



## INVESTIGATING MOMENTUM ON THE JOHANNESBURG STOCK EXCHANGE

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### ABSTRACT

The paper examines if stock price momentum is a common trait amongst top performing shares on the Johannesburg Stock Exchange and whether individual investors can harness the relationship of momentum and return to create a profit.

The viability of the phenomenon as an investment strategy was gauged by comparing annualised average returns of momentum shares, identified through both technical analysis as well as price performance momentum measures, against the market capitalisation weighted JSE All Share Index as well as against an un-weighted representation of the market.

The results revealed a seemingly unmistakable co-dependence between momentum and return, with statistically significant trends being ever present. Applying the maximum taxes and trading costs revealed that the highest ranked momentum shares did indeed outperform both market benchmarks from the period of January 1990 to August 2009, suggesting the validity of the philosophy as an investment strategy.



## 1. INTRODUCTION

In 1970, so-called modern finance and regulated markets witnessed the inception of the Efficient Market Hypothesis by renowned financial theorist Prof. Eugene Fama [9]. His study proclaimed that one could never consistently beat the market, as rational investors quickly absorbed new information to displace any mispricing or 'inefficiencies' within the market. With advances in the field of psychology and in our understanding of how the brain processes decision variables, the application of psychology to financial decisions gave birth to the field of financial behaviour. In opposition to the Efficient Market Hypothesis, financial behavioural theorists believe that the masses settle the market price and that they, as such, are human and imperfect in nature.

Where single shares often outperform the market, proposers of the Efficient Market Hypothesis argue that there is no common trait among these shares and thus no strategy to identify them consistently.

Where previous studies have attempted to identify and/or exploit this phenomenon by pure price performance measures, this dissertation proposed that the price trends can be better identified through technical analysis indicators and that momentum is a consistent common trait amongst the top performing shares on the JSE.

The study focused on the principles of both statistical and economic significance, i.e. by asking whether the investment strategy holds true both statistically and when taking into account the economics of investing, including the costs of trading and taxes.

### Null Hypothesis

*H0: The phenomenon of herd behaviour establishes price momentum on the JSE, which can be better identified through technical analysis indicators to pinpoint the future top performing shares on the JSE. This price pattern can be exploited as an investment strategy to outperform the market as a whole.*

Evidence that would disprove such a theory and relate to the alternate hypothesis includes a low correlation between momentum and top performing shares, as well as the absence of significant excess returns.

### Alternate Hypothesis

*H1: There are no statistically significant price patterns on the JSE and price fluctuations occur too quickly to be harnessed. The implications of trading costs and taxes void an active trading strategy utilizing the momentum philosophy.*

The alternate hypothesis supports the Efficient Market Hypothesis viewpoint of the market and of price trends.

## 2. MOMENTUM

As stated earlier, advances in the areas of psychology and human behaviour led a number of researchers to question the validity of the efficient market hypothesis. Various studies were conducted, and different models developed to try and explain seemingly "irrational" patterns in share prices.

### 2.1. Momentum theories

Behavioural finance theories have been postulated to bridge the gap between theories based on rational investors and contrary price fluctuations.

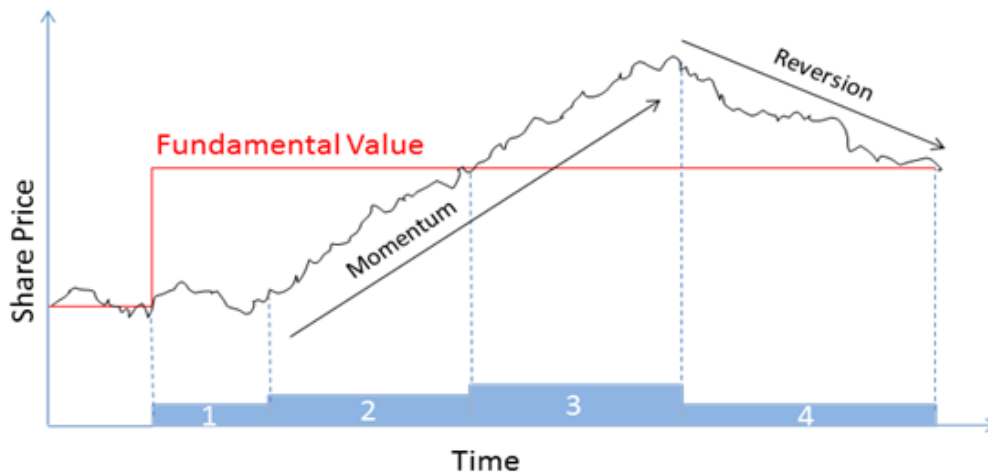


Figure 1: Perceived Price Trend

The stock price trend observed in Figure 1 is a graphical representation of the explanations for momentum and mean reversion, as encapsulated by Hong & Stein [14], using DeBondt and Thaler's [8] model, "The Three Stages of Price Reaction".

The red line illustrates the supposed fundamental value of the share price with the shift at the beginning of point 1 initiated by an announcement that fundamentally increased the value of the underlying stock. Such announcements include earnings announcements, stock issues and repurchases, dividend initiations and omissions and analyst recommendations. An overview of such announcements is provided by Bernard [4].

The price trend has four distinct stages:

- Stage 1: Under-Reaction

The market does not seem to discount new information quickly, with the share price continuing along an undefined trend, as noted by Chan, Jegadeesh and Lakonishok [5].

- Stage 2: Adjustment

The period of adjustment observes a migration towards the new true fundamental value, as the information is gradually absorbed by the public [14].

- Stage 3: Over-Reaction

The period of adjustment initiates momentum, with returns exhibiting an unconditional positive serial correlation to previous returns for short horizons of 6 to 12 months [15]. The phenomenon of momentum causes the share price to extend past the fundamental value. This idea was presented by DeBondt and Thaler [7], who found that stock returns are inversely correlated at long horizons, i.e. shares who experienced high (low) returns over any given five-year period tend to deliver low (high) returns over the subsequent five-year period.

- Stage 4: Reversion

Over longer periods, shares experience a correction towards the fundamental value [14].

The price trend and evidence presented therefore suggests that momentum is a short-term anomaly, lasting between 6 to 12 months, with mean reversion occurring over longer periods. Given this price trend, some theories have been formulated to explain the psychological biases that affect an investor and cause these anomalies.

Behavioural theorists consistently put forward the concept of herd behaviour to justify such price trends. Herd behaviour can be defined as the tendency of individuals to mimic the actions of a larger group, whether rational or irrational [20]. The rationale behind herd behaviour has two main drivers, namely:

- Social pressure - wanting to be part of the group; and
- Common rationale - assuming that such a large group cannot be wrong.

This phenomenon is present throughout the stock exchange, where individual investors are subject to news and fads and adjust their portfolios accordingly. The winner of the Charles H Dow Award, Gary Anderson, tried to explain overreaction and subsequent mean reversion by proposing the so-called Janus Factor in 2003 [1]. Janus was the early Roman god of gates and portals, and was represented by two opposing faces, suggesting the two-sided nature of everything.

Anderson modelled the stock market as a system of capital flows under the influence of traders and their two-sided 'Janus-like' behaviour. He proclaimed that, during certain market periods, a positive feedback loop exists, i.e. a movement in one direction prompts more of the same movement in the same direction.



Figure 2: Positive feedback loops

Anderson further explained that the market as a whole could be modelled as a negative feedback loop, depicted in Figure 3.

#### Negative Feedback = Stable (Cycle)

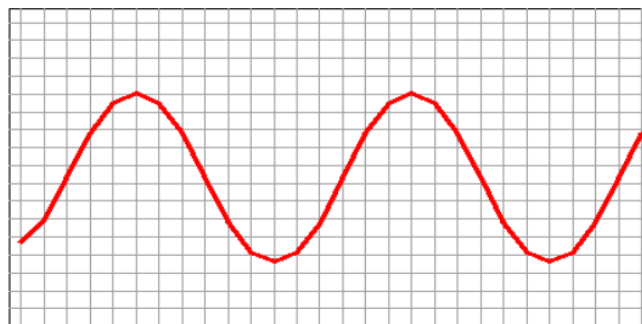


Figure 3: Negative Feedback Loop - Source: Anderson [4], p3

This is evident when investors wish to realise a profit, by selling their assets. This net aggregate of selling triggers the selling of more shares. At a certain point, investors realise that shares are oversold and thus embark on bargain hunting, which triggers more buying, thus leading to a subsequent price rise.

Consequently, as illustrated in Figure 4, during periods of positive feedback, rising share prices trigger more buying of outperforming shares, whereas declining share prices encourage the sale of underperforming shares. During the subsequent negative feedback

period, overbought shares are sold to make a profit, while oversold shares are bought at a discount, as they are perceived as bargains, thus reverting the population to the mean or market aggregate.



Figure 4 - Negative Feedback Loop - Source: Anderson [4], p3

Anderson went on to argue that the market as a whole displays similar traits, with shares moving away from the aggregate line (representing benchmark returns) during bull runs, as rising shares are bought and declining shares are sold. This is illustrated by the spread in Figure 5.

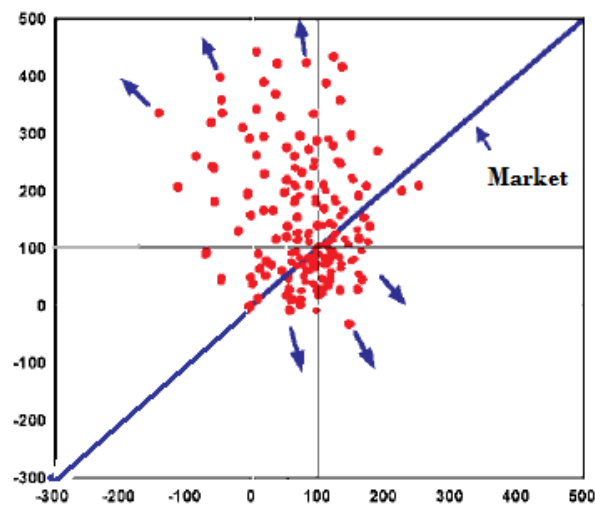


Figure 5: Momentum & Mean reversion - Source: Anderson [4], p7

During market corrections, the shares return to the market mean, depicted by the return to the market line as in Figure 6 below.

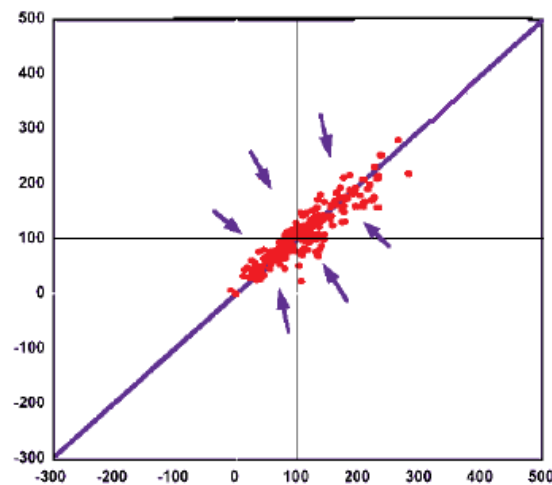


Figure 6: Momentum & Mean reversion - Source: Anderson [4], p7

## 2.2. Evidence of momentum on the stock market

The phenomenon of momentum was first identified by Scholes and Williams [19], when their method of using ordinary least squares was used to speculate over future market returns, i.e. the returns of the previous periods will explain the returns of the current period, a concept that is aptly named momentum.

The phenomenon of momentum and the psychological tendencies behind it was first explicitly proposed on the US stock exchange by Jagadeesh & Titman [15]. Their study set out to explain why mutual funds, which enjoyed abnormally high returns<sup>1</sup>, showed a strong tendency to purchase shares that performed favourably over the previous months. Their curiosity was initiated by a study conducted by Lo & MacKinley [17], who had found positive serial correlation between previous return and future returns on a weekly and monthly basis.

Lo & MacKinley [17] proposed that shares should be weighted according to their past performance, gauged against that of the market. Positive weights were assigned to a winner portfolio, whereas negative weights (short selling) were assigned to the loser portfolio. Their strategy used the entire market instead of a subset, as used by Jegadeesh & Titman[15]. As displayed in Figure 7 the entire share universe was divided into two subsets with those who outperformed being bought and those who underperformed being sold.

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<sup>1</sup> Abnormally high returns are defined as returns greater than the relevant index in which the share is listed.



Figure 7: Lo & MacKinley [17] Methodology Depiction - Own Depiction

In their initial study, Jegadeesh & Titman [15] reviewed the returns of shares over the previous one, two, three and four quarters, along with holding periods of one, two, three and four quarters. This equates to a total of 16 different portfolios.

Each month, the share universe was ranked according to the returns of their prior periods, and grouped into ten deciles. The shares were equally weighted within these deciles, with the top portfolio being the winner portfolio and the bottom being assigned as the loser portfolio. At the beginning of each month, the strategy was to sell the loser portfolio and buy the winner portfolio. Portfolios were equally weighted according to value<sup>2</sup> and held for K months, according to the different holding period strategies. Graphically, the process can be displayed as in Figure 8.

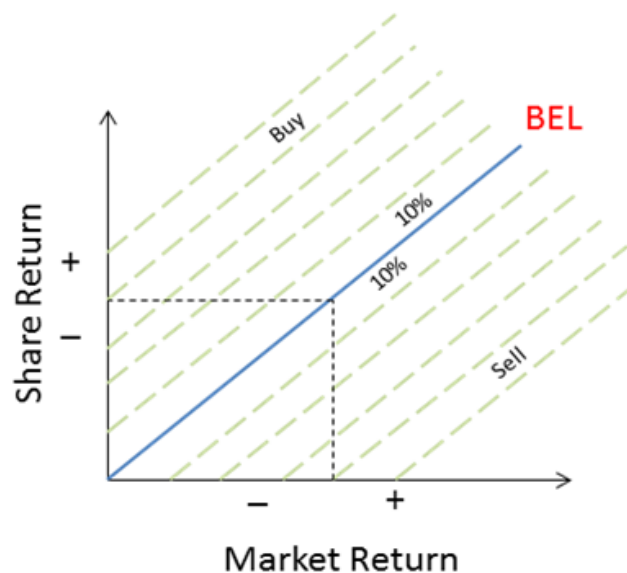


Figure 8: Jegadeesh & Titman [15] Methodology Depiction

<sup>2</sup> Each share is assigned a certain percentage of money, i.e. R100 gives 100 R1 shares or 10 R10 shares.

According to their findings, momentum did exist: the best results were obtained from shares whose performance had been evaluated over the past 12 months and using a 3-month holding period along with the construction of zero cost<sup>3</sup> portfolios.

Conrad & Kaul [6] conducted their own study, testing 120 different trading strategies, including momentum investing. They boldly defied the Efficient Market Hypothesis by stating that, regardless of whether a momentum or a contrarian strategy was used, the success of the strategy was based on the time-series behaviour of a share's price. Conrad & Kaul [6] therefore provided further evidence that momentum strategies were likely to generate abnormal profits.

In 2001, Jegadeesh & Titman [16] found further evidence to support their theory of momentum by applying Lo & MacKinley's [17] strategy to their decile method of reviewing returns over six months and holding shares for a further six months, which they referred to as the "weighted relative strength strategy" or "WRRS".

The WRRS approach is based on buying and selling shares in proportion to their prior returns.

The weighting of share  $i$  at time  $t$  is:

$$w_{i,t} = \frac{1}{N(r_{i,t-1} - \bar{r}_{i,t-1})}$$

where  $N$  is the number of shares in the sample,  $r_{i,t-1}$  is the return of the share  $i$  in the period  $t-1$ , and  $\bar{r}_{i,t-1}$  is the mean return of all shares in period  $t-1$ .

The methodologies presented above have their respective advantages and disadvantages. With the decile portfolio, the share universe is not always divisible by 10. The decile portfolio is a strategy that can be implemented, unlike the theoretical strategy by Lo & MacKinley [17], which proposes covering the entire market in a particular position - this is impossible to implement in practice given the amount of money required to hold the shares.

Given the evidence in support of the momentum phenomenon on the US stock exchanges, the question remained whether the phenomenon existed in other stock exchanges and whether the strategy would produce similar results.

### 2.3. Momentum on the JSE

Only a few studies concerning momentum have been conducted on the JSE by noteworthy scholars, namely Fraser & Page [12], Van Rensburg [21] and Van Rensburg & Robertson [22]. In addition, a Master's degree was completed by Louis Boshoff at the University of Stellenbosch in 2008 to determine the size and effect of the phenomenon.

Based on these studies, one can conclude that, although momentum was present on the JSE, the period over which the studies were conducted did have a significant effect on the results, illustrated by the range of results obtained from the different studies.

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<sup>3</sup> Zero cost portfolio refers to a method of constructing a portfolio where a dollar amount of shares is bought and the same dollar amount of shares is sold (shorted) to incur zero cost to the trader.



## 2.4. Technical analysis indicators

The very first method of establishing momentum was through reviewing price performance over a previous period. Therefore, shares that generated the greatest return over the previous period, had the greatest momentum.

One argument is that this form of gauging momentum is subject to identifying shares that are overvalued and are thus ready for a correction. Figure 9 illustrates how two different shares have the same momentum according to the price performance measure, although they have very different and distinct trends. Share B is in a downward trend towards the end of the review period, whilst share A is still increasing. Technical analysis indicators attempt to identify the underlying trend and thus to identify shares, which are still rising and which will continue to do so.

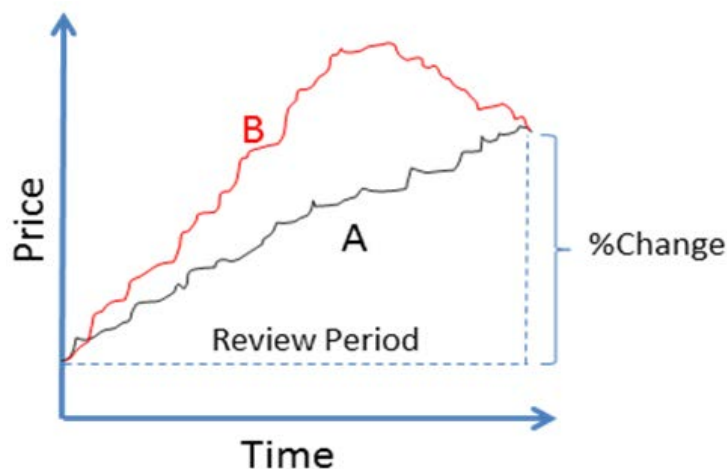


Figure 9: Price Performance

Various methods of identifying momentum have been used successfully used by investors, such as a simple moving average, a normalised moving average converging diverging indicator or generally referred to as MACD[2], a rate of change indicator[3], a relative strength indicator [24]. By combining the concepts of relative strength and momentum (Relative Strength Momentum) through the utilisation of the rate of change concept, technical analysts hope to achieve higher returns more consistently.

## 3. METHODOLOGY

The methodology for the study was designed to identify three principles, namely:

- whether momentum is a common attribute amongst top performing shares;
- whether technical analysis better identifies the phenomenon than price performance momentum measures; and
- whether the return from these shares would justify the momentum concept as a viable investment strategy.

The methodology is illustrated as a flow diagram in Figure 10. This diagram indicates that the share's momentum will be translated into a rank. Given the time and scope of the study, the different settings for each of the technical momentum ranking methods will be obtained from the prospective proposers of each method, as tabulated in Table 1 below.

Ranking Method	Setting
MACD	45 week long term exponential moving average with a 15 week short term exponential moving average
RsmOM	40 week exponential moving average of the share's relative strength against the JSE ALSI, with a 15 week ROC review period
ROC	8 week price comparison

Table 1: Technical Indicator Settings

Also indicated in the flow diagram is the fact that, within the traditional price performance ranking method, several review periods will be tested, including 3, 6, 9, and 12 months.

Price performance will be gauged in terms of the capital gains yield over the holding period. Given the following formula, returns were calculated by:

$$r_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}}$$

Where:

- $r_{it}$  = return obtained over the period  $t$
- $P_{it}$  = Price of the share at the end of the holding period
- $P_{it-1}$  = Price of the share upon purchase

The share's performance will be evaluated 1, 2, 3, 4, 6 and 12 months after momentum ranking, with returns also being translated into a rank. The performance will be utilised to evaluate the return of the various ranking methods, with the return rank being employed to evaluate whether momentum is a common attribute amongst top performing shares.

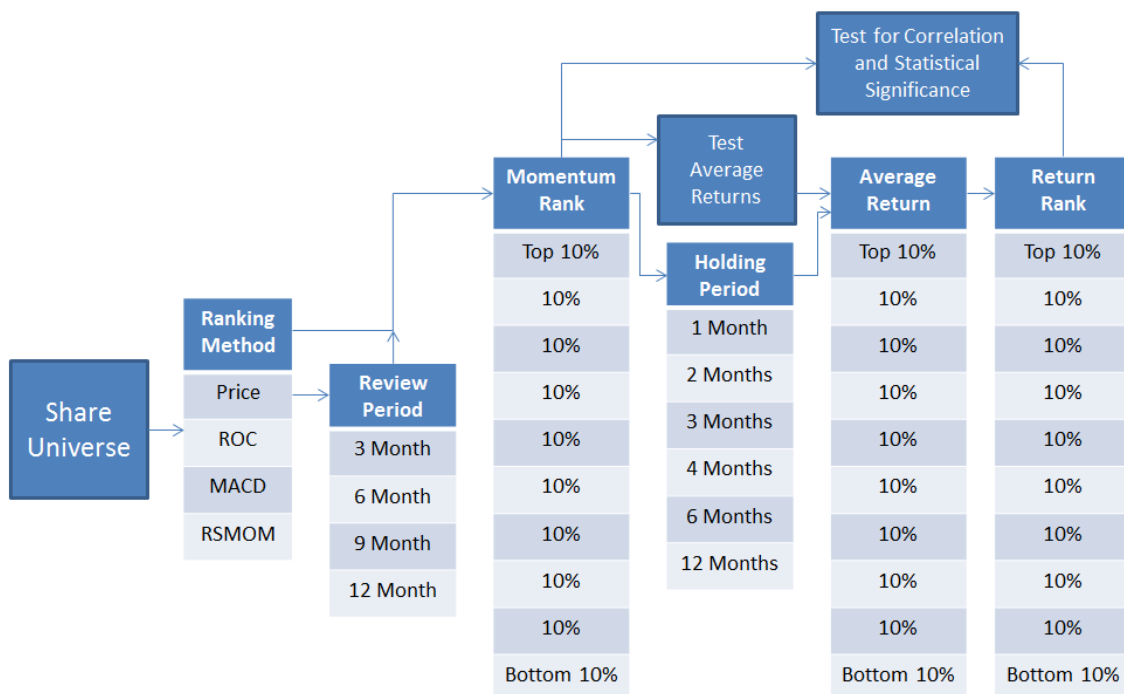


Figure 10: Methodology Flow Diagram

Ranking returns into deciles allow the study to remove the impact of market variance from the results.

### 3.1. The data

The historical share data was obtained from Sharenet. The data included those shares listed on the JSE Securities Exchange from April 1985 updated to account correctly for share splits, unbundling and delisting. Delisted shares were included and considered for their listed period to remove the survivorship bias identified by Gilbert and Strugnelli [13]. The data consisted of daily, weekly and monthly share prices and their respective high, low and closing levels. The data specifically used in the study date from January 1990 to August 2009.

Trading costs were applied appropriately (0.7% buying and selling) with returns of the deciles being gauged in respect to income tax within the 40% taxable income bracket, given the short-term nature of the phenomenon and uncertainty surrounding the principles of tax.

### 3.2. Statistical evaluation

With both the momentum and the subsequent return being functions of a rank, and being grouped into deciles, the Spearman Rank correlation co-efficient was identified as the appropriate statistical measure for measuring the extent to which the variables were co-dependent [10].

The Spearman correlation co-efficient was mathematically stated by:

$$r_s = \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

Where:

- di = xi - yi the difference between the momentum rank and the return rank for a particular share
- n = the number of shares

Statistical software (Statistica TM) was utilised to perform a permutation test to gauge the statistical significance of Rank Spearman Correlations, a theory that evolved from the works of Fisher [11] and Pitman [18]. Also called the randomization or re-randomization test, the statistical significance is determined by rearranging the labels on the observed data points. If the labels are interchangeable at the null hypothesis, H<sub>0</sub>, which is that the two data sets have identical probability distributions. The advantage of this method is that it does not pre-assume a distribution to which the results have to fit.

### 3.3. Economic evaluation

The return of the various ranking methods and holding periods was annualised and compared to a buy and hold strategy of the market for the same holding period from January 1990 to August 2009. The market comparatives included the JSE ALSI, a weighted representation of market participants, and the average return of an un-weighted portfolio that was representative of the entire market.

## 4. RESULTS

The results examined the following issues in accordance with the initial hypothesis:

- 1) whether momentum is a common attribute amongst top performing shares;
- 2) whether technical analysis is better able to identify the phenomenon than price performance momentum measures; and
- 3) whether the return from these shares would justify momentum as a viable investment strategy.

#### 4.1. Statistical results

For the purposes of this study, a maximum p-value of 0.05 was regarded as acceptable, therefore the study allows a 5% chance of wrongfully accepting or rejecting the null hypothesis. The colour gradient applied to the correlation values displays higher correlation values with progressively darker shades of green, with lower values fading towards lighter colours, and the lowest values being displayed in red.

Correlation and Statistical Significance								
Ranking Method			Holding Period					
			1 Month	2 Month	3 Month	4 Month	6 Month	12 Month
Price Performance Review Period	12 Month	Corr	0.02535775	0.09762351	0.13239142	0.12265101	0.16801587	0.1485712
		P-value	0.02599502	<0.01	<0.01	<0.01	<0.01	<0.01
	9 Month	Corr	0.01940237	0.08023338	0.10845208	0.11248693	0.1655183	0.15784433
		P-value	0.08850838	<0.01	<0.01	<0.01	<0.01	<0.01
	6 Month	Corr	0.00229389	0.07976178	0.10857185	0.10716522	0.15285623	0.16651274
		P-value	0.84041729	<0.01	<0.01	<0.01	<0.01	<0.01
	3 Month	Corr	-0.030644	0.02366136	0.05234836	0.05371506	0.0977817	0.12676206
		P-value	<0.01	0.03777311	<0.01	<0.01	<0.01	<0.01
	RsMom	Corr	0.0368799	0.0902084	0.11479817	0.11066463	0.1482654	0.14989621
		P-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	ROC	Corr	-0.0493031	0.00656071	0.03147626	0.03595846	0.0717674	0.09313878
		P-value	<0.01	0.49568489	<0.01	<0.01	<0.01	<0.01
MACD	Corr	0.02882336	0.08461649	0.11160021	0.10834743	0.14829733	0.14981135	
	P-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	

Figure 11: Statistical Results

Reviewing the results in Figure 11, the following observations can be made:

- 1) There is a definite relationship between momentum and future expected returns. This is evident from the statistically significant positive correlations between the momentum ranks and return ranks.
- 2) The price performance ranking method with a 3-month review period and a one-month holding period, along with the ROC technical indicator and respective one-month holding period, had statistically significant inverse correlations.
- 3) The price performance ranking method with a 3-month review period and a two-month holding period, along with the ROC technical indicator and respective two-month holding period, had statistically insignificant positive correlations.
- 4) The correlation between momentum rank and return rank remains significant and increases with longer holding periods.
- 5) Price performance momentum ranking methods have a higher correlation than do the technical analysis ranking methods.
- 6) The price performance ranking method, with a three-month review period, along with the Rate of Change (ROC) technical indicator, has the lowest correlations.
- 7) The highest correlation co-efficient is obtained from a 6-month price performance momentum measure and a 12-month holding period.

From these observations, the following deductions can be made: Momentum is statistically proven, given the seemingly unambiguous correlation between momentum rank and return



rank for almost all of the momentum ranking methods and review periods. Therefore, momentum is a common attribute amongst top performing shares over a period of one to twelve months.

However, the null hypothesis can be rejected in part. Where momentum has been proven to correlate with returns for the periods of one to twelve months, the correlation was greater for price performance momentum measures than technical indicators. Therefore, technical analysis is not a better predictor of future returns, which had been postulated in the initial hypothesis.

A counter argument can be made, namely, that the technical analysis indicators were not optimised for South African shares, and that this therefore leaves some room for improvement.

#### 4.2. Economic results

Given the various arguments surrounding income tax and capital gains tax and the difficulty of defining this for the average investor, the maximum income tax of 40% was applied along with a 0.07% brokerage charge for every purchase and sale. Slippage, or the difference an investor can expect between the spot price of the share and the average cost per share to fill the order, was not taken into account to calculate share returns. Slippage would be much lower for highly liquid shares, and it would be very difficult to apply in this experiment. The consequence of not including slippage in the experiment would be slightly overstated returns; however, slippage was also not included in calculating the average market returns over the same period, making the adjustment unanimous across the board.

The returns for the various ranking methods per decile were annualised and compared (see tables 2 and 3) against the average annualised returns of the JSE ALSI and an un-weighted representation of the market for each respective holding period. The column on the left denotes the ranking method and decile, whereas the columns on the right signify the relevant holding periods. The tables presented are conditionally formatted, with red signifying returns below the JSE ALSI, orange representing returns greater than the JSE ALSI but less than the un-weighted average return of the market, and finally green illustrating those deciles that outperformed the un-weighted market average.



		Holding Period Average Return					
		1 Month	2 Month	3 Month	4 Month	6 Month	12 Month
JSE ALSI		10.02%	9.70%	9.51%	10.28%	12.43%	12.78%
JSE Unweighted		25.47%	24.00%	23.48%	25.07%	25.04%	27.73%
Price Performance 12 Month Review Period	Decile 1	18.88%	12.20%	9.53%	15.09%	15.37%	18.29%
	Decile 2	20.42%	10.60%	7.52%	7.85%	8.65%	10.38%
	Decile 3	8.60%	10.12%	9.30%	9.57%	8.16%	11.78%
	Decile 4	13.95%	10.10%	8.85%	10.09%	10.07%	11.03%
	Decile 5	11.66%	11.12%	9.72%	10.82%	11.00%	11.06%
	Decile 6	9.23%	12.55%	11.37%	11.23%	10.32%	11.65%
	Decile 7	11.14%	17.28%	15.82%	15.48%	13.97%	14.30%
	Decile 8	10.76%	13.61%	13.48%	13.85%	15.87%	16.42%
	Decile 9	16.76%	24.02%	21.24%	19.32%	20.56%	19.76%
	Decile 10	26.88%	34.13%	30.58%	32.98%	32.05%	36.99%
Price Performance 9 Month Review Period	Decile 1	19.47%	11.23%	9.86%	14.04%	13.33%	14.75%
	Decile 2	15.94%	11.19%	7.62%	8.47%	7.94%	9.68%
	Decile 3	18.71%	13.80%	10.96%	10.79%	8.71%	11.25%
	Decile 4	10.32%	10.39%	11.15%	11.05%	9.19%	12.28%
	Decile 5	13.37%	14.41%	11.70%	12.35%	14.07%	13.37%
	Decile 6	7.14%	10.74%	10.20%	11.56%	12.69%	13.44%
	Decile 7	9.27%	12.67%	11.89%	11.82%	11.98%	12.70%
	Decile 8	14.75%	17.07%	15.57%	16.26%	17.37%	17.17%
	Decile 9	13.90%	19.38%	18.56%	16.54%	18.64%	19.08%
	Decile 10	25.58%	34.70%	29.81%	33.39%	32.19%	38.09%
Price Performance 6 Month Review Period	Decile 1	20.98%	12.26%	9.92%	13.46%	13.51%	12.60%
	Decile 2	12.72%	9.11%	6.38%	8.71%	8.38%	9.74%
	Decile 3	13.81%	11.48%	11.32%	11.11%	10.06%	12.04%
	Decile 4	16.24%	11.37%	10.42%	11.21%	11.81%	13.93%
	Decile 5	14.10%	12.33%	10.13%	11.08%	9.75%	11.38%
	Decile 6	17.79%	16.51%	15.02%	14.87%	14.65%	14.11%
	Decile 7	11.83%	13.11%	13.09%	12.74%	12.68%	13.77%
	Decile 8	9.04%	12.79%	10.89%	10.61%	13.49%	13.99%
	Decile 9	14.74%	23.37%	21.25%	20.82%	21.34%	21.74%
	Decile 10	17.66%	33.42%	29.11%	31.86%	30.65%	38.70%
Price Performance 3 Month Review Period	Decile 1	18.11%	16.25%	9.11%	12.34%	11.23%	13.48%
	Decile 2	16.72%	13.16%	10.37%	11.07%	10.20%	10.40%
	Decile 3	18.90%	12.21%	10.83%	11.31%	10.88%	12.53%
	Decile 4	15.87%	16.72%	14.56%	15.41%	14.29%	12.33%
	Decile 5	16.01%	15.81%	17.22%	17.15%	16.61%	14.99%
	Decile 6	13.41%	14.61%	13.31%	13.63%	13.51%	18.41%
	Decile 7	13.61%	13.88%	12.49%	13.10%	13.73%	15.26%
	Decile 8	10.24%	12.37%	11.36%	11.18%	11.98%	13.72%
	Decile 9	10.50%	16.14%	15.06%	14.96%	17.99%	19.38%
	Decile 10	15.55%	24.43%	23.26%	26.39%	26.11%	31.81%

Table 2: Average Returns per holding period

		Holding Period Average Return					
		1 Month	2 Month	3 Month	4 Month	6 Month	12 Month
JSE ALSI		10.02%	9.70%	9.51%	10.28%	12.43%	12.78%
JSE Unweighted		25.47%	24.00%	23.48%	25.07%	25.04%	27.73%
RsMom	Decile 1	15.62%	11.30%	10.27%	11.77%	12.24%	14.06%
	Decile 2	14.25%	9.29%	8.29%	9.27%	8.36%	11.55%
	Decile 3	14.75%	10.96%	8.78%	8.71%	9.31%	11.42%
	Decile 4	10.83%	8.08%	7.10%	6.45%	7.80%	9.12%
	Decile 5	14.00%	12.65%	11.78%	10.52%	10.58%	10.39%
	Decile 6	10.93%	11.87%	10.23%	10.01%	10.99%	11.88%
	Decile 7	9.25%	9.86%	9.04%	7.70%	11.36%	12.01%
	Decile 8	12.57%	14.99%	14.42%	13.00%	16.27%	18.49%
	Decile 9	16.86%	20.81%	19.03%	16.98%	18.09%	18.45%
	Decile 10	23.72%	32.99%	30.83%	28.23%	29.76%	35.16%
ROC	Decile 1	20.19%	12.58%	9.87%	10.05%	9.75%	12.35%
	Decile 2	19.13%	12.67%	10.63%	9.57%	9.55%	9.47%
	Decile 3	19.41%	16.05%	13.41%	12.90%	14.79%	15.69%
	Decile 4	18.25%	15.60%	13.32%	12.62%	13.24%	15.61%
	Decile 5	16.70%	13.71%	11.38%	11.62%	12.98%	13.13%
	Decile 6	10.03%	9.62%	10.96%	9.85%	12.95%	14.16%
	Decile 7	10.98%	14.80%	12.51%	12.25%	12.97%	13.50%
	Decile 8	8.87%	12.96%	13.47%	11.37%	12.34%	15.37%
	Decile 9	7.28%	13.14%	13.59%	12.30%	14.12%	16.30%
	Decile 10	11.87%	21.95%	20.96%	20.43%	22.42%	27.33%
MACD	Decile 1	18.36%	14.21%	12.20%	13.87%	13.64%	15.16%
	Decile 2	13.63%	8.94%	8.12%	8.20%	8.70%	12.03%
	Decile 3	14.86%	9.28%	7.01%	7.59%	6.86%	9.68%
	Decile 4	12.31%	8.93%	8.78%	7.41%	8.91%	9.98%
	Decile 5	11.74%	11.47%	9.30%	9.02%	10.48%	10.12%
	Decile 6	10.43%	10.06%	10.15%	9.55%	10.65%	10.93%
	Decile 7	8.54%	11.79%	10.68%	9.09%	12.19%	12.76%
	Decile 8	15.87%	17.00%	16.09%	14.61%	15.90%	17.90%
	Decile 9	14.99%	17.96%	16.48%	15.06%	17.75%	18.50%
	Decile 10	21.98%	32.97%	30.84%	28.12%	29.55%	35.35%

Table 3- Average Returns per holding period

From tables 2 and 3 above, the following observations are evident:

- 1) The 8th, 9th and 10th decile for each ranking method almost unanimously outperformed the JSE ALSI.
- 2) The 10th decile for the various ranking methods and holding periods, except for the ROC technical indicator, is the only decile to outperform the un-weighted average return of the JSE.
- 3) The 12, 9 and 6-month price performance ranking methods posted higher returns than their technical indicators counterparts.
- 4) The top decile provided significantly higher average annualised returns than the 2nd highest decile for the various ranking methods and holding periods.
- 5) The best performance was obtained from the 6-month price performance ranking method in conjunction with a 12-month holding period, returning an average annual return of 38.7% over the review period.

The observations re-affirm the statistical results, namely, that momentum is a common attribute amongst top performing shares for the period of one to twelve months. Rejecting

the null hypothesis in part, price performance momentum measures delivered superior average annualised returns, when compared to technical analysis indicators.

A proposed explanation for the significant difference in average return between the two highest momentum deciles is that these shares receive a considerable amount of attention. Given the theory of financial herd behaviour, as proposed by Thaler [20], the more attention a share or company receives, the greater its following becomes, which only perpetuates the cycle. Media, both airtime and newspapers, as well as the investment fraternity with their limited portfolio sizes, tend to concentrate on the top performers, a group that is easily made up of 10% of the number of shares on the JSE, i.e. one decile. Therefore the top decile enjoys an overwhelming amount of attention, which accelerates the phenomenon of herd behaviour and the subsequent momentum effect.

The final part of the hypothesis, namely that momentum can be applied as a viable investment strategy to obtain abnormally high returns, cannot be rejected. This is because, even though the maximum allowable tax had been applied, the top decile almost unanimously still outperformed the higher un-weighted market index for various holding periods. The top decile of the 12, 9 and 6-month price performance ranking method with a corresponding 12-month holding period performed the best, outperforming the un-weighted market index by 9.26 %, 10.36% and 10.96% respectively.

## 5. CONCLUSIONS

In the past two decades, a large volume of empirical work has been conducted in an attempt to identify and exploit price patterns on stock exchanges across the globe. It is becoming increasingly accepted that there are shortcomings in the Efficient Market Hypothesis due to its inability to explain these empirical price patterns. In order to account for these price patterns, new theories would have to acknowledge the existence of financial behaviour and the seemingly irrational decisions made by the investment fraternity.

The results support the views of behavioural theorists, in particular De Bondt & Thaler's [8] model, as set out in *The Three Stages of Price Reaction*. The findings in part reject the null hypothesis, as technical indicators were not able to identify top performing shares any better, but they validate the conclusions that:

- Momentum is a common attribute amongst top performing shares.
- Price performance momentum measures can best identify future top performing shares.
- Even with the inclusion of taxes and trading costs, the use of momentum is a viable investment strategy.

These findings are in line with those of Fisher & Page [12] and Van Rensburg [21 & 22] with regard to momentum on the JSE. This study was thus able to illustrate the stability of the theory by translating return as a rank and applying the Spearman Rank Order Correlation Co-efficient, which revealed a seemingly unambiguous co-dependence between return and momentum.

The average annualised returns of the top decile of a momentum strategy applying a nine and six-month price performance comparison, in conjunction with a 12-month holding period, gives the investor the best chance to outperform the market.

Having established evidence of the momentum effect on various international equities markets as well as on the JSE, the phenomenon seems to have been evident in one form or another since the inception of the modern stock exchange.





With the global community attaining an ever-increasing disposable income, more and more individuals will start to invest their money on global stock exchanges. These investors with limited financial experience will make the same decisions as their predecessors and as proposed by financial theorists, and this should result in similar price trends as witnessed up to date.

All of these arguments and results translate into the fact that investors should remain vigilant of the phenomenon and the excellent rewards it can provide. There is no reason why investing should be considered as a binary system that forces the investor to choose one philosophy over another. The concept of price patterns can be combined with other investment philosophies and tools to create synergy to benefit the investor further.

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