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# Momentum trading on the Johannesburg Stock Exchange after the Global Financial Crisis

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**Abstract**

The aim of this paper is to discuss the presence of stock price momentum post the 2008 credit crisis and explore its implications for market participants in South Africa. This study investigates whether momentum was evident on the JSE from 2009 to 2014. Using different indicators of momentum, this paper simulates the possible investment choices using these indicators.


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*Keywords: Investment decisions, random walk hypothesis, efficient market hypothesis, momentum, moving average, exponential moving average, relative strength index.*

## 1. Introduction

Financial market participants have spent much time on developing an understanding of market efficiency. For market participants, the concept of market efficiency has significant implications for trading strategies. A financial market is considered to be efficient when all available information is reflected immediately in security prices. This implies that assets should be efficiently priced in such a way that investors cannot earn abnormal returns. Thus, trading on available information should fail to produce superior profits in an efficient market (Dimson & Mussavian, 1998).

Fama (1965) further investigated this concept of market efficiency and noted that in some cases past security prices contained information about their future paths. Past price behavior can thus be assumed to recur in future behavior and result in price patterns.

An observable price pattern in the market may indicate the existence of price persistence or price momentum. Black and Kaplan (1973) and Jegadeesh and Titman (1993), amongst others, found positive results of momentum in the United States, while McInish et al., (2008) found varying results from studies in Pacific Basin countries. While some studies find positive evidence of stock price momentum, it appears that this is not always the case for South Africa, for which studies display little to no significant evidence.

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Fraser and Page (2000) showed a positive result for a momentum-based strategy for all industrial stocks on the Johannesburg Stock Exchange (JSE). Van Rensburg and Robertson (2003), found no significant evidence of momentum on the JSE.

This article begins by defining the scope of market efficiency and contextualising the concept of price momentum by evaluating and presenting prior studies. The contextualization is followed by a description of the methodology that is applied and the results of the analysis. The article concludes with a discussion of the findings and the implications for market participants.

## 2. Literature review

### *2.1. The empirical evidence: momentum in South Africa*

Fraser and Page (2000) showed the ability to earn superior returns using a momentum-based strategy. The study used a 12-month formation period and a 1-month holding period and covered all industrial stocks on the JSE between 1973 and 1997.

The cross-section regression analysis methods of Fama and MacBeth (1973) were used to estimate the coefficient, or time-series reward, of each proposed characteristic on returns. The characteristics studied were; earnings yield, earnings growth, dividend yield, price to net asset value, turnover, leverage, cash flow-to-debt and momentum. All JSE-listed shares were used except those with a turnover ratio less than 0.01%.The momentum effect was tested on the previous 1-month, 6-month and 12-month stock returns. Van Rensburg and Robertson (2003), however, conclude that in contrast to Fraser and Page (2000), no significant momentum effect was found.

Venter (2009) conducted a study using an intraday, momentum trading strategy on the JSE for the year 2007. The study was limited to companies on the JSE with available intraday data and an investable market capitalisation of R1 billion. Although significant momentum effects were not present, contrarian effects using mid-quote prices were evident. The contrarian effect differed between large- and small-cap funds and disappeared when the mid-quote price was adjusted to the best bid-ask price, highest bid and lowest ask prices. Venter (2009) speculated that the contrarian effects would worsen when marked depth is problematic.

### *2.2. Factors contributing to price momentum*

For the most part international economies such as the United States find positive evidence of stock price momentum. It appears, however, that evidence of this is varied in South Africa. According to Hong and Stein (1999) price momentum can be attributed to the reaction of the stock price to information. Stock price adjustment to new information it can be broken down into four parts:

1. Under-reaction: New information enters the market, but this is not immediately discounted into the share price and the price continues along an indiscernible trend (Bernard, 1992; Chan et al., 1996).
2. Adjustment: The market starts to account for the new information, and the stock price migrates towards its new fundamental value (Hong & Stein, 1999).
3. Overreaction: The price will move past its fundamental value buoyed by investor herd behavior leading to an overreaction to information (DeBondt and Thaler (1990), Bikhchandani & Sharma, 2000).
4. Reversion: Ultimately, the share price will experience a correction and move back towards its fundamental value, bringing the share price back into equilibrium (Hong & Stein, 1999).

The existence of price momentum can therefore be attributed to two main factors: either an under- or an overreaction to information.

In addition Hong & Stein (1999) present three findings for the diffusion of information and the presence of momentum, and conclude that firm-specific information, more so if it is negative, is only gradually absorbed by the market:

- Firm size influences the profitability of momentum strategies. As firm size declines so does momentum profitability.
- Keeping firm size constant, stocks with low analyst coverage are better used for momentum strategies. An additional aspect is that analyst coverage and firm size have been found to be strongly correlated (Bhushan, 1998).

- Past losing stock experiences the effect of analyst coverage more than past winning stock.

### 2.3. Financial crises

Kaminsky et al. (2004) found that during periods of financial crisis, momentum trading is found to have a stronger presence for those strategies that buy current winning stock and sell current losing stock. During periods of non-crisis, however, momentum strategies that buy past winning stock and sell past losing stock are found to be stronger (Kaminsky et al., 2004). As global economies continue to move towards integration, emerging market economies appear to be the first affected (Schmukler & Vesperoni, 2006; Rogoff et al., 2003).

During periods of uncertainty, bad or negative news is absorbed more quickly into the market (Chen & Siems, 2004). Fischer Black, as cited by Shleifer (2000), states that investors trade on noise and not on information as previously assumed by the EMH. Noise traders irrationally believe they have information about the future price of an asset.

### 2.4. Trading strategies

Momentum and contrarian strategies are two trading methods. The under-reaction-driven price momentum suggests that momentum trading by buying past winning stocks and selling past losing stock is assumed to generate abnormal returns (Hon & Tonks, 2002). Alternatively the overreaction-driven price momentum, which suggests that abnormal returns can be generated by buying past losing stock and selling past winning stock, would result in following a contrarian strategy (Jegadeesh and Titman, 1993).

This requires the correct timing of the formation period, the time period during which stock prices are evaluated to identify the trend, and the holding period, the time period during which stocks are bought or sold to make excess profit.

## 3. Technical momentum indicators

This study sets out to identify the presence of momentum in South Africa. Different technical momentum indicators are used to obtain information on whether to buy (go long) or sell (go short). The indicators are momentum based indicators which will result in an investment strategy.

The Top 40 Index is used as a proxy for the South African investible market. The Top 40 represents 99% of the full market capitalized value of the JSE (`www.jse.co.za`), and thus provides a concentration of market activity/behavior. The study is conducted using data acquired from an electronic database (`https://www.jse.co.za/downloadable-files`). The dataset is the daily closing values of the Top 40 from 1 March 2009, until 8 April 2014.

The three technical momentum indicators, namely the simple moving average, the exponential moving average, and the relative strength indicator, were used to analyze the momentum on the Top 40.

### 3.1. Simple moving average

The simple moving average (SMA) analyzes a time series by averaging different subsets of the full data set. These subsets are equally weighted, and the expression of the SMA is given by

$$\mathrm{SMA}_T = \frac{1}{n}\sum_{i=\kappa}^{T} p_i, \tag{1}$$

where $T$ denotes the date for which the SMA is calculated, $p_i$ is the closing price of the index at time $i$, and $\kappa = T - n$, where $n$ is the number of previous closing prices used to calculate the SMA. An example of the SMA is shown is figure 1.

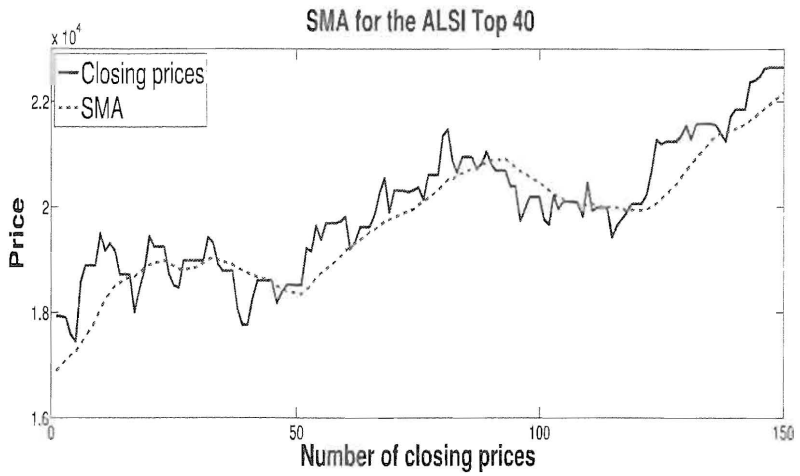


Fig. 1. The SMA for different time periods plotted against the stock prices from the FTSE/JSE Top 40, over 150 working days, with the number of previous closing prices used, $n$, being 14 working days.

The simplest trading strategy of the SMA involves buying an equity when the SMA crosses the closing price from beneath, and shorting the stock when the SMA crosses the closing price from above. This success of this trading strategy relies heavily on the momentum of the stock prices, as we require the stock price to increase over a lengthy amount of time in order to realize a gain on a buy signal, as is demonstrated from day 50 to day 60. On day 50 we receive a buy signal since the SMA crosses the closing price from above, and we hold the stock till day 60, where the SMA crosses the closing price from below.

### *3.2. Exponential moving average*

The exponential moving average (EMA) gives the subsets an exponential weighting, where the most recent data points of the time series have a greater weight. The EMA is calculated by

$$\mathrm{EMA}_T = \alpha \sum_{i=\kappa}^{T} (1-\alpha)^{(i-\kappa)} p_i, \tag{2}$$

where $\alpha$ is a weighting between zero and one and $\kappa = T - n$, where $n$ is the number of previous data points used. A higher value for $\alpha$ discounts the older data points faster. Figure 2 demonstrates the EMA on the same set of data as for figure 1.

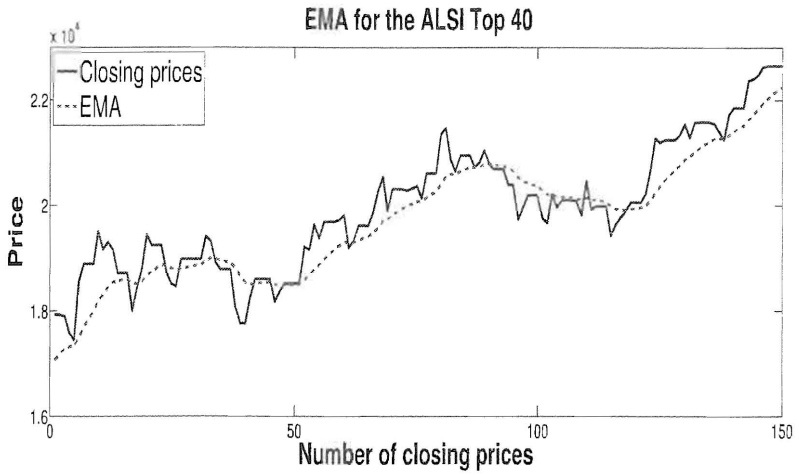


Fig. 2. The EMA for different time periods plotted against the stock prices from the Top 40, over 150 working days, with the number of previous closing prices used being 14 working days.

The EMA is more sensitive to current stock price movements due to the nature of its weightings. If the trading strategy used for the EMA is the same as for the SMA. The EMA will produce significantly different results to the SMA when the number of previous observations $n$ included in the calculations increase, as the weightings will induce a greater effect on the EMA. As for the SMA, the EMA depends on momentum in the market to be evident in order to yield excess returns.

### *3.3. Relative strength index*

The relative strength index is a technical momentum indicator which makes use of the EMA. For each trading period, an upward change $U$ or a downward change $D$ is calculated. Up periods occur when the current closing price is higher than the previous closing price:

$$U = p_i - p_{i-1}$$
$$D = 0.$$

A down period is calculated if the current closing price is lower than the previous closing price:

$$U = 0$$
$$D = p_{i-1} - p_i.$$

The up and down periods are then calculated using the EMA, and the ratio of these averages give us the relative strength, or

$$\mathrm{RS}_T = \frac{EMA(U,n)}{EMA(D,n)},$$

where $n$ is the number of previous data points used for the calculations in the EMA. The relative strength index, RSI, is then given by

$$\mathrm{RSI}_T = 100 - \frac{100}{1+\mathrm{RS}_T}.$$

If no down movements are observed within the observation period, then the RSI is equal to 100. The RSI values which cross predefined boundaries indicate that the stock is being overbought or oversold. If the RSI crosses the

lower boundary, it indicates a buy signal, and vica versa. Reversal strategies are not used, as these strategies rely on a thorough understanding of the market. Figure 3 demonstrates the RSI for the same data as used in the previous examples.

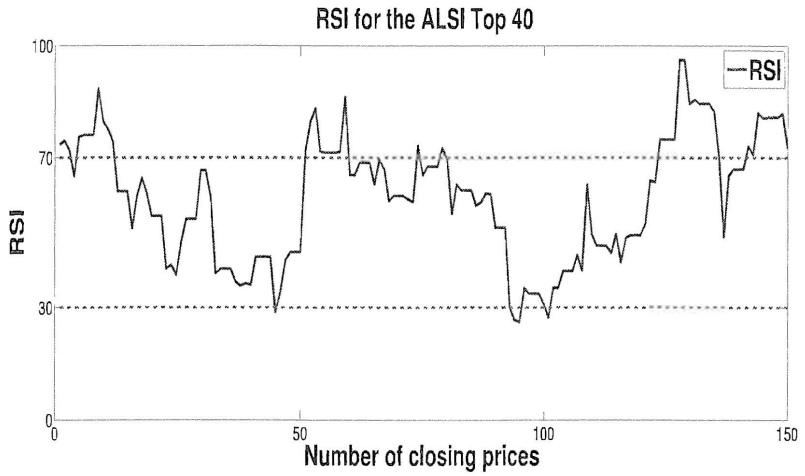


Fig. 3. The RSI for different time periods for the Top 40, over 150 working days, with the number of previous closing prices used for the calculations being 14 working days.

## 4. Momentum in the ALSI Top 40

Momentum is measured by the technical momentum indicators and by their respective excess returns when applying the indicator investment strategies to the Top 40 closing values. The dataset can be viewed in two ways (1) as a complete data set for the investment period or (2) as a specific point in time were data is added as we are moving through time. In order to keep the analysis as realistic as possible, we include the various transaction costs, taxes and levies into our calculations. The fees used in the calculations were; (1) the account maintenance fee (R60 per month), (2) headline brokerage rate of 0.5% (with a R60 minimum) per trade, (3) security transfer tax of 0.25% when purchasing shares, (3) Strate fee of 0.005459%, with a minimum of R10.92 for trades with value below R200,000, and a maximum of R54.59 for trades with value above R1 million(4) additional investor protection levy of 0.0002% on all trades.

### *4.1. Historical data analysis*

First we treat the closing prices of the Top 40 as purely historical data, which means that we apply the different indicators over the whole set of data, and treat each point of data as a known.

Figure 4 shows the total return (in monetary value) achieved using the technical momentum indicators for different initial invested capital.

Intuitively, the higher the initial capital investment, the higher the total return is. With little initial capital, we receive negative returns due to the transaction fees. The RSI indicator performs the worst, the SMA performs the best, followed by the EMA. The difference in the EMA and the SMA total returns are minimal, because we used $n = 14$ working days as the number of observable days for the calculations - as $n$ increases, the EMA will out perform the SMA.

The total return becomes linear when investing larger amounts of money, where as low initial investments cause the total return to become increasingly negative. The slope of the linear total returns in figure 4 determine how high the percentage returns are, as shown in figure 5. The RSI has constant negative returns, irrelevant of how much initial capital we invest.

The returns of the EMA and SMA are very similar, and become very volatile and increase exponentially for initial investments below R100,000

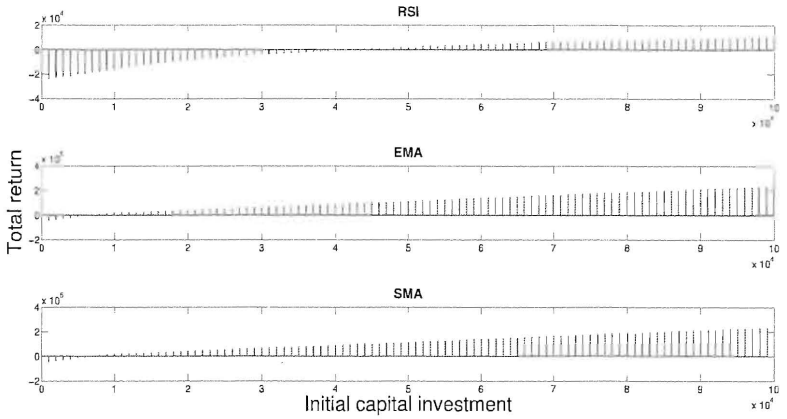


Fig. 4. The total returns versus the initial capital investment for the different technical momentum indicators used on the Top 40 closing prices over the period from $1^{st}$ of March 2009 until $8^{th}$ of April 2014, using $n$=14 observable dates for the calculations. We treat the whole set of data as known.

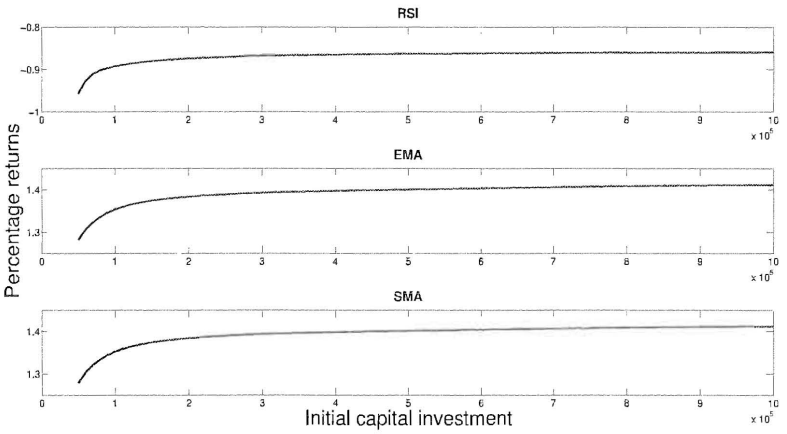


Fig. 5. The percentage returns versus the intial capital investment for the different technical momentum indicators used on the ALSI Top 40 closing prices over the period from 1 March 2009 until 8 April 2014, using $n$=14 observable dates for the calculations. We treat the whole set of data as known.

### 4.2. *Current data analysis*

We now treat the data as though we are currently starting to invest money 14 working days after the 1 March 2009, and we use the technical momentum indicators to decide on our position on the Top 40 Index daily, until the 8 April 2014.

The future closing prices of the Top 40 are unknown and we only realize the closing prices as they occur through time. The investments start 14 working days after the first historical data point since we need $n = 14$ days in order to calculate the indicator values. The total return over the whole investible period is given in figure 6.

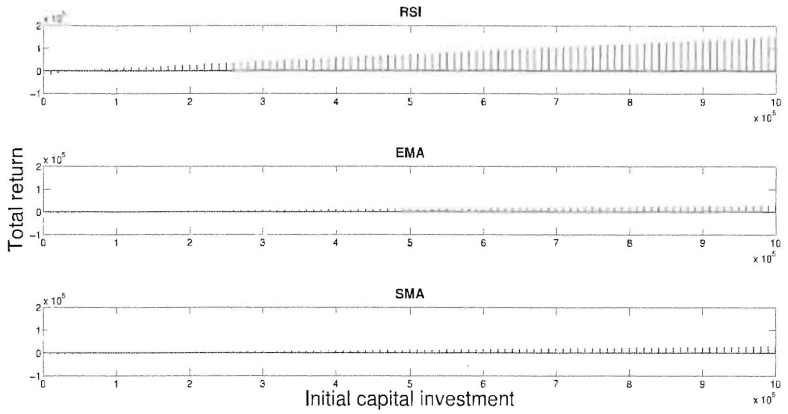


Fig. 6. The total returns versus the initial capital investment for the different technical momentum indicators used on the Top 40 closing prices over the period from 1 March 2009 until 8 April 2014, using $n$=14 observable dates for the calculations.

The RSI indicator outperforms the EMA and the SMA since it has the highest total returns for an initial capital investments greater than R50,000. How ever, when we look at the percentage returns given in figure 7 of the different technical momentum indicators, we see that none of the indicators yield positive returns. We have to take into account the tradeoff between how often we change our position on the stock, and the transaction fees.

We investigate whether our choice in the observable data period $n$ which is used for the calculations of the EMA could yield a positive return. Figure 8 shows that different choices of $n$ yield different returns, all of which are negative. Similar results apply to the RSI and the SMA.

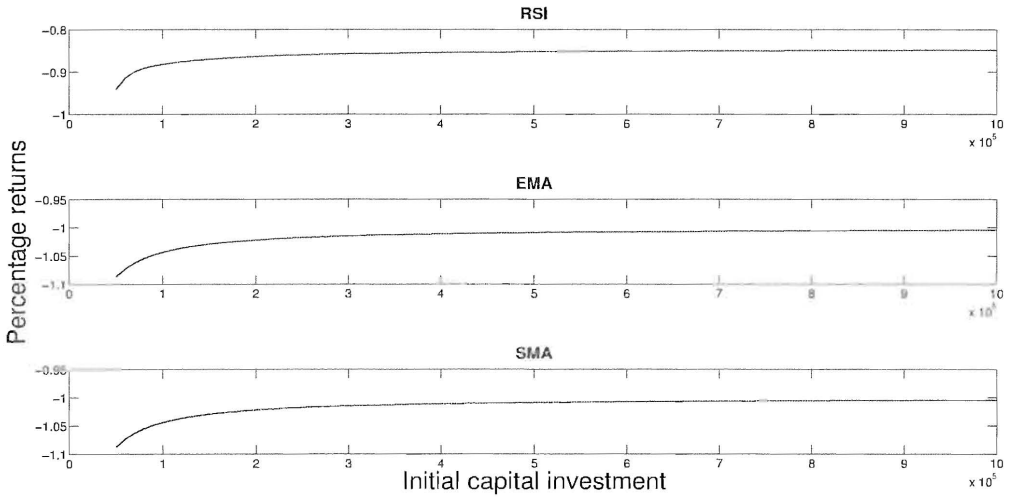


Fig. 7. The returns versus the intial capital investment for the different technical momentum indicators used on the ALSI Top 40 closing prices over the period from 1$^{st}$ of March 2009 until 8$^{th}$ of April 2014, using $n$=14 observable dates for the calculations. We treat each point in time as an unknown.

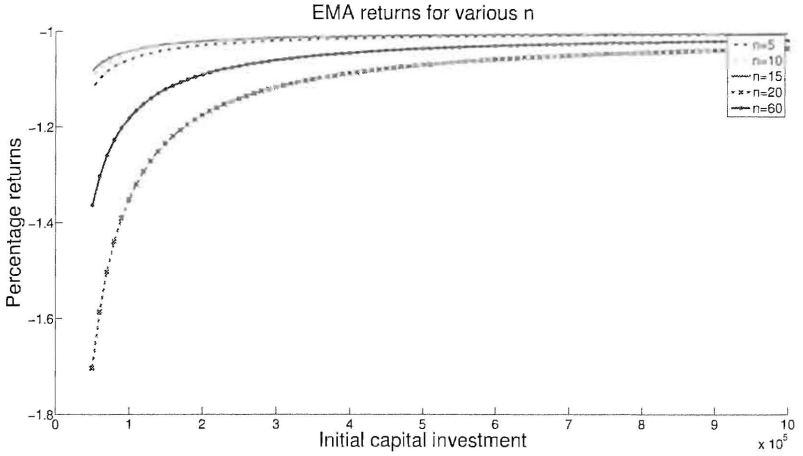


Fig. 8. The returns versus the intial capital investment for the different technical momentum indicators used on the ALSI Top 40 closing prices over the period from $1^{st}$ of March 2009 until $8^{th}$ of April 2014, using $n$=14 observable dates for the calculations.

## 5. Discussion

Treating the data as a set of known points for each date yields positive returns for the EMA and SMA, but negative returns for the RSI technical momentum indicators. However, treating each point in time as known is unrealistic for investors – therefore we treated each closing price in the data as an unknown, until realized. This reversed the performance of the technical momentum indicators, since the RSI indicator performed the best, followed by the EMA and then the SMA indicator. None of the momentum reliant technical indicators yielded positive returns over the total investment period. Taking into account the sensitivity of the indicators by changing the parameter $n$ in the calculations still yielded negative returns. We can conclude that the Top 40, shows no evidence of momentum being present. The Top 40 index returned 261% over the period in which we investigated the evidence of momentum – therefore the negative returns do not lie in the systematic decline of the market.

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