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The Persistence of Investor Overreaction on the JSE

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The Persistence of Investor Overreaction on the JSE

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A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

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ABSTRACT

Since the 1980s, behavioural finance has chipped away at the efficient market hypothesis by pointing out several anomalies, such as market overreaction. The efficient market hypothesis predicts that once an anomaly has been identified, the markets will arbitrage it away. The question asked is whether the effect of market overreaction has reduced as the market took note of this anomaly. Using market data from the JSE, it was tested to ascertain whether the effect of the market overreaction has reduced over time and if this anomaly also fluctuates over time. It was found that the arbitrage opportunity presented by market overreaction fluctuates with market cycles and that the effect of overreaction has diminished over time. Although market overreaction can still be used in the South African equity market to generate outperformance, the market has arbitraged out much of the advantage that could be gained from exploiting it.

DECLARATION

I, Rian Brand, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.



Rian Brand

Signed at Cape Town

On the 14th day of May 2011

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CHAPTER 1

1. INTRODUCTION

1.1. Purpose of the Study

The purpose of this research is to measure investor overreaction on the JSE and its persistence over time.

1.2. Context of the Study

The efficient-market hypothesis (EMH) states that markets are “informationally efficient” and the price of any traded asset already reflects all present publicly available information (Fama 1970). The hypothesis was widely accepted until Behavioural Finance, a fringe element in the 1980s, became mainstream in the early 1990s (Fox 2002).

Behavioural Finance holds that there are specific cognitive biases that result in anomalies in share prices. One of these anomalies is the market’s overreaction to new information. That is, investors overweight recent information and underweight long-term base data. This idea was introduced by De Bondt and Thaler (1985; 1987). Muller carried out a similar study finding that investors on the JSE overreact to new information too (1998; 1999).

The question that comes to mind is – because overreaction bias is well documented in the literature, is it possible that investors realized it and might have altered their behaviour, thereby diminishing the effect of the overreaction bias? When a golfer learns why he keeps hooking the ball, he adjusts his technique to counter this. Over time, he reduces his natural hook. Can investors not learn in the same way?

Another question that arises is – in as far as overreaction bias is concerned, do investors react differently during bull and bear markets?

1.3. Problem Statement

Although the overreaction bias is a well-researched topic, little is known about the persistence of the overreaction bias and specifically, the persistence of the overreaction bias on the JSE.

In particular it is not known if the effect of the overreaction bias has diminished over time, possibly as knowledge of the bias spreads amongst investors. It may also be possible that the effect of the overreaction bias varies with the market cycle. An anomaly that varies with the economic cycle is of less value to investment professionals, because it would make it more difficult to exploit reliably. Only being able to exploit an anomaly during some parts of the market cycle moves the question of investing in specific types of stock to a notoriously difficult question of cycle timing.

1.4. Significance of the Study

This study fills a gap in that studies on market overreaction have typically been done over the entire period under study (Muller 1999; De Bondt and Thaler 1985). This makes maximum use of the data available, but does not investigate variations over the period of study.

Although some research has been done into the persistence of behavioural anomalies on markets (Gibbons and Hess 1981; Lakonishok and Smidt 1988; Connolly 2009), very little has been done on the persistence of investor overreaction (Chen and Sauer 1997).

The question of the persistence of behavioural anomalies asks whether markets are 'second-tier' efficient. That is, once investors realize they have a bias, does the effect of the bias reduce?

This study provides guidance to investors and portfolio managers wishing to exploit overreaction on the JSE and to the effectiveness of this technique. The study adds to the debate between the efficient market hypothesis (EMH) and behavioural science and, in so doing, adds to the debate between active fund management and passive management.

1.5. Delimitations of the Study

This study applies to the JSE only and the results are not necessarily extendable to all financial markets. The study, however, adds to a large corpus of studies on overreaction in various parts of the world (Baytas and Cakici 1999; Da Costa 1994; Mun et al. 2000).

This study looks at the persistence of overreaction, and these results cannot readily be extended to other behavioural anomalies such as seasonality.

If a reduction in the overreaction effect is detected, it would be tempting to attribute this to knowledge of the overreaction bias and that investors, therefore, started compensating for it. However, correlation is not causation. If it is found that the effect of the bias has not reduced over time, it would be possible to state that knowledge of the overreaction bias has not reduced the bias. A reduction in the effect of the overreaction hypothesis (ORH) is thus a necessary but not sufficient condition for 'second-tier' efficiency of the market.

1.6. Definition of Terms

Efficient Market Hypothesis (EMH) – Fama (1965a: 56) defines the efficient market as

> a market where there are large numbers of rational, profit-maximizers actively competing, with each trying to predict future market values of individual securities, and where important current information is almost freely available to all participants.

As noted in 1.2 above, Eugene Fama also says that: “In an efficient market, prices ‘fully reflect’ available information” (Fama 1970: 384).

Behavioural Finance – Behavioural Finance is far harder to define because it is not a coherent single framework, but rather a collection of anomalies. De Bondt et al. (2008: 8) define it as “the study of how psychology impacts financial decisions in households, markets and organizations”. It does not assume rational agents or frictionless markets like the EMH.

Overreaction Hypothesis (ORH) – The overreaction hypothesis states that "stock prices systematically overshoot as a consequence of excessive investor optimism or pessimism" (Dissanaike 1997: 27). Dissanaike adds that price reversals should be predictable from past price performance to qualify. De Bondt and Thaler (1985) do not explicitly define the ORH, but state that in revision of their beliefs, people tend to place more emphasis (or weight) on recent information, as opposed to prior information (De Bondt and Thaler 1985). The ORH is also sometimes referred to as the contrarian hypothesis (Mun et al. 2000).

Market Risk Premium (MRP) – The market risk premium is defined as the difference between the risk-free rate and the equity market return (Chen and Sauer 1997).

1.7. Assumptions

This study aims to test the ORH over an extended period. However, the JSE has not had the depth and width that it has today (and is still small compared with major markets). Further, although the JSE is today resource heavy, before 1980 it had an even heavier weighting to resource shares, in particular gold shares. These limitations of the dataset force several assumptions into the study. It is assumed that:

1) The size of the dataset does not affect the evidence for or against overreaction

2) The lack of liquidity in the early years of the study does not affect the results

3) The difference in market sector weighting does not affect the results

Because a dividend dataset is not available for the early years of the study, all returns are calculated excluding dividends where the earlier years are included. In the case where large special dividends were paid as with Telkom after the sale of Vodacom, an attempt is made to compensate for this. Because all

shares are treated without dividends, it is not expected that the effect would be too large.

Care is taken to use all shares active in the market at the time to avoid a survivorship bias. However, the research depends on the data provided by I-Net Bridge in this regard.

CHAPTER 2

2. LITERATURE REVIEW

2.1. Introduction

The efficient market hypothesis states that an efficient market is a market where the current prices 'fully reflect' the available information. However, Behavioural Finance came about as some anomalies were detected in the pricing of assets that were inconsistent with the EMH. For instance, it was found that investors had a bias toward more recent information, therefore, overreacted to recent news (commonly called the overreaction hypothesis (ORH)).

The literature review will cover the following areas: Section 2.2 describes the EMH, followed by section 2.3 exploring Behavioural Finance. Section 2.4 reviews the literature specific to the ORH, and section 2.5 looks at studies done on the persistence of the ORH and other market anomalies.

2.2. The Efficient Market Hypothesis

The EMH was first alluded to in a paper by Bachelier (1900). However, his work was largely ignored until it was rediscovered by Paul Samuelson, who started distributing Bachelier's work to colleagues in the 1960s (Bachelier et al. 2006). Soon after, Samuelson published a proof for a version of the Efficient Market Hypothesis (Samuelson 1965) and Fama published several papers on the EMH (1965b; 1965a; 1970). As noted in section 1.6, an efficient market is a market where the current prices 'fully reflect' the available information[1].

The implications of the EMH are radical in that it is assumed that all available information is already reflected in the price of a share. Therefore, there are no abnormal returns to be gained from stock selection, relegating all active portfolio managers to nothing more than snake-oil peddlers. The best advice would then

[1] This literature review does not go into the details of weak form vs. strong form efficiency, since the discussion of the EMH may already be seen as excessive for the current study.

be to control cost and to buy index funds and hold them over an extended period.

The principal problem with the EMH is that it is difficult to prove as a hypothesis. It is in fact a dual hypothesis. It states first that the market is efficient in equating prices to the intrinsic value, but second it implies we can calculate the intrinsic value. If it is found that prices are not equal to the intrinsic value, there is no way of knowing if the market is inefficient, or if the intrinsic value was calculated incorrectly (Chuvakhin 2002; Fama 1970).

Some studies aimed at testing the EMH avoided the dual hypothesis problem by looking at short-term autocorrelations of prices with mostly negative results. A different approach was, however, to study the efficiency of markets with event studies. Event studies are where the share price movements around similar events in various companies are studied. In an efficient market, the share price would react quickly to an unexpected event. In an inefficient market, the share price would drift upward to a new level. Initial evidence from these studies pointed toward efficiency in the market (Johnson et al. 1985; Fama et al. 1969).

The EMH was widely accepted until 1975 (Chuvakhin 2002). However, as more studies were done, some criticism began to emerge. Some anomalies were found, such as seasonality of returns and investor overreaction and underreaction. These are discussed in fuller detail in the following section.

Some of the harshest criticism of the EMH, however, still concerns the crash of 1987 where no fresh news came out on the day of the crash (Roll 1988). Later the 'dot-com' bubble of the 1990s shows further problems with efficient markets.

Grossman and Stiglitz (1980) also pointed out that if all relevant information was already reflected in the price, there would be no motivation for investors to acquire this information in the first place. Equilibrium is more likely, therefore, not only where abnormal profits are possible, but also where competition would keep these profits in check. Although this work is often referenced, this prescient view seemingly has been side-lined in the debate that followed.

2.3. Behavioural Finance

As noted in section 2.2 above, during the late 1970s, when computer processing power and the market data became more widely available, some anomalies started to appear in the literature that the EMH could not explain. The 'January Effect' was demonstrated, showing that stock returns in January were on average higher than in other months (Rozeff and Kinney 1976)[2]. This was quickly followed by an edition of the *Journal of Financial Economics* in June 1978 (Jensen and Field 1978) in which several market anomalies were studied. An article followed on the 'Monday Effect', that showed that the average returns on Mondays are significantly lower than on other days (Gibbons and Hess 1981). What should be noted is that Gibbons and Hess (1981) found that the 'Monday Effect' has become less pronounced over time, as, seemingly, some investors began to recognise it and started to profit from it. Shiller (1981) also showed that stock prices move too much to be justified by subsequent changes in dividends.

However, it was Kahneman and Tversky (1974) who provided the explanation to these anomalies by noting that when faced with uncertainty and risk, people rely on mental shortcuts that are economical, but that lead to systematic and predictable errors (Kahneman and Tversky 1974). This observation opened the door to explanations for the anomalies.

It was further shown that markets underreact to earnings shocks in the short term (Rendleman et al. 1982). This study provided justification to why a momentum-based trading strategy could yield abnormal returns.

Shortly after, De Bondt and Thaler (1985) demonstrated that the market overreacted to news in the longer term as investors overweight recent information and underweight long-term base data.

Research into these and other anomalies has continued since (Lakonishok and Smidt 1988; Zarowin 1990; Chopra et al. 1992; Da Costa 1994). Nevertheless,

[2] It is interesting to note that Rozeff and Kinney open the article with the sentence: “I believe there is no other proposition in economics which has more solid empirical evidence supporting it than the Efficient Market Hypothesis.” (1978: 1). This stands in contrast with some of the earlier claims in this document, but can be seen as a way of pacifying criticism, or could it?

a criticism of Behavioural Finance has been that it is less a framework or paradigm, and more a collection of anomalies.

2.4. Investor Overreaction

The ORH was introduced by De Bondt and Thaler in the 1980s (1985; 1987). The study created portfolios of 'winners' and 'losers' and measured its returns over a holding period. 'Winners' were shares that returned the highest excess returns over the formation period of 36 months. Conversely, the 'Losers' portfolio was formed from shares with the lowest excess return over the formation period. Their study showed that losing stocks outperformed winning stocks by 25% although winning stocks were more risky. A puzzling aspect of their study was that much of the 'loser' portfolio's outperformance occurred during January.

Their study sparked both a wave of criticism as well as studies confirming the results. Criticism ranged from stating that other factors caused the abnormal returns (Chan 1988; Zarowin 1990; Conrad and Kaul 1993) to problems with the statistical work (Dissanaike 1994).

A study by Chan (1988) as well as a study by Ball and Kothari (1989) pointed out that when time-varying beta risk is controlled for, no abnormal returns are generated by the 'loser' portfolio.

Zarowin (1989; 1990) showed that the active returns could be attributed to the size effect as identified by Banz (1981). Zarowin found that smaller unknown companies tend to be the 'losers', which then outperform. It was further found that the effect is not observed when only companies of similar size are used, and the 'January Effect' is controlled for. Other studies disagreed with Zarowin, finding evidence of overreaction, even when the 'January Effect' is controlled for, although the evidence is stronger for smaller firms than for larger firms (Chopra et al. 1992).

It was also suggested that the work was only done on closing prices and, once the bid offer spread was taken into account, no abnormal returns were possible (Conrad and Kaul 1993; Atkins and Dyl 2009). Dissanaike criticised De Bondt

and Thaler for using arithmetic rather than geometric compounding of the returns (Dissanaike 1994).

Conversely, several studies found evidence for the ORH. In the Brazilian market, the effect was found even more pronounced (Da Costa 1994). Dissanaike (1997), after criticizing the original study's compounding, repeated the study on only large companies in the UK market and found the results consistent with the ORH.

Baytas and Cakici (1999) studied the ORH in 7 industrial countries, and found that in all but the US, the evidence was consistent with the ORH. It was also found that size and even price was a better indicator of future excess returns than lower returns over the formation period. The study also cautions that some outperformance may be explained by higher risk.

Kryzanowski and Zhang (2009) find that although there is significant momentum over 1 and 2 years in the Canadian market, the reversal behaviour is insignificant. This contradicts an earlier study on the Canadian market that finds significant outperformance of "intermediate term contrarian portfolio" (Mun et al. 2000: 53). This earlier study used a multi-factor methodology and adjusted for risk.

In the Australian market, significant price reversal is not found for a buy-and-hold strategy, but it is found to be significant for portfolios that are rebalanced monthly (Gaunt 2000). Again it is found that most of the effect is found in smaller firms and the study concludes that there is not enough liquidity in these shares to profit from the effect.

Boynton and Oppenheimer (2006) controlled for survivorship bias as well as the bid offer spread and found that although these controls substantially reduce the ORH effect, there is still a significant outperformance.

George and Hwang (2007) studied stock-market overreaction in Hong Kong and the US, and found that long-term return reversal can be explained better by capital-gains tax deferment than by investor overreaction. They point out that

this would be consistent with the seasonal effects in the overreaction observed by earlier studies (De Bondt and Thaler 1985; Zarowin 1990).

Brown, Wei and Wermers (2007) apportion the blame for stock price overreaction on mutual funds in the US and their tendency to follow the same analyst consensus. The herding effect that results causes downgraded stocks to initially underperform and subsequently outperform. Upgraded stocks display an opposite pattern.

A different approach is followed by Mahani and Poteshman (2008) that looks at options data in the days leading up to scheduled earnings announcements. It is found that investors tend to 'load up' on growth stocks as opposed to value stocks although value stocks outperform growth stocks by a wide margin at earnings announcements.

Muller (1998; 1999) studied investor overreaction on the JSE and supports investor overreaction on the JSE.

Although there is some disagreement, it seems that the balance of the evidence points in favour of the ORH.

2.5. Persistence of the Investor Overreaction

It can be expected that as more investors chase the abnormal returns to be achieved from exploiting a specific anomaly, the anomaly will disappear. Black (1993) noted that several anomalies have been found, researched and reported, but they usually vanish when they are discovered.

To make optimal use of the data, most studies used all available data when investigating the ORH and most other anomalies, but a few studies have looked at market anomaly persistence over time. In particular, some studies have speculated and commented on the demise of the small firm effect and the value premium (Roll 1981; Dimson and Marsh 1999; Chan and Lakonishok 2004). Gibbons and Hess (1981) also found that the 'Monday Effect' tended to diminish over time, and it is speculated that this is a result of more traders exploiting the anomaly. Connolly (2009) agrees that seasonal effects in the markets had

largely disappeared by 1975. However, Lakonishok and Smidt (1988) find that weekly, monthly and annual seasonal effects persist over a 90-year period on the Dow Jones Industrial Average.

On persistence of the ORH, less work has seemingly been done, but Chen and Sauer (1997) investigated overreaction from 1926 to 1992 and found that returns on the arbitrage portfolio (buying 'losers' and selling 'winners') were in fact “quite volatile over time”. This study found that ORH was most evident during the pre-war era, but less evident during the post-war era (1940s and 1950s). The ORH is again evident in the pre-energy-crisis era (1960s and 1970s), but during the post-energy-crisis era the effect was negligible to negative. The performance of the arbitrage portfolio is then compared with the market risk premium (MRP), which means the difference between an equity index and the risk-free rate (three-month T-bill rate of return). “A clear positive relationship” (Chen and Sauer 1997: 63) is found between the market risk premium and the returns of the arbitrage portfolio. This is explained by noting that 'losers' fall in value faster and deeper during economic downturns, and gain faster during upturns. This seemingly suggests that the 'loser' portfolio is more volatile and therefore more risky than the 'winner' portfolio. Once this risk is compensated for, the study finds no excess return for the arbitrage portfolio.

2.6. Conclusion of Literature Review

In conclusion, although “market efficiency really is a first approximation to reality” (Roll 1994: 71), numerous anomalies have been documented. In the pursuit of returns, investors always attempt to exploit these anomalies. At least in the case of the 'Monday Effect', research suggests that the opportunity for profiting from an anomaly reduces when it becomes known. The ORH has also been shown to be less than persistent over time by at least one study. The questions, therefore, arise:

2.6.1. Research Question 1:

To what extent is investor reaction on the JSE persistent over time?

2.6.2. Hypothesis 1:

H_0: An arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks does not produce excess returns over 99% of rolling 3-year periods.

H_a: An arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks produces excess returns over 99% of rolling 3 year periods.

2.6.3. Research Question 2:

Is there a trend towards reduced investor overreaction on the JSE?

2.6.4. Hypothesis 2:

H_0: An arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks will not produce lower returns in the latter part of the period under study than in the earlier part of the study.

H_a: An arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks will produce lower returns in the latter part of the period under study than in the earlier part of the study.

2.6.5. Research Question 3:

Is there a relationship between investor overreaction on the JSE and the South African equity premium defined by the difference in returns of the equity market and the risk-free rate?

2.6.6. Hypothesis 3:

H_0: The returns of an arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks are not correlated with the equity premium.

H_a: The returns of an arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks are correlated with the equity premium.

CHAPTER 3

3. RESEARCH METHODOLOGY

3.1. Introduction

This chapter presents the methodology used to test the hypothesis presented in section 2.6. Section 3.2 outlines the research design including portfolio formation process as well as tests used to determine the statistical significance of the hypothesis tests. Section 3.3 describes the data source and sample selection process, and section 3.4 and 3.5 presents limitations, validity and reliability of the study.

3.2. Research Design

3.2.1. Portfolio Formation

To test the effect of market overreaction, a set of 'winner' portfolios and a set of 'loser' portfolios are formed on each month of the study period. Portfolios are established based on share performance over the preceding 3 years, or formation period. On each portfolio formation date, shares with data over the entire formation period are ranked according to returns over the formation period. The top 25% and bottom 25% of counters form the “winner” and “loser” portfolios respectively. The 25% cut-off is used because it provides a sufficient number of shares in a portfolio. The number of shares differs significantly over the period under study. For the period before April 1968, a dataset is only available for 34 shares (with a minimum of 29 shares), while from 1998 to 2000 the number of shares rose as high as 600. Thus, a figure of less than 25% would have resulted in a portfolio of fewer than 7 shares in the earlier years.

A fixed number of shares for each portfolio, results in overlaps during the early years, but in undiversified portfolios in the later years. For instance, if 15 shares are used per portfolio, the portfolios would overlap in the early years, but would be too concentrated in the later years.

Although it is considered ideal not to overlap the formation periods as was done by De Bondt and Thaler (1985), this results in few sample portfolios before 1985. Because the study sets out to test whether the effect of overreaction has diminished since 1985, a sufficient number of formation dates are needed before 1985. For this reason a formation portfolio is formed on each month for which there is a full formation period. It is tempting to include only the shares that have data for the entire holding period and for each of the formation dates, but this implies foresight on the part of the investor to know what shares would be delisted during the holding period, which leads to a selection bias.

Once formed, the geometric and annualised returns from the subsequent 3-year period, called the holding period, are calculated and are then used to test each hypotheses stated in section 2.6. As in De Bondt and Thaler (1985; 1987) and Muller (1998; 1999), a formation period of 3 years is used. The holding period is set to 3 years, as in De Bondt and Thaler (1985; 1987).

It is ideal to test the hypotheses using all shares on the JSE over the period under study, while including dividends and using share-weighted portfolios. This approximates an actual investment environment.

Unfortunately, a dividend dataset for the period before 1979 is not available for all shares. Further, the market capitalization is not available for all shares before 1994. For this reason, returns are calculated excluding dividends, and portfolios are formed equal weighted. Although this is not ideal, it does allow the portfolio returns of the period before 1979 (where a dividend dataset is not available) to be compared with returns after 1994 (where all datasets are available).

Lower market capitalization shares introduce a large amount of noise into the results because they tend to have low liquidity and higher volatility. For this reason, wherever market capitalization is available, all shares are ranked by market capitalization, and shares are included in the investable universe from the largest to the smallest until 90% of the total market capitalization is reached. Because it is impractical to include illiquid shares in portfolios in the real world, this is an acceptable approximation.

Excluding smaller stocks in the latter part of the study where market capitalization is available, while being unable to do so in the earlier years, can be criticized, but this is justified by the fact that smaller companies are not included in the earlier data because of data availability problems (See Appendix A).

The analysis is done by comparing the returns of the 'loser' portfolio and that of the 'winner' portfolio. The comparison takes the form of the subtraction of the 'winner' portfolio's returns from that of the 'loser' portfolio for each formation period. This is equivalent to forming an arbitrage portfolio where all shares in the 'loser' portfolio are bought, and all shares in the 'winner' portfolio are sold short.

To summarise the process until now:

- For each formation date, all shares, with a return history over the holding period, are ranked by return
- The top 25% of shares are selected as the 'winner' portfolio
- The bottom 25% of the shares are selected as the 'loser' portfolio
- The portfolios are held for the holding period of 3 years. If a share delists during this time, the portfolio is rebalanced.
- The returns for each portfolio for each month are calculated.
- The returns for the 'winner' portfolio is deducted from that of the 'loser' portfolio to form the returns of the arbitrage portfolio
- The returns are geometrically compounded and annualised

3.2.2. Rebalanced Portfolios

The above process (section 3.2.1) results in a set of returns over the holding period for each formation date. Tests are performed on the average return of the arbitrage portfolio and the trend of the returns of the arbitrage portfolio as

well as to determine the correlation of the arbitrage portfolio to the Market Risk Premium

However, because a new portfolio is formed monthly, it is impossible to test the rolling return of such a strategy. To do this, the portfolios need to be rebalanced monthly. Two new portfolios are therefore created, called the rebalanced 'winner' and rebalanced 'loser' portfolios. The rebalanced 'loser' portfolios are rebalanced monthly by adding the shares of the newly formed 'loser' portfolio according to the selection criteria described in section 3.2.1. Over the first three years, shares are only added to the portfolios and not disinvested. However, after three years shares that have reached the end of their holding period in the portfolio are disinvested. The rebalanced 'winner' portfolio is formed similarly.

A rebalanced arbitrage portfolio is again formed by selling short the shares in the rebalanced 'winner' portfolio, and buying the shares in the rebalanced 'loser' portfolio.

An unfortunate downside of the rebalanced portfolios is that the portfolios would only be working, as per normal, 6 years after the data started. Three-years of data is required for the first portfolio formation and this would only be disinvested (to be replaced by a newly formed set of shares) another 3 years later after its holding period.

3.2.3. Statistical Tests

Various tests are used to assess the statistical significance of the results. First, to test if the rebalanced arbitrage portfolios have positive returns over a rolling 3-year period more than 99% of the time the z test is used as shown below:

$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

$$p_0 = 0.99$$

Where $\hat{p}$ is the proportion of the sample with returns lower than p_0 and n is the population size (Albright et al. 2006: 504).

Second, to test if an arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks does not produce lower returns later in the period under study than earlier, a mean difference test is used as in Albright et al (2006: 507) as follows:

$$t = \frac{(\overline{X_1} - \overline{X_2}) - D_0}{s_p\sqrt{1/n_1 + 1/n_2}}$$

$$s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

$$D_0 = 0$$

Where $\overline{X_i}$ is the mean of the period, s_i is the standard deviation of the period and n_i number of returns in the period.

Third, to test for the correlation between the returns of the arbitrage portfolio and the equity premium a t-test for correlation as follows is used:

$$t = \frac{r}{\sqrt{\frac{1 - r^2}{n - 2}}}$$

Where r is the correlation between the returns of the arbitrage portfolio and the MRP over the holding period and n is the number of portfolios tested.

The MRP is defined as the difference between the return on equity and that of the risk-free rate. The JSE All Share Index (J203 and CI01) is used as a proxy for the equity return. The total return index is not used, because the research disregards dividends. The risk-free rate is represented as the BESA Short Term Fixed Interest Index (STeFI) where this is available (since February 2000), and replaced by the Alexander Forbes Money Market Index for the period from June 1968 to January 2000.

3.2.4. Post 1994 Testing

To verify the results to some extent with dividends included and market weighted portfolios used, the study is repeated for the period after January 1994 (inclusive), when market capitalization data became available, with dividends included and portfolios weighted according to market capitalization. To simplify the presentation of results and because the results of the post-1994 testing are similar to those of the entire period under study, the results of the 1994 testing are presented in Appendix C.

3.3. Data, Data Source and Sample Selection

The sample for this study is all ordinary shares on the JSE during the period January 1965 to August 2010. Price, market capitalization and dividends data are collected from I-Net Bridge. Dividends are included, where available, but as discussed in detail in Appendix A, a dividend dataset is only available reliably from 1980.

Because the study investigates the persistence of the ORH over time, it is preferable to have as long a period as possible from which to work. All data points available are used and the earliest share prices available from I-Net are January 1965.

For each share, the closing price and market capitalization of the share for each month are collected as well as dividends paid and the date the dividend was paid. The dataset is cleaned using a variety of techniques before the analysis started. Appendix A details the data cleaning process.

Nil-paid shares are excluded because they have a short lifespan. Preference shares are excluded because they are not pure equity investments.

3.4. Limitations of the Study

A few approximations are made in the method. First, trading costs are ignored and the bid offer spread is ignored. Because the primary reason for the study is to compare the ORH over time, this is to some extent automatically controlled in

the comparison, but not in the absolute results. It should also be noted that trading costs have decreased dramatically in the last two decades and this could skew the results.

Unfortunately, because the dividend dataset is unreliable, if available, for the early period under study, dividends have to be ignored for the entire period in scenarios where the early dates are included. This exclusion is mitigated by the fact that all hypotheses are tested over a shorter period with dividends included as well (Appendix C). Where large special dividends are paid as in the sale of Vodacom by Telkom, an attempt is made to control for that.

The study makes no adjustment for risk in the returns of the portfolios. Although some studies (Chen and Sauer 1997) adjust portfolio returns for risk, in the current study the returns are compared between periods. No risk adjustment is therefore made, because this adjustment would affect both periods similarly.

3.5. Validity and Reliability

3.5.1. External Validity

External validity asks if causal relationships detected in research can be generalized across various settings and times (Calder et al. 1982). In terms of this study, this asks if the conclusions of the overreaction hypothesis' persistence or non-persistence can be extrapolated to other markets, securities, time and other market anomalies.

The current research limits itself to the JSE and does not make any claims about other markets. It would, however, add to a corpus of literature about the ORH on other markets as discussed in Investor Overreaction and Persistence of the Investor Overreaction above. In isolation the current research would not be valid across other markets, but it can be argued that in conjunction with other literature, inferences can be made about other markets and indeed securities.

Can the results be extrapolated into the future? If financial markets have taught investors anything, it is that extrapolating into the future is a dangerous

business. Any extrapolation of persistence or non-persistence of the ORH on the JSE would have to be done with extreme caution.

A far more interesting question is whether results about the ORH can be generalized to other anomalies. Research on the persistence of other anomalies has already been done (Lakonishok and Smidt 1988; Connolly 2009; Chan 1988), suggesting that anomalies in the market disappear or diminish once it becomes known. Should the current research find the same with the ORH, it would add to the case for generalizing this notion.

The validity of the research is maximised by using the number of shares (subject to liquidity) and the longest period possible.

3.5.2. Internal Validity

Internal validity asks if an observed covariance should be interpreted as a causal relationship (Calder et al. 1982). The current research asks whether there was a decline in the effect of the ORH on the JSE over the period of study with the view of relating this to the idea that knowledge of this anomaly reduced its effect (hypothesis 2). In isolation there would be a danger that even if such a trend was observed, it was spurious. Hypothesis 3, asking whether the anomaly varies with the market cycle, is added to confirm or deny whether the effects of the anomaly are influenced more by other factors than by the investor's knowledge of the anomaly. This is an attempt to increase the internal validity of the study.

3.5.3. Reliability

Reliability is the measure of how consistent results would be for repeated trials or studies (Neuendorf 2002). The study assumes the datasets obtained from I-Net are correct. However, exception tests are used to detect and explain any anomalies in the data, such as a share losing 50% in a day. Calculation should be repeatable from the same data.

3.6. Conclusion

In conclusion, the proposed hypotheses are tested using portfolio formation techniques similar to those employed by previous studies, for example, De Bondt and Thaler (1985), using data available from I-Net.

A consistency matrix, showing the relationship among the research questions, literature review, hypotheses, data source and analysis is contained in Appendix D.

CHAPTER 4

4. EMPIRICAL RESULTS

4.1. Introduction

This chapter presents the empirical results of the study. Section 4.2 presents the performance of the arbitrage portfolio over the period under study. The principal idea is to see if the rolling 3-year return is positive, more than 99% of the time. Section 4.3 compares the returns of the arbitrage portfolio in the latter part (1986-2007) of the period under study to that of the returns in the earlier part (1968-1985). Finally, section 4.4 presents the correlation between the returns of the arbitrage portfolio and the MRP.

4.2. Performance of the Arbitrage Portfolio

Table 1 shows the yearly returns of the arbitrage portfolio for the research period. A full set of results is available in Table 6 in Appendix B.

With some exceptions, the average returns of the arbitrage portfolio remain positive in each calendar year. The exceptions are portfolios that were held over periods of great momentum in the market which include the early 1970s, the early 1990s, the late 1990s and the late 2000s.

'Loser' portfolios formed in 1970 (mean return of -10.73%) suffered as the recovery from the 1969 to 1970 bear market allowed an extended period of outperformance by 'winner' stocks. This was, however, put to a sharp and sudden end in April 1974 as the market plummeted. The subsequent recession and recovery allowed the arbitrage portfolio its best decade with average returns as high as 36.43% for portfolios formed during 1977.

Portfolios formed in 1995 (mean = -1.58%) and 1996 (mean =-9.24%) would have suffered from the 'dot-com' bubble where 'winner' stocks continued to outperform. These losses are, however, more than compensated for in

portfolios formed during 1998 (mean= 29.92%) and 1999 (mean =29.90%) as the 'winner' portfolios recorded spectacular losses.

Finally, arbitrage portfolios formed in 2006 (mean = -2.31%) and 2007 (mean = -0.57%) underperformed. It would be expected that these portfolios would outperform as the speculative bubble, formed before 2008, burst, but this is not so. Ironically, it seems that 'winner' stocks outperformed 'loser' stocks in the early recovery, the US Federal Reserve lowered interest rates and speculative investment flowed into South Africa in search of returns. The market in 2008 and 2009 came to be dominated by foreign flows. Because speculative investments seldom flow into value stocks, it can be expected that the 'winner' portfolio would perform better than the 'loser' portfolio.

Table 1: Average arbitrage portfolio performance between January, 1965 and August, 2010. The returns are calculated over a period of 3 years from formation date. Dividends are excluded and portfolios are equal weighted.

First Formation Date in Period	Last Formation Date in Period	Mean annualised Return (%)	Median annualised Return (%)	Standard Deviation (%)	Minimum Return (%)	Maximum Return (%)
31-Jan-68	31-Dec-68	6.29	7.49	4.59	-7.29	9.98
31-Jan-69	31-Dec-69	3.69	3.78	2.93	-0.93	7.43
31-Jan-70	31-Dec-70	-10.73	-10.92	6.08	-18.44	-1.06
31-Jan-71	31-Dec-71	30.91	47.74	35.46	-30.98	66.37
31-Jan-72	31-Dec-72	27.15	27.17	9.44	7.51	39.96
31-Jan-73	31-Dec-73	10.94	13.34	10.92	-5.59	23.43
31-Jan-74	31-Dec-74	36.43	37.65	6.80	20.73	42.88
31-Jan-75	31-Dec-75	10.45	7.20	7.42	1.97	25.15
31-Jan-76	31-Dec-76	2.86	1.07	5.48	-3.99	12.77
31-Jan-77	31-Dec-77	34.29	33.70	10.53	15.85	52.52
31-Jan-78	31-Dec-78	24.82	25.28	6.71	14.16	34.37
31-Jan-79	31-Dec-79	7.28	9.84	7.23	-2.65	17.17
31-Jan-80	31-Dec-80	-1.20	-0.70	2.89	-6.09	3.88
31-Jan-81	31-Dec-81	0.30	0.56	3.69	-4.95	6.14
31-Jan-82	31-Dec-82	0.98	2.34	7.45	-9.59	12.24
31-Jan-83	31-Dec-83	4.77	6.74	8.31	-6.30	16.02
31-Jan-84	31-Dec-84	8.91	9.60	4.21	2.81	13.95
31-Jan-85	31-Dec-85	16.54	15.60	2.79	13.11	21.92
31-Jan-86	31-Dec-86	19.41	18.11	5.66	13.23	33.18
31-Jan-87	31-Dec-87	8.85	8.70	4.18	2.62	14.66
31-Jan-88	31-Dec-88	7.38	7.72	3.93	-0.09	12.59
31-Jan-89	31-Dec-89	-3.56	-2.85	3.77	-9.06	2.10
31-Jan-90	31-Dec-90	-12.47	-11.44	4.69	-19.16	-6.14
31-Jan-91	31-Dec-91	0.89	1.32	3.46	-5.90	7.42
31-Jan-92	31-Dec-92	4.59	3.53	5.00	-1.77	15.62
31-Jan-93	31-Dec-93	11.00	11.48	3.61	4.33	17.27
31-Jan-94	31-Dec-94	1.32	2.00	3.20	-3.90	5.92
31-Jan-95	31-Dec-95	-1.58	-1.75	5.17	-13.23	6.14
31-Jan-96	31-Dec-96	-9.24	-8.77	3.22	-14.31	-5.22
31-Jan-97	31-Dec-97	0.39	-1.30	9.37	-11.86	25.62
31-Jan-98	31-Dec-98	29.92	32.28	9.16	13.65	41.85
31-Jan-99	31-Dec-99	29.90	31.64	7.55	20.52	43.35
31-Jan-00	31-Dec-00	11.94	10.09	6.11	4.44	21.53
31-Jan-01	31-Dec-01	1.04	0.75	5.15	-7.08	9.94
31-Jan-02	31-Dec-02	12.38	14.05	6.04	1.20	20.50
31-Jan-03	31-Dec-03	9.48	6.89	6.71	1.59	22.74
31-Jan-04	31-Dec-04	-0.74	-2.06	4.98	-6.64	10.77
31-Jan-05	31-Dec-05	11.92	13.11	7.00	-3.76	20.87

First Formation Date in Period	Last Formation Date in Period	Mean annualised Return (%)	Median annualised Return (%)	Standard Deviation (%)	Minimum Return (%)	Maximum Return (%)
31-Jan-06	31-Dec-06	-2.31	-2.59	2.57	-5.87	1.20
31-Jan-07	31-Aug-07	-0.57	0.58	4.05	-7.83	4.08

Figure 1 below shows performance of the arbitrage portfolio over the period under study. Early in the period a high volatility can be seen with an especially sharp increase in returns in April 1971. This volatility in the early years can be ascribed to the concentration of the portfolio at the time as discussed in Section 3.2.1. Over time the volatility of the return reduces, but it also seems to decline over time.

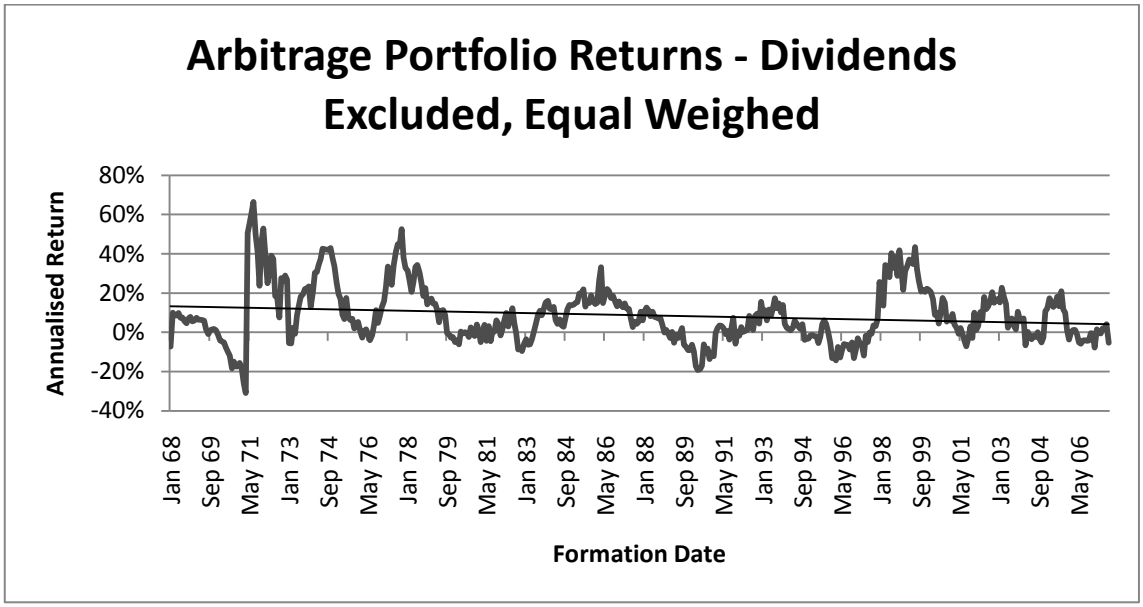


Figure 1: Arbitrage Portfolio Returns - Dividends Excluded, Equal Weighted

4.2.1. Performance of Rebalanced Portfolios

A rebalanced arbitrage portfolio is formed by selling short the shares in the rebalanced 'winner' portfolio and buying the shares in the rebalanced 'loser' portfolio. Figure 2, Figure 3 and Figure 4 show the returns and cumulative performance of the rebalanced 'loser', 'winner' and arbitrage portfolios respectively. The cumulative returns are started on an index value of 100 in December 1970. Over the period between 1970 and 2007, the rebalanced 'loser' portfolio (Figure 2) outperformed the rebalanced 'winner' portfolio (Figure

3). The outperformance results in a positive return for the rebalanced arbitrage portfolio (Figure 4).

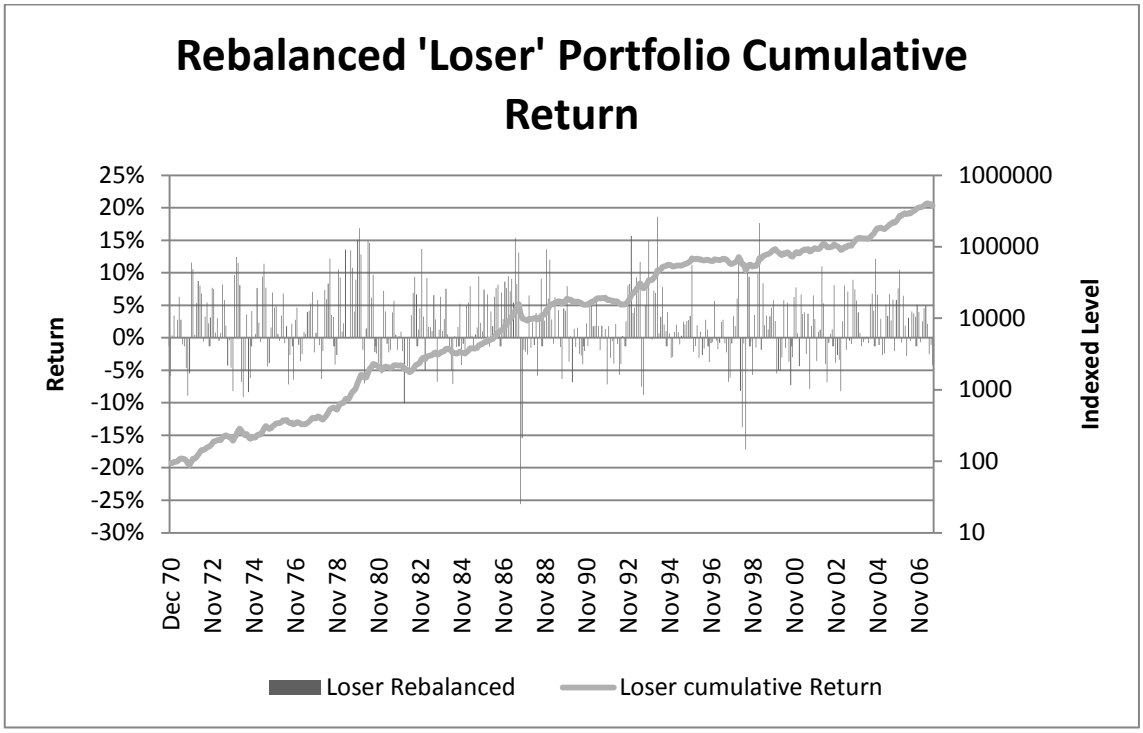


Figure 2: Rebalanced 'Loser' Portfolio Cumulative Return - Dividends excluded, equal weighted.

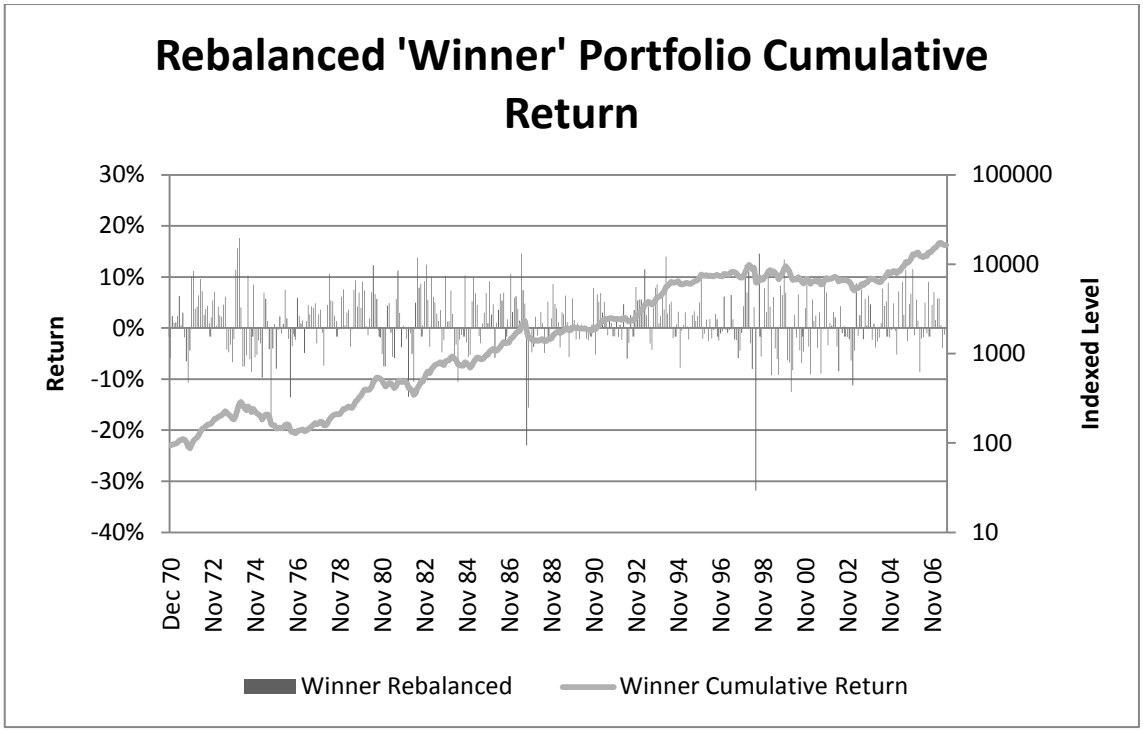


Figure 3: Rebalanced 'Winner' Portfolio Cumulative Return - Dividends excluded, equal weighted.

A R100 invested in the rebalanced 'winner' portfolio at the beginning of December 1970, would return R16 394.77 by 31 August 2007, while it would have returned a R376 141.21 if invested in the rebalanced 'loser'' portfolio. Figure 4 shows the strong performance of the arbitrage portfolio during the 1970s as well as the misfortunes of the arbitrage portfolio during the 1990. A R100 invested in the arbitrage portfolio in the beginning of December 1970 would have yielded R1 693.16.

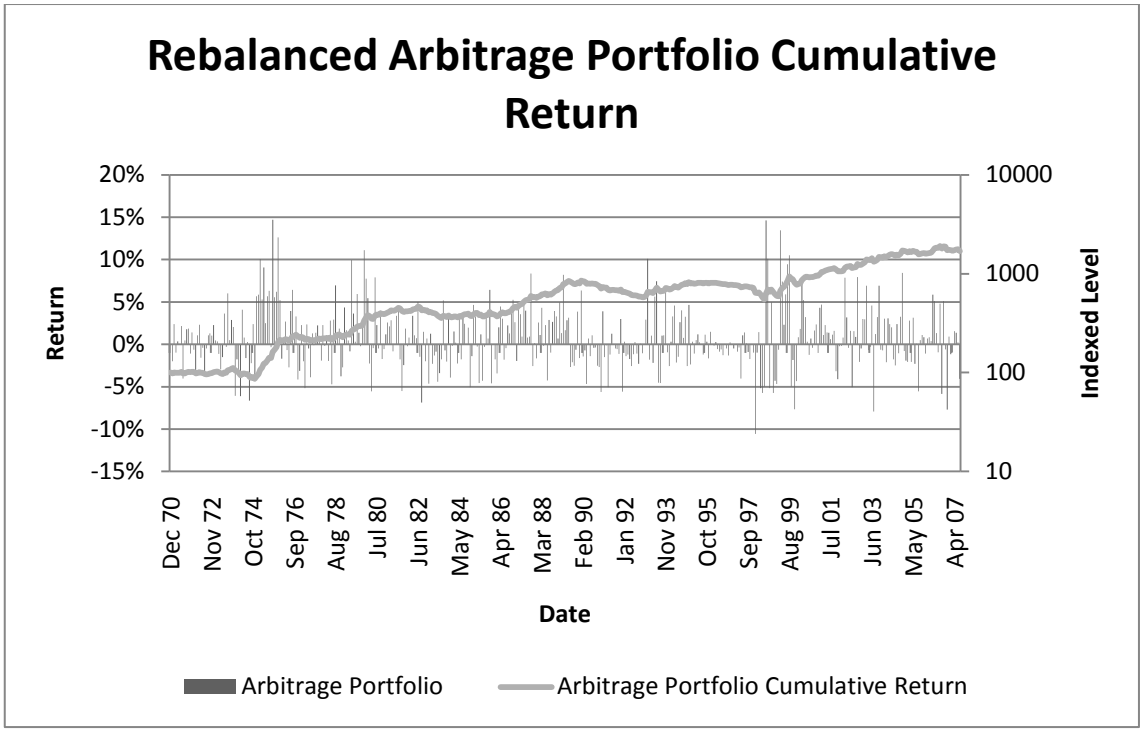


Figure 4: Rebalanced Arbitrage Portfolio Cumulative Return - Dividends excluded, equal weighted.

Figure 5 presents the performance of three portfolios on the same axis showing that the performance of the arbitrage portfolio over the 1970s was the result of both good performance of the “loser” portfolio and poor performance in the 'winner' portfolio.

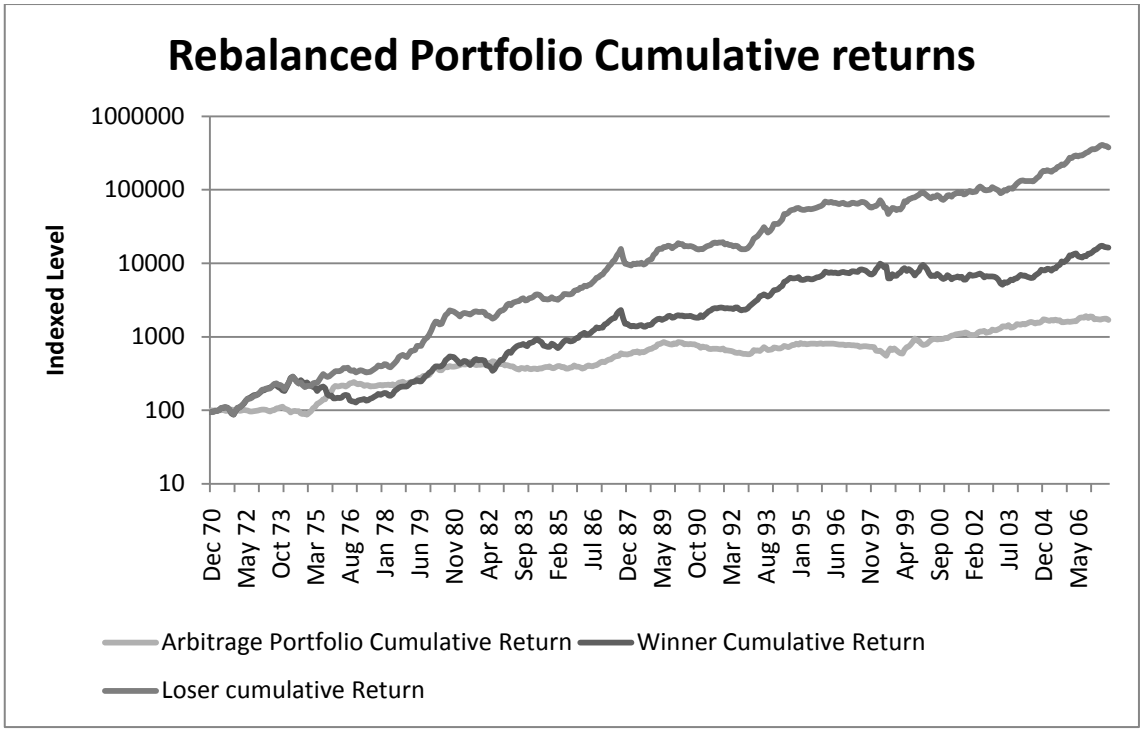


Figure 5: Rebalanced Portfolios Cumulative Return - Dividends excluded, equal weighted.

Table 2 shows the mean return and standard deviation over the entire period under study with dividends included and using an equal weighted portfolio. The mean return is 8.69%, with a standard deviation of 14.54%. The Z test is significant at 0.1% which indicates that the average return of arbitrage portfolio is significantly higher than 0%.

Table 2: Mean Return for Arbitrage Portfolio, Dividends Excluded, Equal Weighted

Item	**Statistical measures**
First Portfolio Formation date	31-Jan-1968
Last Portfolio Formation date	31-Aug-2007
Mean return over the research period	8.69%
Standard Deviation	14.54%
Z statistic	13.05

Figure 6 shows the rolling three-year return of the rebalanced arbitrage portfolio. There are four periods where the rolling 3-year return dips below zero: the early 1970s, the mid 1980s and at the start and end of the 1990s.

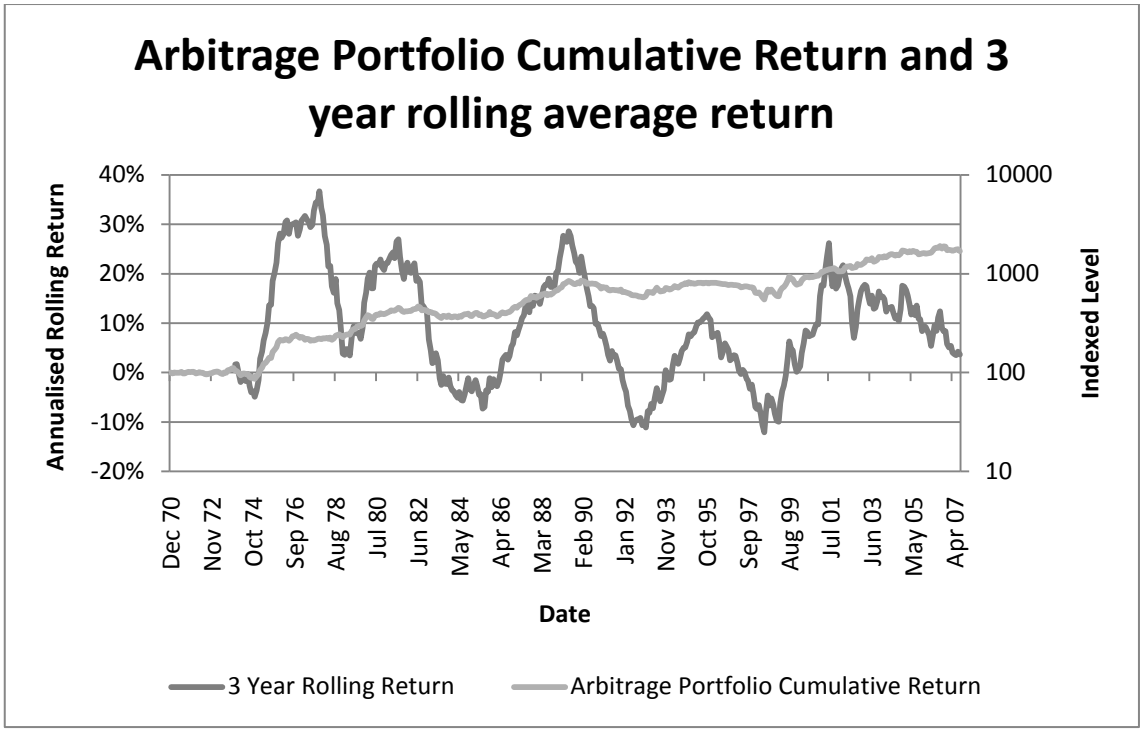


Figure 6: Rebalanced Arbitrage Portfolio Cumulative Return with Rolling 3 year returns - Dividends excluded, equal weighted.

Table 3 presents the proportion of positive returns for rebalanced arbitrage portfolios. Only 76% of 3-year periods had a positive return. This is significantly lower than the 99% positive returns tested in hypothesis 1.

Table 3: Proportion Positive Returns for Rebalanced Arbitrage Portfolio, Dividends Excluded, Equal Weighted

Item	Statistical measures
Start date	01-Dec-1970
End date	31-Aug-2007
Proportion of positive returns	76.05%
Number of returns	405
Z statistic	46.42

4.3. Arbitrage Portfolio Performance before and after 1985

Figure 1 above shows a downward trend in the returns of the arbitrage portfolios. Table 4 below shows the differences in the mean return of the arbitrage portfolio formed before and after 1985. Rather than using the

rebalanced portfolios, the mean of the arbitrage portfolio for each formation date is used over the entire holding period, because this should result in better separation between the periods.

The year 1985 is used as the watershed, because this is the period when De Bondt and Thaler (1985) published their first paper on market overreaction. A reduced arbitrage portfolio return for the period after the study would indicate that market participants learned from the study and that the anomaly was therefore reduced or disappeared. The year 1985 is arbitrarily lumped with the earlier period, because the former period is shorter.

The mean return before 1985 (inclusive) is 11.93% while after 1985, the mean is 6.01%. The returns from the arbitrage portfolio after 1985 are, therefore, significantly lower than up to 1985 with a significance of 1%.

Table 4: Mean return of the arbitrage portfolio before and after 1985

Statistical Measure	**Period 1** **31 Jan 1968 – 31 Dec 1985** **N = 216**	**Period 2** **31 Jan 1986 – 31 Aug 2007** **N = 260**
Mean Return	11.93%	6.01%
Standard Deviation	16.64%	11.91%
Minimum Return	-30.98%	-19.16%
Maximum Return	66.37%	43.35%
Mean Difference	5.92%	
t-stats	4.51	

4.4. The correlation between the returns of the arbitrage portfolio and the market risk premium

Figure 7 plots the arbitrage portfolio returns on the same axis as the market risk premium (MRP) over the holding period with time on the horizontal axis. A correlation between the arbitrage portfolio and the MRP would indicate that the effect of the ORH is related to the economic cycle. A relationship between the ORH and the economic cycle makes it more difficult to exploit the ORH to generate excess returns in the market.

Figure 8 shows the same information in a scatter plot as Figure 7. Both figures show that the arbitrage portfolio return and the MRP, are significantly (p=0.01) positively correlated with an R^2 of 0.075.

The MRP plotted (and tested against) corresponds to the holding period, and not the formation period. The MRP over the holding period would not be available to the investor when the investments are made. The MRP over the formation period can therefore not be used as a predictor of the returns of the arbitrage portfolio, but the MRP over the holding period can be used to shed light on the possible causes of the returns.

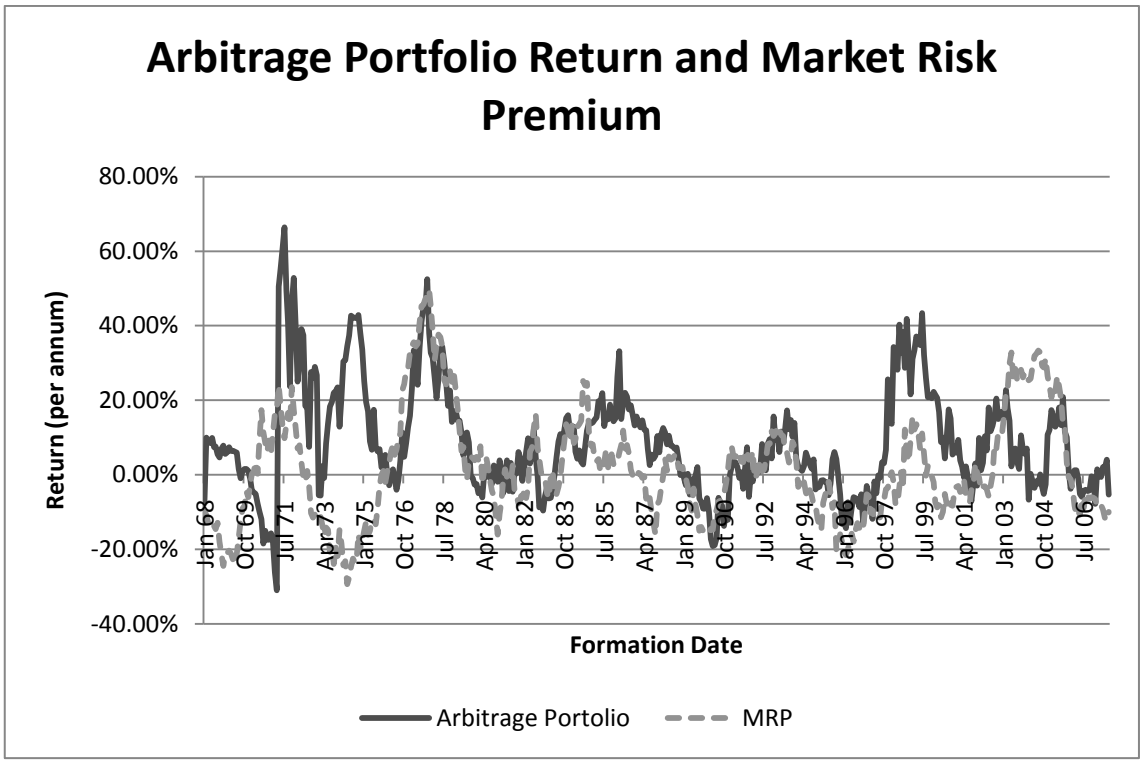


Figure 7: Returns of Arbitrage Portfolio and the Market Risk Premium

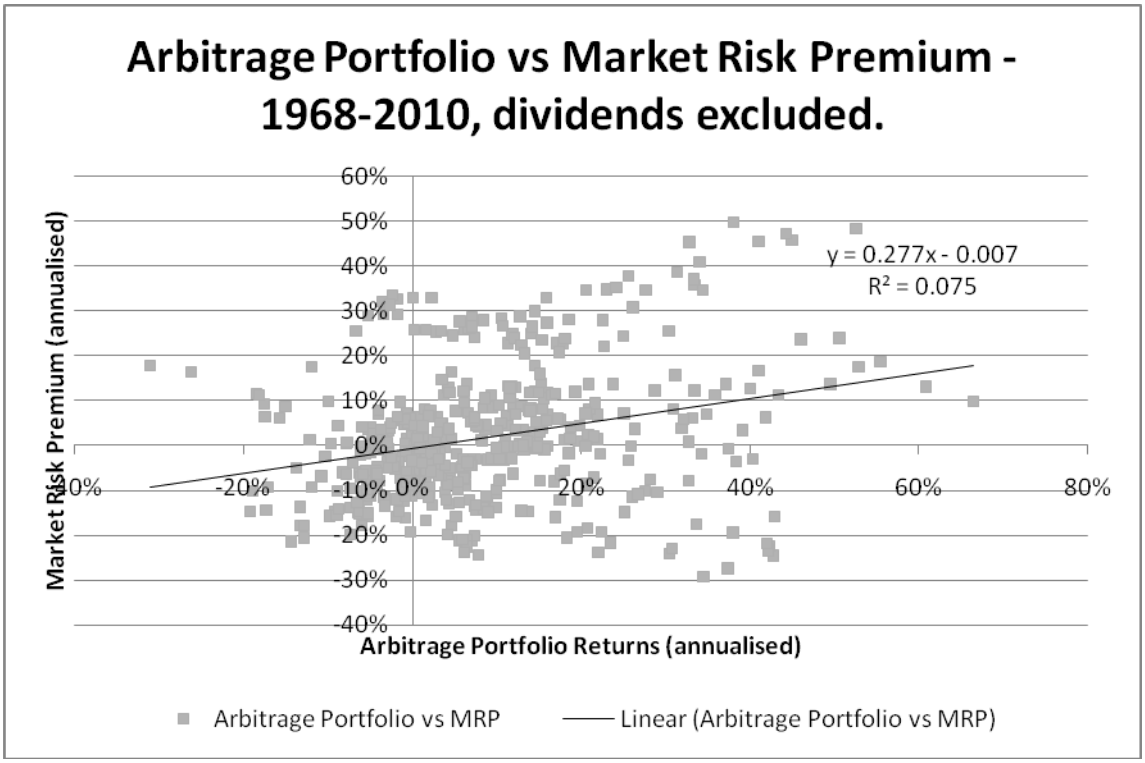


Figure 8: Arbitrage Portfolio vs Market Risk Premium - 1968-2010, Dividends Excluded.

4.5. Conclusion

The arbitrage portfolio is shown to have a positive return and by implication, the 'loser' portfolio has outperformed the 'winner' portfolio over the research period. However, there is a trend to lower outperformance. The correlation of the arbitrage portfolio to the MRP indicates that the returns are cyclical, and this is further supported by the fact that there are several periods where the rebalanced arbitrage portfolio produced negative rolling 3-year return.

CHAPTER 5

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

This research set out to establish if there has been a decrease in the effect of the ORH and if the ORH can reliably be used to generate alpha over a three-year period. To be sure that a reduction in the effect of the ORH is not ascribed to market efficiency, while it may be part of the market cycle, it was also tested if there is a correlation between ORH and the MRP.

Section 5.2 interprets and discusses the results of the study. This is followed by recommendations in section 5.3 which should help investors in applying the results of the study in portfolio management and stock selection. Section 5.4 concludes with suggestions for further study.

5.2. Interpretation and Discussion of Results

The study confirmed that the 'loser' portfolio outperforms the 'winner' portfolio on average. This is a statistically significant outperformance and agrees with the results of research of De Bondt and Thaler (1985; 1987), Muller (1998; 1999), Da Costa (1994), Dissanaike (1997), Baytas and Cakici (1999). However, at 8.69%, the returns were lower than the 25% outperformance found by De Bondt and Thaler (1985).

The null hypothesis, stating that an arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks does not produce excess returns over 99% of rolling 3-year periods, is not to be rejected. This is consistent with the conclusions of Chen and Sauer (1997) that found that there were periods where 'loser' stocks outperformed 'winner' stocks (1926-1946 and 1960-1974) but other periods (1947-1959 and 1974-1992) where the 'loser' portfolio did not outperform. The strong outperformance found in this study in the early 1970s was also found by Chen and Sauer (1997).

A strong underperformance of the arbitrage portfolio was seen in the build-up to the 'dot-com' bubble (1995-1998), a period where the 'loser' portfolio underperformed the 'winner' portfolio by as much as 19% per annum. Eventually the bubble burst and it was, with hindsight, clear for all to see that the market overreacted to good news about technology companies. The bursting of the 'dot-com' bubble brought a period of strong recovery for 'loser' stocks. However, the adage that the market can remain irrational for longer than one can remain solvent might have entered the picture during the build-up of the 'dot-com' bubble with drawdowns of up to 34.77% in August 1998. Using the overreaction gainfully during portfolio construction, therefore, becomes a matter of market cycle prediction, or timing the market, something that is notoriously difficult to do.

The null hypothesis that the returns of the arbitrage portfolio in the latter part of the research period were not lower than the earlier part of the study is rejected. The implication of this is that although the ORH can still be detected in the market, its effect has diminished over time. This is possibly as investors incorporated the work of behavioural finance into their portfolio selection. This suggests that the 'second-tier' market efficiency, alluded to in section 1.4, is present. This is consistent with the reduction of other anomalies once they were discovered. Examples of this are the small firm effect and the value premium (Roll 1981; Dimson and Marsh 1999; Chan and Lakonishok 2004) that are found to diminish once discovered. Seasonal effects in the markets, such as the 'January Effect' had also largely disappeared once discovered (Connolly 2009) although this is disputed (Lakonishok and Smidt 1988). This study adds to the corpus of literature that indicates that the markets are 'second-tier' efficient.

It can be argued that value investing has become 'en vogue' in recent years, especially in South Africa, and that the opportunities for outsized gains has been reduced as more investors chase value stocks, thereby 'pricing in' the value attributes of stocks. Because the ORH points investors towards value stocks that have had recent bad news and are, therefore, cheaper, and away from the latest hot, growth stocks. A fashion in value investing will also negatively affect the returns of investing in 'loser' stocks. It can, therefore, be

argued that at least some reduction in the effect of the ORH should be attributed to the broader shift towards 'Value Investing' that the market has seen in recent years.

It is also well known that various styles of investing work during various parts of the market cycle. For instance, value investing tends to outperform growth investing during bear markets, but growth investing outperforms during bull markets. This proved to be the case with market overreaction as well. The null hypothesis that the returns of the arbitrage portfolio are not correlated with the market risk premium can be rejected with a significance of 1%. At least part of the variation in the effectiveness of using the ORH to select portfolios is related to the market cycle.

Because this study is done over a period from 1968 to 2007, the results cover several cycles. The trend toward lower returns from the ORH is, therefore, less likely to be the result of short-term differences, and more likely to be part of longer term market efficiency. It seems that investors have identified overreaction as an anomaly in the market and over time arbitraged away the opportunity, but not completely.

In conclusion, though this golfer has managed to correct his hook slightly, there is still a natural hook, and the ball still tends to find the side of the fairway, especially in windy conditions.

5.3. Recommendations

It is the view of this report that although the ORH can still be used together with other factors to do stock selection, although the effect has diminished. This suggests a 'second-tier' market efficiency that arbitrages away at least part of the overreaction anomaly.

This study, on the one hand, adds weight to arguments against the EMH, because the anomaly still exists even after it has been known for some time, but on the other hand argues in favour of the EMH because the anomaly has reduced over time. This may point toward the equilibrium that Grossman and

Stiglitz (1980) pointed out, where, if the anomaly was completely eroded, there would be no motivation for investors to continue to select 'loser' stocks. This would, in turn, result in higher returns for 'loser' stocks, thus re-creating the anomaly.

Therefore, it seems that to stay ahead of the market, investment professionals continually need to find new anomalies to exploit and test what anomalies are no longer exploited to the fullest. It seems there is no free lunch.

To the investor this suggests that one should either follow a passive approach, where one controls costs, or find a manager that constantly searches (and finds) new anomalies to exploit. Getting caught in the middle would only result in higher costs, with little additional gain.

5.4. Suggestions for Further Research

There is a host of market anomalies that beg to have the same question asked. It is already known that the publication of the 'Monday Effect' and the 'January Effect' diminished the effects considerably (Gibbons and Hess 1981). The same was found for the small firm effect and the value premium (Roll 1981; Dimson and Marsh 1999; Chan and Lakonishok 2004). The same can be asked about the book-to-market effect.

This research has tested only the returns of the arbitrage portfolio against the MRP, with only a small, if significant correlation. The relationship between the returns of the arbitrage portfolio and several other variables can also be investigated. What would be interesting is to test which flows from which type on investors cause more overreaction. Would it be foreign investors (testing against net inflow) or maybe retail investors? Answers to these questions would help better understand the dynamics and therefore the psychology of markets.

6. REFERENCES

Albright, S.C., Winston, W., and Zappe, C., 2006. *Data analysis and decision making with Microsoft Excel*, Thomson.

Atkins, A.B., and Dyl, E.A., 2009. Price reversals, bid-ask spreads, and market efficiency. *Journal of Financial and Quantitative Analysis*, 25(04), p.535-547.

Bachelier, L., 1900. Théorie de la spéculation. Available at: http://www.numdam.org/item?id=ASENS_1900_3_17__21_0.

Bachelier, L., Davis, M., and Etheridge, A., 2006. *Louis Bachelier's theory of speculation: the origins of modern finance*, Princeton Univ Pr.

Ball, R., and Kothari, S.P., 1989. Nonstationary expected returns:: Implications for tests of market efficiency and serial correlation in returns. *Journal of Financial Economics*, 25(1), p.51-74.

Banz, R.W., 1981. The relationship between return and market value of common stocks* 1. *Journal of financial economics*, 9(1), p.3-18.

Baytas, A., and Cakici, N., 1999. Do markets overreact: International evidence* 1. *Journal of Banking & Finance*, 23(7), p.1121-1144.

Black, F., 1993. Beta and Return. *The Journal of Portfolio Management*, 20(1), p.8-18.

Boynton, W., and Oppenheimer, H.R., 2006. Anomalies in stock market pricing: Problems in return measurements. *Journal of Business*, 79(5), p.2617-2632.

Brown, N.C., Wei, K.D., and Wermers, R., 2007. Analyst recommendations, mutual fund herding, and overreaction in stock prices. *Unpublished working paper, University of Southern California, University of Texas–Dallas, University of Maryland*.

Calder, B.J., Phillips, L.W., and Tybout, A.M., 1982. The concept of external validity. *Journal of Consumer Research*, 9(3), p.240-244.

Chan, K.C., 1988. On the contrarian investment strategy. *Journal of Business*, 61(2), p.147-163.

Chan, K.C., and Lakonishok, J., 2004. Value and growth investing: Review and update. *Financial Analysts Journal*, 60(1), p.71-86.

Chen, C.R., and Sauer, D.A., 1997. Is stock market overreaction persistent over time? *Journal of Business Finance & Accounting*, 24(1), p.51-66.

Chopra, N., Lakonishok, J., and Ritter, J.R., 1992. Measuring abnormal performance:: Do stocks overreact? *Journal of Financial Economics*, 31(2), p.235-268.

Chuvakhin, N., 2002. *Efficient Market Hypothesis and Behavioral Finance-Is a Compromise in Sight?"*, Pepperdine University\uc0\u8217{}s.

Connolly, R.A., 2009. An examination of the robustness of the weekend effect. *Journal of Financial and Quantitative Analysis*, 24(02), p.133-169.

Conrad, J., and Kaul, G., 1993. Long-term market overreaction or biases in computed returns? *Journal of Finance*, 48(1), p.39-63.

Da Costa, N.C.A., 1994. Overreaction in the Brazilian stock market. *Journal of banking & finance*, 18(4), p.633-642.

De Bondt, W.F.M., Shefrin, H., Muradoglu, Y.G., and Staikouras, S.K., 2008. Behavioural Finance: Quo Vadis? *Journal of Applied Finance*, 19, p.7-21.

De Bondt, W.F.M., and Thaler, R.H., 1985. Does the stock market overreact? *Journal of Finance*, 40(3), p.793-805.

De Bondt, W.F.M., and Thaler, R.H., 1987. Further evidence on investor overreaction and stock market seasonality. *Journal of Finance*, 42(3), p.557-581.

Dimson, E., and Marsh, P., 1999. Murphy's Law and Market Anomalies. *The Journal of Portfolio Management*, 25(2), p.53-69.

Dissanaike, G., 1997. Do stock market investors overreact? *Journal of Business Finance & Accounting*, 24(1), p.27-50.

Dissanaike, G., 1994. On the computation of returns in tests of the stock market overreaction hypothesis. *Journal of Banking & Finance*, 18(6), p.1083-1094.

Fama, E.F., 1970. Efficient capital markets: A review of theory and empirical work. *Journal of finance*, 25(2), p.383-417.

Fama, E.F., 1965a. Random walks in stock market prices. *Financial Analysts Journal*, 21(5), p.55-59.

Fama, E.F., 1965b. The behavior of stock-market prices. *Journal of business*, 38(1).

Fama, E.F., Fisher, L., Jensen, M.C., and Roll, R., 1969. The adjustment of stock prices to new information. *International Economic Review*, 10(1), p.1-21.

Fox, J., 2002. Is The Market Rational? No, say the experts. But neither are you--so don't go thinking you can outsmart it. Available at:

http://money.cnn.com/magazines/fortune/fortune_archive/2002/12/09/333473/index.htm [Accessed July 10, 2010].

Gaunt, C., 2000. Overreaction in the Australian equity market: 1974-1997. *Pacific-Basin Finance Journal*, 8(3-4), p.375-398.

George, T.J., and Hwang, C.Y., 2007. Long-term return reversals: overreaction or taxes? *The Journal of Finance*, 62(6), p.2865-2896.

Gibbons, M.R., and Hess, P., 1981. Day of the week effects and asset returns. *Journal of Business*, p.579-596.

Grossman, S.J., and Stiglitz, J.E., 1980. On the impossibility of informationally efficient markets. *The American Economic Review*, 70(3), p.393-408.

JSE, 2011. JSE - JSE/FTSE FAQ's. *JSE*. Available at: http://www.jse.co.za/Products/FTSE-JSE/FAQs.aspx [Accessed February 26, 2011].

Jensen, M.C., and Field, S., 1978. Some anomalous evidence regarding market efficiency. *Journal of Financial Economics*, 6(2/3), p.95-101.

Johnson, B., Magee, R.P., Nagarajan, N.J., and Newman, H.A., 1985. An analysis of the stock price reaction to sudden executive deaths: Implications for the managerial labor market. *Journal of Accounting and Economics*, 7(1-3), p.151-174.

Kahneman, D., and Tversky, A., 1974. Judgment under uncertainty: Heuristics and biases. *Science*, 185, p.1124-1131.

Kryzanowski, L., and Zhang, H., 2009. The contrarian investment strategy does not work in Canadian markets. *Journal of Financial and Quantitative Analysis*, 27(03), p.383-395.

Lakonishok, J., and Smidt, S., 1988. Are seasonal anomalies real? A ninety-year perspective. *Review of Financial Studies*, 1(4), p.403.

Mahani, R.S., and Poteshman, A.M., 2008. Overreaction to stock market news and misevaluation of stock prices by unsophisticated investors: Evidence from the option market. *Journal of Empirical Finance*, 15(4), p.635-655.

Muller, C., 1998. *Investor overreaction on the Johannesburg Stock Exchange*. Johannesburg: Wits Business School.

Muller, C., 1999. Investor overreaction on the Johannesburg Stock Exchange. *Investment Analysts Journal*, 49, p.5-19.

Mun, J.C., Vasconcellos, G.M., and Kish, R., 2000. The Contrarian/Overreaction Hypothesis:: An analysis of the US and Canadian stock markets. *Global Finance Journal*, 11(1-2), p.53-72.

Neuendorf, K.A., 2002. *The content analysis guidebook*, Sage Publications, Inc.

Rendleman, R.J., Jones Henry Jr, A., and Charles, P., 1982. Empirical anomalies based on unexpected earnings and the importance of risk adjustments* 1. *Journal of Financial Economics*, 10(3), p.269-287.

Roll, R., 1981. A possible explanation of the small firm effect. *Journal of Finance*, 36(4), p.879-888.

Roll, R., 1988. The international crash of October 1987. *Financial analysts journal*, 44(5), p.19-35.

Roll, R., 1994. What every CFO should know about scientific progress in financial economics: What is known and what remains to be resolved. *Financial Management*, 23(2), p.69-75.

Rozeff, M.S., and Kinney, W.R., 1976. Capital market seasonality: The case of stock returns. *Journal of Financial Economics*, 3(4), p.379-402.

Samuelson, P.A., 1965. Proof that properly anticipated prices fluctuate randomly. *Management Review*, 6(2).

Shiller, R.J., 1981. Do stock prices move too much to be justified by subsequent changes in dividends? *The American Economic Review*, 71(3), p.421-436.

Zarowin, P., 1989. Does the Stock Market Overract to Corporate Earnings Information? *Journal of Finance*, 44(5), p.1385-1399.

Zarowin, P., 1990. Size, Seasonality, and Stock Market Overreaction. *Journal of Financial and Quantitative Analysis*, 25(01), p.113-125. Available at: [Accessed July 4, 2010].

APPENDIX A - DATA CLEANING

Because of the long period over which the hypotheses are tested, the collection and cleaning of the data was a significant part of the workload for this research. In presenting and discussing the results, a discussion on the collection and cleaning of the data is appropriate. This appendix therefore opens with a discussion on the data collection, followed by a discussion on the analysis of the data.

Data Collection

Datasets were collected using I-Net. The research is therefore dependent on I-Net data and the constraints that come along with it. Some of these constraints will be discussed in this section as well as how they were dealt with.

Corporate Action and Delisting

All counters supplied by I-Net were used to ensure that there is no survivorship bias in the study. Unfortunately, this is a total of 1749 counters. Not all of these counters are unique. I-Net duplicates a counter and keeps the original values (in some cases) in a separate counter where there have been share splits or mergers. Data collection was therefore a process of tying up counters in such a way that it made sense. In this case, it made sense to combine the counters in such a way that shares where the underlying business would remain the same business, and therefore have the same investment characteristic. Where evidence was found that the business changed, the counters were kept separate.

An example of the companies where the underlying business was changed is where all assets in a share were sold and most of the capital paid out to the shareholders, leaving only a cash-shell. If this shell company is then used for a reverse listing, the share is in effect a different share, with various investment characteristics. For the purposes of this research, the share's return series therefore needs to be split.

In the case of delisting, I-Net does not seem to follow a specific set of rules. In some instances a final dividend is shown as a dividend, while the closing price is not adjusted. When calculating the total return, this results in a total return for that month in the order of 100%, clearly incorrect.

To check for such anomalies, all counters were inspected one by one using a tool developed in Excel. Once inspected the monthly data was copied to a database table together with a month by month return and total return.

In the case of recent events (post 1999 typically) it was usually possible to find news sources on the Internet showing the events. In the case of smaller companies and older companies, news sources could not be found and the researcher used clues from the data to make an educated guess at the nature of the corporate action. Shares with zero volume traded for months and a negative price per earnings ratio, can for instance be assumed to have been liquidated.

Rules used were roughly:

- Shares with zero volume traded for extended periods before delisting were assumed to have been suspended.
- If a suspended share had a negative earnings ratio, no liquidation dividend was assumed.
- If a suspended share was still hugely profitable at the time of suspension, a sale at final price was assumed.
- Shares not suspended were assumed to have been acquired or merged. Because investors typically know the terms of such transactions, it was assumed the news was in the final price.

Unfortunately, many assumptions had to be made in this, exposing the research to the classic Garbage In, Garbage Out (GIGO) problem. For this reason much time was spent on cleaning the data in this manner. Although it was originally intended to automate the rules on the oldest and smallest shares, a satisfactory

cut off point to automation was never reached and each share was inspected in the end.

No information on rights issues were available and rights issues were therefore not handled. Because all research is done on relative portfolios, this should not affect the outcome excessively.

Digitization Errors

In cases of share splits, I-Net adjusted the price history of the share to reflect this split. This makes sense because it eases the task of users to compare previous share prices and dividends with that of the present day. However, consider the following scenario: A share lists at 100c and trades between 80c and 120c during the first year. During the second year the share price drops and the share trades between 45c and 120c. Subsequent to this the share price recovers over the next few years and is split 10 to 1 twice, this equals a total split of 100 to 1. Because share prices on I-Net are given only in integers, all share prices in the database would be 1c for the first year, and it would range between 0c and 1c for the second year. The result is that all returns of the first year are 0, while the returns for the second year range between 0 and infinity.

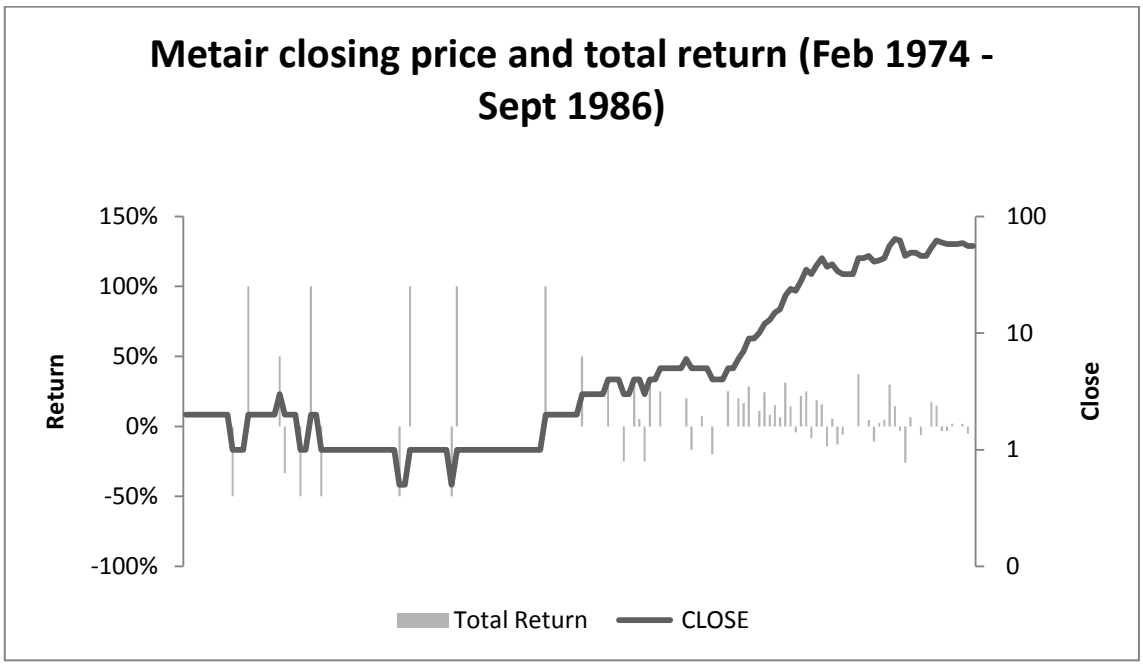


Figure 9: Metair closing price and total return

An example of this occurring during the research is Metair Investment Limited (MTA) that had recorded prices of 0 in 1977 and 1978. To allow the use of the data, the prices were set to 0.5c for those months, but this still leaves a low resolution for the early years, as can be seen in Figure 9. In other words, although there were several smaller movements in returns, the returns seen in the data today would only be -50%, 0% or +100% for the early years. This could wreak havoc with the algorithms during this time and caution should therefore be used when interpreting the results.

Dividend Data

I-Net's dividend datasets before 1980 are spotty to say the least. Although dividend datasets are supplied, this is only on the largest shares. For instance, although there is price data for 92 shares in the database in 1979, there is a dividend dataset for only 39 of these. For the period between 1970 and 1978 this reduces to 8 to 11 shares with dividend data as opposed to 76 to 90 shares with price data. No dividend dataset is available for the period before 1970.

Any analysis using total return should therefore be interpreted with measured caution if the period before 1979 is included in the analysis.

Liquidity Filter

For completeness sake, this research was done with all the data available to the study. This includes a large number of small and often illiquid shares. On the one hand these shares do not form a significant part of the market capitalization of the JSE and on the other, because of its illiquidity, does not form a significant part of the trading opportunity in the market. Although small illiquid shares are therefore included in the study for completeness sake, results are often shown where only the top 90% of market capitalization is included.

The above paragraph assumes that market capitalization and liquidity goes hand in hand. Figure 10 shows that volumes traded are usually proportional to market capitalisation, and this assumption is, therefore, reasonable.

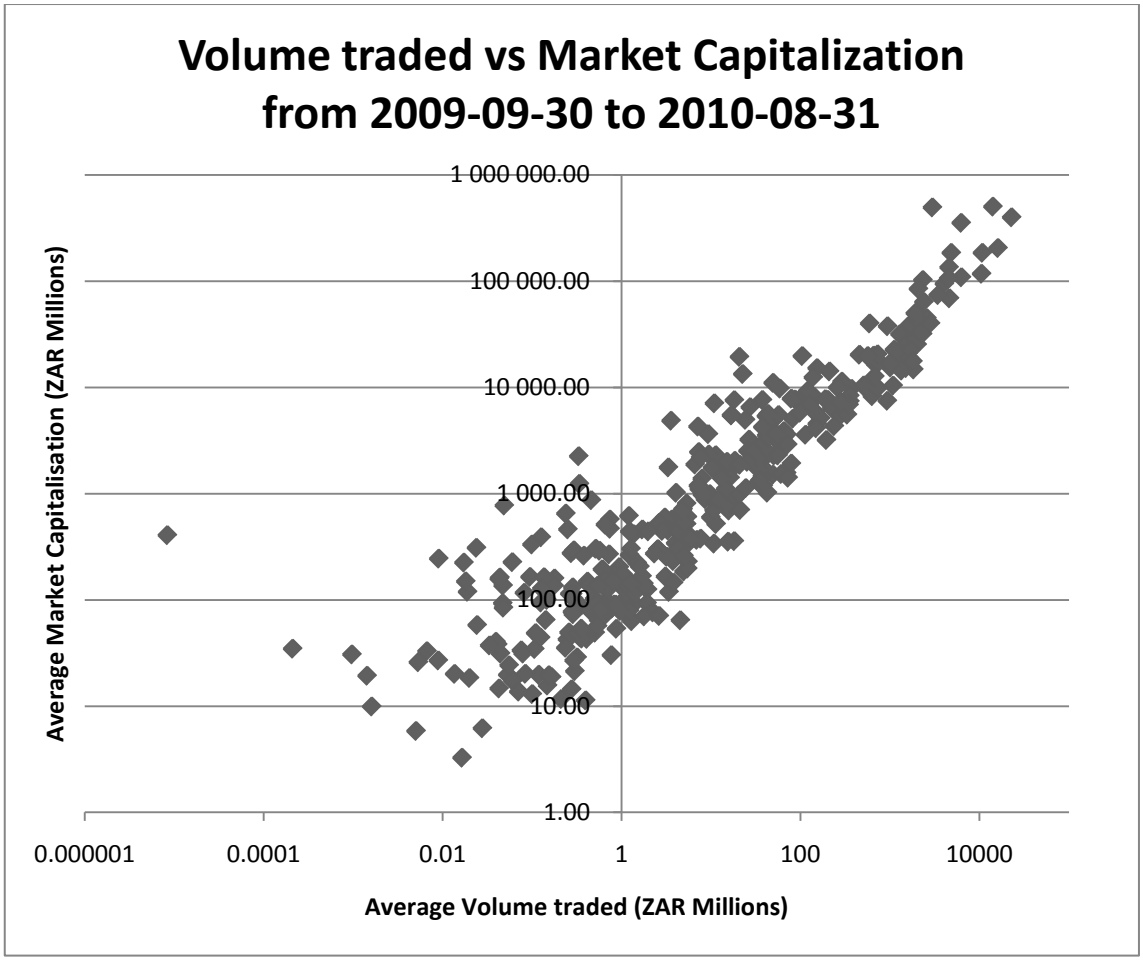


Figure 10: Volume Traded vs Market Capitalization

Market Coverage

To ensure that the database covers the data adequately, it was compared with the market capitalization of the All Share Index. This is measured by JSE Actuarial All Share Index (CI01) before June 2002 as well as by the FTSE/JSE All share Index (J203) after January 2002 with 6 month overlap. The CI01 covered all shares in the market while the J203 only covers the top 99% of eligible listed companies ranked by market capitalisation (JSE 2011).

Figure 11 shows that the market capitalization captured in the database, is essentially in line with that of the All Share Index. There is a large drop of market capitalization covered in the period before November 1993, although the number of shares does not drop at the same time. This is as a result of the fact

that I-Net does not supply Market Capitalisation data for a large number of shares before this period, but only the closing values.

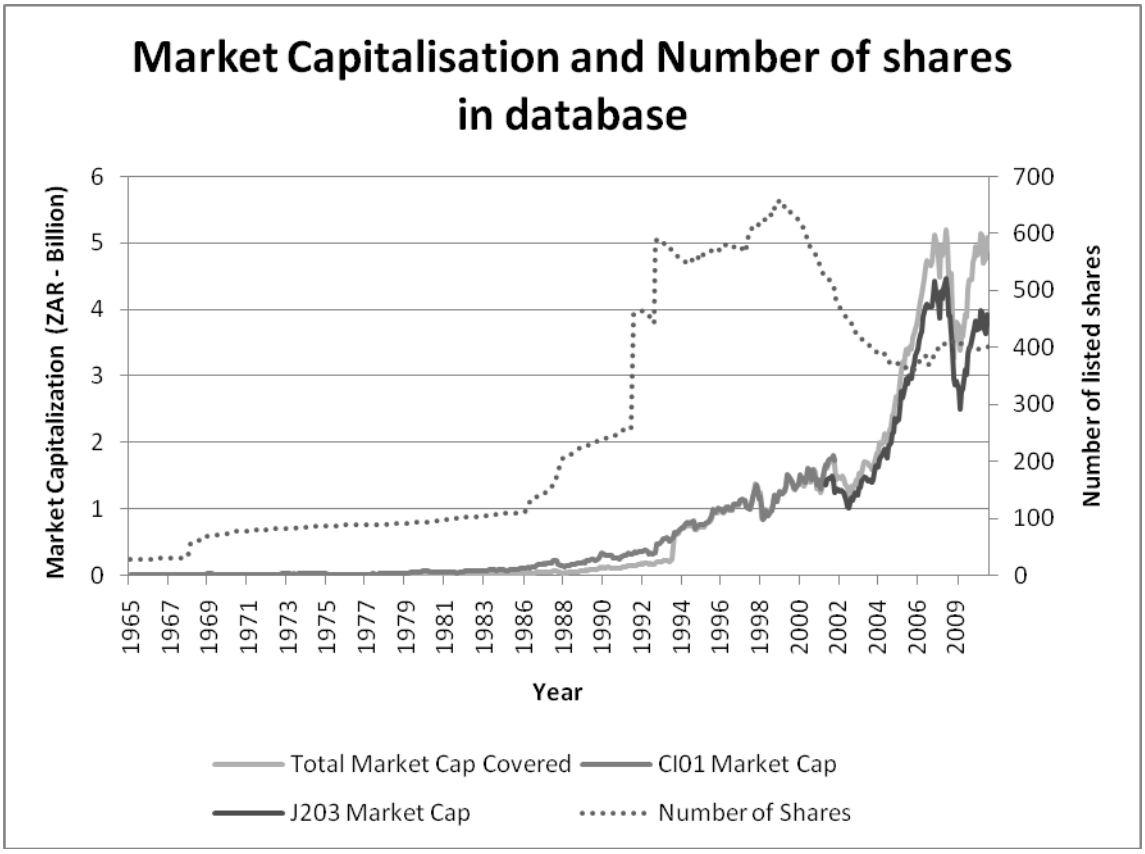


Figure 11: Market Capitalisation and Number of Shares in Database.

The reader can also see two sudden rises in the number of shares that data is available for in November 1992 (145 shares) and October 1991 (202 shares). In the latter part of the graph, the market value accounted for in the database exceeds the market value of the J203 as the J203 excludes foreign portions of dual listed shares.

Table 5 shows a summary of relevant dates in the data quality.

Table 5: Events in database quality

Date	Data Change
Feb-65	Dataset starts with 29 counters
Apr-68	Number of counters jump from 34 to 57
Mar-70	Dividend dataset starts
Oct-79	Dividend dataset expands
Oct-91	Number of counters jump from 257 to 459
Dec-91	Number of counters jump from 443 to 588
Dec-93	Market Cap available for all shares
Jan-02	J203 starts
Jun-02	CI01 ends

In all, the total number of closing price records in the dataset were 147 313.

Technology and Analysis

After the data was cleaned, a script was used to iterate through each counter and calculate the tradability, number of months valid, number of months tradable, periodic returns, market capitalisation weight, market capitalisation rank and market percentile rank. This intermediate step makes the selection of the portfolios and universe for each month far easier.

A second script was used to then calculate the index for each month according to the same parameters used in portfolio formation. Finally, the portfolios were calculated for each formation date. Once formed, the return for each portfolio month was calculated. If a share was delisted during the holding period, it was removed from the portfolio and the weight of each share adjusted in proportion with its current weight. This is equivalent to rebalancing the portfolio according to current weights in the real world.

APPENDIX B - PORTFOLIO RETURNS

Table 6: Returns of the 'Loser', 'Winner' and Arbitrage Portfolios over a 3 year holding period for each formation date. Dividends are excluded, equal weighted portfolios.

Formation Date	Loser Portfolio Annualised Return (%)	Winner Portfolio Annualised Return (%)	Arbitrage Portfolio Annualised Return (%)	MRP over 3 year holding period (%)
1968/01/31	-6.08	1.21	-7.29	-9.74
1968/02/29	1.55	-8.43	9.98	-10.80
1968/03/31	0.35	-8.48	8.83	-13.01
1968/04/30	1.33	-7.21	8.54	-14.39
1968/05/31	0.53	-9.36	9.89	-14.04
1968/06/30	1.45	-5.98	7.43	-13.72
1968/07/31	2.77	-4.78	7.55	-14.62
1968/08/31	1.56	-3.97	5.53	-12.90
1968/09/30	-0.03	-4.70	4.67	-18.02
1968/10/31	-1.53	-8.52	6.99	-21.32
1968/11/30	-4.70	-12.52	7.82	-24.48
1968/12/31	-6.16	-11.72	5.56	-21.30
1969/01/31	-4.12	-10.11	5.99	-21.04
1969/02/28	-2.94	-10.37	7.43	-20.33
1969/03/31	-2.27	-8.68	6.41	-21.16
1969/04/30	-3.28	-9.76	6.48	-22.72
1969/05/31	-3.58	-9.76	6.18	-23.91
1969/06/30	-2.14	-8.09	5.95	-21.19
1969/07/31	-1.13	-2.72	1.60	-16.78
1969/08/31	-1.38	-0.45	-0.93	-12.41
1969/09/30	2.80	1.79	1.00	-9.01
1969/10/31	4.14	2.57	1.57	-8.50
1969/11/30	5.79	4.18	1.60	-4.45
1969/12/31	6.79	5.75	1.04	-5.95
1970/01/31	8.21	9.28	-1.06	-2.59
1970/02/28	9.70	13.93	-4.23	0.20
1970/03/31	10.35	15.07	-4.72	0.89
1970/04/30	12.28	17.40	-5.11	3.38
1970/05/31	10.98	18.73	-7.75	0.29
1970/06/30	12.85	22.80	-9.95	9.67
1970/07/31	17.37	29.26	-11.89	17.37
1970/08/31	19.89	38.33	-18.44	11.45
1970/09/30	14.91	29.93	-15.02	8.48
1970/10/31	12.20	29.65	-17.44	6.20
1970/11/30	11.65	29.11	-17.46	9.17
1970/12/31	14.93	30.60	-15.67	5.98
1971/01/31	14.51	32.62	-18.11	11.21

Formation Date	Loser Portfolio Annualised Return (%)	Winner Portfolio Annualised Return (%)	Arbitrage Portfolio Annualised Return (%)	MRP over 3 year holding period (%)
1971/02/28	15.96	42.10	-26.14	16.32
1971/03/31	17.71	48.69	-30.98	17.71
1971/04/30	71.21	20.67	50.54	23.85
1971/05/31	72.83	17.41	55.42	18.54
1971/06/30	70.30	9.54	60.76	12.95
1971/07/31	73.13	6.75	66.37	9.77
1971/08/31	67.62	18.15	49.47	13.54
1971/09/30	46.14	5.14	41.00	16.59
1971/10/31	25.48	1.74	23.73	13.51
1971/11/30	49.66	3.64	46.02	23.57
1971/12/31	57.84	5.00	52.84	17.45
1972/01/31	46.24	6.28	39.96	12.53
1972/02/29	28.60	3.56	25.04	7.03
1972/03/31	35.86	4.99	30.87	7.95
1972/04/30	43.03	3.93	39.10	3.24
1972/05/31	45.97	8.54	37.42	-0.89
1972/06/30	35.87	17.35	18.52	-1.90
1972/07/31	35.20	17.23	17.97	1.07
1972/08/31	22.47	14.96	7.51	-3.08
1972/09/30	39.21	11.62	27.59	-10.30
1972/10/31	29.96	3.91	26.06	-11.53
1972/11/30	33.46	4.48	28.98	-10.61
1972/12/31	29.78	3.03	26.75	-10.99
1973/01/31	-3.39	2.08	-5.46	-12.37
1973/02/28	-3.55	2.04	-5.59	-11.35
1973/03/31	1.34	-0.99	2.33	-13.37
1973/04/30	-3.17	-2.33	-0.84	-16.28
1973/05/31	5.04	-3.42	8.47	-14.14
1973/06/30	9.75	-4.01	13.76	-14.80
1973/07/31	11.50	-6.83	18.32	-20.69
1973/08/31	10.44	-9.09	19.53	-19.51
1973/09/30	7.26	-14.74	22.00	-23.97
1973/10/31	8.02	-14.40	22.42	-19.43
1973/11/30	9.92	-13.51	23.43	-21.81
1973/12/31	10.95	-1.96	12.91	-14.74
1974/01/31	20.10	-0.63	20.73	-18.49
1974/02/28	22.53	-7.89	30.42	-24.29
1974/03/31	17.82	-12.91	30.73	-23.19
1974/04/30	16.95	-17.49	34.45	-29.35
1974/05/31	15.85	-21.52	37.37	-27.57
1974/06/30	23.86	-18.83	42.69	-24.67
1974/07/31	27.34	-14.94	42.28	-22.51

Formation Date	Loser Portfolio Annualised Return (%)	Winner Portfolio Annualised Return (%)	Arbitrage Portfolio Annualised Return (%)	MRP over 3 year holding period (%)
1974/08/31	29.74	-12.34	42.08	-23.57
1974/09/30	28.16	-13.83	41.98	-21.93
1974/10/31	32.94	-9.94	42.88	-15.96
1974/11/30	31.43	-6.51	37.94	-19.55
1974/12/31	25.93	-7.70	33.63	-17.72
1975/01/31	19.99	-5.16	25.15	-15.03
1975/02/28	18.94	-0.57	19.50	-12.64
1975/03/31	12.49	-4.50	16.99	-16.10
1975/04/30	2.71	-6.27	8.98	-14.99
1975/05/31	2.61	-4.11	6.73	-12.19
1975/06/30	5.23	-12.24	17.48	-12.20
1975/07/31	1.22	-6.29	7.52	-13.32
1975/08/31	3.57	-2.70	6.27	-9.01
1975/09/30	9.45	2.57	6.88	-3.11
1975/10/31	13.31	11.34	1.97	0.01
1975/11/30	15.43	12.83	2.61	1.09
1975/12/31	11.83	6.52	5.30	-2.01
1976/01/31	12.20	11.89	0.32	0.88
1976/02/29	12.74	15.51	-2.77	3.22
1976/03/31	16.86	16.15	0.71	6.29
1976/04/30	18.12	16.68	1.44	7.98
1976/05/31	18.29	19.31	-1.02	5.38
1976/06/30	15.75	19.74	-3.99	6.79
1976/07/31	15.52	16.95	-1.43	9.60
1976/08/31	20.75	16.98	3.77	11.22
1976/09/30	32.46	21.14	11.32	22.72
1976/10/31	35.61	30.78	4.83	24.35
1976/11/30	37.89	29.49	8.40	27.81
1976/12/31	46.02	33.25	12.77	28.64
1977/01/31	54.14	38.28	15.85	32.82
1977/02/28	63.18	40.21	22.97	34.63
1977/03/31	72.71	39.29	33.42	35.61
1977/04/30	70.94	43.28	27.65	34.48
1977/05/31	70.17	46.00	24.16	35.12
1977/06/30	75.05	41.07	33.98	40.78
1977/07/31	86.17	45.18	40.99	45.32
1977/08/31	93.45	48.54	44.91	45.65
1977/09/30	92.22	47.97	44.24	47.17
1977/10/31	96.91	44.40	52.52	48.18
1977/11/30	83.04	45.01	38.03	49.61
1977/12/31	78.64	45.86	32.78	45.22
1978/01/31	75.03	43.63	31.40	38.59

Formation Date	Loser Portfolio Annualised Return (%)	Winner Portfolio Annualised Return (%)	Arbitrage Portfolio Annualised Return (%)	MRP over 3 year holding period (%)
1978/02/28	69.37	43.27	26.10	30.69
1978/03/31	60.01	39.47	20.54	34.59
1978/04/30	73.26	47.65	25.62	37.62
1978/05/31	79.24	45.96	33.28	36.96
1978/06/30	74.97	40.59	34.37	34.45
1978/07/31	68.33	37.95	30.38	25.46
1978/08/31	56.97	32.03	24.94	24.24
1978/09/30	51.10	32.59	18.51	28.02
1978/10/31	56.44	33.86	22.58	27.85
1978/11/30	51.89	37.74	14.16	24.91
1978/12/31	50.17	34.21	15.96	27.29
1979/01/31	54.19	37.02	17.17	22.71
1979/02/28	48.98	34.43	14.56	17.60
1979/03/31	39.30	24.75	14.55	11.87
1979/04/30	31.43	20.19	11.23	6.38
1979/05/31	28.97	23.80	5.17	7.53
1979/06/30	24.22	13.22	11.00	0.99
1979/07/31	22.48	11.10	11.38	-1.23
1979/08/31	23.52	14.83	8.69	3.55
1979/09/30	19.49	19.87	-0.38	4.99
1979/10/31	17.67	18.54	-0.86	4.48
1979/11/30	17.39	20.04	-2.65	3.86
1979/12/31	14.80	17.24	-2.43	4.87
1980/01/31	14.00	18.93	-4.93	3.96
1980/02/29	15.28	19.24	-3.97	7.63
1980/03/31	15.49	21.58	-6.09	-2.36
1980/04/30	16.58	16.22	0.36	1.30
1980/05/31	20.87	21.42	-0.55	4.76
1980/06/30	20.96	20.94	0.02	2.08
1980/07/31	19.25	19.68	-0.42	-1.28
1980/08/31	14.87	17.33	-2.47	-4.27
1980/09/30	16.05	13.55	2.49	-5.83
1980/10/31	12.71	13.56	-0.84	-10.82
1980/11/30	9.82	11.68	-1.85	-16.03
1980/12/31	14.40	10.52	3.88	-10.56
1981/01/31	16.25	15.25	1.00	-6.97
1981/02/28	17.26	22.21	-4.95	-1.61
1981/03/31	22.60	23.25	-0.66	1.48
1981/04/30	22.64	18.76	3.88	-0.60
1981/05/31	21.93	26.29	-4.36	-1.04
1981/06/30	20.06	16.86	3.20	-1.82
1981/07/31	22.01	26.54	-4.53	2.48

Formation Date	Loser Portfolio Annualised Return (%)	Winner Portfolio Annualised Return (%)	Arbitrage Portfolio Annualised Return (%)	MRP over 3 year holding period (%)
1981/08/31	21.73	20.96	0.78	-4.42
1981/09/30	19.97	19.63	0.34	-5.52
1981/10/31	14.84	8.70	6.14	-7.73
1981/11/30	14.48	10.13	4.34	-6.70
1981/12/31	16.39	17.97	-1.58	-3.88
1982/01/31	18.22	16.52	1.70	-5.84
1982/02/28	18.09	11.85	6.24	-6.29
1982/03/31	18.87	9.09	9.78	-3.50
1982/04/30	21.28	18.29	2.99	6.29
1982/05/31	30.18	23.60	6.58	7.14
1982/06/30	31.11	18.87	12.24	12.74
1982/07/31	35.99	31.34	4.65	16.21
1982/08/31	30.08	30.69	-0.61	7.13
1982/09/30	24.11	32.89	-8.78	4.30
1982/10/31	22.09	29.79	-7.70	0.48
1982/11/30	18.39	27.97	-9.59	0.31
1982/12/31	20.80	26.48	-5.68	-0.88
1983/01/31	19.91	23.45	-3.54	-4.87
1983/02/28	17.35	23.64	-6.30	-6.12
1983/03/31	17.17	23.34	-6.17	-0.24
1983/04/30	22.35	25.86	-3.51	0.97
1983/05/31	20.46	20.29	0.18	-5.53
1983/06/30	19.37	14.54	4.83	-5.17
1983/07/31	21.14	12.20	8.94	-3.28
1983/08/31	22.47	11.53	10.94	-0.43
1983/09/30	20.95	12.30	8.65	4.43
1983/10/31	23.49	11.56	11.92	8.74
1983/11/30	27.96	12.72	15.24	13.61
1983/12/31	30.41	14.39	16.02	11.58
1984/01/31	24.79	12.83	11.96	9.15
1984/02/29	27.71	15.91	11.79	13.20
1984/03/31	28.33	15.40	12.93	8.54
1984/04/30	27.18	21.01	6.17	9.41
1984/05/31	29.99	25.70	4.29	12.92
1984/06/30	32.52	26.01	6.51	13.56
1984/07/31	31.11	27.62	3.49	14.56
1984/08/31	44.43	41.62	2.81	25.21
1984/09/30	48.45	41.04	7.41	24.01
1984/10/31	58.68	46.83	11.86	24.67
1984/11/30	46.34	32.39	13.95	11.72
1984/12/31	35.98	22.20	13.78	7.82
1985/01/31	40.30	26.29	14.01	8.20

Formation Date	Loser Portfolio Annualised Return (%)	Winner Portfolio Annualised Return (%)	Arbitrage Portfolio Annualised Return (%)	MRP over 3 year holding period (%)
1985/02/28	36.54	21.72	14.82	4.11
1985/03/31	36.05	20.70	15.35	3.64
1985/04/30	40.92	21.11	19.81	4.22
1985/05/31	36.76	17.12	19.64	0.86
1985/06/30	37.33	15.41	21.92	1.28
1985/07/31	29.71	16.60	13.11	3.48
1985/08/31	35.83	19.87	15.96	6.91
1985/09/30	32.51	17.66	14.85	2.00
1985/10/31	37.05	18.25	18.80	3.92
1985/11/30	34.26	18.41	15.85	5.49
1985/12/31	36.08	21.72	14.36	2.77
1986/01/31	36.17	21.05	15.12	2.75
1986/02/28	44.07	17.75	26.32	3.60
1986/03/31	50.70	17.52	33.18	5.90
1986/04/30	39.64	24.68	14.96	7.95
1986/05/31	44.16	24.88	19.28	11.85
1986/06/30	42.12	20.13	21.99	6.72
1986/07/31	44.20	23.21	20.98	8.03
1986/08/31	40.06	22.54	17.52	5.65
1986/09/30	41.96	23.26	18.69	1.42
1986/10/31	36.94	20.93	16.01	-0.22
1986/11/30	29.40	16.17	13.23	-1.00
1986/12/31	32.69	17.03	15.65	-1.00
1987/01/31	32.41	18.56	13.85	0.57
1987/02/28	28.06	15.36	12.70	0.19
1987/03/31	27.65	12.99	14.66	-0.85
1987/04/30	22.50	10.39	12.10	-0.30
1987/05/31	18.70	6.77	11.93	-6.38
1987/06/30	11.99	5.00	7.00	-4.59
1987/07/31	10.32	7.69	2.62	-6.21
1987/08/31	7.47	2.06	5.41	-10.03
1987/09/30	1.60	-2.71	4.31	-13.12
1987/10/31	-0.34	-5.53	5.19	-16.05
1987/11/30	8.36	-2.04	10.40	-7.86
1987/12/31	10.35	4.29	6.05	-6.95
1988/01/31	15.29	4.47	10.81	-3.42
1988/02/29	13.91	1.32	12.59	-0.37
1988/03/31	16.26	4.90	11.36	4.37
1988/04/30	14.76	6.54	8.22	1.09
1988/05/31	19.03	8.55	10.48	4.88
1988/06/30	20.26	12.45	7.80	4.02
1988/07/31	22.01	14.38	7.63	4.42

Formation Date	Loser Portfolio Annualised Return (%)	Winner Portfolio Annualised Return (%)	Arbitrage Portfolio Annualised Return (%)	MRP over 3 year holding period (%)
1988/08/31	20.26	13.28	6.99	5.22
1988/09/30	21.95	14.61	7.35	5.44
1988/10/31	18.80	14.66	4.14	1.82
1988/11/30	16.73	16.83	-0.09	1.92
1988/12/31	16.96	15.72	1.23	2.17
1989/01/31	14.08	14.93	-0.85	0.38
1989/02/28	12.69	15.54	-2.85	-1.00
1989/03/31	11.02	10.73	0.29	-3.32
1989/04/30	6.35	11.68	-5.32	-7.73
1989/05/31	8.35	9.55	-1.21	-9.59
1989/06/30	9.39	12.24	-2.85	-3.68
1989/07/31	8.06	8.33	-0.27	-7.86
1989/08/31	7.31	5.21	2.10	-10.73
1989/09/30	-1.90	4.44	-6.34	-15.01
1989/10/31	-2.49	4.80	-7.29	-13.98
1989/11/30	-1.65	7.40	-9.04	-15.08
1989/12/31	-0.94	8.12	-9.06	-14.96
1990/01/31	2.70	8.96	-6.26	-15.41
1990/02/28	2.31	12.12	-9.81	-15.82
1990/03/31	-1.70	15.55	-17.25	-14.53
1990/04/30	-2.00	17.17	-19.16	-14.77
1990/05/31	-0.31	18.56	-18.86	-10.36
1990/06/30	0.77	17.77	-17.01	-9.51
1990/07/31	8.75	14.89	-6.14	-7.22
1990/08/31	7.76	18.53	-10.77	-6.99
1990/09/30	13.30	21.51	-8.21	-6.13
1990/10/31	9.73	23.41	-13.68	-5.20
1990/11/30	13.03	23.35	-10.32	-2.49
1990/12/31	14.52	26.62	-12.11	1.06
1991/01/31	25.01	25.26	-0.24	5.94
1991/02/28	29.14	27.01	2.13	7.56
1991/03/31	26.79	23.29	3.50	4.84
1991/04/30	24.51	21.17	3.34	4.80
1991/05/31	29.14	27.10	2.04	6.19
1991/06/30	31.68	32.55	-0.87	5.62
1991/07/31	32.33	31.61	0.73	3.53
1991/08/31	32.12	35.86	-3.74	3.35
1991/09/30	38.30	36.39	1.91	6.44
1991/10/31	41.61	34.19	7.42	6.16
1991/11/30	35.02	40.92	-5.90	4.02
1991/12/31	38.63	38.31	0.32	4.24
1992/01/31	40.63	42.39	-1.77	6.29

Formation Date	Loser Portfolio Annualised Return (%)	Winner Portfolio Annualised Return (%)	Arbitrage Portfolio Annualised Return (%)	MRP over 3 year holding period (%)
1992/02/29	42.78	40.14	2.64	-1.14
1992/03/31	42.75	42.52	0.23	-0.25
1992/04/30	38.78	38.13	0.65	1.33
1992/05/31	43.38	42.13	1.25	3.88
1992/06/30	43.13	34.83	8.30	0.92
1992/07/31	43.45	38.84	4.60	1.40
1992/08/31	45.77	44.53	1.24	4.15
1992/09/30	48.20	39.81	8.39	8.21
1992/10/31	63.61	54.09	9.52	8.39
1992/11/30	50.13	45.70	4.43	11.73
1992/12/31	52.73	37.11	15.62	10.43
1993/01/31	50.31	40.93	9.37	11.18
1993/02/28	51.28	39.89	11.38	13.11
1993/03/31	53.84	47.77	6.08	12.02
1993/04/30	48.94	37.37	11.57	10.66
1993/05/31	47.24	38.64	8.59	10.41
1993/06/30	42.02	29.78	12.24	6.80
1993/07/31	46.25	28.97	17.27	5.84
1993/08/31	42.35	30.11	12.24	3.27
1993/09/30	42.43	27.75	14.68	5.22
1993/10/31	48.53	38.31	10.21	8.83
1993/11/30	52.35	38.38	13.97	7.57
1993/12/31	16.37	12.03	4.33	3.55
1994/01/31	10.45	8.11	2.34	-3.27
1994/02/28	12.30	10.62	1.68	-2.23
1994/03/31	13.60	12.58	1.02	-0.67
1994/04/30	10.70	8.38	2.32	-1.98
1994/05/31	13.27	7.35	5.92	-4.79
1994/06/30	7.75	3.32	4.44	-6.06
1994/07/31	8.96	6.11	2.84	-4.12
1994/08/31	7.56	5.93	1.63	-5.55
1994/09/30	7.67	3.56	4.11	-8.00
1994/10/31	3.37	7.27	-3.90	-8.05
1994/11/30	2.10	5.41	-3.32	-11.64
1994/12/31	-1.93	1.27	-3.21	-13.55
1995/01/31	-1.61	-0.08	-1.53	-14.90
1995/02/28	2.17	3.58	-1.42	-7.48
1995/03/31	5.58	7.56	-1.98	-5.52
1995/04/30	7.83	9.86	-2.03	-3.87
1995/05/31	6.59	12.11	-5.51	-1.84
1995/06/30	6.72	8.99	-2.26	-4.95
1995/07/31	3.34	-0.82	4.15	-8.92

Formation Date	Loser Portfolio Annualised Return (%)	Winner Portfolio Annualised Return (%)	Arbitrage Portfolio Annualised Return (%)	MRP over 3 year holding period (%)
1995/08/31	2.91	-3.23	6.14	-7.39
1995/09/30	-6.51	-10.74	4.22	-20.01
1995/10/31	-7.76	-7.54	-0.22	-19.37
1995/11/30	-3.76	1.52	-5.28	-15.99
1995/12/31	-4.94	8.29	-13.23	-18.03
1996/01/31	-6.66	6.11	-12.78	-20.70
1996/02/29	-5.92	8.39	-14.31	-21.57
1996/03/31	-5.72	1.66	-7.38	-20.05
1996/04/30	-2.87	9.96	-12.83	-18.00
1996/05/31	0.52	9.44	-8.92	-15.76
1996/06/30	-2.41	3.56	-5.96	-17.90
1996/07/31	3.27	9.51	-6.24	-14.86
1996/08/31	0.46	6.97	-6.51	-12.94
1996/09/30	1.05	9.73	-8.68	-14.26
1996/10/31	-0.50	4.72	-5.22	-15.26
1996/11/30	-0.52	12.70	-13.22	-13.87
1996/12/31	3.51	12.36	-8.85	-10.25
1997/01/31	7.50	10.51	-3.01	-5.20
1997/02/28	7.38	12.90	-5.52	-5.69
1997/03/31	4.38	10.38	-6.00	-10.22
1997/04/30	1.25	13.11	-11.86	-9.51
1997/05/31	0.24	2.05	-1.81	-12.11
1997/06/30	-4.65	0.34	-4.98	-11.48
1997/07/31	7.03	7.17	-0.14	-11.48
1997/08/31	3.07	3.85	-0.78	-11.42
1997/09/30	6.84	3.43	3.41	-6.84
1997/10/31	6.66	3.56	3.10	-6.70
1997/11/30	11.87	5.17	6.70	-3.80
1997/12/31	33.53	7.91	25.62	-3.52
1998/01/31	21.31	6.45	14.86	-0.42
1998/02/28	16.95	3.30	13.65	0.71
1998/03/31	30.72	-3.53	34.25	-2.03
1998/04/30	19.19	-13.48	32.67	-7.98
1998/05/31	11.58	-16.60	28.18	-7.74
1998/06/30	17.94	-22.33	40.27	-3.12
1998/07/31	19.25	-13.51	32.77	0.71
1998/08/31	18.99	-19.31	38.30	-3.76
1998/09/30	22.63	-6.09	28.71	12.09
1998/10/31	29.20	-12.65	41.85	6.14
1998/11/30	19.93	-11.97	31.89	3.66
1998/12/31	15.07	-6.53	21.59	9.30
1999/01/31	23.95	-7.17	31.12	15.55

Formation Date	Loser Portfolio Annualised Return (%)	Winner Portfolio Annualised Return (%)	Arbitrage Portfolio Annualised Return (%)	MRP over 3 year holding period (%)
1999/02/28	16.56	-16.85	33.40	12.09
1999/03/31	21.36	-15.78	37.14	13.56
1999/04/30	20.70	-15.14	35.84	11.22
1999/05/31	14.32	-20.51	34.84	6.90
1999/06/30	21.97	-21.38	43.35	11.06
1999/07/31	12.87	-19.28	32.16	5.64
1999/08/31	12.00	-13.94	25.94	-0.27
1999/09/30	10.26	-10.55	20.81	2.36
1999/10/31	11.16	-10.35	21.50	1.82
1999/11/30	16.90	-3.63	20.52	-0.29
1999/12/31	15.79	-6.45	22.23	-1.92
2000/01/31	10.62	-10.90	21.53	-7.31
2000/02/29	8.49	-12.15	20.63	-8.74
2000/03/31	5.36	-11.45	16.81	-8.13
2000/04/30	0.99	-7.79	8.78	-11.39
2000/05/31	4.89	-5.07	9.96	-9.92
2000/06/30	3.82	-0.62	4.44	-5.12
2000/07/31	8.94	-1.28	10.22	-7.94
2000/08/31	14.48	-3.09	17.57	-6.39
2000/09/30	13.17	-1.94	15.11	-8.05
2000/10/31	4.57	-0.85	5.43	-8.32
2000/11/30	11.64	4.81	6.84	-4.66
2000/12/31	12.42	6.45	5.97	-3.22
2001/01/31	9.39	-0.02	9.41	-2.98
2001/02/28	-0.10	-4.01	3.91	-4.63
2001/03/31	1.33	-0.88	2.21	-4.32
2001/04/30	3.71	4.45	-0.75	-1.48
2001/05/31	4.66	2.45	2.22	-5.82
2001/06/30	-0.55	0.16	-0.70	-7.07
2001/07/31	-1.36	2.86	-4.22	-7.35
2001/08/31	-0.26	6.82	-7.08	-4.07
2001/09/30	3.39	5.89	-2.50	-2.93
2001/10/31	12.81	9.83	2.98	2.93
2001/11/30	8.48	11.38	-2.91	0.50
2001/12/31	10.90	0.96	9.94	-0.73
2002/01/31	11.71	10.51	1.20	-4.03
2002/02/28	13.28	10.11	3.17	-3.14
2002/03/31	14.35	4.04	10.31	-3.05
2002/04/30	16.72	10.18	6.54	-3.90
2002/05/31	14.87	-3.14	18.02	-5.80
2002/06/30	13.32	1.59	11.74	-3.00
2002/07/31	19.64	6.51	13.13	-0.13

Formation Date	Loser Portfolio Annualised Return (%)	Winner Portfolio Annualised Return (%)	Arbitrage Portfolio Annualised Return (%)	MRP over 3 year holding period (%)
2002/08/31	28.50	13.03	15.46	7.99
2002/09/30	28.86	8.36	20.50	7.01
2002/10/31	32.94	17.97	14.98	11.64
2002/11/30	35.62	19.09	16.53	11.11
2002/12/31	31.81	14.84	16.97	11.31
2003/01/31	29.76	14.60	15.16	15.85
2003/02/28	39.60	16.86	22.74	22.01
2003/03/31	41.44	23.54	17.90	22.71
2003/04/30	49.27	34.76	14.52	29.82
2003/05/31	48.90	46.62	2.28	32.80
2003/06/30	38.93	32.74	6.18	25.72
2003/07/31	39.50	32.43	7.07	28.47
2003/08/31	35.40	31.94	3.46	25.47
2003/09/30	32.88	31.29	1.59	25.76
2003/10/31	39.50	28.94	10.56	28.20
2003/11/30	35.15	28.45	6.70	26.13
2003/12/31	33.89	28.25	5.64	27.49
2004/01/31	33.12	26.03	7.09	26.35
2004/02/29	31.28	37.92	-6.64	25.35
2004/03/31	33.01	32.75	0.26	25.76
2004/04/30	36.64	38.38	-1.74	29.09
2004/05/31	42.14	45.65	-3.52	31.90
2004/06/30	45.50	47.20	-1.70	32.50
2004/07/31	43.25	45.63	-2.38	33.38
2004/08/31	39.91	39.80	0.10	32.81
2004/09/30	36.20	39.55	-3.35	29.24
2004/10/31	33.42	38.59	-5.18	28.82
2004/11/30	36.34	38.93	-2.59	31.24
2004/12/31	35.26	24.49	10.77	26.49
2005/01/31	33.31	21.23	12.08	23.81
2005/02/28	34.13	16.75	17.39	20.70
2005/03/31	34.82	19.45	15.36	23.39
2005/04/30	33.24	20.34	12.91	22.29
2005/05/31	37.00	22.78	14.22	26.43
2005/06/30	38.68	20.59	18.09	23.71
2005/07/31	29.71	16.39	13.32	20.44
2005/08/31	28.46	7.58	20.87	13.58
2005/09/30	25.32	13.76	11.56	12.69
2005/10/31	17.83	7.78	10.05	3.17
2005/11/30	6.64	5.71	0.93	-0.68
2005/12/31	1.54	5.29	-3.76	-1.19
2006/01/31	2.87	2.95	-0.07	-3.55

Formation Date	Loser Portfolio Annualised Return (%)	Winner Portfolio Annualised Return (%)	Arbitrage Portfolio Annualised Return (%)	MRP over 3 year holding period (%)
2006/02/28	-2.24	-3.43	1.19	-8.24
2006/03/31	-1.71	-2.91	1.20	-10.82
2006/04/30	-2.14	-1.02	-1.13	-9.82
2006/05/31	-5.80	-0.62	-5.17	-10.70
2006/06/30	-0.45	5.42	-5.87	-6.55
2006/07/31	-2.34	1.90	-4.24	-8.79
2006/08/31	-1.06	2.99	-4.05	-4.97
2006/09/30	-1.29	3.05	-4.34	-5.77
2006/10/31	2.01	6.17	-4.16	-6.46
2006/11/30	1.05	1.44	-0.39	-5.96
2006/12/31	-2.67	-1.99	-0.68	-6.14
2007/01/31	-4.02	3.82	-7.83	-6.50
2007/02/28	-2.69	-4.21	1.52	-8.44
2007/03/31	-2.83	-2.48	-0.35	-8.75
2007/04/30	-4.17	-3.56	-0.61	-8.17
2007/05/31	-6.08	-8.17	2.09	-9.36
2007/06/30	-6.55	-8.44	1.89	-11.61
2007/07/31	-5.62	-9.70	4.08	-12.30
2007/08/31	-3.93	1.40	-5.33	-9.96

APPENDIX C - POST 1994 RESULTS

Introduction

Because of the lack of dividend and market capitalization data for the earlier periods under study, dividends had to be excluded from the returns and portfolios weighted equally. This appendix presents the results of the post-1994 results, where this dataset is available, to test if the results are similar.

Empirical Results

Table 7 shows the returns of the arbitrage portfolio for the years after 1994, where market capitalization became available. These results include dividends, and shares are weighted in proportion to their market capitalization in the portfolios. A full set of results is available in Table 11 at the end of the current Appendix. The results are plotted in Figure 12.

Although the numbers differ, the same trends can be identified with negative returns for portfolios formed in 1996 in the build up to the 'dot-com' bubble, and even stronger mean returns for arbitrage portfolios formed in 1998 (34.85%) and 1999 (32.08%).

Table 7: Arbitrage portfolio performance over the period 1994 to study Aug 2007. Dividends included, share weighted.

First Formation Date in Period	Last Formation Date in Period	Mean Annualised Return (%)	Median Annualised Return (%)	Standard Deviation (%)	Maximum Return (%)	Minimum Return (%)
31 Jan 94	31 Dec 94	6.73	8.42	4.45	12.46	-1.28
31 Jan 95	31 Dec 95	1.10	1.98	2.92	4.77	-5.81
31 Jan 96	31 Dec 96	-13.38	-13.78	6.84	1.36	-23.18
31 Jan 97	31 Dec 97	5.87	5.19	14.26	34.87	-11.36
31 Jan 98	31 Dec 98	34.85	35.42	5.01	40.05	23.74
31 Jan 99	31 Dec 99	32.08	37.27	12.19	43.33	4.03
31 Jan 00	31 Dec 00	6.42	5.98	9.38	20.81	-7.46
31 Jan 01	31 Dec 01	-1.32	-1.24	4.92	7.88	-11.24
31 Jan 02	31 Dec 02	8.18	9.43	4.98	15.67	0.25
31 Jan 03	31 Dec 03	3.32	2.38	5.54	12.23	-4.89
31 Jan 04	31 Dec 04	-0.39	-0.73	3.51	6.45	-4.78
31 Jan 05	31 Dec 05	8.52	10.17	6.62	21.05	-1.43
31 Jan 06	31 Dec 06	-1.77	-0.87	2.41	0.80	-6.41
31 Jan 07	31 Aug 07	1.42	0.50	2.43	6.16	-1.19

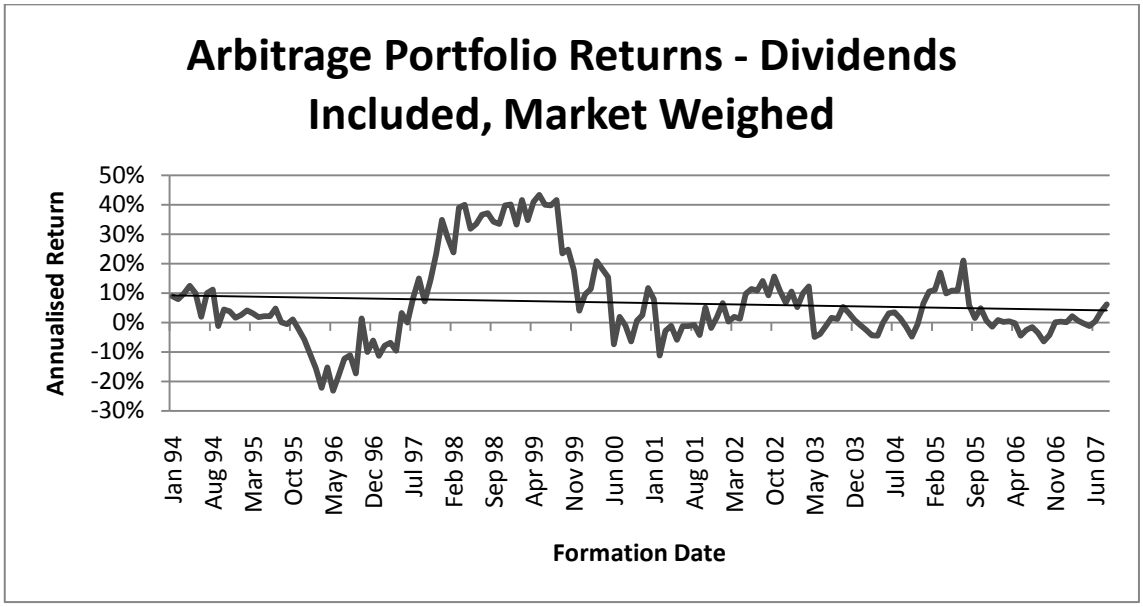


Figure 12: Arbitrage Portfolio Returns - Dividends Included, Market Weighed

Table 8 shows the mean and standard deviation of the arbitrage portfolio over the period where market capitalization is available (post 1994). The mean is positive at 6.67% and a similar standard deviation of 14.16%. The return is significantly higher than 0% with a significance of 0.1%.

Table 8: Mean Return for Arbitrage Portfolio, Dividends Included, Market Weighted

First Formation Date in Period	Last Formation Date in Period	Mean Return	Standard Deviation	Z statistic
31 Jan 94	31 Aug 07	6.67%	14.16%	6.03

Table 9 shows the proportion of positive returns for the arbitrage portfolios after the study when shares are added to the portfolios in proportion to their market weighting and when dividends are included in returns. It can be seen that a portfolio manager who managed his funds purely using the ORH would still have had to explain his underperformance of the market over the previous three years a third of the time.

Table 9: Proportion Positive Returns for Arbitrage Portfolio, Dividends Included, Market Weighted

First Formation Date in Period	Last Formation Date in Period	Proportion Positive Returns	Number of returns	Z statistic
31 Jan 94	31 Aug 07	67.68%	164	40.31

Figure 13 and Figure 14 show a correallation between the returns of the arbitrage portfolio and the MRP when dividends are excluded and market weighted portfolios are used. As was the case previously, the correlation is low but statistically significant with a significance of 1%.

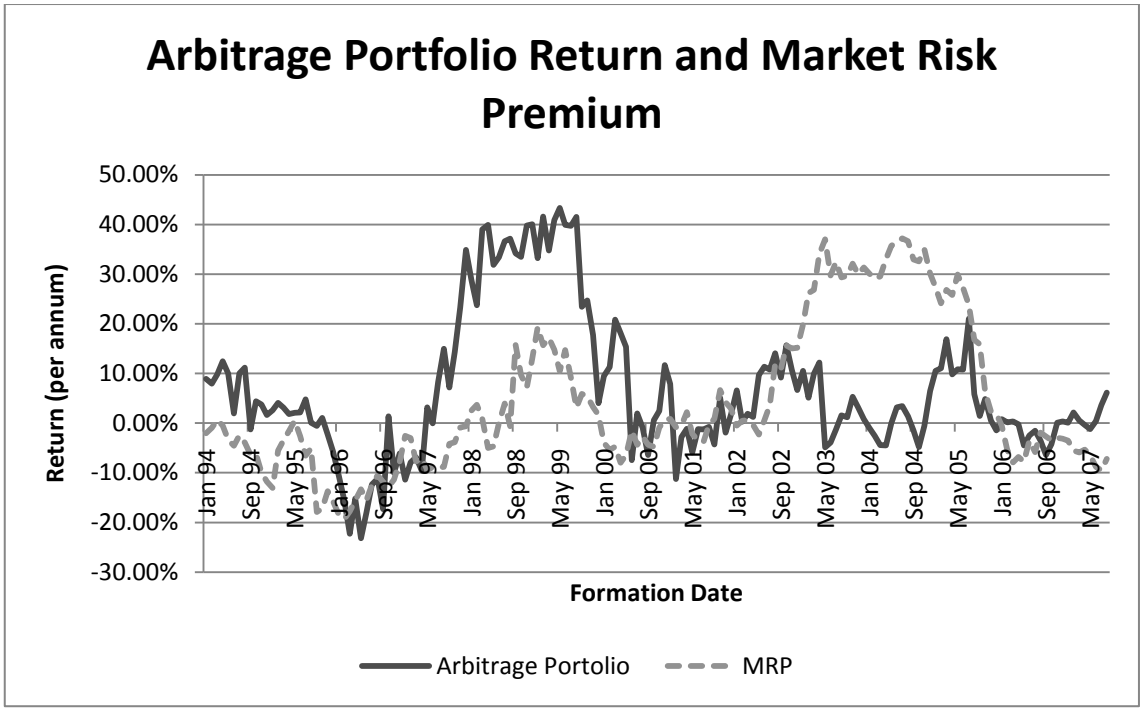


Figure 13: Returns of the Arbitrage Portfolio and the Market Risk Premium, Dividends Included, Market Weighted.

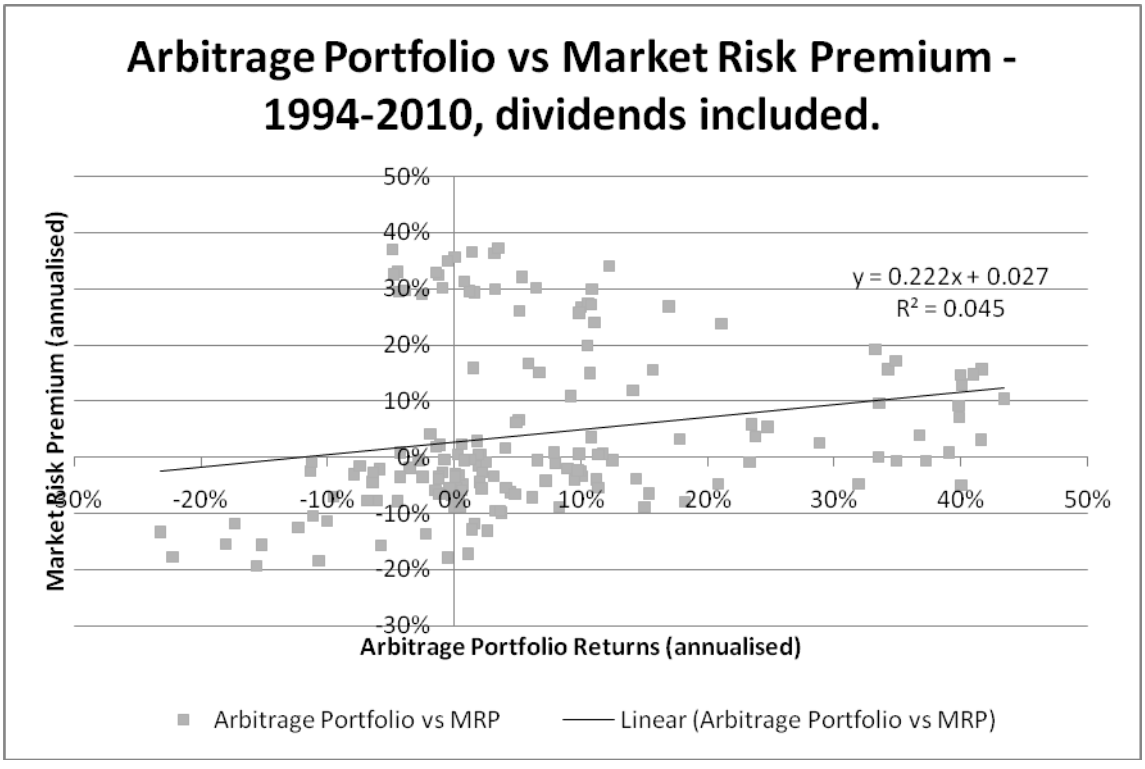


Figure 14: Arbitrage Portfolio vs Market Risk Premium - 1994-2010, Dividends Included

Table 10: Correlation between Returns of the Arbitrage Portfolio and Market Risk Premium, Dividends Included, Market Weighted.

Correlation	Degrees Of Freedom	t-statistic	p
0.21	163	2.76	0.65%

Unfortunately, although market capitalization datasets are available before 1985 it is not possible to test if there is a significant decrease in the returns from the market capitalization.

Conclusion

This appendix shows that for the two hypotheses, for which dividend and market capitalization datasets are available, the results are similar if these are included. The fact that the results are similar gives comfort that the compromises that were made to work with the lack of these datasets is reasonable and did not have an impact on the validity of the research.

Table 11: Returns of the 'Loser', 'Winner' and Arbitrage Portfolios over a 3-year holding period for each formation date. Dividends are included, market weighted portfolios.

Formation Date	'Loser' Portfolio Return over 3 year holding period (%)	'Winner' Portfolio Return over 3 year holding period (%)	Arbitrage Portfolio Return over 3 year holding period (%)	MRP over 3 year holding period (%)
31 Jan 94	18.68	9.77	8.91	-2.03
28 Feb 94	18.90	10.98	7.92	-0.98
31 Mar 94	23.61	13.79	9.81	0.66
30 Apr 94	23.34	10.88	12.46	-0.52
31 May 94	18.47	8.45	10.02	-3.33
30 Jun 94	15.21	13.26	1.95	-4.55
31 Jul 94	17.39	7.41	9.98	-2.47
31 Aug 94	17.28	6.10	11.18	-3.91
30 Sep 94	14.07	15.35	-1.28	-6.34
31 Oct 94	11.17	6.76	4.41	-6.26
30 Nov 94	7.78	4.05	3.73	-9.89
31 Dec 94	4.14	2.53	1.61	-11.77
31 Jan 95	3.15	0.54	2.61	-13.05
28 Feb 95	10.97	6.90	4.07	-5.49
31 Mar 95	11.10	8.00	3.09	-3.43
30 Apr 95	12.60	10.74	1.85	-1.61
31 May 95	15.29	13.19	2.10	0.47
30 Jun 95	11.71	9.53	2.17	-2.64
31 Jul 95	6.50	1.74	4.77	-6.57
31 Aug 95	5.16	5.04	0.12	-5.05
30 Sep 95	-3.29	-2.75	-0.54	-17.90
31 Oct 95	1.78	0.71	1.08	-17.17
30 Nov 95	1.96	4.25	-2.28	-13.69
31 Dec 95	-0.63	5.17	-5.81	-15.78
31 Jan 96	-2.36	8.33	-10.70	-18.48
29 Feb 96	-1.12	14.47	-15.59	-19.32
31 Mar 96	-7.88	14.37	-22.26	-17.75
30 Apr 96	1.42	16.64	-15.22	-15.59
31 May 96	0.56	23.74	-23.18	-13.31
30 Jun 96	-1.87	16.19	-18.06	-15.50
31 Jul 96	1.80	14.13	-12.33	-12.46
31 Aug 96	5.41	16.58	-11.17	-10.50
30 Sep 96	2.82	20.13	-17.31	-11.87
31 Oct 96	18.30	16.94	1.36	-12.82
30 Nov 96	6.21	16.23	-10.02	-11.36
31 Dec 96	7.19	13.31	-6.12	-7.69
31 Jan 97	11.31	22.67	-11.36	-2.53

Formation Date	'Loser' Portfolio Return over 3 year holding period (%)	'Winner' Portfolio Return over 3 year holding period (%)	Arbitrage Portfolio Return over 3 year holding period (%)	MRP over 3 year holding period (%)
28 Feb 97	17.67	25.57	-7.89	-3.04
31 Mar 97	7.08	13.96	-6.88	-7.70
30 Apr 97	6.12	15.68	-9.56	-6.97
31 May 97	8.94	5.75	3.19	-9.48
30 Jun 97	1.64	1.66	-0.02	-8.88
31 Jul 97	12.10	3.81	8.29	-8.93
31 Aug 97	12.57	-2.41	14.98	-8.83
30 Sep 97	7.71	0.52	7.18	-4.14
31 Oct 97	17.45	3.10	14.35	-3.87
30 Nov 97	27.30	4.01	23.29	-0.89
31 Dec 97	40.52	5.65	34.87	-0.64
31 Jan 98	34.30	5.48	28.82	2.55
28 Feb 98	30.24	6.49	23.74	3.70
31 Mar 98	33.60	-5.44	39.04	0.88
30 Apr 98	33.39	-6.56	39.95	-5.00
31 May 98	17.75	-14.11	31.86	-4.71
30 Jun 98	23.90	-9.54	33.44	-0.01
31 Jul 98	29.47	-7.18	36.65	3.96
31 Aug 98	20.41	-16.76	37.16	-0.59
30 Sep 98	28.45	-5.75	34.20	15.73
31 Oct 98	20.53	-12.95	33.48	9.71
30 Nov 98	24.56	-15.24	39.79	7.15
31 Dec 98	27.17	-12.88	40.05	12.95
31 Jan 99	29.10	-4.10	33.20	19.28
28 Feb 99	34.39	-7.19	41.59	15.71
31 Mar 99	26.31	-8.48	34.79	17.15
30 Apr 99	23.39	-17.51	40.91	14.76
31 May 99	26.40	-16.93	43.33	10.47
30 Jun 99	33.67	-6.26	39.93	14.72
31 Jul 99	22.24	-17.51	39.76	9.13
31 Aug 99	30.77	-10.78	41.55	3.10
30 Sep 99	24.20	0.74	23.46	5.89
31 Oct 99	21.36	-3.35	24.70	5.39
30 Nov 99	15.22	-2.53	17.74	3.25
31 Dec 99	11.51	7.48	4.03	1.60
31 Jan 00	11.43	1.93	9.50	-4.00
29 Feb 00	10.35	-0.98	11.33	-5.40
31 Mar 00	18.13	-2.69	20.81	-4.73
30 Apr 00	13.04	-5.11	18.15	-7.98
31 May 00	21.66	6.30	15.36	-6.45

Formation Date	'Loser' Portfolio Return over 3 year holding period (%)	'Winner' Portfolio Return over 3 year holding period (%)	Arbitrage Portfolio Return over 3 year holding period (%)	MRP over 3 year holding period (%)
30 Jun 00	9.79	17.25	-7.46	-1.49
31 Jul 00	9.50	7.53	1.97	-4.38
31 Aug 00	7.42	8.40	-0.98	-2.76
30 Sep 00	5.96	12.41	-6.45	-4.37
31 Oct 00	6.35	5.74	0.62	-4.76
30 Nov 00	8.95	6.48	2.47	-0.88
31 Dec 00	11.48	-0.23	11.72	0.64
31 Jan 01	14.29	6.41	7.88	0.83
28 Feb 01	6.72	17.96	-11.24	-0.80
31 Mar 01	10.10	12.93	-2.83	-0.52
30 Apr 01	15.13	16.29	-1.16	2.22
31 May 01	9.02	14.95	-5.93	-2.15
30 Jun 01	8.45	9.68	-1.23	-3.44
31 Jul 01	8.43	9.69	-1.25	-3.80
31 Aug 01	11.27	12.05	-0.78	-0.38
30 Sep 01	13.04	17.34	-4.31	0.84
31 Oct 01	22.49	17.41	5.08	6.69
30 Nov 01	22.00	23.90	-1.90	4.23
31 Dec 01	20.91	19.13	1.78	2.94
31 Jan 02	18.05	11.48	6.57	-0.48
28 Feb 02	11.68	11.42	0.25	0.47
31 Mar 02	12.61	10.70	1.91	0.58
30 Apr 02	13.83	12.61	1.22	-0.36
31 May 02	13.24	3.53	9.71	-2.33
30 Jun 02	17.25	5.91	11.34	0.56
31 Jul 02	19.18	8.38	10.80	3.58
31 Aug 02	29.89	15.81	14.09	11.96
30 Sep 02	26.48	17.32	9.16	10.91
31 Oct 02	33.68	18.01	15.67	15.60
30 Nov 02	32.99	22.29	10.70	15.01
31 Dec 02	30.97	24.28	6.69	15.18
31 Jan 03	38.36	27.85	10.51	19.85
28 Feb 03	42.31	37.18	5.14	26.16
31 Mar 03	44.18	34.22	9.96	26.84
30 Apr 03	53.59	41.36	12.23	34.05
31 May 03	45.45	50.34	-4.89	37.02
30 Jun 03	36.94	40.87	-3.93	29.72
31 Jul 03	39.15	40.43	-1.28	32.47
31 Aug 03	37.60	36.02	1.58	29.38
30 Sep 03	40.91	39.71	1.20	29.65

Formation Date	'Loser' Portfolio Return over 3 year holding period (%)	'Winner' Portfolio Return over 3 year holding period (%)	Arbitrage Portfolio Return over 3 year holding period (%)	MRP over 3 year holding period (%)
31 Oct 03	40.79	35.49	5.30	32.15
30 Nov 03	40.38	37.21	3.17	29.98
31 Dec 03	36.55	35.75	0.80	31.34
31 Jan 04	38.65	39.57	-0.92	30.15
29 Feb 04	36.73	39.27	-2.54	29.08
31 Mar 04	35.36	39.76	-4.40	29.54
30 Apr 04	36.98	41.47	-4.48	33.03
31 May 04	43.21	43.21	0.00	35.75
30 Jun 04	44.15	40.99	3.16	36.41
31 Jul 04	46.42	42.96	3.46	37.25
31 Aug 04	39.90	38.52	1.38	36.64
30 Sep 04	33.75	35.19	-1.44	32.94
31 Oct 04	35.79	40.57	-4.78	32.56
30 Nov 04	40.95	41.48	-0.53	35.00
31 Dec 04	35.78	29.33	6.45	30.14
31 Jan 05	35.98	25.45	10.53	27.37
28 Feb 05	31.84	20.79	11.05	24.11
31 Mar 05	39.48	22.59	16.89	26.87
30 Apr 05	32.48	22.66	9.82	25.78
31 May 05	37.91	27.07	10.83	29.95
30 Jun 05	34.64	23.83	10.81	27.21
31 Jul 05	40.34	19.29	21.05	23.79
31 Aug 05	27.06	21.25	5.81	16.76
30 Sep 05	22.10	20.64	1.45	15.89
31 Oct 05	18.86	14.00	4.86	6.27
30 Nov 05	11.06	10.50	0.56	2.34
31 Dec 05	10.51	11.94	-1.43	1.88
31 Jan 06	11.15	10.35	0.80	-0.55
28 Feb 06	5.28	5.10	0.17	-5.37
31 Mar 06	3.52	3.16	0.36	-7.93
30 Apr 06	4.40	4.64	-0.24	-6.82
31 May 06	-0.47	4.01	-4.48	-7.79
30 Jun 06	6.33	8.83	-2.50	-3.51
31 Jul 06	5.69	7.20	-1.51	-5.81
31 Aug 06	7.93	11.47	-3.54	-1.92
30 Sep 06	5.45	11.85	-6.41	-2.71
31 Oct 06	8.38	12.64	-4.26	-3.45
30 Nov 06	9.57	9.49	0.08	-2.95
31 Dec 06	6.84	6.53	0.31	-3.12
31 Jan 07	6.18	6.12	0.05	-3.52

Formation Date	'Loser' Portfolio Return over 3 year holding period (%)	'Winner' Portfolio Return over 3 year holding period (%)	Arbitrage Portfolio Return over 3 year holding period (%)	MRP over 3 year holding period (%)
28 Feb 07	4.72	2.59	2.13	-5.52
31 Mar 07	5.20	4.64	0.56	-5.88
30 Apr 07	5.33	5.73	-0.40	-5.35
31 May 07	3.99	5.19	-1.19	-6.51
30 Jun 07	-1.69	-2.13	0.43	-8.84
31 Jul 07	1.02	-2.61	3.63	-9.54
31 Aug 07	7.23	1.07	6.16	-7.17

APPENDIX D - CONSISTENCY MATRIX

A consistency matrix to indicate the consistency of the research questions to the methodology used is shown on the next page.

Table 12: Consistency matrix

Is investor overreaction persistent on the JSE?					
Sub-problem	**Literature Review**	**Hypotheses or Propositions or Research questions**	**Source of data**	**Type of data**	**Analysis**
The first sub problem is to investigate whether investor overreaction on the JSE is consistent over the period under review.	De Bondt and Thaler 1985 De Bondt and Thaler 1987 Muller 1998 Muller 1999	*H_0: An arbitrage portfolio formed by buying 'loser'" stocks and selling 'winner' stocks does not produce excess returns over 99% of rolling 3 year periods.* *H_a: An arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks produces excess returns over 99% of rolling 3 year periods.*	Monthly closing prices and market capitalization of shares on the JSE from June 1968 to July 2010.	Ordinal data, although once monthly returns are calculated, it becomes ratio data	Test to see whether a rolling 3 year return of an arbitrage portfolio formed by buying 'losers' and selling 'winners' remain positive.

Is investor overreaction persistent on the JSE?					
Sub-problem	**Literature Review**	**Hypotheses or Propositions or Research questions**	**Source of data**	**Type of data**	**Analysis**
The second sub problem is to investigate whether there is a trend towards a lower effect of overreaction on the JSE over time.	De Bondt and Thaler 1985 De Bondt and Thaler 1987 Muller 1998 Muller 1999 Connolly 2009 Chen and Sauer 1997	*H_0: An arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks will not produce lower returns in the latter part of the period under study than in the earlier part of the study.* *H_a: An arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks will produce lower returns in the latter part of the period under study than in the earlier part of the study.*	Monthly closing prices and market capitalization of shares on the JSE from June 1968 to July 2010.	Ordinal data, although once monthly returns are calculated, it becomes ratio data	Test if the return of arbitrage portfolio is significantly lower in the latter part of the period under study.

Is investor overreaction persistent on the JSE?					
Sub-problem	**Literature Review**	**Hypotheses or Propositions or Research questions**	**Source of data**	**Type of data**	**Analysis**
The third sub problem is to investigate whether any variation in overreaction strength can be attributed to market cycle as represented by the equity premium.	De Bondt and Thaler 1985 De Bondt and Thaler 1987 Muller 1998 Muller 1999 Connolly 2009 Chen and Sauer 1997	*H_0: The returns of an arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks are not correlated with the equity premium.* *H_a: The returns of an arbitrage portfolio formed by buying 'loser' stocks and selling 'winner' stocks are correlated with the equity premium.*	Monthly closing prices and market capitalization of shares on the JSE from June 1968 to July 2010. Monthly STeFI index since inception replaced by the Alexander Forbes Money Market Index before this. Monthly All Share Index (CI01) from June 1968 to June 1995 and FTSE All Share Index June 1995 to July 2010.	Ordinal data, although once monthly returns are calculated, it becomes ratio data	Test the correlation between the arbitrage portfolio and the equity premium.