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Article

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Journal of Applied Finance & Banking

Provided in Cooperation with:

Scienpress Ltd, London

Suggested Citation: Hsieh, Heng-hsing; Hodnett, Kathleen (2011) : Tests of the overreaction hypothesis and the timing of mean reversals on the JSE Securities Exchange (JSE): The case of South Africa, Journal of Applied Finance & Banking, ISSN 1792-6599, International Scientific Press, Vol. 1, Iss. 1, pp. 107-130

This Version is available at:

<https://hdl.handle.net/10419/49035>

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Tests of the Overreaction Hypothesis and the Timing of Mean Reversals on the JSE Securities Exchange (JSE): the Case of South Africa

Heng-Hsing Hsieh¹ and Kathleen Hodnett²

Abstract

This paper examines the overreaction hypothesis on the JSE Securities Exchange (JSE) documented by Page and Way [5] and Muller [4] over a longer and more recent period from 01 January 1993 to 31 March 2009. The mean reversals due to investor overreaction are found to be stronger for the past winner and loser portfolios with longer formation periods. Similar to the results of De Bondt and Thaler [1] and Page and Way [5], the loser portfolios exhibit stronger mean reversals than their winner counterparts over the examination period. The delayed mean reversals for the winner portfolios might be attributable to behavioral biases such as fear of regret or being reference dependent, which cause investors to hold on too long to the past winners. The strength of mean reversals is found to be cyclical and fluctuates around the South African business cycle. Study results also suggest that contrarian investing could be a safe haven during the financial market turmoil due to their low correlations with the market during the economic downturn.

JEL classification numbers: JEL: G11

Keywords: Overreaction, Mean reversal, Market timing, Contrarian, Momentum

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1 Introduction

The weak-form efficient market hypothesis states that investors cannot consistently outperform the market by using historical price patterns. In a market where share prices systematically overshoot as a result of investor overreaction, the reversals of share prices should be predictable to provide arbitrage investment opportunities [1]. Thus, the overreaction hypothesis is in direct contradiction to the efficient market hypothesis. Investor overreaction could be attributed to the persistent overweighting of recent information and underweighting of long-term fundamental information by irrational investors [1]. The herd behaviour of investors discussed in Shiller [2] and the representativeness behavioural bias quoted in Nofsinger [3] could also contribute to the overpricing of past winners and the underpricing of past losers. Given that the long-term fundamentals remain the same, the overstated or understated share prices would be expected to correct to their long-term fundamental values [4].

If investor overreaction is present in the equity market, profitable strategies can be devised by buying past losers and selling past winners when the market is ready to correct (that is, when mean reversal takes place). This contrarian-based investment style is termed the reverse relative strength strategy since it bets on the lower historical relative strength of the shares in the market. The profitability of the reverse relative strength strategy might be cyclical since the strategy is based on market sentiment that fluctuates throughout different states of the economy. Thus, there might exist specific timing for investor overreaction and the subsequent mean reversals of the past winners and losers. Since investors are most aggressive in an overheated bull market, the market reversals are likely to be strongest when the speculative bubble developed during the bull market eventually bursts.

This paper examines the existence of investor overreaction on the JSE Securities Exchange (JSE) documented by Page and Way [5] and Muller [4] over a longer and more recent period from 01 January 1993 to 31 March 2009 (a total of 195

months). In the case where investor overreaction is found to be present on the JSE, the paper undertakes to determine whether the mean reversals of past winners and losers are cyclical and the implications for the reverse relative strength strategy on the JSE over the examination period. The investigation of the timing of reversals on the JSE is possible since the examination period covers the financial market turmoil of 2003 and the stock market crashes of mid-1998 and late 2008.

2 Review of Prior Literature

De Bondt and Thaler [1] test the overreaction hypothesis on the New York Stock Exchange (NYSE) by examining the average cumulative abnormal returns (ACAR) of the prior winner and loser portfolios over the period from 01 January 1933 to 31 December 1982. The prior 36-month loser portfolios outperform their winner counterparts by 24.6% 36 months after formation, on average, over the examination period. The loser portfolios are found to accumulate positive abnormal returns while the winner portfolios accumulate negative abnormal returns since formation. The outperformance of the loser portfolios is less significant for the portfolios formed using shorter formation periods. In addition, the mean reversals of the loser portfolios are three times stronger than the mean reversals of the winner portfolios on average in terms of their 36-month ACARs. However, due to the fact that the majority of the positive abnormal returns of the loser portfolios are earned in January, the study results might be due to the tax-loss selling effect for the losers.

In a follow-up paper, De Bondt and Thaler [6] re-evaluate their prior tests by including factors such as firm size, seasonality and market risk in the research. The January excess returns are found to be negatively related to prior December excess returns for the past winners, which serves as an evidence of capital gains tax lock-in effect for the past winners. On the other hand, the proposed tax-loss selling for the losers was not found in the study. In general, the re-evaluation

supports the overreaction hypothesis in that the mean reversals of past winners and losers cannot be explained by the size effect and market risk. However, Chan [7] argues that the market risk of losers increases while the market risk of winners decreases over time. When the risk changes are controlled for, the abnormal returns between prior losers and winners appear to be insignificant over the period from 01 January 1933 to 31 December 1985.

Chopra, Lakonishok and Ritter [8] perform regression analysis on the abnormal returns of prior winners and losers on the NYSE over the period from 01 January 1931 to 31 December 1986. The results reveal that significant differences in the abnormal returns of prior losers and winners are realised even when the time-varying betas are taken into account. Furthermore, Chopra *et al* [8] argue that since size, prior returns and betas are interrelated in general, any study that attempts to relate security performance to just one or two of these factors would suffer from an omitted variable bias. When these three factors are incorporated in a multiple regression analysis, the study results indicate that prior losers outperform prior winners by 4.8% on average for the 5 years after formation after controlling for size and beta. The degree of mean reversion is nevertheless stronger for smaller firms. The authors attribute this result to the fact that large firms are held predominantly by institutional investors and hence are less subject to investor overreactions as opposed to smaller firms that are held by individual investors.

Jegadeesh and Titman [9], on the other hand, examine the returns to buying prior winners and selling prior losers as a form of relative strength strategy on the NYSE and the American Stock Exchange (AMEX) over the period from 01 January 1965 to 31 December 1989 based on 3- to 12-month prior returns. They found that significant abnormal returns are available for the short-term relative strength strategies in the first year after formation and subsequently dissipates in the following 2 years. This finding, in conjunction with the positive correlation

between the length of the formation period and the degree of the mean reversal documented by De Bondt and Thaler [1], imply that the momentum of short-term momentum portfolios are non-exhaustive and are indications of their near-term performance after formation.

Schiereck, De Bondt and Weber [10] investigate the profitability of contrarian and momentum investing on the Frankfurt Stock Exchange (FSE) over the period from 01 January 1961 to 31 December 1991. The momentum strategies formed based on prior 6-month and 12-month winners are found to outperform the passive investing in the DAX stock index by the largest margin amongst other strategies over the examination period. On the other hand, the contrarian strategies formed based on prior 36-, 48- and 60-month losers outperform the DAX stock index over the examination period.

Chan, Hameed and Tong [11] analyse the profitability of momentum investing in the international equity market indices over the period from 01 January 1980 to 30 June 1995. The 23 equity market indices that are available for constructing the relative strength strategies include 9 countries from the Asia-Pacific region, 11 countries from Europe, 2 countries from North America and South Africa. The relative strength strategy is implemented by buying the winner country indices and simultaneously selling the loser country indices based on 1-, 2-, 4-, 12- and 26-week prior returns of the respective indices. The results indicate that momentum profits are statistically significant for short holding periods of less than 4 weeks. Forner and Marhuenda [12] investigate the profitability of momentum and contrarian strategies in the Spanish Stock Exchange over the period from 01 January 1963 to 31 December 1997. The results indicate that the 12-month momentum strategy and the 60-month contrarian strategy yield significant positive abnormal returns over the examination period.

Page and Way [5] test the overreaction hypothesis on the Johannesburg Stock Exchange (now the JSE Securities Exchange) over the period from 01 July 1974

to 30 June 1989. The loser portfolios of 50 shares formed based on 36-month prior cumulative excess returns earned cumulative abnormal returns of 10% while their winner counterparts accumulate 4.5% negative abnormal returns on average over the examination period. Overall, the loser portfolios outperform the winner counterparts by 14.5% on average 36 months after formation. Consistent with the international studies, the past winners and losers mainly accumulate their abnormal returns 12 months after formation. In addition, the asymmetrical mean reversals of winners and losers observed by De Bondt and Thaler [1] are also observed. The results provide evidence of investor overreaction on the JSE and indicate that the JSE is less than weak-form efficient over the examination period.

Muller [4] investigates investor overreaction on the largest 200 shares by market capitalisation on the JSE over the period from 01 January 1985 to 28 February 1998. The middle-third of the examination period is divided into 30 equally-spaced sub-periods to provide 30 randomly-chosen portfolio formation dates within the respective sub-periods. This selection method avoids the seasonality bias in the studies conducted by De Bondt and Thaler [1] and Page and Way [5]. However, Page and Way [5] argue that the January effect documented in the U.S. studies are unlikely to impact on the tests conducted on the JSE since the majority of shares in South Africa are held by institutional investors and companies are free to choose the calendar month to end their financial years. The size of the winner and loser portfolios are kept to either 30 or 60 shares and the formation and holding periods are varied from 60 days to 4 years based on computer simulation. The results indicate that both winner and loser portfolios yield positive abnormal returns initially. However, while the holding period of the loser portfolios is optimised at 340 days, the winner portfolios lost their initial momentum after approximately 600 days. This suggests that the asymmetrical reversals of the winners and losers might be due to their unique timings in market correction. Fraser and Page [13] evaluate the profitability of value and momentum investing on the JSE over the period from 01 January 1978 to 30 September 1997

based on the results of the cross-sectional regression analysis. Test results indicate that value investing and momentum investing independently explain the 1-month leading cross-sectional returns on the JSE.

The results from the prior local and international research discussed above suggest that return momentum is non-exhaustive for the winner and loser portfolios with 12 months or shorter formation periods. On the other hand, significant mean reversals are observed for portfolios with 36-months or longer formation periods. In addition, the mean reversals are asymmetrical for the winner and loser portfolios in that the loser portfolios are found to earn greater positive cumulative abnormal returns than the negative abnormal returns accumulated by their winner counterparts. The mean reversals in the international studies are partially explained by the January effect, the firm size effect and the changing risk of the past winners and losers since formation. In South Africa, seasonality biases are less pronounced since companies are free to choose their tax reporting month and the majority of the shares are held by institutional investors as opposed to individual investors.

3 Research Methodology

The monthly values of the total return index of the companies comprising the FTSE/JSE All Share Index are obtained from DataStream International in the finance research laboratory at the University of Cape Town over the period from 01 January 1988 to 31 March 2009. As of 01 April 2009, there are 166 shares in the database. The research sample is subject to survivorship bias due to the fact that only shares that are still in existence are available in the database. Muller [4] suggests that the survivorship bias can be mitigated by excluding smaller shares in the sample since the larger shares are less likely to be delisted. Thus, the research sample is reduced by selecting the top 100 shares by market capitalisation. Page and Way [5] support this method by arguing that the abnormal returns for the

larger well-established companies would likely to be smaller and hence place a higher standard for testing the overreaction hypothesis.

The market proxy employed in this research is a monthly-rebalanced, equally-weighted portfolio of all sample shares available in each month of the examination period. The choice of the market proxy is in line with the methodology adopted by Page and Way [5] and Muller [4]. Constructing the market proxy from the sample shares ensures that fair comparison is drawn between the performance of the pre-specified portfolios and the performance of the pool where the portfolios select their constituents from. The choice of an equally-weighted market proxy over the cap-weighted proxy is based on the argument of Hsu [14] that the cap-weighted portfolios are mean-variance inefficient portfolios. More specifically, the periodic rebalancing of the cap-weighted portfolio involves buying overvalued shares and selling undervalued shares in an overreacted market. Thus, the use of such proxy would introduce a bias in the investigation of the overreaction hypothesis.

The momentum attributes examined in this research are prior 12-month, 36-month, and 60-month sample share returns. These attributes are calculated from the total return index that incorporates both the capital appreciation from the share price and the dividend yield. The past L -month return momentum of share i at the beginning of month t (that is, month $t-1$) is computed using Equation 1.

$$MOM(L)_{i,t-1} = \frac{TRI_{i,t-1}}{TRI_{i,t-1-L}} - 1 \quad (1)$$

where:

L = 12, 36, or 60;

$TRI_{i,t-1}$ = the total return index of share i in month $t-1$; and

$TRI_{i,t-1-L}$ = the total return index of share i in month $t-1-L$.

The sample shares at the beginning of each quarter (that is, 01 January, 01 April,

01 July and 01 October in the calendar year) are ranked based on their respective values for each momentum attribute over the period from 01 January 1993 to 31 March 2006. There are in total 53 quarters in this period. The top-ranked 20 shares at the beginning of each quarter are grouped to form the equally-weighted winner portfolio for each momentum attribute. Similarly, the bottom-ranked 20 shares are grouped to form the equally-weighted loser portfolio for each momentum attribute. Thus, there are 53 winner portfolios and 53 loser portfolios in total for each momentum attribute under examination. Constructing winner and loser portfolios quarterly as opposed to any particular month of the calendar year ensures that the test results are free from the seasonality bias in the studies conducted by De Bondt and Thaler [1, 6] and Page and Way [5].

Following the methodology of De Bondt and Thaler [1], the performance of the winner and loser portfolios are evaluated monthly based on their cumulative average residual returns (CAR) for each of the 36 months after portfolio formation. The K -month CAR of portfolio P formed at the beginning of month t (that is, month $t-1$) is the average of the cumulative residual returns (CR) for the shares in the portfolio as shown in Equation 2, where the K -month CR of the j th share in the portfolio is computed using Equation 3.

$$CAR(K)_{P,t-1} = \frac{\sum_{j=1}^{20} CR(K)_{j,t-1}}{20} \quad (2)$$

$$CR(K)_{j,t-1} = \left(\frac{TRI_{j,t-1+K}}{TRI_{j,t-1}} - 1 \right) - \left(\frac{TRI_{M,t-1+K}}{TRI_{M,t-1}} - 1 \right) \quad (3)$$

where:

K = 1, 2, 3... 36; and

M = the monthly-rebalanced equally-weighted market proxy of sample shares.

The post-formation monthly CARs for portfolios formed in each of the 53 quarters are averaged to obtain the K -month average cumulative abnormal returns (ACAR) for the respective momentum portfolios. Comparing the ACAR of the winner portfolio to that of the loser portfolio provides an indication as to whether there exists a potentially successful reverse relative strength strategy over the examination period. If the ACAR for the winner portfolio is positive while the ACAR for the loser portfolio is negative for a particular momentum attribute, a profitable strategy would be to long the winner portfolio and simultaneously short the loser portfolio with the expectation that the historical relative performance will continue. On the other hand, if the ACAR for the winner portfolio is negative while the ACAR for the loser portfolio is positive, a profitable reverse relative strength strategy can be established by longing the loser portfolio and simultaneously shorting the winner portfolio to exploit the mean reversal of the respective momentum portfolios.

A relative strength (or reverse relative strength) strategy is only profitable if the winner and the loser portfolios have consistent CARs over time. In other words, the long portfolio should accumulate positive abnormal returns and the short portfolio should accumulate negative abnormal returns consistently over time. As a result, the correlation coefficient between the abnormal returns of the long and short portfolios of a successful relative strength (or reverse relative strength) strategy would be significantly negative. This is true despite the fact that the returns of both the long and the short portfolios are positively correlated with the return of the market proxy as they represent the components of the market proxy.

To evaluate the above hypothesis, the correlation coefficients between the post-formation momentum portfolio returns and market proxy returns are computed for each of the momentum portfolios formed at the beginning of each of the 53 quarters in the examination period. The correlation coefficients between these 53 post-formation portfolio returns and the market proxy returns are

subsequently averaged to indicate the degree to which each momentum portfolio and the market proxy move in tandem. The same method is applied to compute the average correlation coefficients between the post-formation monthly abnormal returns of the winner and the loser portfolios for each momentum attribute.

In order to test whether there exists a specific market timing of the mean reversal over the examination period, a monthly-rebalanced reverse relative strength strategy for the momentum attribute that exhibits the most significant mean reversal is implemented from 01 January 1993 to 31 March 2009. At the beginning of each month, the new loser and winner portfolios (of 20 shares in each portfolio) are formed, and the loser less winner spread earned from the previous month is reinvested into the new loser portfolio. Simultaneously, the short position in the new winner portfolio is revised to equate the investment held long in the new loser portfolio. From 01 January 1996, the prior 36-month cumulative per rand (South African currency) long spread of the reverse relative strength strategy is computed monthly to examine the consistency of the market reversal throughout the examination period.

Following the methodology of Jegadeesh and Titman [9], the market model is used to evaluate the risk-adjusted performance of the reverse relative strength strategy as shown in Equation 4. The monthly per rand long spread in excess of the risk-free rate is regressed on the market risk premium for the 14 overlapping 36-month periods with a 12-month moving window. The first period is from 01 January 1993 to 31 December 1995, the second period is from 01 January 1994 to 31 December 1996 and the last period is from 01 January 2006 to 31 December 2008.

$$Spread_{Loser-Winner,t} - Rf_t = \alpha_{Spread} + \beta_{Spread} \times (R_{M,t} - Rf_t) + \varepsilon_{Spread,t} \quad (4)$$

where:

$R_{M,t}$ = the return on the market proxy in month t ;

- Rf_t = the return on the risk-free proxy (90-day Treasury bill) in month t ;
- α_{Spread} = the per-rand long return in excess of the risk-adjusted return estimated by the market model over the regression period;
- β_{Spread} = the sensitivity of the per-rand strategy return to movements of the market risk premium; and
- $\varepsilon_{Spread,t}$ = the random error of the regression in month t .

The intercept term (alpha) of the regression indicates the risk-adjusted abnormal return of the reverse relative strength strategy while the slope (beta) of the regression is a measure of systematic risk for the strategy. The statistical significance of the alpha and beta in each of the 14 overlapping periods are examined at the 5% significance level.

4 Results

4.1 Post-formation performance of winner and loser portfolios

The post-formation ACARs of the past 60-month momentum portfolios (MOM60), the past 12-month momentum portfolios (MOM12) and the past 36-month momentum portfolios (MOM36) are demonstrated in Figure 1, Figure 2 and Figure 3 respectively. The ACARs of the winner portfolios are marked by solid dots while the ACARs of the loser portfolios are marked by empty dots. The ACARs obtained from quarterly-formed portfolios with overlapping post-formation periods are less prone to seasonality bias and are smoother than the ACARs obtained from the annually-formed portfolios in the studies conducted by De Bondt and Thaler [1] and Page and Way [5].

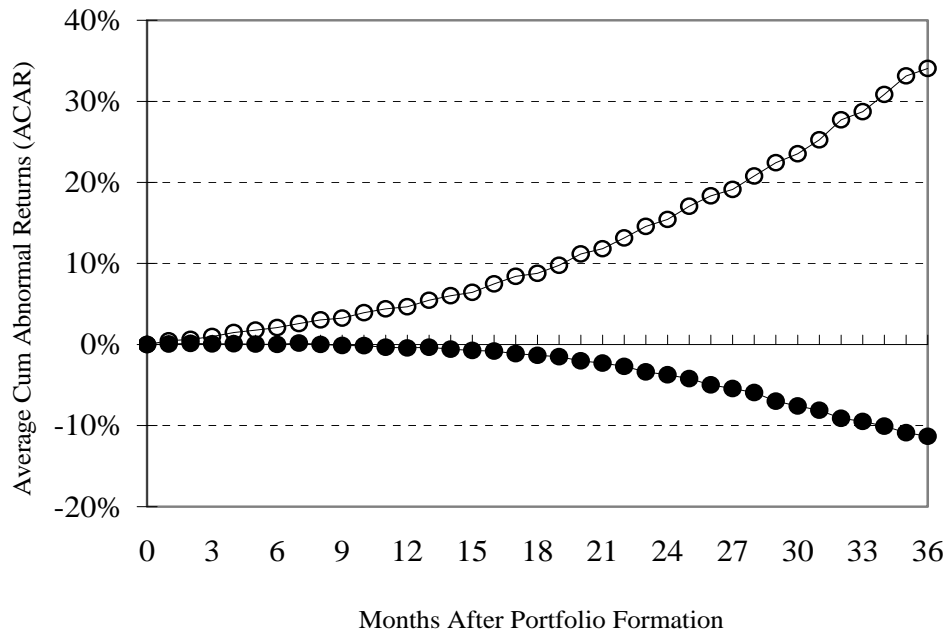


Figure 1: Post-formation performance of MOM60 Winners and Losers

It is apparent that the loser portfolios outperform their winner counterparts for the MOM60, MOM12 and MOM36 portfolios in terms of their 36-month ACARs. The mean reversal is most obvious for the MOM60 portfolios, and least apparent in the post-formation performance of the MOM12 portfolios. Figure 1 shows that the MOM60 losers outperform the market proxy by 34.06%, while the MOM60 winners underperform the market by 11.32% on average 36 months after formation over the examination period. The MOM60 losers accumulate positive abnormal returns while the MOM60 winners accumulate negative abnormal returns at an increasing rate. In addition, the observed reversals for the MOM60 winner and loser portfolios take place immediately after their formation.

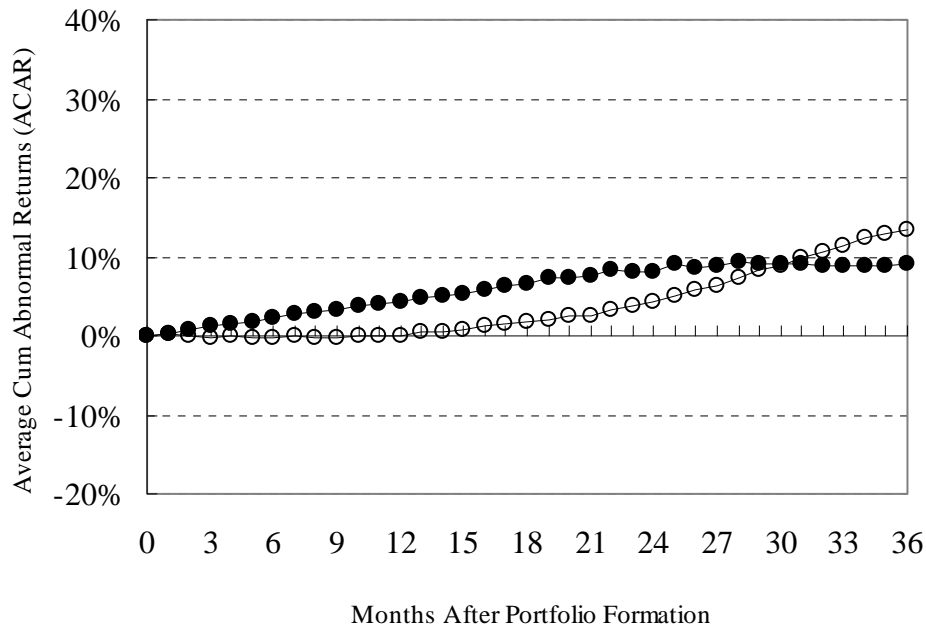


Figure 2: Post-formation performance of MOM12 Winners and Losers

With regard to the post-formation performance of the MOM12 portfolios (see Figure 2), although the ACARs of the MOM12 winners are positive and higher than the ACARs of the loser counterparts at the beginning, they become flat 27 months after formation. Contrary to the immediate reversals of the MOM60 winner and loser portfolios, the reversals for the MOM12 winner and loser portfolios take place on average 18 months after formation when the difference between the ACARs of the winners and their loser counterparts starts shrinking over time. This finding is consistent with the study results of Muller [4] and Jegadeesh and Titman [9] in that the momentum built up by the short-term momentum portfolios are non-exhaustive at first but dissipate over time. While the MOM12 winners accumulate positive abnormal returns at a decreasing rate, the MOM12 losers accumulate positive abnormal returns at an increasing rate. The ACARs of the MOM12 winners are caught up and outperformed by the ACARs of the MOM12 losers 30 months after formation. The MOM12 losers outperform the

market proxy by 13.35%, while the MOM12 winners outperform the market by 8.99% on average 36 months after formation over the examination period.

The post-formation performance of the MOM36 portfolios (see Figure 3) are somewhere in between that of the MOM12 and MOM60 portfolios. Similar to the post performance of the MOM60 portfolios, the MOM36 winners accumulate negative abnormal returns while the MOM36 losers accumulate positive abnormal returns 36 months after formation. However, the reversals for the MOM36 portfolios are not as drastic compared to that of the MOM60 portfolios. The MOM36 losers outperform the market proxy by 29.33%, while the MOM60 winners underperform the market by 7.89% on average 36 months after formation over the examination period (compared to 34.06% and 11.32% for the MOM60 losers and winners respectively). In addition, the ACARs of the MOM36 winners are positive since formation and eventually turn negative 20 months after formation.

When the post-formation ACARs of MOM60, MOM12 and MOM36 are examined collectively, it is found that the reversals for the losers are much greater than their winner counterparts in terms of the absolute values of the ACARs 36 months after formation. More specifically, the losers accumulate much greater ACARs than the winner counterparts 36 months after formation. The greater reversals of the losers are also evident in that the reversals take place (that is, where the graph kinks) much earlier for the losers than it is for the winner counterparts. This test result is in line with most of the local and international studies discussed earlier, which suggests that investors are more prompt in acquiring past losers than letting go of past winners.

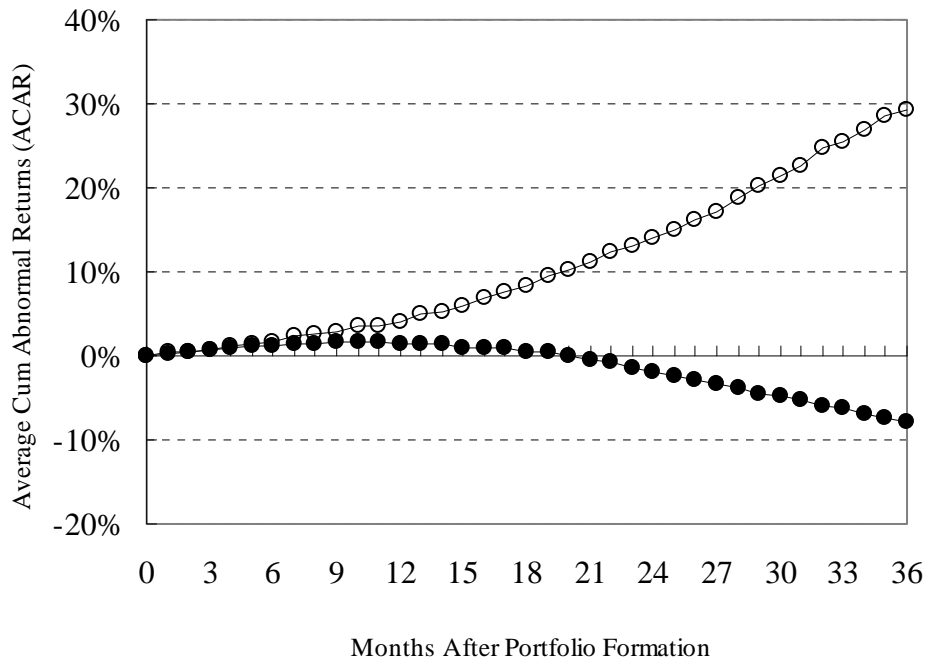


Figure 3: Post-formation performance of MOM36 Winners and Losers.

4.2 Correlation analysis

The average correlation coefficients between the post-formation monthly returns of the momentum portfolios and the market proxy are displayed in Panel A of Table 1. Panel B of Table 1 demonstrates the average correlation coefficients between the post-formation monthly abnormal returns of the winners and their loser counterparts for the respective momentum attributes.

The t -statistics that are significant at a 5% level for the correlation coefficients are in italics and highlighted in bold. It is apparent in Panel A of Table 1 that the post-formation returns of all momentum portfolios are positively significantly correlated with the returns of the market proxy as they are part of the market proxy.

Table 1: Average correlation coefficients of post-formation performance

		Panel A: Post-Formation Monthly Returns					
		MOM12	MOM36	MOM60	MOM12	MOM36	MOM60
		Winner	Winner	Winner	Loser	Loser	Loser
Market		0.871	0.887	0.889	0.806	0.776	0.824
<i>t-Statistic</i>		10.316	11.191	11.314	7.932	7.175	8.466
Counter (Loser)		0.561	0.566	0.650	-----	-----	-----
<i>t-Statistic</i>		3.952	4.008	4.981	-----	-----	-----
		Panel B: Post-Formation Monthly Abnormal Returns					
		MOM12	MOM36	MOM60			
		Winner	Winner	Winner			
Counter (Loser)		-0.441	-0.424	-0.316			
<i>t-Statistic</i>		-2.862	-2.726	-1.941			

In addition, the post-formation returns of the winners and their loser counterparts for the respective momentum portfolios are also positively significantly correlated. When the post-formation performance of the momentum portfolios are measured in terms of the abnormal returns in Panel B of Table 1, the abnormal returns of the winners and their loser counterparts are negatively significantly correlated for the MOM12 and MOM36 portfolios at a 5% significant level. On the other hand, the abnormal returns of the winners and their loser counterparts are negatively significantly correlated for the MOM60 portfolios at a 10% significant level. The results of the correlation analysis support the argument that the performance of the winners and their loser counterparts are distinguished by their respective performance relative to the market proxy in terms of the abnormal returns. The winners and their loser counterparts accumulate abnormal returns in the opposite manner despite the fact that the returns of the winners, the losers and the market proxy are positively significantly correlated.

4.3 Timing of the reverse relative strength strategy

Prior test results suggest that the reversals of the MOM60 winner and loser portfolios are immediate and most significant compared to the MOM12 and MOM36 portfolios. The reverse relative strength strategy is thus constructed by buying MOM60 losers and selling MOM60 winners from 01 January 1993 to 31 March 2009. The prior 36-month cumulative per rand long spread for the strategy is examined monthly over the examination period as illustrated in Figure 4.

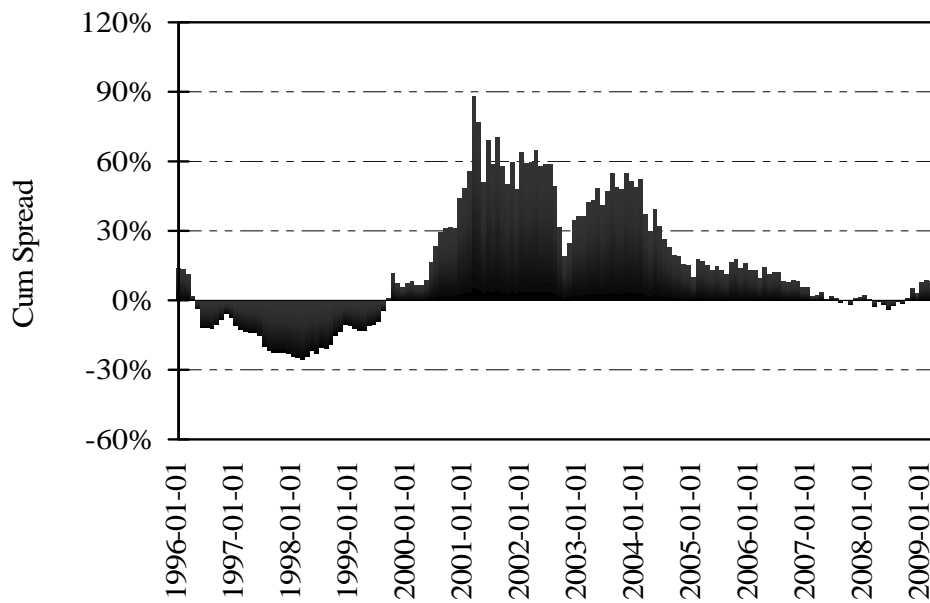


Figure 4: The market timing of mean reversal

The prior 36-month cumulative spread (histograms in Figure 4) shows that the strategy accumulated negative spread prior to 1998. According to the annual report of the South African Reserve Bank (SARB), the Asian financial crisis in the middle of 1997 has little effect on the growth prospects of the South African economy at first. By the first quarter of 1998, the South African economy came under intense pressure as monetary conditions tightened considerably [15].

The reverse relative strength strategy starts accumulating positive returns since the first quarter of 1998 until the downward change in the outlook of the world economy in 2001. According to the annual report of SARB, the considerable depreciation of the rand during 2001 helped to cushion the effect of the downward change in the outlook of the global economy. The weighted average value of the rand lost more than 30% in 2001. The domestic economy showed great resilience and maintained its growth in real output in 2001. The strong growth in the export sector (especially the resources) has provided impetus for continuous growth in the economy. The domestic expenditures from both the public and private sectors were also expanding into 2002 [16, 17].

After a sharp fall of the cumulative spread of the reverse relative strength strategy in the July 2002, the strategy started accumulating positive returns again in 2003. The stock market lost almost a third of its value since the peak in May 2002 to the end of the first quarter 2003. This is primarily due to the strong recovery of the rand coupled with weak global economic growth, war in Iraq and the threat of the SARS virus. The real economic growth in the domestic economy decelerated to merely 2% annually for 2003 [18].

The global economy grew briskly for both developed and developing countries since late 2003. Lower interest rates environment, growth-oriented fiscal policies and higher prices for export commodities such as gold and platinum resulted in the real domestic output to rise above 3% in 2004. The cumulative spread for the reverse relative strength strategy has since diminished to the negative territory until the global financial market crisis in 2008 and recovered gradually thereafter.

The timing of mean reversals is also revealed by the periodic risk-adjusted performance of the reverse relative strength strategy demonstrated in Table 2. All of the 14 regressions are significant at the 5% significance level as the *p*-value of the regression slopes indicated by beta are far less than 5% as shown in Table 2.

The statistically significant regression intercepts, alpha, are highlighted in bold.

Table 2: Risk-adjusted performance of the reverse relative strength strategy

Period:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	`93-`95	`94-`96	`95-`97	`96-`98	`97-`99	`98-`00	`99-`01
R ²	30%	39%	42%	21%	16%	19%	26%
Alpha	0.016	0.012	0.010	0.019	0.039	0.055	0.053
<i>p-Alpha</i>	0.460	0.260	0.256	0.271	0.052	0.004	0.000
Beta	1.676	1.054	1.043	0.701	0.648	0.664	0.837
<i>p-Beta</i>	0.001	0.000	0.000	0.005	0.017	0.008	0.002
Period:	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	`00-`02	`01-`03	`02-`04	`03-`05	`04-`06	`05-`07	`06-`08
R ²	41%	32%	38%	44%	45%	59%	48%
Alpha	0.039	0.047	0.025	0.022	0.015	0.013	0.024
<i>p-Alpha</i>	0.000	0.000	0.016	0.034	0.164	0.111	0.002
Beta	1.052	0.844	1.007	1.057	1.082	1.103	0.699
<i>p-Beta</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Observing the *p*-value of alpha indicates that the risk-adjusted abnormal returns become less significant towards the market meltdown in 1998 and 2008. On the contrary, the reversals are strongest (indicated by significant alpha in period 6 and period 14) immediately after the crises. The extreme swings of alpha around the crises might be an indication of the extreme switch of investor sentiment from positive to negative. In addition, the swings of the beta coefficients from above average (beta > 1.0) to below average (i.e. beta < 1.0) during market downturns in periods 4, 9 and 14 suggest that contrarian investing is a safe haven in the financial market turmoil in 1998, 2003 and 2008. This result implies that the correlations between the returns on the reverse relative strength strategy (and hence the strength of mean reversal) and the market returns are likely to be low during turbulent times. It is also observed that the beta coefficients of the reverse

relative strength strategy increase over time when investor confidence is gradually restored post-crises.

5 Conclusion

When the post-formation performance of the winner and loser portfolios are examined based on their 36-month ACARs since formation, the losers of the MOM12, MOM36 and MOM60 portfolios outperform their winner counterparts over the examination period from 01 January 1993 to 31 March 2009. The mean reversals are most significant for the MOM60 portfolios and least significant for the MOM12 portfolios. The prior momentum carried by the MOM12 and MOM36 winners is non-exhaustive and the winner portfolios continue to accumulate positive abnormal returns after formation. Whereas the ACARs of the MOM36 winners eventually turn negative 20 months after formation, the ACARs of the MOM12 winners become flat 27 months but remain positive 36 months after formation. The test results suggest that there exists a saturation point for the past winners and losers to continue their prior trends. The mean reversal is likely to take place once the saturation point is reached.

When the post-formation performance of the winner portfolios are compared to their loser counterparts, it is found that the degree of mean reversal is stronger for the losers than their winner counterparts. The asymmetrical reversals of past winners and losers imply that market correction is more prompt for the losers than it is for the winners. The delayed correction for the winners might be attributed to the behavioural biases outlined in Nofsinger [3] such as fear of regret or being reference dependent. Fear of regret causes investors to hold on too long to the past winners. Investors could also be unwilling to sell their past winners at a price lower than the historical peak price.

The result of the correlation analysis reveals that the performance of the winner portfolios and their loser counterparts are distinguished by their performance relative to the market proxy (that is, their abnormal returns), despite the fact that their returns are all positively significantly correlated. Examining the monthly prior 36-month cumulative spread of the MOM60 reverse relative strength strategy suggests that mean reversals are likely to take place when investors are less confident about the future prospects of the economy. The regression analysis of the reverse relative strength strategy support this argument in that the risk-adjusted abnormal returns represented by the alpha of the regressions are most significant immediately after the market crash. The alpha of the regression diminishes over time and become less significant towards the market meltdowns in 1998 and 2008. The swings of the beta coefficients from above- to below-average during economic crises suggest that contrarian investing is a safe haven in the financial market turmoil through the low correlation between the return of the contrarian investing and the market returns. In conclusion, the study found that mean reversals, as a consequence of investor overreaction, are strongest immediately after the market crash. The profitability of the reverse relative strength strategy is thus determined by the prevailing market sentiment of the investors.

ACKNOWLEDGEMENTS We acknowledge the use of the Finance Research Laboratory in the School of Management Studies at the University of Cape Town. We thank Professor Paul van Rensburg of Salient Quants Asset Management for his professional insights and views.

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