4,2%	-0,2%	0,9%	0,3%	2,6%	0,9%	1,6%	-2,5%	1,8%	0,5%	0,5%
150	4,1%	2,2%	1,5%	1,8%	1,3%	-0,3%	3,0%	3,0%	0,5%	1,0%	1,9%	1,4%	-0,6%	1,3%	-0,5%	3,0%	0,2%	1,5%	-0,2%	0,7%	-1,6%	3,1%	-3,0%	2,6%	0,5%	0,5%
160	6,2%	2,8%	1,7%	0,5%	-0,2%	0,8%	-0,5%	2,8%	0,6%	-0,6%	1,4%	0,2%	2,2%	0,9%	-1,0%	2,6%	-0,6%	2,5%	-3,2%	1,7%	-0,3%	1,2%	0,0%	2,0%	-0,5%	-0,5%
170	4,5%	1,4%	1,7%	0,4%	0,6%	2,3%	1,1%	1,9%	2,5%	-0,8%	1,7%	0,0%	1,4%	1,4%	0,0%	1,8%	0,8%	3,4%	-2,7%	-1,9%	-1,0%	0,5%	-0,1%	1,3%	-0,4%	-0,4%
180	3,7%	1,3%	0,3%	-0,2%	-2,2%	1,7%	0,2%	0,5%	-0,6%	-0,2%	0,7%	0,3%	-1,3%	0,4%	-1,6%	-0,6%	-1,0%	2,1%	-1,9%	-0,7%	-0,9%	1,0%	1,4%	0,3%	0,3%	0,3%
190	3,5%	1,3%	1,9%	0,7%	2,5%	0,6%	2,8%	0,7%	0,6%	1,5%	-1,1%	-0,9%	-2,0%	2,9%	-0,2%	0,4%	-1,2%	1,2%	-2,5%	1,6%	0,1%	-1,2%	0,1%	0,8%	1,4%	1,4%
200	4,6%	3,4%	1,0%	2,1%	0,8%	-0,2%	0,2%	1,3%	-0,6%	1,3%	-1,7%	-0,8%	-1,5%	1,3%	0,1%	1,2%	-1,0%	-1,2%	-1,8%	1,2%	-1,3%	-0,8%	1,2%	0,8%	1,4%	1,4%
210	5,6%	3,2%	2,1%	1,2%	0,3%	-0,7%	0,8%	0,1%	0,4%	0,2%	-1,2%	-0,8%	-1,5%	2,7%	0,1%	-1,6%	-0,8%	0,2%	-0,7%	0,6%	0,3%	0,1%	2,2%	1,3%	-2,3%	-2,3%
220	4,6%	2,5%	2,0%	-0,2%	1,1%	1,5%	0,8%	-0,2%	1,7%	1,2%	0,5%	0,9%	0,7%	1,8%	0,6%	-1,0%	1,1%	2,9%	0,6%	0,7%	1,9%	0,2%	-0,8%	1,7%	0,2%	0,2%
230	5,1%	1,8%	2,1%	0,2%	0,3%	-0,1%	-0,6%	0,6%	0,0%	0,0%	0,6%	3,2%	0,6%	-0,6%	1,8%	1,1%	2,4%	0,6%	0,5%	2,0%	-0,7%	0,6%	1,7%	4,9%	2,2%	2,2%
240	3,4%	2,1%	0,3%	0,5%	0,8%	0,4%	0,3%	2,1%	0,1%	2,3%	-1,4%	2,6%	0,9%	0,8%	3,2%	0,8%	3,0%	-0,4%	-0,2%	3,2%	-1,0%	-0,4%	1,4%	3,7%	1,2%	1,2%
250	3,4%	1,4%	1,0%	-0,7%	-0,5%	-0,8%	0,0%	-1,3%	0,7%	-0,6%	-0,3%	-0,4%	0,7%	0,3%	2,5%	-0,6%	2,7%	-0,1%	2,5%	-0,5%	0,6%	-0,1%	-1,4%	0,9%	-0,6%	-0,6%

Appendix 3.3:

Winner Portfolio: Formation Period up to 850 days;

Holding Period up to 250 days (30% quantile)

The heat map below contains percentage returns in excess of the market (relative to the equally weighted index).

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

		Holding Period (Days)									
		25	50	75	100	125	150	175	200	225	250
Formation Period (Days)	fp/hp										
	25	-5,2%	-2,0%	-2,8%	-3,3%	-1,0%	-3,6%	-0,8%	-1,5%	-4,8%	-0,8%
	50	0,5%	3,8%	2,2%	1,4%	3,7%	0,1%	-1,0%	0,5%	-1,0%	2,1%
	75	3,6%	4,9%	1,8%	0,4%	1,3%	-1,4%	-3,5%	0,3%	-0,5%	-0,9%
	100	1,8%	0,9%	0,9%	0,4%	-0,3%	-3,9%	-1,1%	0,3%	0,0%	-0,2%
	125	1,0%	0,8%	2,4%	1,4%	0,6%	2,7%	1,0%	0,5%	5,0%	2,6%
	150	1,6%	2,0%	2,0%	0,5%	1,2%	4,5%	5,2%	1,9%	5,4%	2,5%
	175	3,0%	3,0%	0,4%	0,3%	3,6%	2,8%	4,1%	2,4%	3,8%	4,4%
	200	3,3%	4,2%	3,4%	3,9%	1,8%	2,8%	3,0%	1,9%	3,0%	3,9%
	225	3,1%	6,1%	3,5%	3,3%	-1,0%	1,2%	2,5%	2,9%	3,5%	2,3%
	250	3,5%	3,4%	1,2%	2,6%	2,9%	-0,8%	0,5%	0,9%	-2,4%	2,8%
	275	2,4%	3,3%	3,8%	3,6%	2,1%	4,4%	3,4%	2,5%	-0,4%	1,4%
	300	4,8%	3,7%	3,8%	2,1%	3,6%	5,7%	0,9%	2,3%	-0,5%	2,5%
	325	4,9%	3,4%	2,8%	3,7%	4,2%	4,8%	4,3%	2,7%	0,3%	2,9%
	350	2,3%	3,7%	3,6%	2,7%	0,4%	1,5%	3,0%	2,6%	2,6%	1,3%
	375	5,0%	3,7%	5,6%	3,9%	2,2%	1,3%	2,5%	2,7%	4,8%	1,2%
	400	4,0%	5,3%	3,0%	4,9%	2,5%	0,8%	2,9%	4,9%	2,4%	2,2%
	425	3,9%	3,1%	3,0%	2,4%	2,8%	3,2%	1,2%	1,8%	2,4%	3,5%
	450	4,3%	4,3%	4,2%	2,5%	1,7%	4,7%	0,8%	0,7%	2,8%	3,4%
	475	2,4%	2,8%	1,7%	1,6%	2,5%	2,2%	-0,1%	0,7%	-0,9%	2,2%
	500	2,6%	2,8%	3,3%	3,4%	0,9%	2,2%	3,6%	2,4%	-0,8%	0,5%
	525	2,5%	2,4%	3,2%	2,0%	0,7%	-0,4%	2,5%	-0,5%	0,4%	-0,3%
	550	3,1%	3,3%	2,7%	1,5%	2,0%	-1,0%	1,6%	0,9%	1,5%	0,2%
	575	2,3%	2,0%	2,2%	0,1%	1,2%	0,9%	0,7%	0,5%	2,9%	-1,6%
	600	2,3%	1,5%	2,2%	0,9%	0,1%	1,9%	-2,4%	0,7%	1,1%	-0,8%
625	1,2%	0,8%	-0,2%	0,4%	-0,9%	0,9%	-1,3%	-1,0%	0,7%	-2,7%	
650	0,8%	1,1%	1,3%	1,2%	-0,7%	-0,1%	-1,2%	-1,6%	0,4%	-1,2%	
675	0,5%	-0,1%	1,4%	-0,6%	-0,3%	-0,7%	0,8%	-0,5%	1,0%	0,6%	
700	0,8%	0,6%	-0,7%	0,7%	0,7%	-0,6%	0,1%	-0,6%	-3,1%	0,1%	
725	1,2%	0,2%	1,2%	0,9%	0,2%	0,6%	0,1%	-3,1%	-3,0%	-0,6%	
750	0,8%	0,2%	0,8%	0,4%	-0,7%	-0,6%	1,0%	-0,7%	-2,1%	-2,6%	
775	0,1%	1,0%	-0,4%	-0,3%	-1,0%	-0,4%	-1,4%	-0,8%	-1,6%	-1,9%	
800	-0,8%	-0,2%	-0,9%	0,6%	-0,6%	-1,7%	-2,4%	0,2%	-1,1%	-2,1%	
825	-0,7%	-0,4%	-0,3%	-2,2%	-1,6%	-1,9%	-4,2%	-2,1%	0,0%	-2,9%	
850	-0,6%	-0,4%	-0,7%	-1,4%	-1,5%	-1,4%	-0,2%	-4,6%	-0,7%	-2,9%	

Max	6,1%
Min	-5,2%
Proportion positive	71,2%
Median	1,1%
Mean	1,2%
ST Dev	2,1%

Appendix 3.4:

Loser Portfolio: Formation Period up to 850 days:

Holding Period up to 250 days (30% quantile)

The heat map below contains percentage returns in excess of the market (relative to the equally weighted index).

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

		Holding Period (Days)									
		25	50	75	100	125	150	175	200	225	250
Formation Period (Days)	fp/hp										
	25	6,6%	-0,1%	2,1%	4,1%	1,0%	4,8%	3,8%	2,2%	5,6%	-0,8%
	50	1,9%	0,5%	-0,2%	2,8%	-1,1%	3,1%	5,0%	1,2%	0,8%	0,5%
	75	1,6%	1,0%	-0,9%	0,7%	0,3%	4,7%	2,8%	1,2%	1,7%	2,8%
	100	1,8%	1,8%	0,2%	3,0%	3,5%	5,4%	2,1%	1,3%	3,3%	2,9%
	125	0,7%	0,6%	0,1%	0,3%	-0,8%	0,4%	2,6%	1,4%	2,0%	0,8%
	150	1,9%	1,3%	-0,1%	1,0%	-1,0%	-0,5%	1,2%	0,7%	-2,0%	0,5%
	175	0,1%	-2,2%	-0,9%	-1,3%	-0,4%	-1,9%	1,7%	-1,9%	-0,3%	-1,0%
	200	1,5%	0,8%	-0,5%	1,3%	-0,2%	-0,2%	2,3%	1,2%	1,0%	1,4%
	225	0,8%	-1,7%	-0,6%	-1,2%	0,8%	-0,2%	2,4%	1,0%	0,6%	0,6%
	250	0,5%	-0,9%	0,2%	-0,6%	-0,1%	2,5%	4,6%	-0,5%	4,4%	-0,6%
	275	1,1%	-0,6%	2,4%	1,8%	2,5%	3,1%	3,8%	1,5%	5,3%	0,6%
	300	2,8%	2,7%	3,7%	2,7%	4,6%	1,5%	2,8%	-0,8%	5,6%	3,4%
	325	3,2%	2,4%	2,6%	1,9%	2,9%	0,8%	1,2%	-0,3%	4,2%	2,6%
	350	2,2%	1,2%	1,8%	4,1%	4,1%	2,2%	2,2%	2,8%	2,6%	3,6%
	375	3,9%	2,0%	4,2%	1,6%	3,8%	3,3%	3,3%	1,7%	3,1%	3,8%
	400	4,3%	3,4%	4,2%	1,5%	3,1%	5,4%	3,5%	2,2%	3,2%	3,1%
	425	4,5%	2,6%	2,7%	2,1%	2,7%	4,4%	4,6%	4,2%	3,7%	4,6%
	450	5,0%	3,4%	4,2%	4,2%	4,8%	4,0%	4,7%	4,9%	3,8%	5,7%
	475	5,8%	4,1%	4,6%	3,3%	7,0%	4,9%	6,4%	4,0%	5,7%	7,7%
	500	5,0%	3,7%	4,1%	4,2%	6,8%	3,6%	5,5%	5,5%	5,3%	5,8%
	525	5,2%	4,3%	4,6%	5,1%	4,5%	3,7%	4,4%	5,2%	6,4%	4,9%
	550	5,0%	5,3%	6,2%	6,5%	4,7%	5,8%	3,7%	5,1%	7,3%	4,5%
	575	7,3%	6,2%	6,0%	4,5%	5,7%	4,8%	6,0%	5,0%	6,2%	4,8%
	600	7,2%	6,6%	5,6%	6,1%	5,8%	3,7%	4,9%	5,5%	5,4%	4,9%
625	6,9%	5,4%	4,7%	4,6%	5,6%	4,8%	4,8%	5,4%	6,8%	3,5%	
650	6,4%	5,4%	4,4%	5,1%	4,6%	6,1%	6,0%	6,0%	6,6%	3,2%	
675	6,0%	5,0%	6,5%	4,1%	3,2%	6,7%	6,0%	5,6%	7,5%	3,1%	
700	6,7%	6,1%	6,0%	7,2%	6,9%	8,2%	4,6%	7,6%	4,4%	6,7%	
725	7,4%	6,5%	5,8%	6,2%	8,3%	7,1%	5,7%	3,6%	4,5%	7,7%	
750	7,3%	6,0%	7,7%	7,3%	6,1%	4,3%	7,1%	4,2%	6,4%	4,2%	
775	6,9%	6,6%	5,7%	6,7%	5,3%	5,7%	5,6%	5,8%	5,9%	5,6%	
800	6,6%	6,6%	5,1%	7,0%	4,2%	5,4%	4,9%	6,4%	5,2%	5,3%	
825	7,0%	7,8%	6,9%	4,2%	4,7%	5,1%	3,8%	5,9%	5,6%	3,6%	
850	7,2%	5,8%	6,2%	4,6%	5,9%	5,0%	3,7%	5,4%	6,2%	5,1%	

Max	8,3%
Min	-2,2%
Proportion positive	90,3%
Median	4,1%
Mean	3,7%
ST Dev	2,4%

Appendix 4:

Ranking shares based on prior returns at the 20% quantile

Appendix 4.1:

Winner Portfolio: Formation and Holding Period up to 250 days (20% quantile)

The heat map below contains percentage returns in excess of the market (relative to the equally weighted index).

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

fp/hp	Holding Period (Days)																									Max	Min	Proportion positive	Median	Mean	Std Dev
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250						
10	-21.1%	-8.5%	-2.3%	-4.6%	-1.5%	2.1%	1.6%	-0.1%	1.0%	-0.1%	-3.8%	1.5%	-1.3%	-1.5%	3.1%	0.5%	-4.3%	1.9%	3.4%	-1.5%	3.3%	0.3%	-0.4%	0.2%	1.6%						
20	-12.7%	-9.1%	-2.8%	-1.6%	-2.3%	-1.1%	0.8%	0.9%	4.9%	-1.4%	0.3%	-1.6%	0.8%	0.6%	-3.8%	2.2%	3.7%	4.6%	2.7%	-0.8%	0.2%	2.2%	7.6%	-0.6%	0.7%						
30	-12.8%	-5.2%	-4.4%	0.6%	-0.3%	1.8%	4.6%	1.5%	3.3%	0.6%	0.4%	-2.4%	-4.8%	1.4%	-1.4%	3.1%	5.3%	2.7%	4.4%	1.1%	-1.8%	1.5%	4.5%	-0.2%	2.4%						
40	-11.8%	-4.6%	-0.7%	2.3%	2.3%	3.5%	6.2%	6.2%	5.2%	0.2%	-1.3%	-2.1%	-6.3%	2.9%	1.0%	5.0%	5.4%	6.8%	0.7%	2.6%	-1.3%	3.3%	2.1%	3.2%	1.3%						
50	-6.8%	-1.9%	0.9%	3.6%	4.2%	4.6%	4.3%	4.6%	5.1%	2.4%	1.5%	-2.5%	-0.1%	-2.8%	-0.1%	5.8%	2.4%	9.0%	-1.5%	1.7%	-3.0%	1.0%	5.5%	5.1%	-0.6%						
60	-3.3%	-1.5%	1.7%	2.4%	7.1%	3.6%	3.6%	3.3%	4.8%	4.2%	1.6%	-0.7%	2.0%	-0.1%	1.5%	4.1%	0.0%	8.3%	-2.7%	2.2%	-3.0%	3.6%	2.7%	6.7%	2.1%						
70	1.5%	4.0%	6.6%	7.1%	6.6%	6.9%	4.7%	3.3%	7.7%	0.7%	-1.4%	4.4%	5.7%	0.2%	-0.2%	0.3%	1.7%	9.4%	-3.7%	2.6%	-0.3%	3.6%	2.7%	8.9%	1.6%						
80	1.7%	5.5%	6.8%	7.8%	6.4%	5.5%	5.2%	7.3%	5.9%	1.8%	6.0%	6.4%	4.6%	2.1%	-2.6%	2.7%	3.7%	9.8%	-3.2%	3.4%	2.1%	7.3%	3.9%	8.9%	1.2%						
90	3.0%	3.3%	6.3%	5.5%	4.1%	5.4%	4.8%	3.4%	6.4%	1.6%	8.3%	5.0%	6.2%	1.8%	-6.2%	-0.6%	5.9%	9.8%	-2.1%	4.5%	1.0%	3.4%	0.9%	8.0%	-0.8%						
100	-1.3%	4.1%	4.0%	5.0%	2.3%	5.1%	3.8%	1.9%	4.5%	3.0%	6.8%	4.1%	5.4%	2.3%	-2.5%	-1.6%	6.3%	8.4%	0.8%	4.5%	3.3%	2.9%	3.1%	4.1%	0.7%						
110	2.5%	5.4%	3.9%	6.5%	7.9%	4.6%	5.4%	5.0%	2.6%	8.0%	5.3%	4.6%	4.4%	5.1%	1.5%	0.4%	1.2%	6.0%	1.8%	8.8%	1.0%	1.2%	3.2%	5.1%	1.4%						
120	1.6%	3.5%	4.4%	3.8%	2.5%	5.1%	2.5%	4.1%	3.1%	3.9%	6.8%	3.5%	6.4%	4.5%	3.4%	1.4%	0.4%	7.5%	2.2%	1.3%	0.9%	0.8%	2.4%	4.0%	2.7%						
130	3.0%	3.4%	3.6%	3.6%	2.9%	6.5%	3.8%	3.8%	5.8%	2.5%	7.0%	4.1%	5.9%	4.2%	5.4%	-0.5%	-0.5%	5.2%	1.4%	3.0%	1.2%	2.1%	5.2%	4.5%	6.3%						
140	0.9%	2.3%	1.3%	4.6%	4.4%	3.0%	2.1%	5.6%	4.3%	2.1%	3.9%	2.9%	4.6%	4.3%	3.1%	-2.0%	4.1%	4.7%	0.7%	4.5%	2.5%	1.8%	3.3%	4.2%	5.7%						
150	0.2%	3.6%	4.3%	5.1%	4.4%	4.6%	3.8%	0.3%	2.6%	3.7%	3.8%	0.2%	2.9%	4.4%	4.4%	-1.2%	2.5%	2.5%	3.6%	3.8%	3.7%	2.6%	6.7%	1.7%	4.3%						
160	0.8%	3.5%	5.6%	3.1%	9.4%	5.3%	6.1%	4.5%	5.1%	7.5%	0.7%	3.0%	1.1%	5.4%	9.7%	1.8%	3.7%	2.8%	5.3%	5.3%	4.8%	3.1%	5.6%	3.9%	7.7%						
170	2.7%	3.7%	4.7%	4.7%	6.9%	5.2%	7.5%	4.7%	3.0%	3.2%	2.4%	0.1%	0.5%	5.9%	5.4%	3.5%	5.3%	0.4%	7.8%	2.8%	5.2%	5.3%	5.4%	1.5%	6.0%						
180	2.2%	4.1%	4.5%	4.8%	4.5%	6.9%	4.2%	2.0%	3.6%	2.6%	4.2%	3.7%	2.0%	3.2%	2.0%	5.0%	6.0%	3.6%	9.0%	4.3%	4.7%	8.6%	2.7%	6.7%	5.7%						
190	0.6%	3.6%	5.3%	4.7%	5.7%	7.3%	0.1%	4.2%	3.5%	3.8%	7.6%	5.9%	7.2%	0.3%	7.0%	6.4%	6.1%	4.0%	7.0%	2.0%	5.4%	9.4%	5.4%	6.6%	6.3%						
200	1.9%	4.1%	3.5%	4.7%	6.6%	4.5%	5.0%	7.1%	5.0%	5.8%	7.3%	5.1%	7.2%	2.2%	5.9%	7.8%	7.1%	5.4%	10.7%	4.5%	5.1%	7.3%	4.8%	6.1%	6.3%						
210	1.0%	4.0%	4.4%	4.4%	8.6%	6.2%	3.4%	5.8%	5.4%	7.4%	6.5%	5.2%	6.1%	2.4%	6.1%	8.3%	5.8%	4.7%	9.0%	6.2%	5.2%	7.7%	1.6%	4.0%	7.4%						
220	2.1%	6.4%	4.1%	3.8%	7.9%	4.6%	7.0%	3.7%	5.6%	7.0%	5.9%	3.1%	5.0%	4.7%	6.7%	5.0%	6.3%	5.0%	10.3%	5.1%	7.3%	6.9%	4.3%	3.0%	6.5%						
230	2.0%	3.5%	2.3%	5.1%	8.7%	3.6%	5.8%	4.3%	5.1%	8.5%	6.1%	3.7%	5.2%	7.0%	6.0%	6.4%	4.1%	6.2%	7.2%	6.9%	6.9%	6.4%	2.0%	3.6%	4.0%						
240	2.2%	4.1%	5.6%	6.0%	7.0%	5.7%	6.0%	2.3%	4.3%	6.4%	6.6%	4.8%	5.5%	4.7%	2.1%	4.7%	3.9%	6.3%	6.9%	4.1%	6.6%	8.4%	4.8%	2.5%	5.6%						
250	3.2%	4.2%	7.7%	6.8%	6.8%	8.5%	7.6%	5.4%	8.3%	5.7%	5.5%	7.6%	5.7%	7.5%	2.8%	5.8%	5.1%	10.2%	2.9%	4.3%	9.0%	8.8%	6.3%	5.6%	6.0%						

Formation Period (Days)

Appendix 4.2:

Loser Portfolio: Formation and Holding Period up to 250 days (20% quantile)

The heat map below contains percentage returns in excess of the market (relative to the equally weighted index).

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

Max 20,0%
 Min -5,8%
 Proportion positive 66,2%
 Median 0,9%
 Mean 1,2%
 Std Dev 2,8%

Holding Period (Days)

Formation Period (Days)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250
10	20,0%	9,6%	8,8%	3,0%	4,5%	0,2%	1,0%	-1,6%	0,8%	0,7%	1,9%	1,2%	5,3%	3,6%	3,7%	-0,9%	2,5%	2,8%	-0,7%	2,3%	2,2%	-3,5%	-2,8%	1,2%	2,4%
20	15,2%	9,8%	7,9%	6,8%	5,4%	0,8%	0,1%	2,6%	-3,7%	5,3%	4,1%	4,3%	0,1%	0,5%	6,8%	1,4%	1,3%	4,3%	3,1%	2,7%	3,6%	-2,0%	-3,2%	4,2%	3,3%
30	17,1%	7,9%	7,4%	1,9%	0,5%	-1,5%	-1,8%	1,8%	-1,4%	4,3%	2,7%	1,7%	7,1%	2,0%	4,7%	-2,2%	-2,6%	-4,4%	-2,8%	0,4%	7,0%	-1,3%	-0,5%	-1,1%	-0,2%
40	13,2%	9,4%	4,7%	2,0%	3,2%	-1,5%	-2,7%	1,3%	-1,2%	6,8%	3,6%	2,9%	3,6%	0,7%	3,4%	-1,0%	-2,1%	-3,1%	1,9%	3,2%	4,1%	-0,6%	1,7%	-0,9%	0,2%
50	13,3%	7,8%	5,0%	3,6%	2,5%	2,0%	1,9%	2,3%	2,8%	4,1%	3,2%	4,2%	0,1%	6,7%	4,3%	-1,3%	-3,8%	-2,8%	3,2%	0,5%	7,0%	0,4%	0,1%	0,1%	1,5%
60	11,7%	5,8%	2,9%	3,5%	1,5%	1,2%	0,5%	0,5%	1,2%	-1,7%	5,2%	3,1%	1,3%	5,2%	3,1%	-0,1%	-2,1%	0,0%	2,2%	-1,1%	5,6%	2,0%	-0,1%	0,4%	2,6%
70	8,0%	3,5%	0,9%	2,6%	1,5%	-1,2%	2,8%	1,8%	0,3%	1,5%	1,5%	2,1%	1,0%	4,9%	0,9%	2,0%	0,7%	-0,4%	5,5%	1,1%	3,4%	-1,3%	-2,4%	-1,5%	3,5%
80	8,2%	4,4%	1,6%	0,3%	-0,6%	-0,3%	4,1%	-1,4%	1,8%	1,3%	0,4%	-3,4%	1,4%	6,4%	1,0%	-1,1%	1,4%	-1,4%	3,4%	1,2%	5,6%	-1,4%	-0,5%	-2,6%	3,1%
90	6,2%	1,7%	-0,1%	-0,5%	2,0%	-1,2%	-0,5%	-3,1%	1,0%	2,0%	-5,8%	-2,8%	-0,1%	2,6%	7,3%	-4,0%	-2,9%	-1,4%	1,9%	1,9%	3,4%	-2,9%	2,0%	-2,9%	3,4%
100	5,5%	3,8%	0,4%	-0,5%	-0,6%	-1,0%	-1,6%	-1,2%	0,5%	2,1%	-5,3%	-1,8%	-0,9%	-0,8%	1,5%	-0,1%	-2,7%	0,7%	-0,3%	0,6%	0,9%	-2,9%	-1,7%	2,3%	2,0%
110	7,9%	3,1%	3,6%	-0,2%	1,5%	2,2%	-0,5%	-3,0%	1,4%	2,7%	-4,7%	0,5%	-2,0%	0,6%	0,4%	1,3%	-1,4%	-0,7%	2,0%	3,1%	-2,0%	-0,7%	-2,7%	3,1%	-0,1%
120	4,6%	-0,3%	1,1%	-2,5%	-0,4%	-0,5%	4,4%	-1,9%	0,6%	-0,9%	0,5%	3,4%	-1,2%	0,3%	-2,4%	1,2%	-1,8%	0,4%	-3,8%	1,6%	-1,3%	3,5%	-0,7%	0,9%	-1,1%
130	4,9%	2,2%	0,1%	-1,8%	-2,6%	-0,3%	0,8%	-0,4%	-1,7%	0,6%	0,3%	-1,4%	-1,6%	-1,2%	-0,7%	5,1%	-1,8%	-1,9%	-0,8%	1,4%	-3,0%	1,2%	-1,2%	-0,4%	-3,7%
140	4,4%	0,3%	0,4%	-1,1%	0,2%	-2,9%	0,9%	-1,7%	-3,9%	1,4%	0,4%	-2,2%	-1,4%	0,7%	-1,2%	1,3%	-1,3%	-1,7%	-0,1%	0,1%	-2,2%	2,4%	-1,9%	-0,6%	-2,1%
150	5,7%	3,1%	1,7%	1,4%	2,2%	-1,9%	-1,6%	4,2%	-0,3%	0,9%	-0,5%	-1,1%	-1,5%	1,8%	-0,2%	2,8%	-2,3%	1,5%	-1,2%	0,5%	-2,1%	2,6%	-2,6%	0,0%	0,3%
160	5,2%	2,4%	1,1%	-0,3%	-2,5%	0,1%	-2,6%	2,3%	-2,1%	-1,3%	0,5%	-0,4%	0,6%	-1,0%	-2,0%	3,4%	-1,3%	-1,7%	-2,1%	-2,2%	-2,3%	1,7%	1,2%	-2,6%	0,0%
170	3,1%	1,9%	2,0%	-0,3%	-0,4%	1,8%	0,3%	0,0%	1,0%	-0,5%	1,5%	0,2%	1,3%	3,0%	1,2%	-0,1%	-3,1%	3,8%	-2,7%	-1,8%	-0,6%	0,9%	2,7%	1,6%	0,1%
180	4,4%	2,5%	2,1%	0,7%	0,8%	3,3%	2,5%	1,1%	1,3%	1,1%	0,5%	0,0%	-0,8%	3,9%	0,3%	0,0%	-0,4%	2,8%	0,2%	1,0%	-0,2%	1,2%	4,1%	0,2%	1,9%
190	4,3%	3,9%	3,9%	1,5%	3,3%	1,7%	4,9%	-0,2%	1,4%	1,4%	-0,5%	-0,9%	-2,6%	3,0%	0,7%	-0,3%	-1,2%	0,3%	-0,9%	2,0%	-2,3%	-0,5%	3,4%	0,1%	2,6%
200	5,5%	4,2%	1,4%	2,2%	1,5%	0,2%	1,6%	1,3%	1,4%	1,2%	-1,2%	-0,6%	-0,5%	3,0%	0,7%	-0,1%	0,2%	-0,4%	1,0%	1,2%	0,7%	-0,2%	3,0%	1,5%	-1,4%
210	5,6%	4,8%	2,2%	0,9%	-0,1%	-1,2%	-1,5%	0,3%	0,2%	-0,2%	-2,2%	-0,4%	0,8%	0,6%	1,8%	-0,2%	0,2%	0,2%	1,1%	0,1%	-0,2%	-0,4%	1,8%	4,2%	-1,7%
220	5,6%	4,7%	2,7%	1,7%	1,9%	2,3%	-0,7%	0,5%	1,1%	1,4%	-1,3%	1,5%	0,5%	0,9%	1,5%	-1,0%	1,0%	2,4%	-0,8%	1,3%	1,0%	0,4%	0,8%	3,8%	3,1%
230	4,6%	3,4%	2,8%	0,9%	-0,5%	0,6%	-1,7%	2,3%	-0,1%	1,7%	-0,7%	4,2%	2,4%	0,2%	2,2%	3,2%	2,9%	0,6%	-0,8%	2,3%	0,0%	1,9%	3,5%	5,9%	-0,5%
240	5,2%	5,1%	1,7%	2,8%	0,3%	2,1%	0,7%	2,9%	2,2%	3,3%	0,7%	4,9%	2,9%	1,4%	4,6%	2,4%	4,8%	1,8%	1,9%	4,4%	0,5%	2,0%	2,3%	6,6%	0,5%
250	4,4%	1,4%	2,6%	-1,3%	0,3%	-1,4%	0,5%	-1,3%	0,6%	1,0%	-0,2%	-0,5%	1,7%	1,4%	2,5%	0,1%	5,0%	0,2%	1,9%	0,6%	2,1%	1,9%	0,3%	2,2%	1,6%

Formation Period (Days)

Appendix 4.3:

Winner Portfolio: Formation Period up to 850 days;

Holding Period up to 250 days (20% quantile)

The heat map below contains percentage returns in excess of the market (relative to the equally weighted index).

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

		Holding Period (Days)									
		25	50	75	100	125	150	175	200	225	250
Formation Period (Days)	fp/hp										
	25	-5,0%	-4,4%	-3,7%	-2,6%	-0,4%	-5,5%	-3,8%	-1,9%	-6,5%	-3,5%
	50	-0,5%	4,2%	4,3%	2,4%	4,3%	-0,1%	-2,1%	1,7%	-0,5%	-0,6%
	75	5,8%	7,1%	2,9%	2,2%	2,4%	-3,1%	-5,5%	4,1%	-2,9%	0,0%
	100	3,7%	2,3%	2,1%	3,0%	-0,1%	-2,5%	-2,2%	4,5%	3,2%	0,7%
	125	3,7%	2,2%	4,8%	2,3%	0,3%	4,9%	2,0%	2,6%	6,2%	3,7%
	150	2,3%	7,0%	4,6%	3,7%	1,3%	7,7%	7,4%	3,8%	8,9%	4,3%
	175	5,3%	6,0%	2,4%	3,2%	5,4%	6,5%	7,5%	3,4%	7,1%	6,3%
	200	5,5%	6,6%	5,4%	5,8%	6,0%	5,9%	5,9%	4,5%	6,2%	6,3%
	225	4,7%	7,3%	2,6%	7,0%	1,2%	3,1%	4,2%	4,8%	6,1%	4,8%
	250	5,7%	6,8%	4,0%	5,7%	5,5%	2,8%	2,8%	4,3%	1,5%	6,0%
	275	3,8%	6,6%	6,9%	6,2%	3,0%	7,7%	5,2%	6,0%	1,0%	2,2%
	300	5,8%	5,2%	8,0%	6,8%	4,3%	10,4%	4,3%	4,8%	2,0%	2,3%
	325	4,5%	5,9%	4,7%	4,1%	1,8%	3,3%	5,1%	3,7%	4,2%	1,8%
	350	5,3%	6,4%	6,3%	5,3%	2,9%	6,2%	5,7%	4,6%	6,9%	3,3%
	375	5,6%	5,7%	6,0%	5,7%	2,9%	2,2%	4,9%	5,0%	2,9%	3,6%
	400	3,7%	5,7%	3,8%	7,2%	5,2%	1,2%	4,3%	8,1%	5,9%	5,0%
	425	6,0%	5,4%	5,1%	5,1%	5,2%	5,0%	0,8%	4,3%	5,2%	6,6%
	450	4,1%	5,3%	5,3%	1,6%	4,6%	7,3%	1,7%	-0,1%	3,5%	6,4%
	475	2,7%	4,4%	2,0%	3,1%	4,3%	3,5%	1,3%	2,8%	-0,4%	6,6%
	500	4,7%	5,9%	3,8%	6,6%	2,3%	4,0%	6,5%	4,9%	0,8%	3,6%
	525	6,8%	5,6%	7,0%	4,1%	2,5%	2,0%	5,7%	1,2%	2,8%	3,3%
	550	6,5%	7,1%	4,7%	4,6%	5,2%	1,5%	4,6%	4,1%	5,2%	3,1%
	575	7,1%	6,0%	5,1%	2,1%	4,1%	2,7%	3,7%	2,0%	6,0%	-0,7%
	600	7,1%	6,2%	5,8%	6,1%	2,2%	5,2%	0,9%	4,8%	5,9%	-1,0%
625	5,8%	5,6%	1,7%	4,2%	1,0%	1,4%	1,3%	1,3%	2,4%	-1,9%	
650	4,9%	4,2%	2,8%	3,7%	2,0%	2,0%	1,4%	0,1%	4,0%	-0,6%	
675	4,2%	4,4%	4,2%	3,6%	1,3%	1,7%	4,8%	1,9%	4,7%	1,0%	
700	3,7%	3,1%	2,5%	4,4%	1,9%	1,0%	3,1%	2,3%	-1,5%	1,8%	
725	5,1%	4,3%	2,4%	3,0%	5,2%	3,8%	5,1%	-0,6%	0,4%	2,3%	
750	3,8%	3,8%	4,0%	2,9%	1,9%	3,8%	5,1%	1,6%	1,3%	-1,0%	
775	3,2%	3,0%	1,6%	0,5%	1,5%	1,7%	0,8%	0,2%	0,3%	-2,1%	
800	1,2%	2,2%	1,0%	2,8%	1,3%	0,3%	0,0%	3,7%	1,8%	-1,3%	
825	2,5%	1,8%	3,1%	0,3%	0,7%	-0,9%	-1,4%	-0,6%	4,0%	-0,9%	
850	2,4%	2,4%	1,3%	0,4%	0,6%	-0,3%	-0,5%	-3,8%	1,4%	-1,1%	

Max	10,4%
Min	-6,5%
Proportion positive	87,9%
Median	3,7%
Mean	3,2%
ST Dev	2,7%

Appendix 4.4:

Loser Portfolio: Formation Period up to 850 days;

Holding Period up to 250 days (20% quantile)

The heat map below contains percentage returns in excess of the market (relative to the equally weighted index).

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

		Holding Period (Days)																			
		25	50	75	100	125	150	175	200	225	250										
Formation Period (Days)	fp/hp																				
	25	7,3%	0,3%	2,0%	3,6%	2,7%	4,4%	3,3%	1,4%	6,0%	1,1%										
	50	3,8%	2,3%	1,1%	4,1%	-2,4%	4,3%	6,9%	0,5%	2,1%	1,5%										
	75	3,2%	1,2%	0,1%	2,6%	-2,2%	3,6%	1,7%	1,3%	1,5%	3,4%										
	100	1,6%	-0,6%	-2,1%	2,1%	2,6%	1,5%	1,8%	0,6%	1,3%	2,0%										
	125	-2,0%	-2,3%	-1,6%	-0,2%	-1,0%	-1,3%	1,6%	1,6%	-0,4%	-1,3%										
	150	0,0%	2,2%	-0,3%	0,9%	-0,6%	-0,2%	2,1%	0,5%	-1,8%	0,3%										
	175	2,2%	-1,6%	-0,4%	-0,9%	-1,8%	-0,2%	1,4%	-1,3%	1,0%	-1,7%										
	200	1,8%	1,3%	-2,4%	1,2%	-2,2%	0,7%	0,4%	1,2%	1,8%	-1,4%										
	225	3,0%	-0,2%	0,6%	1,3%	3,1%	3,8%	3,1%	2,1%	2,5%	4,6%										
	250	2,1%	0,3%	0,1%	1,0%	2,7%	2,5%	3,7%	0,6%	6,4%	1,6%										
	275	2,4%	0,6%	2,0%	1,0%	3,8%	2,2%	3,2%	0,3%	6,9%	3,4%										
	300	5,7%	3,4%	5,2%	4,5%	5,4%	3,4%	3,6%	1,6%	7,5%	5,6%										
	325	5,4%	3,4%	4,1%	5,4%	5,9%	5,2%	4,9%	3,8%	6,8%	5,4%										
	350	2,2%	0,4%	1,5%	1,0%	1,4%	1,4%	1,5%	5,5%	2,4%	5,6%										
	375	5,3%	3,2%	5,1%	4,2%	2,6%	6,0%	4,6%	5,3%	5,1%	7,4%										
	400	6,1%	4,9%	5,0%	1,6%	3,5%	6,8%	6,0%	4,5%	3,8%	6,0%										
	425	5,4%	3,1%	3,8%	2,4%	5,3%	6,0%	7,3%	5,9%	4,1%	6,3%										
	450	6,4%	4,9%	7,2%	5,2%	8,9%	6,7%	8,0%	7,6%	5,2%	10,9%										
	475	5,4%	4,9%	5,2%	4,6%	9,8%	6,4%	9,5%	7,7%	6,7%	11,0%										
	500	6,7%	5,4%	4,9%	7,5%	10,7%	6,5%	7,9%	8,9%	8,7%	9,0%										
	525	7,4%	6,1%	7,7%	7,6%	7,3%	6,3%	8,2%	9,2%	9,2%	8,2%										
	550	8,3%	8,2%	10,4%	9,9%	8,8%	7,4%	7,1%	8,5%	10,1%	9,0%										
	575	13,2%	11,5%	9,3%	9,0%	9,5%	7,4%	10,4%	7,9%	9,5%	10,1%										
	600	13,2%	11,4%	11,2%	10,2%	8,9%	8,8%	8,3%	9,0%	9,1%	10,0%										
	625	10,9%	9,1%	6,5%	8,8%	10,6%	7,5%	8,6%	10,5%	10,2%	7,7%										
	650	9,4%	8,1%	7,1%	8,7%	8,1%	10,2%	10,6%	10,1%	9,9%	6,7%										
	675	9,5%	8,7%	11,0%	7,8%	8,4%	12,7%	10,8%	10,4%	13,7%	7,9%										
	700	9,4%	8,6%	8,3%	10,2%	13,7%	11,2%	9,9%	12,0%	9,1%	11,2%										
	725	10,9%	10,4%	7,9%	10,7%	14,5%	11,6%	9,4%	9,3%	7,6%	13,1%										
750	10,9%	10,8%	11,7%	11,9%	12,3%	9,1%	11,1%	9,4%	9,8%	10,2%											
775	11,2%	10,4%	10,4%	9,3%	11,3%	11,5%	10,6%	9,3%	10,2%	10,2%											
800	10,7%	10,3%	8,7%	10,0%	9,5%	10,7%	8,2%	10,5%	9,1%	10,9%											
825	10,2%	11,3%	10,6%	7,3%	9,7%	10,0%	7,9%	10,5%	8,3%	10,1%											
850	11,6%	9,7%	10,2%	8,6%	10,2%	11,0%	8,3%	10,1%	10,0%	10,8%											

Max	14,5%
Min	-2,4%
Proportion positive	91,8%
Median	6,2%
Mean	5,9%
ST Dev	4,1%

Appendix 5:

Information ratios

Appendix 5.1:

Winner Portfolio: Formation and Holding Period up to 250 days (30% quantile)

The heat map below contains information ratios corresponding to the returns in the heat map in appendix 3.1

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

fp/hp	Holding Period (Days)																				Max	Min	Proportion positive	Median	Mean
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200					
10	-1,77	-0,80	-0,32	-0,30	-0,16	0,20	-0,06	0,14	0,02	-0,19	-0,21	0,07	-0,15	-0,18	0,11	-0,02	-0,03	0,07	0,37	-0,14	0,07	0,02	-0,12	-0,05	0,19
20	-1,27	-0,99	-0,36	-0,24	-0,39	-0,12	0,17	0,15	0,47	-0,30	-0,06	-0,18	0,09	0,12	-0,52	0,30	0,42	0,32	0,19	-0,25	-0,02	0,29	0,53	-0,10	-0,01
30	-1,16	-0,58	-0,40	-0,09	-0,08	0,18	0,39	0,14	0,30	-0,05	0,05	-0,27	-0,27	0,02	-0,15	0,22	0,57	0,29	0,38	-0,08	-0,06	0,23	0,23	0,16	0,22
40	-0,92	-0,29	-0,10	0,09	0,15	0,28	0,38	0,40	0,37	-0,10	0,09	0,01	-0,28	0,19	0,07	0,49	0,21	0,68	0,28	0,00	-0,08	0,20	0,10	0,27	0,10
50	-0,72	-0,26	0,12	0,32	0,38	0,37	0,23	0,41	0,38	0,14	-0,03	-0,12	0,08	-0,28	0,01	0,58	0,32	0,78	-0,12	0,05	-0,21	0,16	0,43	0,41	0,22
60	-0,43	-0,14	0,17	0,29	0,56	0,52	0,30	0,38	0,39	0,49	0,03	0,07	0,36	-0,11	0,03	0,19	0,04	0,76	0,14	-0,02	-0,03	0,20	0,38	0,54	0,33
70	-0,08	0,16	0,34	0,42	0,55	0,55	0,36	0,07	0,34	0,06	-0,05	0,42	0,42	0,03	-0,11	-0,10	-0,03	0,71	-0,15	0,06	0,02	0,37	0,06	0,58	0,12
80	-0,07	0,21	0,35	0,38	0,33	0,28	0,18	0,39	0,25	0,05	0,34	0,39	0,41	-0,02	-0,33	0,10	0,12	0,59	-0,20	0,13	-0,11	0,35	0,15	0,62	0,04
90	-0,05	0,06	0,28	0,36	0,19	0,30	0,23	0,09	0,33	0,09	0,46	0,28	0,33	0,18	-0,55	-0,27	0,24	0,69	-0,20	0,25	-0,10	0,08	-0,02	0,46	-0,04
100	-0,27	0,17	0,17	0,15	0,09	0,14	0,28	-0,14	0,01	0,04	0,43	0,06	0,20	0,10	-0,39	-0,25	0,20	0,32	-0,12	0,03	0,14	-0,04	0,12	0,17	-0,02
110	-0,03	0,18	0,12	0,39	0,41	0,26	0,33	0,16	-0,01	0,44	0,28	0,16	0,25	0,30	0,05	-0,01	0,18	0,21	0,06	0,37	0,03	-0,08	0,37	0,27	0,10
120	-0,11	0,11	0,18	0,20	0,14	0,21	0,00	0,20	-0,02	0,24	0,47	0,13	0,28	0,14	0,13	-0,09	-0,12	0,26	0,05	0,03	0,04	-0,14	0,39	0,13	0,22
130	-0,03	0,10	0,15	0,20	0,20	0,38	0,13	0,17	0,20	0,28	0,40	0,17	0,37	0,27	0,39	0,05	0,02	0,25	0,18	0,26	0,10	-0,07	0,45	0,22	0,36
140	-0,09	0,03	0,09	0,37	0,15	0,18	0,01	0,34	0,37	0,03	0,24	0,21	0,41	0,24	0,29	-0,13	0,12	0,21	0,03	0,19	0,18	0,07	0,14	0,25	0,37
150	-0,25	0,02	0,10	0,19	0,19	0,25	0,19	0,13	0,02	0,05	0,08	-0,08	-0,08	0,17	0,42	0,00	0,18	-0,09	0,17	0,17	0,23	-0,05	0,38	0,12	0,23
160	-0,06	0,23	0,22	0,22	0,43	0,14	0,22	0,20	0,23	0,41	-0,12	-0,07	-0,22	0,23	0,46	0,00	0,36	0,05	0,19	0,28	0,18	0,09	0,30	0,09	0,54
170	-0,06	0,12	0,18	0,12	0,38	0,18	0,16	0,17	0,08	0,15	-0,03	-0,05	-0,14	0,06	0,25	0,09	0,31	-0,04	0,46	0,27	0,21	0,25	0,29	0,13	0,42
180	-0,06	0,29	0,22	0,35	0,24	0,28	0,01	0,14	0,20	0,00	0,11	0,20	0,08	0,06	0,27	0,34	0,33	0,04	0,46	0,25	0,20	0,38	0,16	0,41	0,46
190	-0,24	0,06	0,11	0,28	0,27	0,28	-0,13	0,29	0,14	0,31	0,42	0,31	0,36	-0,21	0,30	0,36	0,44	0,15	0,57	0,06	0,35	0,57	0,17	0,32	0,28
200	-0,16	0,10	0,09	0,34	0,40	0,26	0,13	0,40	0,17	0,38	0,45	0,38	0,53	-0,11	0,26	0,35	0,41	0,25	0,66	0,18	0,23	0,44	0,23	0,28	0,35
210	-0,19	0,15	0,07	0,24	0,44	0,18	0,09	0,39	0,17	0,32	0,32	0,32	0,42	-0,10	0,19	0,39	0,38	0,13	0,57	0,26	0,23	0,47	0,13	0,26	0,46
220	-0,10	0,19	0,32	0,26	0,54	0,25	0,23	0,29	0,15	0,40	0,22	0,26	0,28	0,12	0,41	0,21	0,33	0,16	0,49	0,25	0,39	0,36	0,15	0,16	0,34
230	-0,11	0,08	0,10	0,21	0,41	0,26	0,18	0,17	0,17	0,34	0,32	0,29	0,36	0,17	0,27	0,30	0,09	0,39	0,56	0,19	0,34	0,43	-0,03	0,10	0,19
240	-0,17	0,01	0,22	0,24	0,33	0,31	0,17	0,03	0,05	0,25	0,38	0,29	0,36	0,11	-0,13	0,21	0,16	0,34	0,38	0,16	0,34	0,46	-0,08	0,14	0,26
250	0,06	0,22	0,43	0,33	0,32	0,45	0,29	0,23	0,32	0,24	0,29	0,40	0,38	0,35	-0,07	0,34	0,23	0,56	0,28	0,08	0,47	0,53	0,33	0,19	0,24

Appendix 5.2:

Loser Portfolio: Formation and Holding Period up to 250 days (30% quantile)

The heat map below contains information ratios corresponding to the returns in the heat map in appendix 3.2.

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

fp/hp	Holding Period (Days)																									1,62	-0,40	66,1%	0,07	0,10
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250					
	1,62	0,84	0,77	0,33	0,43	-0,05	0,00	-0,13	0,15	0,20	0,34	0,02	0,59	0,18	0,20	0,08	0,26	0,00	0,02	0,37	0,34	-0,23	-0,14	0,07	0,38					
	1,44	0,89	0,61	0,45	0,32	0,15	-0,01	0,20	-0,32	0,13	0,30	0,34	0,04	0,12	0,34	-0,03	-0,03	-0,33	0,09	0,19	0,36	-0,14	-0,30	0,39	0,04					
	1,48	0,76	0,56	0,46	0,08	-0,04	-0,10	0,19	-0,21	0,34	0,32	0,24	0,53	0,05	0,26	-0,01	-0,14	-0,39	-0,21	-0,02	0,37	0,21	-0,02	-0,07	-0,08					
	0,90	0,63	0,29	0,10	0,06	-0,08	-0,14	-0,15	-0,02	0,45	0,31	0,17	0,42	0,15	0,12	-0,11	-0,18	-0,32	0,34	0,30	0,24	-0,01	-0,06	0,05	0,08					
	0,88	0,33	0,33	0,00	0,05	0,08	-0,05	0,03	0,10	0,28	0,21	0,41	0,02	0,51	0,30	-0,14	-0,19	-0,25	0,13	0,12	0,47	0,15	-0,10	0,06	0,06					
	0,82	0,40	0,18	0,25	0,10	0,00	-0,01	-0,02	-0,05	-0,19	0,39	0,34	0,09	0,37	0,14	-0,02	-0,09	-0,19	0,31	0,18	0,28	0,18	-0,10	-0,01	-0,03					
	0,55	0,24	-0,02	0,20	0,06	-0,14	0,22	0,24	-0,03	0,07	0,17	0,09	0,06	0,45	0,11	0,11	0,07	-0,21	0,27	0,19	0,24	-0,07	-0,20	0,02	0,02					
	0,49	0,39	0,11	0,09	0,05	0,11	0,17	-0,11	0,26	0,16	-0,09	-0,08	-0,10	0,48	0,49	-0,08	0,21	-0,05	0,40	0,04	0,35	-0,16	-0,16	0,10	0,10					
	0,47	0,20	0,04	-0,06	0,12	-0,13	-0,06	-0,13	0,09	0,14	-0,34	-0,34	-0,09	0,18	0,57	-0,11	-0,25	-0,23	0,24	0,07	0,14	-0,15	0,03	-0,40	0,22					
	0,44	0,30	0,08	-0,05	0,18	0,02	-0,03	-0,10	0,16	0,29	-0,29	-0,26	-0,08	-0,13	0,53	0,11	-0,18	-0,01	0,22	0,13	0,15	-0,05	0,07	0,05	0,31					
	0,54	0,14	0,28	-0,02	0,00	0,18	0,08	-0,10	0,09	0,18	-0,17	0,03	-0,15	0,10	0,10	0,11	-0,15	0,10	0,14	0,19	0,03	0,16	-0,15	0,18	0,34					
	0,53	0,24	0,15	-0,16	-0,01	0,00	0,33	-0,16	0,08	-0,06	-0,17	0,16	-0,19	0,07	-0,04	0,16	-0,08	-0,10	-0,06	0,11	0,05	0,11	-0,02	-0,02	0,16					
	0,53	0,24	0,15	-0,16	-0,01	0,00	0,34	-0,16	0,08	-0,06	-0,17	0,16	-0,19	0,07	-0,04	0,15	-0,08	-0,10	-0,06	0,11	0,05	0,12	-0,02	-0,02	0,17					
	0,39	0,04	0,15	0,08	0,14	-0,07	0,04	0,02	-0,09	0,28	0,07	-0,04	0,20	0,17	0,02	0,39	-0,02	0,08	0,02	0,25	0,08	0,15	-0,24	0,16	0,05					
	0,37	0,20	0,13	0,16	0,12	-0,03	0,02	0,27	0,04	0,10	0,17	0,12	-0,06	0,13	-0,05	0,28	0,02	0,14	0,02	0,07	-0,16	0,30	-0,29	0,23	0,05					
	0,56	0,25	0,15	0,05	-0,02	0,07	-0,04	0,26	0,06	-0,06	0,13	0,02	0,21	0,09	-0,10	0,25	-0,05	0,24	-0,30	-0,12	-0,02	0,12	0,00	0,19	-0,05					
	0,41	0,13	0,15	0,03	0,05	0,22	0,10	0,18	0,22	-0,08	0,16	0,00	0,13	0,13	0,00	0,18	0,08	0,31	-0,26	-0,19	-0,09	0,05	-0,01	0,12	-0,04					
	0,33	0,12	0,02	-0,02	-0,20	0,16	0,02	0,05	-0,05	-0,02	0,07	0,03	-0,13	0,04	-0,15	-0,06	-0,09	0,20	-0,18	-0,07	-0,08	0,10	0,13	0,03	0,02					
	0,31	0,12	0,17	0,06	0,23	0,05	0,26	0,07	0,05	0,15	-0,11	-0,09	-0,19	0,26	-0,02	0,04	-0,11	0,11	-0,24	0,17	0,01	-0,12	0,01	0,01	0,14					
	0,42	0,30	0,10	0,19	0,08	-0,02	0,02	0,12	-0,05	0,13	-0,16	-0,07	-0,14	0,11	-0,02	0,12	-0,09	-0,11	-0,14	0,12	-0,12	-0,08	0,11	0,08	0,13					
	0,51	0,30	0,19	0,11	0,03	-0,07	0,07	0,01	0,04	0,02	-0,11	-0,12	-0,11	0,25	0,01	-0,16	-0,07	0,02	-0,07	0,06	0,03	0,01	0,20	0,12	-0,22					
	0,42	0,23	0,18	-0,02	0,10	0,14	0,04	-0,02	0,16	0,11	0,05	0,08	0,06	0,17	0,06	-0,09	0,10	0,27	0,06	0,06	0,18	0,02	-0,04	0,15	0,02					
	0,46	0,16	0,19	0,02	0,03	-0,01	-0,06	0,06	0,00	0,00	0,06	0,30	0,04	-0,06	0,16	0,09	0,23	0,06	0,05	0,18	-0,07	0,06	0,15	0,44	0,20					
	0,31	0,19	0,03	0,05	0,08	0,04	0,03	0,19	0,01	0,21	-0,13	0,24	0,08	0,07	0,29	0,07	0,27	-0,03	-0,02	0,29	-0,10	-0,04	0,13	0,33	0,10					
	0,31	0,13	0,09	-0,07	-0,09	-0,08	0,00	-0,12	0,06	-0,06	-0,03	-0,04	0,06	0,02	0,22	-0,05	0,24	-0,01	0,23	-0,05	0,06	-0,01	-0,13	0,08	-0,06					

Formation Period (Days)

Appendix 5.3:

Winner Portfolio: Formation and Holding Period up to 250 days (20% quantile)

The heat map below contains information ratios corresponding to the returns in the heat map in appendix 4.1

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

Formation Period (Days)	Holding Period (Days)																									Max	Min	Proportion positive	Median	Mean
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250					
10	-1,66	-0,67	-0,19	-0,38	-0,13	0,17	0,13	0,00	0,08	-0,01	-0,35	0,12	-0,11	-0,12	0,28	0,04	-0,37	0,15	0,25	-0,14	0,28	0,02	-0,04	0,02	0,77					
20	-1,00	-0,74	-0,23	-0,13	-0,20	-0,09	0,07	0,07	0,37	-0,12	0,02	-0,12	0,06	0,05	-0,32	0,18	0,29	0,37	0,22	-0,06	0,01	0,18	0,75	-0,05	0,06					
30	-0,98	-0,40	-0,35	0,05	-0,03	0,14	0,38	0,11	0,25	0,05	0,04	-0,18	-0,36	0,12	-0,12	0,24	0,42	0,22	0,35	0,08	-0,16	0,13	0,40	-0,02	0,19					
40	-0,90	-0,20	-0,05	0,17	0,17	0,27	0,50	0,47	0,40	0,01	-0,11	-0,16	-0,48	0,24	0,08	0,39	0,40	0,57	0,05	0,18	-0,10	0,26	0,19	0,24	0,10					
50	-0,52	-0,14	0,07	0,27	0,31	0,35	0,33	0,36	0,39	0,18	0,12	-0,19	0,00	-0,23	-0,01	0,44	0,19	0,73	-0,11	0,12	-0,21	0,08	0,50	0,38	-0,05					
60	-0,26	-0,12	0,13	0,19	0,55	0,29	0,28	0,26	0,38	0,34	0,13	-0,06	0,15	-0,01	0,12	0,31	0,00	0,69	-0,20	0,15	-0,22	0,27	0,23	0,51	0,16					
70	0,11	0,30	0,50	0,54	0,51	0,53	0,37	0,26	0,59	0,05	-0,11	0,35	0,44	0,02	-0,01	0,02	0,12	0,75	-0,26	0,18	-0,02	0,26	0,23	0,67	0,12					
80	0,12	0,41	0,50	0,59	0,50	0,42	0,42	0,56	0,45	0,14	0,49	0,50	0,35	0,17	-0,20	0,19	0,28	0,77	-0,22	0,23	0,15	0,53	0,33	0,69	0,09					
90	0,22	0,25	0,48	0,43	0,32	0,42	0,40	0,27	0,49	0,12	0,66	0,41	0,45	0,15	-0,46	-0,04	0,42	0,75	-0,14	0,30	0,07	0,23	0,08	0,62	-0,06					
100	-0,09	0,31	0,29	0,38	0,18	0,38	0,31	0,15	0,33	0,23	0,52	0,33	0,39	0,19	-0,19	-0,11	0,46	0,60	0,06	0,31	0,23	0,20	0,25	0,30	0,05					
110	0,19	0,41	0,29	0,48	0,59	0,35	0,41	0,38	0,20	0,59	0,40	0,35	0,32	0,40	0,12	0,03	0,09	0,43	0,12	0,59	0,07	0,08	0,26	0,37	0,10					
120	0,12	0,27	0,33	0,29	0,19	0,39	0,19	0,31	0,25	0,28	0,52	0,28	0,47	0,35	0,27	0,10	0,03	0,55	0,15	0,09	0,06	0,05	0,19	0,29	0,18					
130	0,22	0,25	0,27	0,27	0,22	0,48	0,29	0,28	0,42	0,18	0,53	0,32	0,45	0,33	0,42	-0,04	-0,04	0,38	0,10	0,20	0,08	0,15	0,39	0,33	0,41					
140	0,07	0,17	0,10	0,34	0,33	0,23	0,16	0,40	0,33	0,15	0,29	0,21	0,35	0,34	0,24	-0,14	0,29	0,33	0,05	0,30	0,16	0,12	0,24	0,30	0,37					
150	0,02	0,26	0,32	0,37	0,52	0,35	0,29	0,02	0,19	0,27	0,28	0,02	0,21	0,34	0,57	-0,08	0,16	0,18	0,23	0,26	0,25	0,18	0,48	0,12	0,28					
160	0,06	0,26	0,41	0,24	0,70	0,40	0,47	0,33	0,37	0,56	0,05	0,21	0,08	0,42	0,71	0,13	0,26	0,20	0,35	0,39	0,32	0,20	0,39	0,28	0,56					
170	0,20	0,28	0,35	0,36	0,52	0,39	0,55	0,36	0,22	0,24	0,17	0,01	0,03	0,44	0,40	0,26	0,37	0,03	0,51	0,22	0,36	0,37	0,39	0,11	0,45					
180	0,17	0,31	0,34	0,36	0,33	0,51	0,31	0,15	0,26	0,19	0,29	0,26	0,15	0,24	0,15	0,38	0,42	0,25	0,60	0,31	0,34	0,56	0,20	0,48	0,42					
190	0,04	0,27	0,38	0,35	0,41	0,54	0,00	0,31	0,24	0,27	0,53	0,41	0,51	0,02	0,50	0,47	0,42	0,27	0,50	0,15	0,38	0,62	0,38	0,47	0,44					
200	0,14	0,30	0,26	0,35	0,48	0,33	0,35	0,53	0,36	0,42	0,52	0,38	0,51	0,15	0,42	0,55	0,49	0,38	0,75	0,34	0,35	0,49	0,32	0,42	0,43					
210	0,07	0,29	0,32	0,32	0,63	0,45	0,25	0,43	0,40	0,53	0,46	0,37	0,43	0,16	0,44	0,58	0,40	0,34	0,66	0,46	0,37	0,52	0,11	0,26	0,50					
220	0,15	0,46	0,30	0,28	0,57	0,34	0,51	0,27	0,41	0,48	0,42	0,23	0,34	0,33	0,47	0,34	0,42	0,35	0,75	0,36	0,51	0,49	0,29	0,19	0,46					
230	0,15	0,25	0,17	0,37	0,63	0,26	0,43	0,30	0,37	0,59	0,45	0,26	0,34	0,48	0,42	0,43	0,26	0,45	0,52	0,44	0,50	0,46	0,13	0,23	0,29					
240	0,16	0,30	0,39	0,44	0,49	0,41	0,43	0,16	0,32	0,45	0,48	0,34	0,38	0,32	0,15	0,33	0,25	0,45	0,47	0,28	0,47	0,60	0,33	0,15	0,39					
250	0,22	0,30	0,54	0,48	0,49	0,60	0,53	0,37	0,60	0,40	0,40	0,54	0,38	0,50	0,19	0,39	0,33	0,71	0,20	0,28	0,62	0,63	0,44	0,35	0,40					

Appendix 5.4:

Loser Portfolio: Formation and Holding Period up to 250 days (20% quantile)

The heat map below contains information ratios corresponding to the returns in the heat map in appendix 4.2

Moving vertically down the table increases the formation period, while moving horizontally across the table increases the holding period.

Formation Period (Days)	Holding Period (Days)																									Max	Min	Proportion positive	Median	Mean
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250					
10	1,65	0,80	0,76	0,27	0,39	0,02	0,08	-0,14	0,07	0,15	0,10	0,45	0,30	0,33	-0,08	0,22	0,24	-0,07	0,20	0,18	-0,29	-0,23	0,11	0,21	0,21					
20	1,19	0,78	0,63	0,54	0,42	0,06	0,01	0,21	-0,31	0,42	0,31	-0,01	0,03	0,52	0,11	0,11	0,34	0,24	0,20	0,27	-0,15	-0,24	0,37	0,28	0,28					
30	1,29	0,61	0,57	0,15	0,04	-0,11	-0,14	0,14	-0,12	0,33	0,20	0,56	0,15	0,36	-0,17	-0,23	-0,34	-0,22	0,03	0,50	-0,10	-0,04	-0,09	-0,01	-0,01					
40	0,99	0,73	0,37	0,16	0,26	-0,11	-0,21	0,11	-0,09	0,55	0,27	0,29	0,06	0,27	-0,07	-0,18	-0,24	0,14	0,25	0,31	-0,05	0,12	-0,08	0,02	0,02					
50	0,99	0,59	0,37	0,27	0,18	0,15	0,14	0,18	0,22	0,32	0,25	0,33	0,01	0,50	-0,10	-0,30	-0,21	0,24	0,04	0,54	0,03	0,01	0,01	0,12	0,12					
60	0,87	0,44	0,22	0,27	0,12	0,09	0,04	0,04	0,09	-0,14	0,40	0,10	0,41	0,24	-0,01	-0,18	0,00	0,16	-0,08	0,40	0,16	-0,01	0,04	0,20	0,20					
70	0,60	0,26	0,07	0,20	0,11	-0,09	0,20	0,14	0,02	0,12	0,12	0,08	0,38	0,07	0,16	0,06	-0,03	0,41	0,08	0,25	-0,10	-0,17	-0,14	0,27	0,27					
80	0,60	0,33	0,12	0,02	-0,04	-0,02	0,30	-0,11	0,13	0,10	0,04	0,11	0,50	0,07	-0,08	0,11	-0,11	0,27	0,09	0,42	-0,12	-0,04	-0,23	0,23	0,23					
90	0,46	0,13	0,00	-0,04	0,15	-0,09	-0,04	-0,24	0,07	0,15	-0,46	-0,01	0,21	0,55	-0,30	-0,23	-0,10	0,15	0,15	0,26	-0,23	0,14	-0,24	0,29	0,29					
100	0,40	0,28	0,03	-0,04	-0,05	-0,07	-0,12	-0,09	0,04	0,16	-0,40	-0,07	-0,06	0,12	-0,01	-0,21	0,05	-0,02	0,05	0,06	-0,13	0,15	0,03	0,15	0,15					
110	0,58	0,22	0,26	-0,01	0,11	0,16	-0,04	-0,22	0,11	0,21	-0,35	-0,16	0,05	0,03	0,10	-0,11	-0,05	0,15	0,24	-0,15	-0,06	-0,20	0,23	-0,01	-0,01					
120	0,33	-0,03	0,08	-0,18	-0,03	-0,04	0,31	-0,14	0,05	-0,07	0,03	-0,09	0,02	-0,19	0,09	-0,14	0,03	-0,30	0,12	-0,10	0,25	-0,05	0,07	-0,08	-0,08					
130	0,35	0,16	0,00	-0,13	-0,19	-0,02	0,06	-0,03	-0,13	0,05	0,02	-0,11	-0,13	-0,09	0,36	-0,14	-0,15	-0,07	0,11	-0,21	0,09	-0,09	-0,03	-0,28	-0,28					
140	0,32	0,02	0,03	-0,08	0,01	-0,21	0,06	-0,12	-0,30	0,10	0,03	-0,11	0,05	-0,09	0,10	-0,09	-0,13	0,00	0,01	-0,16	0,18	-0,14	-0,05	-0,16	-0,16					
150	0,41	0,22	0,12	0,10	0,16	-0,13	-0,12	0,30	-0,02	0,07	-0,03	-0,08	-0,11	0,13	-0,02	-0,17	0,10	-0,09	0,04	0,00	0,20	-0,20	0,00	0,02	0,02					
160	0,37	0,17	0,08	-0,02	-0,18	0,01	-0,19	0,17	-0,16	-0,10	0,03	0,04	-0,08	-0,15	0,25	-0,10	-0,13	-0,15	-0,18	-0,17	0,13	0,09	0,22	0,03	0,03					
170	0,22	0,13	0,14	-0,02	-0,03	0,13	0,02	0,00	0,07	-0,04	0,11	0,02	0,10	0,20	-0,01	-0,22	0,27	-0,21	-0,14	-0,04	0,07	0,19	0,11	0,01	0,01					
180	0,31	0,18	0,15	0,05	0,06	0,24	0,18	0,08	0,09	0,08	0,03	0,00	-0,06	0,27	0,02	-0,03	0,20	0,02	0,08	-0,02	0,09	0,29	0,02	0,15	0,15					
190	0,04	0,26	0,37	0,33	0,39	0,53	0,00	0,30	0,24	0,28	0,56	0,43	0,55	0,02	0,49	0,46	0,28	0,53	0,15	0,40	0,70	0,38	0,47	0,47	0,47					
200	0,39	0,29	0,11	0,16	0,10	0,01	0,11	0,09	0,10	0,08	-0,09	-0,04	0,22	0,05	-0,01	-0,01	-0,03	0,07	0,10	0,05	-0,02	0,21	0,11	-0,10	-0,10					
210	0,39	0,34	0,16	0,07	-0,01	-0,08	-0,11	0,02	0,02	-0,01	-0,16	-0,03	0,06	0,04	-0,01	-0,01	0,01	0,08	0,01	-0,02	-0,03	0,13	0,31	-0,13	-0,13					
220	0,39	0,34	0,19	0,12	0,14	0,16	-0,05	0,04	0,08	0,10	-0,09	0,10	0,03	0,06	-0,07	0,07	0,17	-0,06	0,10	0,07	0,03	0,06	0,27	0,22	0,22					
230	0,33	0,24	0,20	0,06	-0,04	0,05	-0,12	0,16	-0,01	0,12	-0,05	0,30	0,17	0,02	0,16	0,22	0,04	-0,06	0,17	0,00	0,14	0,24	0,42	-0,03	-0,03					
240	0,36	0,36	0,12	0,19	0,02	0,15	0,05	0,20	0,15	0,24	0,05	0,34	0,21	0,10	0,32	0,17	0,33	0,13	0,13	0,04	0,14	0,16	0,46	0,04	0,04					
250	0,31	0,10	0,18	-0,09	0,02	-0,10	0,03	-0,09	0,04	0,07	-0,01	-0,04	0,12	0,10	0,17	0,01	0,35	0,01	0,13	0,15	0,13	0,02	0,15	0,15	0,11					

Appendix 6:

Effect of Portfolio Size on Optimal returns

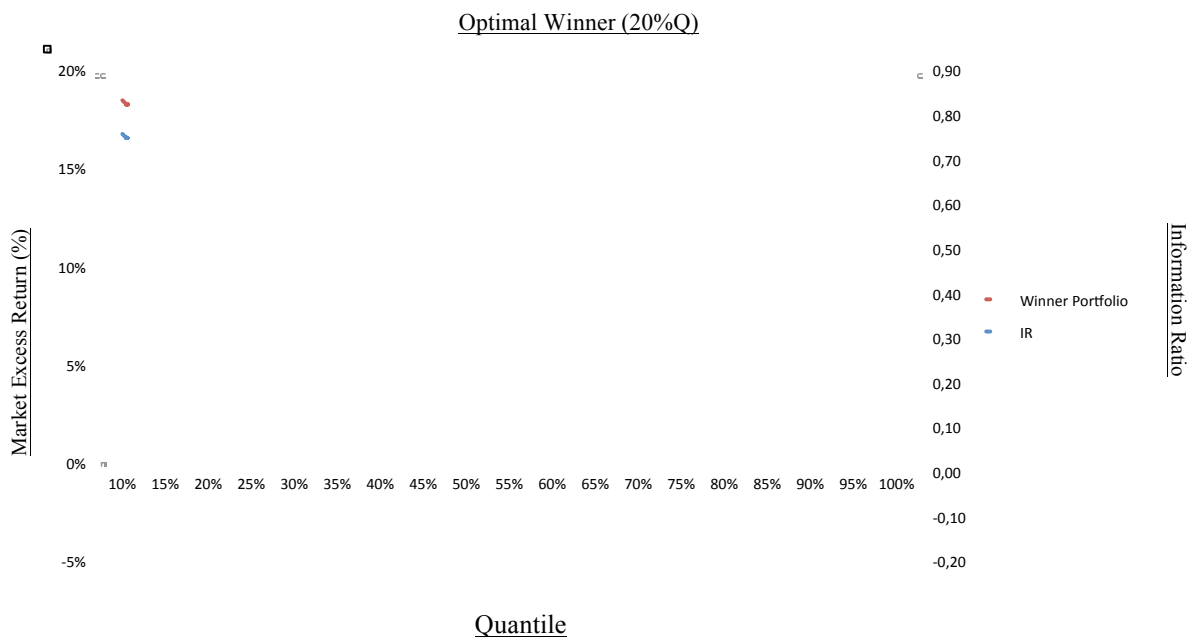
Appendix 6.1:

Optimal Winner Portfolio: 20%Q

The table and graph below contain data points for the market excess percentage returns (with the equally weighted index as the market) and associated Information Ratios achieved for the optimal combination of formation and holding period at the 20% quantile. Each data point in the graph represents a different quantile, moving from 10% to 100% in steps of 5%.

fp 200; hp 190			
Quantile	Absolute Return	Excess Return	IR
10%	38,5%	18%	0,756470
15%	31,9%	12%	0,647841
20%	30,8%	11%	0,745830
25%	29,4%	9%	0,730079
30%	27,4%	7%	0,660974
35%	25,5%	6%	0,543455
40%	24,6%	5%	0,511777
45%	23,7%	4%	0,463045
50%	23,0%	3%	0,406772
55%	22,2%	2%	0,321500
60%	21,8%	2%	0,288142
65%	21,6%	2%	0,270874
70%	20,6%	1%	0,110544
75%	20,5%	0%	0,092542
80%	19,7%	0%	-0,066465
85%	20,1%	0%	0,005050
90%	19,7%	0%	-0,088834
95%	19,5%	0%	-0,123375
100%	20,0%	0%	0,000000

EWI
20,037%



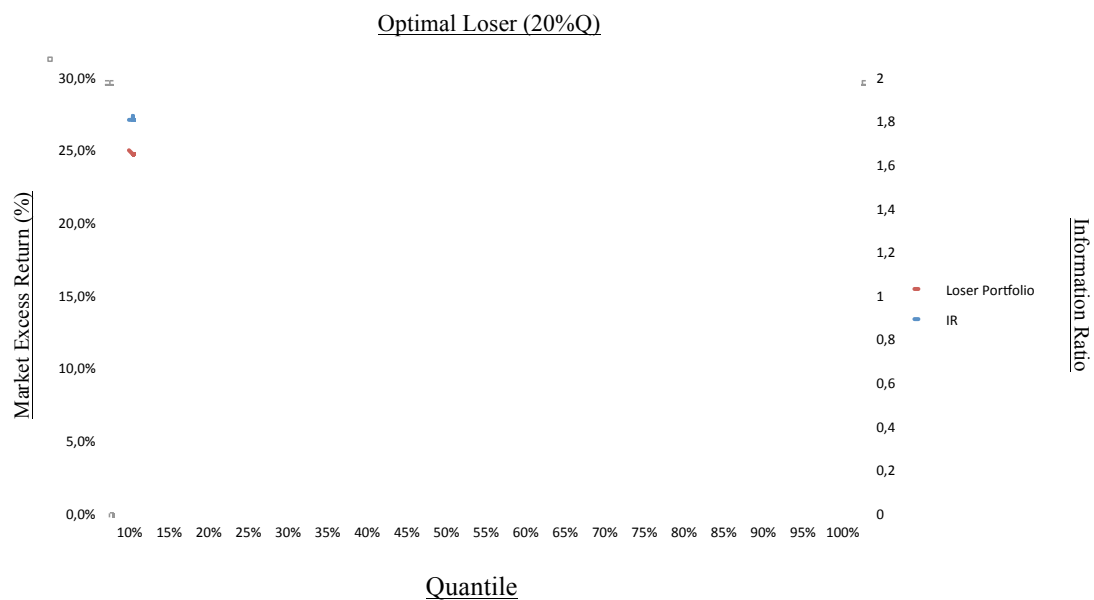
Appendix 6.2:

Optimal Loser Portfolio: 20%Q

The table and graph below contain data points for the market excess percentage returns (with the equally weighted index as the market) and associated Information Ratios achieved for the optimal combination of formation and holding period at the 20% quantile. Each data point in the graph represents a different quantile, moving from 10% to 100% in steps of 5%.

fp 10; hp 10			
Quantile	Absolute Return	Excess Return	IR
10%	45,0%	25,0%	1,26644422
15%	42,2%	22,2%	1,49130221
20%	40,1%	20,0%	1,64609257
25%	37,3%	17,3%	1,61928751
30%	35,4%	15,3%	1,61640596
35%	33,9%	13,8%	1,67057513
40%	32,8%	12,8%	1,77301196
45%	31,8%	11,8%	1,81270513
50%	30,4%	10,3%	1,72882547
55%	29,2%	9,2%	1,72066780
60%	28,4%	8,4%	1,71540705
65%	28,3%	8,2%	1,83891314
70%	27,0%	6,9%	1,70355092
75%	26,2%	6,2%	1,72043292
80%	25,4%	5,4%	1,71481983
85%	24,2%	4,1%	1,56219163
90%	22,8%	2,8%	1,29961132
95%	21,6%	1,6%	0,99427874
100%	20,0%	0,0%	0

EWI	
	20,037%



Appendix 7:

Ranking Stocks as overbought or Oversold

Appendix 7.1:

Winner Portfolio: Formation Period up to 300 days;

Holding Period up to 50 days (20% quantile)

The heat map below contains percentage returns in excess of the market (relative to the Equally Weighted Index).

Moving vertically down the table increases the moving average length (formation period), while moving horizontally across the table increases the holding period.

		Holding Period (Days)														
		5	10	15	20	25	30	35	40	45	50					
Moving Average (Days)	fp/hp															
	5	-16,4%	-10,5%	-3,8%	-3,0%	-5,2%	1,1%	0,2%	-2,3%	-1,6%	-4,6%					
	10	-25,2%	-15,6%	-8,0%	-12,2%	-9,4%	-0,7%	-5,8%	-4,9%	-0,9%	-6,0%					
	15	-25,4%	-16,8%	-13,0%	-8,7%	-3,0%	-6,8%	-3,9%	-3,8%	-6,5%	0,8%					
	20	-25,7%	-18,3%	-10,7%	-10,4%	-3,9%	-8,8%	-4,1%	-5,8%	-7,5%	-2,4%					
	25	-25,6%	-15,8%	-10,9%	-7,6%	-7,6%	-4,2%	-3,1%	-2,3%	-0,8%	-4,3%					
	30	-24,3%	-17,4%	-11,9%	-11,0%	-7,0%	-9,2%	-0,9%	-3,1%	-4,4%	-1,5%					
	35	-23,4%	-15,4%	-10,1%	-7,8%	-11,0%	-6,5%	-5,9%	-3,5%	-2,6%	-3,3%					
	40	-21,0%	-14,7%	-9,7%	-9,6%	-1,9%	-5,7%	-5,3%	-4,7%	-2,4%	0,7%					
	45	-22,4%	-14,4%	-10,3%	-9,2%	-4,9%	-5,7%	-7,1%	-4,3%	2,3%	3,2%					
	50	-21,8%	-13,8%	-7,3%	-7,8%	-4,9%	-4,7%	-3,4%	-1,7%	1,2%	1,6%					
	100	-10,2%	-5,9%	-4,1%	-2,0%	0,1%	1,5%	4,9%	0,7%	4,9%	4,8%					
	150	-6,3%	-3,2%	-0,6%	-0,1%	1,8%	2,4%	-1,1%	3,5%	4,1%	5,7%					
	200	-3,2%	-0,3%	2,4%	2,0%	3,9%	3,2%	5,6%	4,5%	5,2%	7,4%					
	250	-3,0%	-0,2%	0,2%	3,3%	4,8%	4,2%	4,8%	5,4%	6,1%	7,1%					
	300	-2,2%	-0,1%	2,4%	5,3%	4,6%	5,0%	6,1%	5,4%	4,5%	7,1%					

Max	7,4%
Min	-25,7%
Proportion positive	28,7%
Median	-3,8%
Mean	-4,6%
Std Dev	7,7%

Appendix 7.2:

Loser Portfolio: Formation Period up to 300 days;

Holding Period up to 50 days (20% quantile)

The heat map below contains percentage returns in excess of the market (relative to the equally weighted index).

Moving vertically down the table increases the moving average length (formation period), while moving horizontally across the table increases the holding period

		Holding Period (Days)																			
		5	10	15	20	25	30	35	40	45	50										
Moving Average (Days)	fp/hp																				
	5	21,3%	12,2%	7,5%	5,5%	9,0%	3,7%	5,1%	5,8%	3,2%	6,3%										
	10	24,3%	15,4%	11,1%	14,2%	8,8%	6,6%	9,2%	5,1%	2,7%	8,3%										
	15	22,6%	15,4%	11,4%	11,8%	4,3%	5,6%	6,1%	7,7%	6,1%	0,9%										
	20	21,9%	14,9%	8,7%	8,1%	4,3%	6,0%	2,2%	3,3%	4,4%	-0,8%										
	25	21,9%	16,2%	14,1%	8,0%	8,1%	9,9%	2,0%	2,2%	5,4%	3,1%										
	30	23,0%	17,0%	13,9%	15,5%	10,2%	7,1%	2,1%	5,7%	5,4%	8,5%										
	35	22,6%	15,4%	10,2%	10,5%	7,7%	5,4%	8,4%	4,7%	5,2%	2,5%										
	40	18,9%	15,2%	13,4%	8,8%	5,5%	7,0%	6,2%	2,6%	5,4%	4,3%										
	45	18,1%	14,4%	13,2%	7,8%	6,3%	5,6%	6,0%	3,4%	1,2%	2,7%										
	50	16,9%	14,0%	9,1%	9,5%	6,8%	2,5%	4,3%	4,9%	1,0%	-0,7%										
	100	13,8%	7,9%	6,0%	1,3%	2,9%	2,0%	-0,9%	-0,8%	-1,4%	-1,0%										
	150	10,8%	8,0%	5,5%	4,9%	1,8%	1,5%	3,1%	-0,9%	0,0%	0,9%										
	200	9,2%	8,3%	6,0%	5,6%	3,8%	3,3%	2,7%	4,1%	3,6%	3,3%										
	250	6,0%	4,8%	4,0%	3,4%	2,2%	3,0%	1,3%	4,1%	3,3%	0,5%										
	300	5,1%	4,7%	3,7%	3,4%	1,6%	1,3%	0,7%	0,4%	0,5%	-0,2%										

Max	24,3%
Min	-1,4%
Proportion positive	94,7%
Median	5,6%
Mean	7,0%
Std Dev	5,7%

Appendix 8:

Tests for significance (formation and holding period up to 250 days)

While the effect of changing the number of shares in the portfolio and alternating between the winner and the loser portfolio has been documented in this research report, the significance of the difference in proportion positive and difference in mean market excess returns is elaborated on below. Each heat map was comprised of a 25 by 25 cell grid, resulting in 625 return observations, of which positive observations indicate market excess returns.

Appendix 8.1:

Significant differences of Proportion positive of each heat map

The diagram (and corresponding tests below) exhibits the results of the statistical significance for the proportion of positive observations for each heat map at the 5% significance level. Reading vertically holds the portfolio size constant, while reading horizontally holds the strategy constant.

Significant differences of Proportion positive of each heat map

	Q20	Q30	Z	Result
Winner	88,3%	79,8%	4,1	Diferent
Loser	66,2%	66,9%	-	0,2 Not Different
Z	9,3	5,2		
Result	Different	Different		

The differences when switching between portfolio size for a given strategy were less notable than the effect of changing strategy for a given portfolio size. This supports the findings of Muller (1999). The null and alternative hypotheses and associated tests are documented below.

Significant differences of Proportion positive of each heat map

$H_0: p_1 = p_2; p_1 > p_2$

Because the test is two-tailed and the level of significance is $\alpha = 0.05$, the critical values are ± 1.96 .

The rejection regions are $z < -1.96$ and $z > 1.96$.

The standardized test statistic is:

Z stat	$z = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\bar{p}\bar{q}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$
Where	$\bar{p} = \frac{x_1 + x_2}{n_1 + n_2}$
And	$\bar{q} = 1 - \bar{p}$

Calculations:

1.) Change in strategy (30Q Winner/loser)

$\bar{p} = \frac{499 + 418}{625 + 625} = \frac{917}{1250} \approx 0.734$	Given that the Z statistic of 5,2 exceeds the 5% significance critical value of 1,96 for this two-tailed test, the null hypothesis can be rejected and the alternative hypothesis that the winner portfolio has a greater proportion positive at the 30% quantile is accepted.
$\bar{q} = 1 - \bar{p} = 1 - 0.734 = 0.266$	
$z = \frac{(0.798 - 0.669) - (0)}{\sqrt{(0.734)(0.266)\left(\frac{1}{625} + \frac{1}{625}\right)}} \approx 5,2$	

2.) Change in strategy (20Q Winner/loser)

$\bar{p} = \frac{552 + 414}{625 + 625} = \frac{966}{1250} \approx 0.773$	Given that the Z statistic of 9,3 exceeds the 5% significance critical value of 1,96 for this two-tailed test, the null hypothesis can be rejected and the alternative hypothesis that the winner portfolio has a greater proportion positive than the loser portfolio at the 20% quantile is accepted.
$\bar{q} = 1 - \bar{p} = 1 - 0.773 = 0.227$	
$z = \frac{(0.883 - 0.662) - (0)}{\sqrt{(0.773)(0.227)\left(\frac{1}{625} + \frac{1}{625}\right)}} \approx 9,3$	

3.) Change in portfolio size (Winner 20Q to 30Q)

$\bar{p} = \frac{552 + 499}{625 + 625} = \frac{1051}{1250} \approx 0.841$	Given that the Z statistic of 4,1 exceeds the 5% significance critical value of 1,96 for this two-tailed test, the null hypothesis can be rejected and the alternative hypothesis that the winner portfolio has a greater proportion positive at the 20% quantile than at the 30% quantile is accepted.
$\bar{q} = 1 - \bar{p} = 1 - 0.841 = 0.159$	
$z = \frac{(0.883 - 0.798) - (0)}{\sqrt{(0.841)(0.159)\left(\frac{1}{625} + \frac{1}{625}\right)}} \approx 4,1$	

4.) Change in portfolio size (Loser 20Q to 30Q)

$\bar{p} = \frac{414 + 418}{625 + 625} = \frac{832}{1250} \approx 0.666$	Given that the Z statistic of -0,2 fails to exceed the 5% significance critical value of 1,96 for this two-tailed test, the null hypothesis cannot be rejected and thus the loser portfolio does not have a greater proportion positive at the 20% quantile than at the 30% quantile. Thus the two proportion positive percentages are not significantly different.
$\bar{q} = 1 - \bar{p} = 1 - 0.666 = 0.334$	
$z = \frac{(0.662 - 0.669) - (0)}{\sqrt{(0.666)(0.334)\left(\frac{1}{625} + \frac{1}{625}\right)}} \approx -0,2$	

Appendix 8.2:

Significant differences of mean excess return of each heat map

While the results above indicate a more notable indication stemming from a change in strategy, rather than portfolio size, criticisms of this measure of a surface difference test by Muller (1999) (namely that differences in proportion have increasingly less meaning at values close to 0% or 100%, and that chosen portfolio sizes are merely arbitrary values of a particularly portfolio attribute) are noted. This calls for a difference in means test being applied in addition to the test above.

Significant differences of mean excess return of each heat map

	Q20	Q30	Z	Result
Winner	Mean = 3,51% Std Dev =3,4%	Mean = 1,67% Std Dev =2,5%	10,98	Different
Loser	Mean = 1,22% Std Dev =2,8%	Mean = 1% Std Dev =2,2%	1,53	Not Different
Z	13,01	5,04		
Result	Different	Different		

The results in the diagram above are similar to those presented in appendix 8.1. Reading vertically holds the portfolio size constant, while reading horizontally holds the strategy constant. Switching between portfolio size for a given strategy exhibited less notable differences than the effect of changing between a loser and a winner strategy for a given portfolio size. This further supports the findings of Muller (1999). The null and alternative hypotheses and associates tests are documented below.

Significant differences of mean excess return of each heat map

$H_0: \mu_1 = \mu_2; \mu_1 > \mu_2$

Because the test is two-tailed and the level of significance is $\alpha = 0.05$, the critical values are ± 1.96 .

The rejection regions are $z < -1.96$ and $z > 1.96$.

Standardized test statistic:

Z stat	$z = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$
--------	--

*Note: an assumption of equal variances has been employed for this test

1.) Change in strategy (30Q Winner/loser)

$z = \frac{(0.0167 - 0.01) - (0)}{\sqrt{\left(\frac{0.00006}{625} + \frac{0.00005}{625}\right)}} \approx 5$	<p>Given that the Z statistic of 5 exceeds the 5% significance critical value of 1,96 for this two-tailed test, the null hypothesis can be rejected and the alternative hypothesis that the winner portfolio has a greater mean excess return at the 30% quantile is accepted.</p>
---	--

2.) Change in strategy (20Q Winner/loser)

$z = \frac{(0.0351 - 0.0122) - (0)}{\sqrt{\left(\frac{0.0011}{625} + \frac{0.0008}{625}\right)}} \approx 13,01$	<p>Given that the Z statistic of 13,01 exceeds the 5% significance critical value of 1,96 for this two-tailed test, the null hypothesis can be rejected and the alternative hypothesis that the winner portfolio has a greater mean excess return than the loser at the 20% quantile is accepted.</p>
---	---

3.) Change in portfolio size (Winner 20Q to 30Q)

$z = \frac{(0.0351 - 0.0167) - (0)}{\sqrt{\left(\frac{0.0011}{625} + \frac{0.0006}{625}\right)}} \approx 10,98$	<p>Given that the Z statistic of 10,98 exceeds the 5% significance critical value of 1,96 for this two-tailed test, the null hypothesis can be rejected and the alternative hypothesis that the winner portfolio has a greater proportion positive at the 20% quantile than at the 30% quantile is accepted.</p>
---	--

4.) Change in portfolio size (Loser 20Q to 30Q)

$z = \frac{(0.0122 - 0.01) - (0)}{\sqrt{\left(\frac{0.0008}{625} + \frac{0.0005}{625}\right)}} \approx 1,53$	<p>Given that the Z statistic of 1,53 fails to exceed the 5% significance critical value of 1,96 for this two-tailed test, the null hypothesis cannot be rejected and thus the loser portfolio does not have a significantly greater mean at the 20% quantile than at the 30% quantile. Thus the two means are not significantly different.</p>
--	---

Appendix 9:

Eviews code

Appendix 9.1:

Eviews code for Price and Moving Average

```
subroutine movavrule(scalar ma1, scalar hp)
'Working Simulation: Moving averages rules only

smpl @all
'PARAMETERS and INITIALISATION

        !ma = ma1
!hperiod = hp' the holding period
!length = @obsrange
!test_start = !hperiod + 1408 'Allows for testing in periods
!test_end = !length - !hperiod - !hperiod

        vector(60) daily_ret = 0
vector(60) period_mas = 0
vector(60) price_on_day = 0

        series_shorts = 0
        series_longs = 0
series_num_shorts = 0
series_num_longs = 0
scalar temp

%top60= "SAB BIL AGL MTN CFR SOL NPN SBK KIO FSR VOD AMS ANG OML ASA SHP
NED IMP GFI SLM REM BVT APN EXX RMH TBS TRU WHL GRT SHF IPL MSM CSO HAR
ARI TFG DSY MPC MMI REI INP MDC ABL LBH MNP NTC RDF TSH SNT PIK SPP ACL AVI
LON BAW NPK CPL HYP PPC RLO"

group price
group moving
group dailyreturns

for %share {%top60}
genr {%share}_ma_{!ma} = 0
{%share}_ma_{!ma} = @movav({%share}_p,{!ma})
moving.add {%share}_ma_{!ma}
price.add {%share}_p
dailyreturns.add {%share}_return

next

for !i = !test_start to !test_end step !hperiod
'Get decision-making data from one day before
smpl @first + !i - 1 @first + !i - 1

for !x = 1 to 60
if (period_ret(!x) = "NA") then
period_ret(!x) = 0

endif
```

```

%series = moving.@seriesname(!x)
period_mas(!x) = @max( {%series})
%series = price.@seriesname(!x)
price_on_day(!x) = @max( {%series})
next

'SHORT POSITIONS
for !y = !i to (!i + !hperiod) step 1
'Note that @first has a value of 1 !!!

smpl @first + !y @first +!y

'Use the dailyreturns group to build a vector of daily returns
for !z = 1 to 60
%series = dailyreturns.@seriesname(!z)
daily_ret(!z) = @min( {%series})
next

'temp counts the number of longs and shorts
temp = 0

for !z = 1 to 60

'exclude all shares that do NOT meet criteria
if (daily_ret(!z) = "NA") then
daily_ret(!z) = 0

endif

if (price_on_day(!z) >= period_mas(!z)) then

daily_ret(!z) = 0
endif

if (daily_ret(!z) <> 0) then
_shorts(!y+1)= _shorts(!y+1) - daily_ret(!z)

endif

'count the number of shares which do meet criteria
if (price_on_day(!z) < period_mas(!z)) then
temp = temp + 1
endif
next
'record the number of postions entered into
_num_shorts(!y+1) = temp
if temp = 0 then temp = 1
endif
'calculate correct returns assuming equal weighting
_shorts(!y+1)= _shorts(!y+1)/temp
next

'LONG POSITIONS

for !y = !i to (!i + !hperiod) step 1
smpl @first + !y @first +!y
for !z = 1 to 60 'build the daily_ret vector using the dailyreturns group
%series = dailyreturns.@seriesname(!z)
daily_ret(!z) = @min( {%series})
next

```

```

temp = 0
for !z = 1 to 60
if (daily_ret(!z) = "NA") then
daily_ret(!z) = 0
endif
if (price_on_day(!z) <= period_mas(!z)) then
daily_ret(!z) = 0

endif
if (daily_ret(!z) <> 0) then
_longsg(!y+1) = _longsg(!y+1) + daily_ret(!z)
endif
if (price_on_day(!z) > period_mas(!z)) then
temp = temp + 1
endif
next
_num_longsg(!y+1) = temp
if temp = 0 then temp = 1
endif
_longsg(!y+1) = _longsg(!y+1)/temp
next
next
'Clean up unnecessary series...
for %share {%top60}
delete {%share}_ma_{!ma}

next
'delete stocks'clear the stocks group
delete dailyreturns
delete moving
delete price

'create series with useful names!!!
'temp = !percentile*100
smpl @all
%namedlongs = "_l" + @STR(!hperiod) + "d" + "_" + @STR(!ma) + "ma"
%namedshorts = "_s" + @STR(!hperiod) + "d" + "_" + @STR(!ma) + "ma" %numlongs = "_nol" +
@STR(!hperiod) + "d" + "_" + @STR(!ma) + "ma" %numshorts = "_nos" + @STR(!hperiod) + "d" +
"_" + @STR(!ma) + "ma"

genr {%namedlongs } = _longs
genr {%namedshorts } = _shorts
genr {%numlongs } = _num_longsg
genr {%numshorts } = _num_shortsg
endsub

call movavrule(5,5)
'RESET SAMPLE PERIOD to the beginning of 1998 onwards...
smpl @first + 1408 @last - 14

```

Appendix 9.2:

Eviews code for Ranking shares based on prior returns at a specified formation period, holding period and % quantile

```
'MOMENTUM TESTER
' Percentile ranking method
'Set formation period, holding period and percentile selected. Programs loops for each non-overlapping
holding period. Longs and shorts done simultaneously and named. No of shares in each is also made
and named.

'parameters are formation period, holding period and percentiles

for !j = 25 to 250 step 25

call percentileMethod(25,!j,0.30)

group longs
group shorts
group nologs
group noshorts

'create series with useful names!!!
temp = !percentile*100
smpl @all

%namedlongs = "_l" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"
%namedshorts = "_s" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"
%numlongs = "_nol" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"
%numshorts = "_nos" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"

genr {%namedlongs} = _longs
longs.add {%namedlongs}
genr {%namedshorts} = _shorts
shorts.add {%namedshorts}
genr {%numlongs} = _num_long
nologs.add {%numlongs}
genr {%numshorts} = _num_shorts
noshorts.add {%numshorts}

next
'delete "_l" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"
'delete "_s" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"
'delete "_nol" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"
'delete "_nos" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"

' delete longs
' delete shorts
' delete nologs
' delete noshorts

'next

subroutine percentileMethod(scalar fp, scalar hp, scalar p)

smpl @all
'PARAMETERS and INITIALISATION

!fperiod = fp 'the formation period
```

```

!hperiod = hp 'the holding period
!percentile = p
!length = @obsrange

!test_start = !fperiod
!test_end = !length-!hperiod-!fperiod

vector(60) period_ret = 0
vector(60) daily_ret = 0
series _shorts = 0
series _longs = 0
series _num_shorts = 0
series _num_long = 0
scalar temp

%top60= "SAB BIL AGL MTN CFR SOL NPN SBK KIO FSR VOD AMS ANG OML ASA SHP
NED IMP GFI SLM REM BVT APN EXX RMH TBS TRU WHL GRT SHF IPL MSM CSO HAR
ARI TFG DSY MPC MMI REI INP MDC ABL LBH MNP NTC RDF TSH SNT PIK SPP ACL AVI
LON BAW NPK CPL HYP PPC RLO"

group stocks
group dailyreturns'use daily returns, NOT period returns, for comparing strategies!

for %share {%top60}
  genr {%share}_ret_{!fperiod} = 0
  {%share}_ret_{!fperiod} = ({%share}_p - {%share}_p(-!fperiod)) / ( {%share}_p(-!fperiod) )
  stocks.add {%share}_ret_{!fperiod}
  dailyreturns.add {%share}_return
next

for !i = !test_start to !test_end step !hperiod
  'Get decision-making data from one day before (next day implementation)
  smpl @first +!i - 1 @first +!i - 1
  for !x = 1 to 60
    %series = stocks.@seriesname(!x)
    period_ret(!x) = @max({%series})
    if (period_ret(!x) = "NA") then
      period_ret(!x) = 0
    endif
  next

  'SHORT POSITIONS
  for !y = !i to (!i + !hperiod) step 1
    'Note that @first has a value of 1 !!!
    smpl @first + !y @first +!y
    'Use the dailyreturns group to build a vector of daily returns
    for !z = 1 to 60
      %series = dailyreturns.@seriesname(!z)
      daily_ret(!z) = @min({%series})
    next
    'temp counts the number of longs and shorts
    temp = 0
    for !z = 1 to 60
      'exclude all shares that do NOT meet criteria
      if (daily_ret(!z) = "NA") or (period_ret(!z) > @quantile(period_ret, !percentile)) then
        daily_ret(!z) = 0
      endif
      if (daily_ret(!z) <> 0) then
        _shorts(!y+1) = _shorts(!y+1) - daily_ret(!z)
      endif
    next
  next

```

```

'count the number of shares which do meet criteria
if (period_ret(!z) < @quantile(period_ret,!percentile)) then
temp = temp + 1
endif
next
'record the number of postions entered into
_num_shorts(!y+1) = temp
if temp = 0 then temp = 1
endif
'calculate correct returns assuming equal weighting
_shorts(!y+1)= _shorts(!y+1)/temp

next
'LONG POSITIONS
for !y = !i to (!i + !hperiod) step 1
smp1 @first + !y @first +!y
for !z = 1 to 60'build the daily_ret vector using the dailyreturns group
%series = dailyreturns.@seriesname(!z)
daily_ret(!z) = @min({%series})
next
temp = 0
for !z = 1 to 60
if (daily_ret(!z) = "NA") or (period_ret(!z) < @quantile(period_ret,1- !percentile)) then
daily_ret(!z) = 0
endif
if (daily_ret(!z) <> 0) then
_longs(!y+1)= _longs(!y+1) + daily_ret(!z)
endif
if (period_ret(!z) > @quantile(period_ret,1-!percentile)) then
temp = temp + 1
endif
next'build the vector of daily returns accross shares at a single point in time
_num_longs(!y+1) = temp
if temp = 0 then temp = 1
endif
_longs(!y+1) = _longs(!y+1)/temp

next
next
'Clean up unnecessary series...
for %share {%top60}
delete {%share}_ret_{!fperiod}
next
'delete stocks'clear the stocks group
'delete dailyreturns

endsub

'RESET SAMPLE PERIOD to the beginning of 1998 onwards...
smp1 @first + 1408 @last - 14

```

Appendix 9.3:

Eviews code for Ranking shares as overbought or oversold

```
'OBOS TESTER
' Percentile ranking method
'Set formation period, holding period and percentile selected (at end). Programs loops for each non-
overlapping holding period. Longs and shorts done simultaneously and named. No of shares in each is
also made and named.

for !j = 5 to 50 step 5
call percentileMethod(5,!j,0.20)
group longs
group shorts
group nologs
group noshorts

'create series with useful names!!!
temp = !percentile*100

smpl @all
%namedlongs = "_l" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"
%namedshorts = "_s" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"
%numlongs = "_nol" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"
%numshorts = "_nos" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"

genr {%namedlongs} = _longs
longs.add {%namedlongs}
genr {%namedshorts} = _shorts
shorts.add {%namedshorts}
genr {%numlongs} = _num_long
nologs.add {%numlongs}
genr {%numshorts} = _num_shorts
noshorts.add {%numshorts}
next
subroutine percentileMethod(scalar fp, scalar hp, scalar p)
smpl @all

'PARAMETERS and INITIALISATION
!fperiod = fp' the formation period
!hperiod = hp' the holding period
!percentile = p
!length = @obsrange

!test_start = !fperiod+1408
!test_end = !length-!hperiod-!fperiod

vector(60) period_ret = 0
vector(60) daily_ret = 0
series _shorts = 0
series _longs = 0
series _num_shorts = 0
series _num_long = 0
scalar temp
%top60= "SAB BIL AGL MTN CFR SOL NPN SBK KIO FSR VOD AMS ANG OML ASA SHP
NED IMP GFI SLM REM BVT APN EXX RMH TBS TRU WHL GRT SHF IPL MSM CSO HAR
ARI TFG DSY MPC MMI REI INP MDC ABL LBH MNP NTC RDF TSH SNT PIK SPP ACL AVI
LON BAW NPK CPL HYP PPC RLO"
group stocks
group dailyreturns 'use daily returns, NOT period returns, for comparing strategies!
```

```

for %share {%top60}
genr {%share}_ret_{!fperiod} = 0
'NOTE CHANGE HERE
{%share}_ret_{!fperiod} = ({%share}_p - @movav({%share}_p, {!fperiod})) /
(@movav({%share}_p, {!fperiod}))
stocks.add {%share}_ret_{!fperiod}
dailyreturns.add {%share}_return
next
for !i = !test_start to !test_end step !hperiod
'Get decision-making data from one day before (next day implementation)
smpl @first +!i - 1 @first +!i - 1
for !x = 1 to 60
%series = stocks.@seriesname(!x)
period_ret(!x) = @max({%series})
if (period_ret(!x) = "NA") then
period_ret(!x) = 0
endif
next

'SHORT POSITIONS
for !y = !i to (!i + !hperiod) step 1
'Note that @first has a value of 1 !!!
smpl @first + !y @first +!y
'Use the dailyreturns group to build a vector of daily returns
for !z = 1 to 60
%series = dailyreturns.@seriesname(!z)
daily_ret(!z) = @min({%series})
next
'temp counts the number of longs and shorts
temp = 0
for !z = 1 to 60
'exclude all shares that do NOT meet criteria
if (daily_ret(!z) = "NA") or (period_ret(!z) > @quantile(period_ret, !percentile)) then
daily_ret(!z) = 0
endif

if (daily_ret(!z) <> 0) then
_shorts(!y+1) = _shorts(!y+1) - daily_ret(!z)
endif
'count the number of shares which do meet criteria
if (period_ret(!z) < @quantile(period_ret, !percentile)) then
temp = temp + 1
endif
next
'record the number of postions entered into
_num_shorts(!y+1) = temp
if temp = 0 then temp = 1
endif
'caluculate correct returns assuming equal weighting
_shorts(!y+1) = _shorts(!y+1)/temp
next

'LONG POSITIONS
for !y = !i to (!i + !hperiod) step 1
smpl @first + !y @first +!y
for !z = 1 to 60' build the daily_ret vector using the dailyreturns group
%series = dailyreturns.@seriesname(!z)
daily_ret(!z) = @min({%series})
next

```

```

temp = 0
for !z = 1 to 60
if (daily_ret(!z) = "NA") or (period_ret(!z) < @quantile(period_ret,1- !percentile)) then
daily_ret(!z) = 0
endif
if (daily_ret(!z) <> 0) then
_longsg(!y+1)= _longsg(!y+1) + daily_ret(!z)
endif

if (period_ret(!z) > @quantile(period_ret, 1-!percentile)) then
temp = temp + 1
endif
next
'build the vector of daily returns accross shares at a single point in time
_num_longsg(!y+1) = temp
if temp = 0 then temp = 1
endif
_longsg(!y+1) = _longsg(!y+1)/temp
next
next
'Clean up unnecessary series...
for %share {%top60}
delete {%share}_ret_{!fperiod}
next
delete stocks 'clear the stocks group
delete dailyreturns
'create series with useful names!!!
'temp = !percentile*100
'smpl @all
'%namedlongs = "_lo" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"
'%namedshorts = "_so" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"
'%numlongs = "_nolo" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod) + "d"
'%numshorts = "_noso" + @STR(!fperiod) + "d" + @STR(temp) + "q" + @STR(!hperiod)+ "d"
'genr {%namedlongs } = _longs
'genr {%namedshorts } = _shorts
'genr {%numlongs } = _num_longsg
'genr {%numshorts } = _num_shortsg
endsub

'RESET SAMPLE PERIOD to the beginning of 1998 onwards...
smpl @first + 1408 @last - 14

```

Appendix 9.4:

Eviews code for the equally weighted index

```
'EWI
smpl @all
!length = @obsrange
!test_start = 14'Allows for testing in periods
!test_end = !length-14
vector(60) daily_ret = 0
vector(60) pricev = 0

'delete _nolewi
series _lewi = 0
series _nolewi = 0
scalar temp = 0

%top60= "SAB BIL AGL MTN CFR SOL NPN SBK KIO FSR VOD AMS ANG OML ASA SHP
NED IMP GFI SLM REM BVT APN EXX RMH TBS TRU WHL GRT SHF IPL MSM CSO HAR
ARI TFG DSY MPC MMI REI INP MDC ABL LBH MNP NTC RDF TSH SNT PIK SPP ACL AVI
LON BAW NPK CPL HYP PPC RLO"

group dailyreturns
group price

for %share {%top60}
genr {%share}_return = 0
price.add {%share}_p
{%share}_return = log({%share}_p) - log({%share}_p(-1))
dailyreturns.add {%share}_return

next
for !i = !test_start to !test_end step 1
smpl @first +!i @first +!i
_nolewi(!i+1) = 0
temp = 0
for !z = 1 to 60'build the daily_ret vector using the dailyreturns group
%series = dailyreturns.@seriesname(!z)
daily_ret(!z) = @min({%series})
%series = price.@seriesname(!z)
pricev(!z) = @min({%series})

next

for !z = 1 to 60
if (pricev(!z)<>na) then
if (pricev(!z) > 0) then
_nolewi(!i+1) = _nolewi(!i+1) + 1
_lewi(!i+1) = _lewi(!i+1) + daily_ret(!z)
endif
endif
next
_lewi(!i+1) = _lewi(!i+1)/_nolewi(!i+1)
'_nolewi(!i+1) = temp

next

delete dailyreturns
delete price
smpl @first+1408 @last-14
```