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Panagiotis Andrikopoulos
De Montfort University, Pandrikopoulos@dmu.ac.uk

Daynes Arief
University of Portsmouth, Arief.Daynes@port.ac.uk

Paraskevas Pagas
Universityof Portsmouth, paraskevas.pagas@port.ac.uk

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THE TIME-VARYING NATURE OF THE OVERREACTION EFFECT: EVIDENCE FROM THE UK

Panagiotis Andrikopoulos, Arief Daynes and Paraskevas Pagas
De Montfort University, University of Portsmouth and University of Portsmouth, United Kingdom

Abstract

Previous studies on the overreaction effect in the UK show that prior losers consistently outperform prior winners in the period 1975 to 1990. This paper extends current knowledge by assessing the above phenomenon in the UK market for the period 1987 to 2007. In contrast to earlier research, we produce evidence of a weak presence of the overreaction effect for the latest test period. Further, we show that, after adjusting for size, the overreaction effect almost disappears and any additional excess post-formation return to prior-losers is attributable to market cycles. This study implies that the presence of the overreaction effect in the UK stock market is time-varying and difficult to exploit in practice.

Keywords: Overreaction, Stock market efficiency, Small-size effect, Time-variation, Behavioral finance
JEL classification: G14, G32

1. Introduction

This study is on the overreaction hypothesis in the United Kingdom (UK). One of the central hypotheses of behavioral finance is that stock prices systematically overreact. In their seminal study, De Bondt and Thaler (1985) show that stocks that have earned the highest positive abnormal returns during the pre-formation period tend to exhibit negative abnormal returns during the post-formation period and vice versa. Moreover, it is further reported that stocks that have overreacted the most - that is where the pre-formation period is longer and, hence, where the abnormal returns are more extreme - tend to exhibit a correspondingly greater correction during the post-formation period. The overreaction hypothesis is further corroborated in a follow up

paper (De Bondt and Thaler, 1987), in which the authors conclude that the overreaction phenomenon persists even after controlling for size and risk.

Such findings pose significant questions on the validity of the efficient markets (EMH) paradigm. If consistent mispricing phenomena such as those supported by De Bondt and Thaler (1985: 1987) do exist, market participants can devise profitable trading rules resulting in consistent above-average profits thereby violating EMH's key assumption of investors' rationality. It poses questions regarding the extent to which the stochastic process of securities' market pricing may indeed represent a fair game.

Four main hypotheses have been advanced in the now larger and controversial literature on the above hypothesis. The first of these is the behavioral explanation given originally by De Bondt and Thaler (1985) namely that investors fail to act as ideal Bayesian decision-makers, systematically overreacting to recent events such as companies' earnings announcements and under-reacting to prior information. Analytically, in their study of stock price reversals in the United States (US) market for the period 1926 to 1982, De Bondt and Thaler (1985) report a difference in the cumulative average residuals between extreme prior losing and extreme prior winning securities of approximately 25 percent (24.6 percent, t-statistic of 2.20). These economically significant excess returns for prior losers are found to be persistent even after controlling for size effect and changes in the systematic risk element for prior losers (De Bondt and Thaler, 1987) indicating a consistency with the behavioral hypothesis of investor overreaction. This hypothesis was further corroborated by subsequent studies in the US and abroad (Dissanaike, 1997; 2002; Dreman and Lufkin, 2000; Nam, Pyun and Avard, 2001).

The remaining three explanations come from within the efficient markets paradigm. The first of these is that the overreaction effect is encompassed by already existing anomalies and in particular the size and seasonal effects (Zarowin, 1990; Grinblatt and Moskowitz, 1999).[1] By replicating the De Bondt and Thaler (1985) results with appropriate adjustments for risk and seasonal effects, Zarowin (1990) shows that the mean reversion phenomenon is not due to investors' overreaction but

[1] This is classified as an explanation within the efficient markets framework since the small firm and seasonal effects are often regarded as temporary anomalies within the wider EMH research programme.

rather due to size discrepancies between winners and losers. As the author concludes (Zarowin, 1990 p.130) "…the winner vs. loser phenomenon found by De Bondt and Thaler appears to be another manifestation of the size phenomenon in finance". This plausible relationship between the overreaction hypothesis and its size/seasonal explanation is also corroborated by Clare and Thomas (1995) in their study of the UK market.

The second explanation focuses on the relationship between the reported overreaction premium and the time-varying risk characteristics for losing and winning portfolios (Ball and Kothari, 1989). In detail, as Ball and Kothari (1989) show, on an aggregate level 97.4 percent of the variation in pre-formation and post-formation returns can be explained by analogous changes in the systematic risk component of such portfolios proxied by beta. This hypothesis was further corroborated by Chen and Sauer (1997). In their study on the overreaction effect in the US for the period 1926 to 1992, the authors show that the winner-loser relationship is vastly inconsistent over their selected four time-regimes (a) pre-war period, b) 1940s-1950s c) pre-energy-crisis d) post-energy-crisis) while the overall effect appears to be non-stationary and mostly related to alternative market cycles. As the authors conclude (Chen and Sauer, 1997, p.63) "…during economic downturns, losers go down faster and deeper than winners. On the other hand, losers go up faster than winners during economic upturns. During periods of economic stability, losers perform just as well as winners and there are little abnormal profits for the arbitrage portfolio". [2]

This non-stationary nature of the overreaction effect poses an important challenge to the applied aspect of any strategy aiming to exploit such an effect. An arbitrage portfolio consisting of buying past losers and shorting past winners is unlikely to be exploitable and, in particular, might even result in zero or negative abnormal returns for extended periods of years or even longer. In addition, in line with the efficient markets paradigm, the observation of an apparent anomaly in one time period might have little predictive power for either its persistence or reversal in a subsequent period as subsequent empirical evidence suggests that the market over

[2] In Chen and Sauer's (1997) study, the arbitrage portfolio returns are defined as the return differential between a long position in the extreme loser portfolio and a short position in the extreme winner portfolio.

extended periods under-reacts as often as it overreacts (Fama, 1998). This is especially valid in the case of the overreaction effect due to its link with the size/calendar anomaly whose time-varying nature is documented in prior research (Dimson and Marsh, 1999; Andrikopoulos *et al*., 2008).

Contrary to these studies, subsequent research on the overreaction effect in the US and abroad failed to corroborate the relationship between size/seasonal effects and time-varying risk with the winner-loser mean reversion hypothesis. In their study on the US market Chopra *et al*. (1992) provide evidence of an economically significant overreaction effect of approximately 5 percent per year even after controlling for size and risk. In addition, as the authors documented, the effect appears to be asymmetric amongst larger and smaller companies with extreme winner and loser deciles suggesting that the underlying effect could be caused by the difference in the investment patterns between individual and institutional investors (Chopra *et al*., 1992 p.262). These results were further corroborated by Dissanaike (2002, p.152) who suggests that "…the size and winner-loser effects are not completely independent of each other, but there is no evidence to suggest that the size effect subsumes the winner-loser effect".

The third and last main explanation is that the overreaction effect is, at least to some extent, spurious, and is caused by bias in the data or in the methods used in computing returns. Survivorship bias in the data may create a spurious overreaction effect by excluding bankrupt stocks, but may also understate a genuine overreaction effect by excluding takeover premiums on acquired companies not contained in the data set (Dissanaike, 1997). In addition, computing returns by summing monthly abnormal returns causes an upward bias in the post-formation returns of past losers (Conrad and Kaul, 1993) while an apparent anomaly may also be created by data mining or methodology mining (Fama, 1991).

It is noted, however, that the criticism of survivorship bias has little force for most US studies, since the CRSP returns data is generally regarded as being free from survivorship bias and any weaknesses and/or omissions from the CRSP returns data appear to have little impact on the results or main conclusions. Moreover, as Boynton and Oppenheimer (2006) show for the US market, even after correcting for both survivorship and micro-structure distortions from the bid-ask bounce biases,

past-losers outperform past-winners by an average annual return of 8.3 percent during the sample-period 1926 to 2002. However, what is most interesting in this most recent study on the US market is that contrarian strategies appear to have a neutral performance in more recent years (Boynton and Oppenheimer, 2006, pp.2626-2627) indicating that the overreaction effect may have gone into reverse.

The rest of the paper deals with the UK scenario as this study is about overreaction in the UK. The next section is a brief review of the findings from the UK market. Data and computation issues are described in section 3 and the findings are then presented and discussed in sections 4 and 5: the latter section is about adjusting the results for size effect. Finally, this paper concludes in section 6 with a summary of the main findings and their empirical implications.

2. The Overreaction Effect in the UK

A similar picture of the persistence of the overreaction effect has been also documented in the UK using out-of-sample data. Using a data set covering the period 1955 to 1990, Clare and Thomas (1995) report an annual out-performance of 1.7 percent for portfolios consisting of prior losers compared to that of prior winners. According to statistical evidence reported in Table 1 in this paper, the performance reported in Clare and Thomas' (1995) study is supportive of most prior findings for the US market, with a strong momentum for the short-term period following portfolio formation and a reversal afterwards (De Bondt and Thaler, 1985; 1987). Nonetheless, this effect becomes marginal and statistically insignificant after controlling for size.

Hence, their conclusion is similar to that of Zarowin (1990) that the overreaction effect is just another manifestation of the size effect. These results were corroborated by Campbell and Limmack (1997). Using a dataset covering the period 1979 to 1990, the authors provide evidence of a strong momentum effect in the first twelve months following portfolio formation and subsequently an economically and statistically significant reversal in the fortunes of prior losers for a period of up to five years (Campbell and Limmack, 1997, p. 544). In addition, as their results suggest, the reversal documented was restricted only to the smallest 'loser'

companies indicating that this evident long-term overreaction is asymmetric and could be explained by the tax-loss selling hypothesis. These findings were further confirmed by George and Hwang (2007) in their study of the Hong-Kong market.

Subsequent studies of the overreaction effect in the UK appear to provide an alternative picture. The studies of Dissanaike (1997; 2002) are of particular value in that it is substantially free from the biases discussed earlier for the US studies. The research is based on a data set constructed by the author that appears to be free from survivorship and look-ahead biases. In addition, the buy and hold returns metric is used to avoid upward bias in the post-formation returns of past loser stocks, as documented in Conrad and Kaul (1993), while restricting the data set to large and liquid stocks within the FTSE500 Index minimised the impact induced by bid-ask spreads and infrequent trading. As the overreaction hypothesis has mostly been studied in the US context, Dissanaike (1997) also addresses the problem of data-snooping bias by carrying out tests on out-of-sample UK data.

Table 1: Prior findings on the overreaction effect in the UK (*W-L%*)

Study	***Date***	***Meth/logy***	***Sample Period***	***t+1 to t+12 (W-L%)***	***t+1 to t+24 (W-L%)***	***t+1 to t+36 (W-L%)***	***t+1 to t+48 (W-L%)***	***t+1 to t+60(W -L%)***
Clare and Thomas	1995	$CAR^{q,\#}$	1955-1990	+0.37	-1.68**	-1.57*	-	-
-//-	-//-	$CAR^{q,\#,sa}$	1955-1990	+0.57	-1.13***	-0.83	-	-
Campbell and Limmack	1997	$CAR^{d,\#}$	1979-1990	+10.07***	-	-4.44	-	-9.35*
-//-	-//-	$CAR^{d,sa}$	-//-	+11.11***	-	-0.69	-	+0.20
Dissanaike	1997	$BHAR^{d}$	1979-1988	-0.05~,c	-0.09~	-0.31~	-0.99~	-

Notes: This table provides a summary of prior literature on the overreaction hypothesis in the UK. All results are based on equally weighted portfolios of prior 'losers' and 'winners'. Campbell and Limmack's (1997) study uses as a sample the complete universe of the Risk Measurement Service compiled by London Business School. The study of Clare and Thomas (1995) is based on a random selection of 1000 securities in each calendar year and for all years under examination. W stands for 'winners' and L stands for 'losers'.

The coding system used for the description of the adopted methodologies is as follows: *BHAR*-Buy and Hold Abnormal Returns; *CAR*-Cumulative Abnormal Returns; *q* – based on quintiles; # – abnormal returns based on CAPM; d- deciles; ~ - aggregate t-statistic not provided by the author; c – aggregate results based on a 48 month pre-formation period. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

The main conclusion of this study is that the overreaction effect existed in the UK market for the period 1979 to 1988, thus validating prior evidence that the effect is both economically and statistically significant. In a follow-up paper the author also provided evidence to show that the overall overreaction effect, although not independent of the size effect, is not subsumed under the latter, results that are difficult to reconcile with the joint market efficiency and CAPM hypothesis (Dissanaike, 2002).

This paper reports the findings of a study to extend our current knowledge on the overreaction effect in the UK market by assessing Chen and Sauer's (1997) hypothesis that the overall effect is associated with alternative market cycles and more specifically that prior losers' abnormal performance is mostly triggered during periods of economic recovery. Following this initial hypothesis, the study also addresses the relationship between the overreaction and size effects. As recent evidence suggests, the small size effect in the UK appears to be non-stationary in the post-1990 period and highly sensitive to the return measurement methodology adopted (Dimson and Marsh, 1999; Andrikopoulos *et al*., 2008). Hence, under all prior findings that the overreaction and small-size effects are interrelated, we would expect a similar reversal in the performance for the latter in the post-1990 period.

Compared to prior overreaction studies in the UK that were restricted by limited samples or used an FTSE500 data set and covered periods only up to 1990, this study examines the presence of overreaction in the UK market using a bias-free dataset comprised of the entire universe of securities in the official listing of the London Stock Exchange for the entire period 1987 to 2007. As the data set used here is different from and was constructed independently of those used in all previous studies, it can provide further evidence on the effect in the UK limiting possible data snooping bias that may have been present in prior studies using almost identical data sets and covering similar periods.

Previewing the main results and conclusions, this paper finds weak evidence for the overreaction hypothesis for the UK market for the 1987 to 2007 period. Considering that this paper and Dissanaike's (1997; 2002) studies control for the main sources of bias discussed in the literature, the overall conclusion is that a genuine overreaction effect exist in the UK from 1975 to the late 1980s and

weakened subsequently. This is consistent with the claim that the overreaction premium is compensation for time-varying risk and with the arguments of Fama (1991; 1998), that many anomalies can be merely the result of data mining and that regularities observed in one period are equally likely to persist or reverse in subsequent periods.

3. Data and Return Computation

3.1 The Data

Compared to prior UK studies on the overreaction effect that used the London Share Price Database as the main source of data for dataset selection (Clare and Thomas, 1995; Campbell and Limmack, 1997; Dissanaike, 1997; 2002), our data set is obtained from the combination of two alternative sources. Most of our out-of-sample data are obtained from UK Equity Data (UKED).[3] This data set comprises of the entire universe of UK securities that have been fully listed on the London Stock Exchange at any time during the period July 1987 to March 2004, excluding investment companies and investment trusts. The data selected are free from survivorship bias and look-ahead bias. For each company, data are given for the entire period covered by the file, not merely for the period when the company was fully listed.

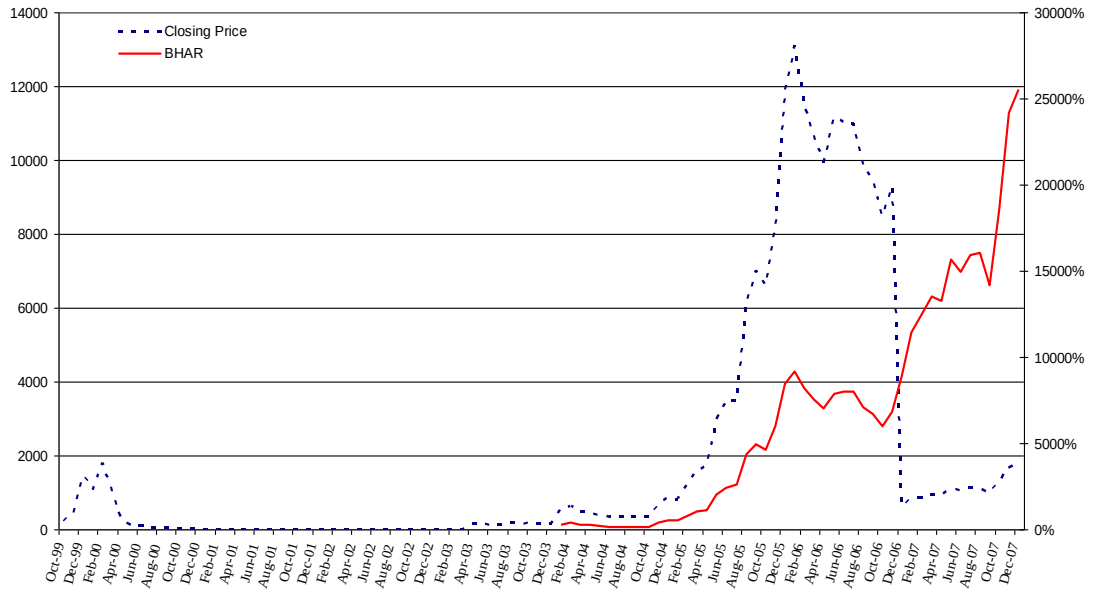
The data files used in the present study are the total returns file and the market-listing file. UKED's total returns file gives monthly returns for each stock, adjusted for dividends, capital changes, mergers and acquisitions and other events impacting upon the computation of monthly total returns and covers the twenty-two year period April 1982 to April 2004. The market listing file also covers the same period and contains for each month the end-of-month market listing and trading status for each stock. As the present study covers the period January 1987 to December 2007, all December 1986 to July 1987 and post-April 2004 market listings and returns data were obtained from the London Share Price Database (LSPD) currently maintained and updated by London Business School.

[3] A detailed discussion of the characteristics of the UKED is presented in Andrikopoulos *et al*. (2008).

To avoid any errors in the reconciliation of the data, all securities were matched manually using SEDOL numbers and official company names and the entire universe of stocks was further re-validated by a cross examination of all post-2004 securities against the Lehmann Communications Company Guide and Pinsents Company Guide for accuracy and re-confirmation of their listing status. In total, for the period December 1986 to December 2006, when the last portfolio was formed, there were 3063 securities officially listed shares on London's main market.

From this data set, 235 securities were excluded as they were either associated with non-ordinary securities and/or those shares that were found to be suspended, de-listed or traded under Rule 535.2, Rule 4.2(a) or Rule 163(2) at each of the portfolio formation dates.

Figure 1: QXL Ricardo Stock Price and BHARs Series



Notes: This figure illustrates closing prices and buy-and-hold returns of QXL Ricardo Plc for the period October 1999 to December 2007. Buy-and-hold abnormal returns for QXL Ricardo Plc are estimated as $BHAR_{QXL,k=48} = \left[\prod_{t=1}^{k=48}\left(1+r_{QXL,t}\right)-1\right]-\left[\prod_{t=1}^{k=48}\left(1+r_{FTSEAll,t}\right)-1\right]$ where *k* refers to the holding period of *k=48* months taking a long position on the 1st of January 2004 and selling the stock on 31December 2007. All stock closing prices and returns for the company are obtained from the London Share Price Database *(LSPD)* maintained and updated by London Business School. Returns on the FTSE All-Share index are obtained from Thomson's Datastream International. The large decrease in the company's share price in December 2006 was caused by a 20-for-1 stock split. All returns are adjusted for dividend payments and capital changes.

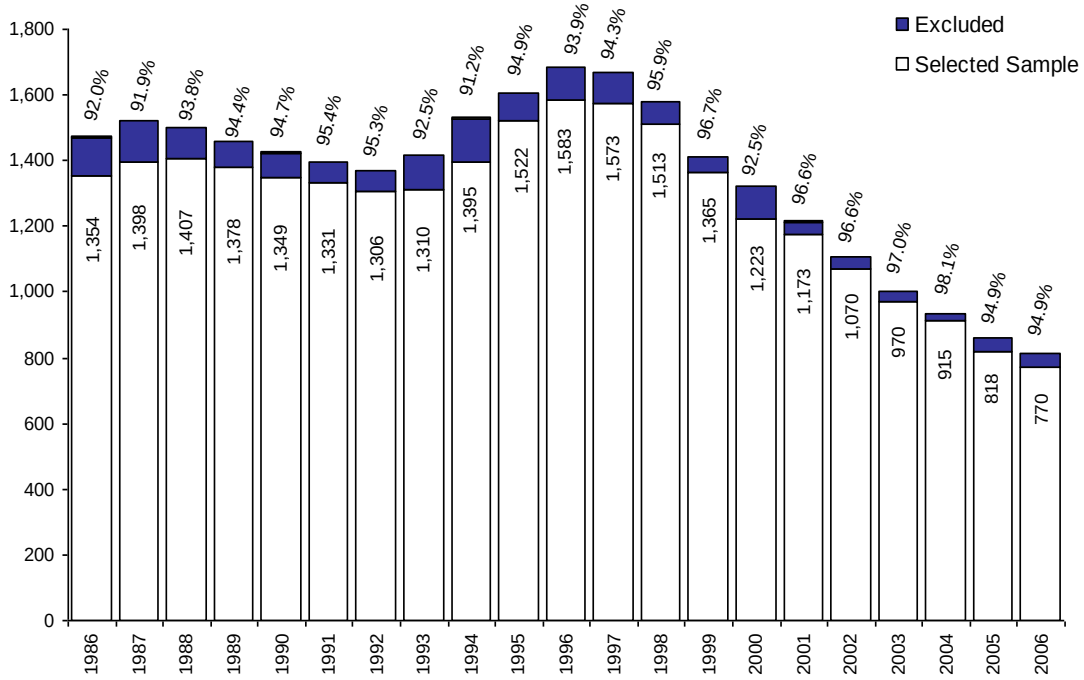
In addition, further examination of the properties of the dataset lead us to exclude one particular security, QXL Ricardo Plc. Our rationale for such a decision

was the unique performance of this company mostly caused by the enormous amount of speculative trading associated with this stock during the period 2004-2005, mostly a result of ongoing speculation regarding the solvency of the business and a potential takeover bid fed by the continuous increase in the equity holdings in the business of two competing investment banks.

As Figure 1 illustrates, including this company in any of our stock portfolios would misrepresent its true return properties as a long position in this security starting on the 1 January 2004 and held up to the end of the examined period would have yielded a unique outlier return of 25,513 percent.

Our final sample comprises of 2,827 securities representing 92.30 percent of the entire universe of fully-listed securities. Figure 2 illustrates the distribution of the selected sample over the period under examination.

Figure 2: Sample selection and official listing coverage.



Notes: This figure summarises the distribution of the selected sample. From a total universe of 3063 securities officially listed on London's main market during the period December 1986 to December 2006, we exclude 235 securities as they were either associated with non-ordinary securities and/or those shares that were found to be suspended, de-listed or traded under Rule 535.2, Rule 4.2(a) or Rule 163(2) during each of the portfolio formation dates. The final sample comprises of 2827 securities *(after excluding QXL Ricardo Plc)*, representing 92.30% of the entire universe of fully-listed securities.

The largest number of stocks included in a portfolio formation is reported for December 1986 with 1583 securities actively traded. Nonetheless, the highest

percentage of coverage is reported for December 2004 with 98.1 percent of all actively-traded officially-listed securities included in the study.

What is most interesting from these statistics is the falling trend of UK-registered companies listed on London's main market in the post-1999 period. The inflation of the dot.com bubble in the middle of 1998 led to an increasing preference for companies in this newly established sector to become listed on AIM rather than on the main market. Nonetheless, following the bursting of the bubble, the trend did not reverse resulting in a number of UK companies remaining in the main market consistently falling from 1,578 securities listed in December 1998 to 811 in December 2006.[4]

3.2 The Buy-and-Hold Abnormal Returns Model

Because of the impact on the results produced from alternative return measurement methodologies and to allow comparison with prior research in the UK, this study uses two methods for computing returns. The first of these two, BHARs, is the methodology recommended in Conrad and Kaul (1993) and adopted in the studies of Dissanaike (1997; 2002). In addition, due to the reduced transaction costs associated with such an investment strategy, its use especially within a UK perspective is more realistic in practical terms.[5] Analytically, at the end of each calendar year all securities that were actively traded in the official listing of the UK market were sorted on the basis of their performance for the period of k=12,24,…,60 months prior to portfolio formation, with each k-month period referring to an alternative holding time-interval.

Using the Market Listing file of UKED, we identified all stocks that were fully listed and trading in the market at the end of each calendar year and for which UKED reported a monthly return for each of the k-month periods. For example, for the k=48 months in December 1986, only those securities that reported a return for the entire period January 1983 to December 1986 were selected. The only exception is the k=60 months strategy for the December 1986 formation, where pre-formation

[4] These numbers include only UK registered companies. Since 2001, the London Stock Exchange's main market has attracted a large number of foreign companies, while UK registered companies have preferred to list on AIM where listing criteria can be met more easily and an initial listing is more cost-effective.

BHARs are based on 57 observations, that is, starting in April 1982. The buy-and-hold returns for each stock with monthly compounding were calculated as:

$$BHR_{i,k} = \prod_{t=1}^{k}\left[\left(1 + r_{i,t}\right)\right] - 1 \quad (1)$$

where, $BHR_{i,k}$ is the buy-and-hold return for security *i* for a holding period of k = 12, 24,…,60 months and, $r_{i,t}$ is the raw return on security *i* in month *t*.

Using the k=12,24,36,48 and 60 months pre-formation *BHRs*, all stocks were then sorted into equally-weighted deciles, with the number of stocks in each decile differing by up to one stock and ranked from highest to lowest k-month pre-formation return. Decile one (d1) is therefore the ten percent of stocks with the highest k-month pre-formation *BHRs*, with decile ten (d10) containing the ten percent of stocks with the lowest k-month pre-formation performance. For each stock, post-formation buy-and-hold returns were computed using the return-estimation methodology in (1) for all alternative k=12, 24,…,60 months holding periods. Post-formation returns for each of the ten decile-portfolios were then estimated as the simple average of the returns computed for each stock in each decile.[6] This is algebraically formulated as

$$BHR_{p,k} = \frac{1}{n}\sum_{i=1}^{n}\left[\prod_{t=1}^{k}\left(1 + r_{i,t}\right) - 1\right] \quad (2)$$

where $\left[\prod_{t=1}^{k}\left(1 + r_{i,t}\right) - 1\right]$ is the *k-months BHRs* for security *i*, and $r_{i,t}$ is the raw return in security *i* at month *t*.

Monthly returns for all stocks that became de-listed during the post-formation

[5]Buy-and-hold post-formation decile returns equal the returns on a strategy of buying the equally weighted portfolio of all stocks in the decile on the formation date, reinvesting dividends in the stock paying the dividend and investing any proceeds from de-listed stocks equally across the remaining stocks in the portfolio. BHARs' transaction costs are much lower than those of CARs, not only because of much less frequent trading, but also because the long-term buy-and-hold strategy adopted in this study would allow the investor to minimise the price impact by building holdings in smaller stocks over a period of time. Thus, if a large overreaction effect is found using the BHAR methodology, these profits would probably be exploitable in the UK stock market.

[6]These post-formation portfolio returns were computed under the assumption that equal-weighted portfolios are constructed on the portfolio-formation date and held throughout the post-formation periods.

period were replaced by the average monthly return of the remaining stocks in the decile portfolio. The only exceptions were those stocks that became valueless. We classified a stock as valueless whenever there was a subsequent UK Inland Revenue pronouncement that the stock was deemed to have become valueless and we assigned the –1 return to the month in which the stock was suspended for the last time.[7] This procedure corresponds to a strategy of investing any proceeds from a dead stock equally across the remaining stocks in the decile-portfolios.

Overall, the study examined twenty-one k=12 non-overlapping formation periods starting from December 1986 and ending in December 2006, twenty k=24, nineteen k=36, eighteen k=48 and seventeen k=60 months overlapping portfolio formation periods, generating a total of 950 investment portfolios for the entire examined period 1January 1987 to 31 December 2007. Finally, the assessment of post-formation momentum profits and the 'winner-loser' effect is reported in terms of buy-and-hold abnormal returns. This is estimated as the k-month difference between the average $BHR_{p,k}$ of each momentum portfolio and the buy-and-hold returns of the FTSE All-share index, or

$$BHAR_{p,k} = BHR_{p,k} - BHR_{FTSE,k} \tag{3}$$

where $BHR_{FTSE,k}$ is the k-month buy-and-hold returns on the index calculated as $\left[\prod_{t=1}^{k}\left(1+r_{FTSE,t}\right)-1\right]$.

As prior UK studies on the overreaction effect have reported a relationship between 'winner-loser' and 'size' effects (Clare and Thomas, 1995; Dissanaike, 2002), this study also addressed this issue by adopting a methodology similar to that introduced in Lakonishok *et al*. (1994). Analytically, at the end of each calendar year and for the entire sample period all securities included in our dataset were sorted on the basis of market capitalisation. All stocks were then assigned to decile portfolios with decile one (d1) consisting of the largest 10% of stocks and decile ten (d10) of the smallest. Post-formation average buy-and-hold returns for all size portfolios were

[7]The adoption of this methodology will help us avoid introducing survivorship and sample selection bias into our results. These problems were found to be present in Conrad and Kaul's (1993) methodology and are thoroughly investigated and discussed in Loughran and Ritter (1996).

calculated as in (2).

Finally, the k-month size-adjusted $BHAR_{p,i,k}^{sa}$ for all portfolios was then estimated as the difference between the post-formation $BHR_{i,k}$ of each security and their corresponding matching size-portfolio $BHR_{p,k}^{SIZE}$ for *k=12, 24, 36, 48* and *60* post-formation holding periods, or

$$BHR_{p,i,k}^{sa} = \left[\prod_{t=1}^{k}\left(1+r_{i,t}\right)-1\right] - \frac{1}{n}\sum_{i=1}^{n}\left[\prod_{t=1}^{k}\left(1+r_{i,t}\right)-1\right] \tag{4}$$

Moreover, average size-adjusted buy-and-hold abnormal returns, $BHAR_{p,i,k}^{sa}$ were estimated following a similar methodology to that described in (3). Overall, if the 'size-effect' is subsumed within the 'winner-loser' effect as Dissanaike (2002) suggested, the adoption of this methodology will allow the exclusion of common returns elements between the two and provide a better picture of the pure performance of the mean reversion effect in the UK during the 1990s.

As regards the estimation of statistical significance, the *t*-statistics for the k=12 months holding period were computed using the conventional *t*-statistic methodology given as

$$t = \overline{\vartheta} - \nu / S_{\overline{\vartheta}} \tag{5}$$

where $\overline{\vartheta}$ is the mean difference in the *k-month* average buy-and-hold abnormal returns between winners and losers, $\left(BHAR_k^w - BHAR_k^L\right)$, ν is equal to zero, $S_{\overline{\vartheta}}$ is the standard error of the mean difference estimated as $\sigma/\sqrt{W}$ and *W* is the sum of weights.

However, as the portfolio formation periods for the k=24, 36, 48, and 60 months investment strategies overlap, the conventional *t*-statistic methodology would lead to overestimated *t*-values and possibly erroneous inferences. To solve this problem, statistical significance for the 'winner-loser' return differences for the k=24, 36, 48, and 60 months was computed using the Fama and MacBeth (1973) procedure with certain adjustments for the relevant *k*-th order autocorrelation. Hence, similar to prior studies (Chopra *et al*., 1992; Dissanaike, 2002), the *t*-statistic for the

$ABHAR_{p,k}$ difference between 'winners' and 'losers' for the k=60 months holding period is estimated as in (5) but we adjust $S_{\bar{g}}$ for fourth-order autocorrelation as

$$S_{\bar{g}} = \frac{\sigma}{N}\sqrt{N + 2(N-1)\rho_1 + 2(N-2)\rho_2 + 2(N-3)\rho_3 + 2(N-4)\rho_4} \qquad (6)$$

where N = 17 (December 2002 being the last portfolio formation period), σ is the standard deviation of the time series of the average buy-and-hold returns' differential between winners and losers $\left(BHAR_k^w - BHAR_k^L\right)$ and, ρ_t is the estimated *n*th order autocorrelation coefficient. A similar methodology is also adopted for the remaining k=24, 36 and 48 months holding periods.

3.3 The Cumulated Abnormal Returns Model

The second methodology for calculating momentum abnormal returns is similar to the one adopted in De Bondt and Thaler (1985). Cumulative monthly portfolio abnormal returns were obtained by taking the average abnormal returns for all stocks in the portfolio, which corresponds to an assumption of monthly rebalancing by forming an equally weighted portfolio at the end of every month. Nonetheless, due to the presence of UK Stamp Duty of 0.5 percent which is payable on all stock purchases, realistically, this strategy is highly cost-inefficient. In addition, small capitalisation stocks in the UK market are in general much smaller and less liquid than in the US.

Hence, as past-losers in particular might contain a very high proportion of highly illiquid penny shares, any possible overreaction effect under *CAR* is unlikely to be exploitable in the UK because of transaction costs. In addition, in contrast to the buy-and-hold returns methodology, the monthly rebalancing process used in the *CAR* methodology will tend to put more weight on current performance leading to a different classification of companies with extreme recent performances into 'winning'/'losing' deciles compared to that obtained using the former method. Nonetheless, as Loughran and Ritter (1996, p.1963) argue "…the buy-and-hold method provides a sharper distinction between portfolios when classifying firms. However, once the portfolios are selected, *CARs* and buy-and-hold returns give rise to similar empirical conclusions".

Although the buy-and-hold returns approach is the preferred method for the above methodological and empirical reasons, the use of *CARs* will allow comparison with those results reported in earlier work in the US and UK markets (De Bondt and Thaler, 1985; 1987; Clare and Thomas, 1995; Campbell and Limmack, 1997; Chen and Sauer, 1997). In detail, for each calendar month prior to the portfolio formation, abnormal stock returns were calculated as the difference between the monthly raw return on each stock and the monthly return of the average of all stocks actively trading in the UK equity market or

$$ARR_{i,t} = r_{i,t} - \left[\frac{1}{n}\sum_{i=1}^{n} r_{i,t}\right] \tag{7}$$

Cumulative abnormal returns *(CAR)* are defined as the sum of the abnormal monthly returns notated as:

$$CAR_{i,k} = \sum_{i=1}^{k} ARR_{i,t} \tag{8}$$

where $ARR_{i,t}$ is the abnormal raw returns on each security *i* at time *t*, and *k* is the number of months prior to the portfolio formation date, *k = 12, 24,…, 60 months.*

All equally weighted momentum deciles were constructed by sorting all actively-traded stocks at the portfolio formation date on the basis of prior k-months $CAR_{i,k}$ with decile one (d1) being the extreme prior-winners and decile ten (d10) the extreme prior losing stocks. Similarly, the average abnormal post-formation decile monthly return is defined as

$$AAR_{p,t} = \frac{1}{u(p)}\sum_{i=1}^{u(p)}\left[r_{i,t} - \left(\frac{1}{n}\sum_{i=1}^{n} r_{i,t}\right)\right] \tag{9}$$

where $\left(\frac{1}{n}\sum_{i=1}^{n} r_{i,t}\right)$ is the average return on the market index for each calendar month *t* following portfolio formation, *p* is the decile portfolio formed at the end of December of each calendar year (p = d1, …, d10), u(p) is the number of stocks in *p* and where $r_{i,t}$ is the monthly return on stock *i*. Finally, the cumulative abnormal post-formation decile return is the sum of the monthly average abnormal post-

formation decile returns or

$$CAR_{p,k} = \sum_{i=1}^{k} AAR_{p,t} \quad (10)$$

where $AAR_{p,t}$ is the average abnormal returns on each momentum portfolio *p* at time *t* and *k* is the number of months after the portfolio formation date, *k* = 12,24,36,48 and 60. Similarly to De Bondt and Thaler's (1985) methodology, our universe of stocks only includes all those with 60 months of unbroken pre-formation returns. The present study uses all stocks in the *UKED* universe that have monthly returns throughout the pre-formation period, i.e. sixty continuous observations for the k=60 months investment horizon, forty-eight for the k=48 months one and so on.

4. Results

4.1 Results for the BHAR Methodology

Table 2 contains the averages of pre-formation and post-formation *BHARs* for each decile, with the averages taken across all portfolio formation dates. Table 2 reveals the extreme variations in pre-formation abnormal returns across past winner and past loser deciles and for all *k*-month holding periods.

According to Panel A, for the k=12 months test-period, the abnormal returns range from 129 percent for prior winners (d1) to a loss of 52.5 percent for prior losers (d10). As regards post-formation performances, the results suggest a consistent momentum effect with prior winners still outperforming prior losers. The difference in performance between (d1) and (d10) is 7.4 percent, a result which is only significant at the 15 percent level (*t*-value of 1.551). Furthermore, these k=12 months post-formation returns increase almost uniformly from decile 1 to decile 10, while the same pattern is evident when individual formation dates are considered.

A similar picture is reported in Panel B which summarises the results from the k=24 months holding period. Winners again appear to outperform losers up to the end of the buy-and-hold period with a total return differential of 2.4 percent. Nonetheless, although these results are significant in economic terms these

Table 2: Pre- and post-formation average $BHAR_{p,k}$ on momentum portfolios for the period January 1987 to December 2007

Panel A: Average BHARs for momentum deciles based on 12 months pre-formation performance

	d1 (W)	*d2*	*d3*	.....	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	126	126	126		126	126	126	
k=[-12,0]	1.298	0.544	0.356		-0.132	-0.266	-0.525	1.822***
k=[0,+12]	0.073	0.058	0.050		0.001	-0.005	-0.001	0.074

Panel B: Average BHARs for momentum deciles based on 24 months pre-formation performance

	d1 (W)	*d2*	*d3*	.....	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	123	123	123		123	123	123	
k=[-24,0]	2.473	0.965	0.638		-0.165	-0.346	-0.638	3.111***
k=[0,+12]	0.045	0.048	0.054		0.023	0.031	0.037	0.008
k=[0,+24]	0.033	0.047	0.063		0.058	0.040	0.009	0.024

Panel C: Average BHARs for momentum deciles based on 36 months pre-formation performance

	d1 (W)	*d2*	*d3*	.....	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	120	120	120		120	120	120	
k=[-36,0]	3.624	1.369	0.892		-0.177	-0.394	-0.701	4.325***
k=[0,+12]	0.017	0.050	0.029		0.028	0.041	0.040	-0.023
k=[0,+24]	-0.012	0.079	0.039		0.075	0.092	0.070	-0.082
k=[0,+36]	-0.066	0.053	0.047		0.062	0.123	0.075	-0.140

Panel D: Average BHARs for momentum deciles based on 48 months pre-formation performance

	d1 (W)	*d2*	*d3*	.....	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	116	116	116		116	116	116	
k=[-48,0]	5.098	1.914	1.252		-0.119	-0.370	-0.705	5.803***
k=[0,+12]	0.007	0.040	0.035		0.061	0.073	0.046	-0.039
k=[0,+24]	-0.017	0.041	0.031		0.101	0.127	0.058	-0.075
k=[0,+36]	-0.054	0.038	0.022		0.107	0.132	0.077	-0.131
k=[0,+48]	-0.091	0.023	-0.007		0.120	0.148	0.034	-0.125

Panel E: Average BHARs for momentum deciles based on 60 months pre-formation performance

	d1 (W)	*d2*	*d3*	.....	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	113	113	113		113	113	113	
k=[-60,0]	6.669	2.565	1.706		-0.014	-0.320	-0.691	7.360***
k=[0,+12]	-0.002	0.025	0.015		0.048	0.088	0.038	-0.040
k=[0,+24]	-0.029	0.011	0.021		0.107	0.128	0.056	-0.085
k=[0,+36]	-0.085	-0.014	0.018		0.129	0.152	0.031	-0.116
k=[0,+48]	-0.109	-0.033	0.043		0.173	0.172	0.019	-0.129
k=[0,+60]	-0.155	-0.085	-0.005		0.125	0.161	0.053	-0.208*

Notes: This figure illustrates the difference in the buy-and-hold abnormal returns *(BHARs)* between past winners and losers for all *k=12,24,…60 months* holding periods. All portfolios are calculated as follows: at the beginning of each calendar year for the period January 1987 to December 2007, our final dataset is sorted into deciles on the basis of their *k*-month pre-formation *BHARs* performance. Post-formation *BHARs* for each decile-portfolio are estimated as the difference between the simple average of the returns computed for each stock in each decile and the *BHRs* for the FTSE All-share index. All *t-statistics* are estimated using the Fama and MacBeth (1973) procedure and are adjusted for the relevant *k*th order autocorrelation. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level.

differences are insignificant in statistical terms. These results confirm those findings reported in prior momentum literature (Rouwenhorst, 1998; Grinblatt and Moskowitz, 1999) and they are consistent with De Long *et al*.'s (1990) argument that short-term momentum is not inconsistent with overreaction over 3 to 5-year horizons.

For the remaining k=36, 48 and 60 months holding periods, according to *Panels C, D* and *E* there is evidence of a 'winner-loser' effect, as prior 'losers' report a mean reversion in the post-formation period. The most immediate reaction on observing these post-formation returns is that they appear to be normal and unremarkable for both past winners and past losers and for all these three alternative post-formation holding periods. Nonetheless, a closer examination reveals certain weak regularities in these post-formation returns figures. For example, according to all the Panels C, D and E the post-formation returns for the extreme prior losers (d10) on average revert within the first year followed by a continuous and symmetrical increase from t+2 onwards (BHARs' difference on k=12 of -2.27 percent for Panel C, -3.93 percent for Panel D and -4.05 for Panel E). Nonetheless, although these short-term reversals are significant in economic terms, they are not significant at all in statistical terms (unreported t-value of -0.401 for the k=36 months pre-formation strategy, t-values of -0.746 and -0.853 for the k=48 and k=60 months respectively).

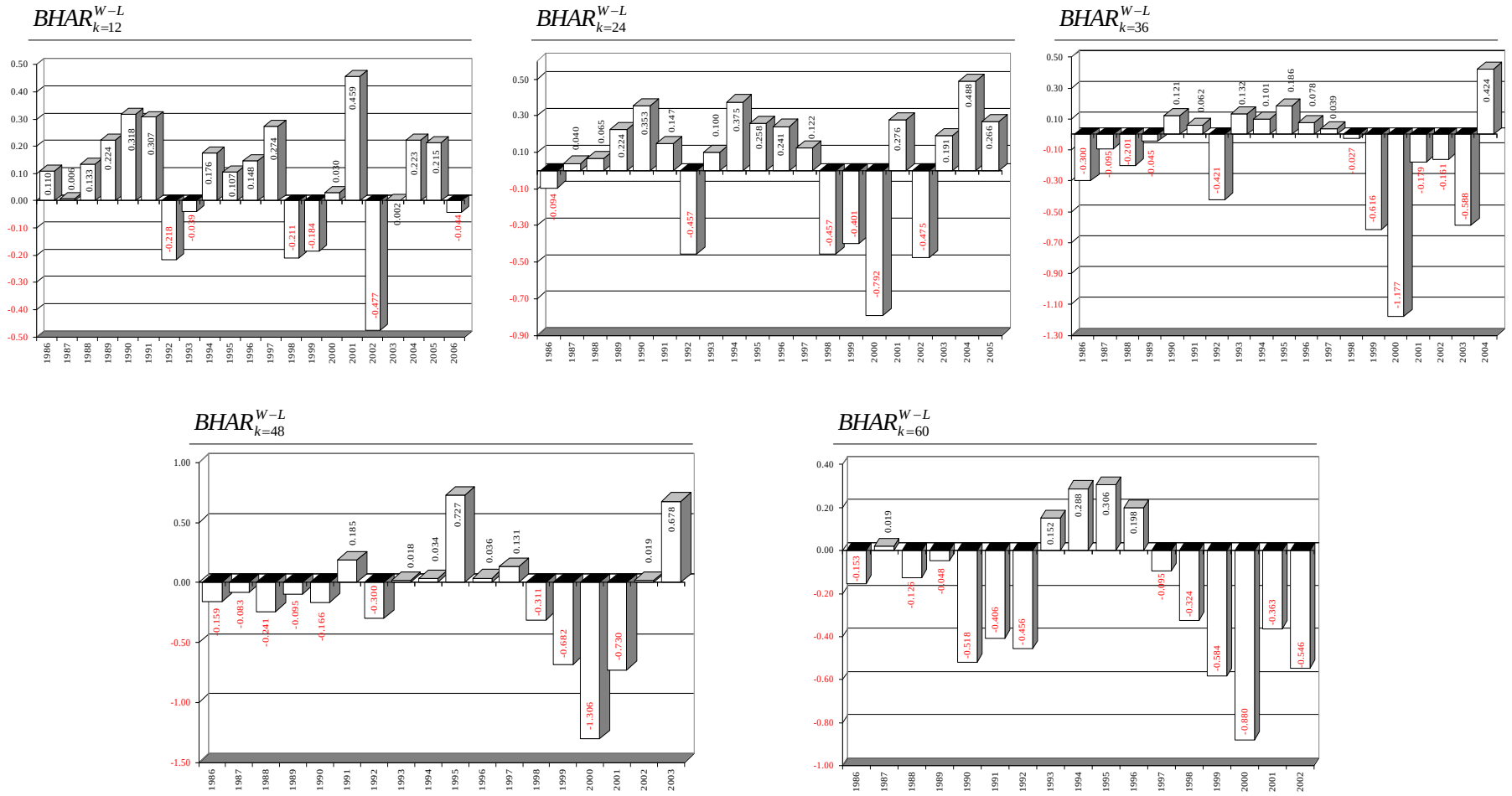
Moreover, the reported out-performance of prior 'losers' in these post-formation periods appears not to be associated with a considerable improvement in their reported performance but rather appears to be associated with an asymmetric and detrimental deterioration in the market performance of the prior 'winning' stocks. For example, according to Panel E, in the k=60 buy-and-hold period there is an inconsistent performance for the prior 'losers' portfolios by reporting an improvement for the first twenty-four months but then followed by a deterioration in the reported *BHARs* in the k=36 to k=48 holding periods and a reversion afterwards. The reported difference in performance for k=60 months between winners and losers is -20.8 percent, significant at the 10 percent level (t-value of -1.952).

As the results in Table 2 indicate, there is no clear evidence that the UK market during the 1987 to 2007 period consistently overreacts in the way reported in

previous overreaction studies (De Bondt and Thaler, 1985; Dissanaike, 1997; 2002). For example, for the average *BHRs* for a k=48 months holding period Dissanaike (1997, p. 32) reports excess abnormal returns of 98.9 percent for prior losers while the differences in *BHARs* between the winner and loser portfolios are strongly significant in eight out of the ten formation periods. A possible explanation for such a large difference between our own results and the results of Dissanaike (1997) might be the different dataset selected, with the former study restricted to the largest five hundred companies in the UK market. Nonetheless, the more plausible explanation is that the effect varies over time. This time-variability nature of the effect is illustrated in Figure 3.

Compared to most previous UK studies that cover periods up to 1990 (Clare and Thomas, 1995; Campbell and Limmack, 1997; Dissanaike, 1997) and report an almost consistent appearance of the 'winner-loser' effect, Figure 3 shows prior-losing portfolios failing to outperform prior-winners in every year under examination. For example, in the *k=48* months holding period, losers outperform winners in 10 out of 18 portfolio formation periods, with most of the aggregate *BHARs* differential reported in the period following the dot.com bubble of 1998-2000. A clearer but equally inconsistent pattern is evident in the k=60 holding period, where the year-by-year results show extreme mean reversion for losers in the period 1990-1992 followed by a clear momentum for 1993 to 1996 and then a more extreme reversal in the post-1997 post-formation test-period. This latest reversal was caused by the bursting of the dot.com bubble and its effects on a large proportion of companies listed in this period and an increasing number of companies falling into bankruptcy/administration in the period 2000-2002. As the formation periods 1993 to 1996 report post-formation results from 1998 and up to 2001, the use of the buy-and-hold methodology may have been affected by these failing stocks. On the contrary, the remainder of the prior-losing companies that survived the crash and the economic turmoil of the period soon recovered leading to the asymmetric post-formation performance reported for the December 1997 to December 2002 test-period.

Figure 3: Average BHARs' difference for "winner" and "loser" portfolios for all *k*-month holding periods (January 1987 to December 2007)



This hypothesis becomes even more plausible when examining Table 3. This table reports the aggregate number of stocks in each decile and for each formation that became valueless during the post-formation holding period. Clearly the valueless securities are heavily concentrated in the losing decile-portfolios with a maximum of 44.2 percent of all de-listed stocks occurring in the extreme past-loser deciles for the k=12 months period and a minimum of approximately 24.0 percent for k=60 months.

Table 3: Distribution of valueless securities across decile portfolios and alternative *k-month* holding periods

	d1 (W)	*d2*	*d3*	....	*d8*	*d9*	*d10 (L)*
k=[0,12]	33	13	8		19	29	114
k=[0,24]	23	23	9		33	53	150
k=[0,36]	39	28	24		49	72	144
k=[0,48]	33	35	36		56	74	129
k=[0,60]	32	38	33		59	72	121

Notes: This table reports the distribution of stocks becoming valueless during the post-formation period across deciles *d1 (winners), d1*,…, *d10 (losers)* and across all portfolio-formation periods. *UKED* classifies a stock as valueless when there is a pronouncement by the UK Inland Revenue that the stock is deemed to be valueless. *UKED* then assigns the –1 end-of-month return to the stock in that month when the stock is suspended for the last time. For the period after April 2004, all valueless securities were collected from the London Share Price Database (LSPD) Master Index file and cross-examined against the Lehmann Communications Company Guide and Pinsents Company Guide.

This pattern also indirectly reveals that the probability of a prior-losing portfolio being affected by a large number of bankruptcies is more likely to be reduced as the k-months holding period increases since most prior-losers at risk of liquidation will mostly go bust within the first thirty-six months subsequent to the formation of the portfolios. A way to validate this hypothesis is by examining the results from the *CARs* methodology. As the use of *CARs* assumes monthly rebalancing, the impact of valueless securities should be minimal as we should expect a stronger reversal in the post-formation performance of the 'loser' portfolio and a clearer picture of a 'winner-loser' effect. This is discussed in the next section.

4.2 Results from the CAR Methodology

The average *CARs* results are summarised in Table 4.

Table 4: Pre- and post-formation *ACARs* on momentum decile-portfolios during the period January 1987 to December 2007

Panel A: Average CARs for momentum deciles based on 12 months pre-formation performance

	d1 (W)	*d2*	*d3*	.....	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	126	126	126		126	126	126	
k=[-12,0]	0.839	-0.386	-0.236		0.214	0.359	-0.798	1.637***
k=[0,+12]	0.014	-0.054	-0.016		0.002	0.036	-0.026	0.040

Panel B: Average CARs for momentum deciles based on 24 months pre-formation performance

	d1 (W)	*d2*	*d3*	.....	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	123	123	123		123	123	123	
k=[-24,0]	1.260	0.538	0.322		-0.352	-0.566	-1.067	2.327***
k=[0,+12]	-0.031	-0.000	0.014		-0.022	-0.014	0.002	-0.033
k=[0,+24]	-0.099	-0.052	-0.011		0.005	0.010	0.029	-0.128

Panel C: Average CARs for momentum deciles based on 36 months pre-formation performance

	d1 (W)	*d2*	*d3*	.....	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	120	120	120		120	120	120	
k=[-36,0]	1.560	0.671	0.403		-0.423	-0.680	-1.323	2.882***
k=[0,+12]	-0.067	-0.011	-0.002		-0.006	0.007	0.043	-0.110**
k=[0,+24]	-0.164	-0.049	-0.020		0.009	0.059	0.074	-0.238*
k=[0,+36]	-0.233	-0.080	-0.036		0.005	0.094	0.076	-0.310**

Panel D: Average CARs for momentum deciles based on 48 months pre-formation performance

	d1 (W)	*d2*	*d3*	.....	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	116	116	117		117	116	116	
k=[-48,0]	1.765	0.770	0.454		-0.475	-0.757	-1.451	3.216***
k=[0,+12]	-0.082	-0.018	-0.013		0.021	0.022	0.068	-0.150**
k=[0,+24]	-0.165	-0.055	-0.046		0.044	0.066	0.096	-0.261**
k=[0,+36]	-0.220	-0.084	-0.063		0.061	0.065	0.109	-0.329***
k=[0,+48]	-0.263	-0.112	-0.091		0.087	0.081	0.087	-0.350***

Panel E: Average CARs for momentum deciles based on 60 months pre-formation performance

	d1 (W)	*d2*	*d3*	.....	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	113	113	113		112	113	113	
k=[-60,0]	3.238	1.213	0.740		-0.411	-0.678	-1.237	4.475***
k=[0,+12]	-0.073	-0.023	-0.027		0.017	0.034	0.062	-0.134***
k=[0,+24]	-0.153	-0.063	-0.054		0.040	0.070	0.096	-0.249***
k=[0,+36]	-0.194	-0.110	-0.071		0.055	0.079	0.088	-0.282***
k=[0,+48]	-0.229	-0.124	-0.082		0.056	0.082	0.072	-0.301***
k=[0,+60]	-0.268	-0.169	-0.099		0.067	0.056	0.058	-0.326***

Notes: This table gives the average *k*-month pre-formation and *k-month* post-formation cumulative monthly abnormal return *(CAR)*, with the average taken over all formations with the *k-month* pre-formation period. All *t-statistics* are estimated using the Fama and MacBeth (1973) procedure and are adjusted for the relevant *k*-th order autocorrelation. * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level.

For the methodological reasons discussed earlier, the average cumulative abnormal returns *(CAR)* results are of less interest than the *BHAR* outcomes and will be

discussed only briefly. These results largely corroborate the results reported in De Bondt and Thaler (1985). They also give evidence of a larger mean reversion for prior losers than those reported in prior UK research using the same return metric (Clare and Thomas, 1995; Campbell and Limmack, 1997) both in terms of direction and magnitude of the results as well as in their statistical significance.

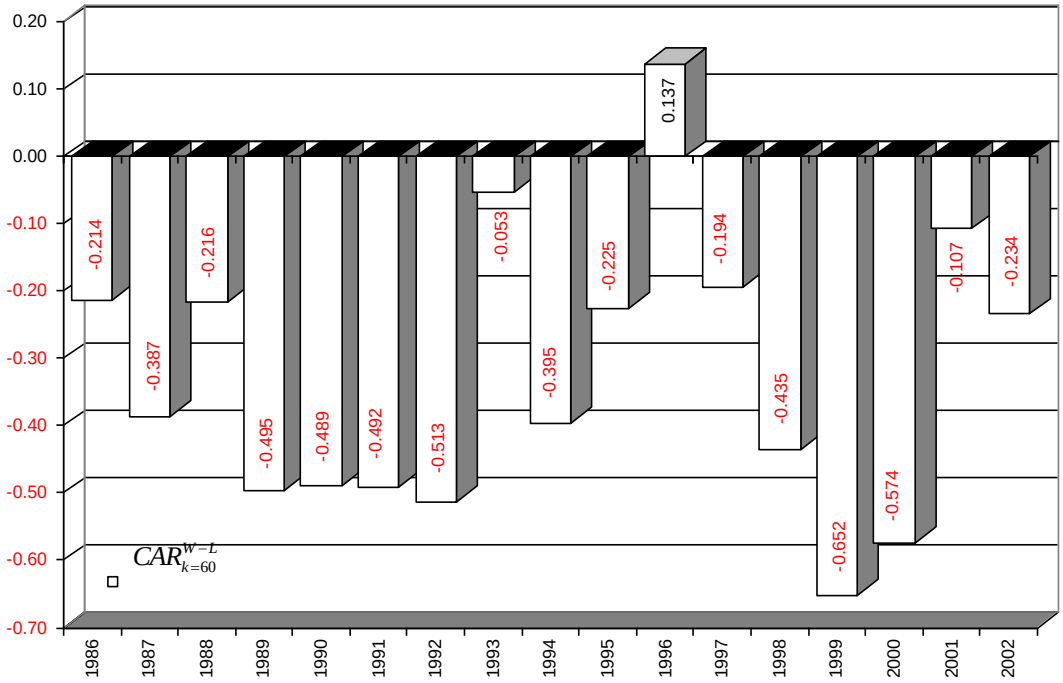
However, there are minor differences. The use of *CARs* in this study has an asymmetric impact on the estimation of the pre-formation returns with more extreme pre-formation abnormal returns reported for prior losers (d10) than for prior winners (d1). As the De Bondt and Thaler (1985) study included only stocks with 84 months of unbroken pre-formation returns, it perhaps lead to the omission of some of the more extreme past losers and past winners. Furthermore, in contrast to the buy-and-hold returns, the monthly rebalancing procedure in *CARs* was also expected to lead to the overestimation of post-formation performance, especially in the k=48 and 60 month holding periods, as bankrupt stocks and their losses will be excluded/accumulated soon after they arise and they will not affect the performance at the end of the holding period. In detail, according to Table 4, there is economically and statistically significant evidence of overreaction for the k=36, 48 and 60 months holding-periods.

On average, the reversal in performance is found to be asymmetric between the two groups with *d1* reporting a deterioration in performance for k=36, 48 and 60 months of approximately -179.3 -202.8 and -350.6 percent respectively while d10 reports an improvement in performance of +139.9, +153.8 and +129.5 percent over the same k-month periods. In terms of statistical significance, the k=48 and k=60 formation replications are significant at the 1% level, with t-values after adjusting for a third- and fourth-order autocorrelation of -3.791 and -17.256 respectively. The results associated with the k =12 and k = 24 month periods confirm those reported earlier using the *BHARs* methodology. This negative return differential between d1 and d10 is found to be evident throughout the entire period under examination.

Figure 4 summarises the k=60 months difference for individual portfolio formation dates. Compared to the *BHRs* results, prior losers outperform prior

winners in 16 out of the 17 formation dates, while, as mentioned before, the return differences are found to be more extreme.

Figure 4: Average *CARs* difference between winners and losers for the *t+60* months holding period January 1987 to December 2007



Overall, the results for *BHARs* and *CARs* taken together partly contradict Loughran and Ritter's (1996, p.1963) findings that the use of *BHARs* and *CARs* in the post-formation periods lead to similar empirical conclusions. These results are found to be mostly supportive of the claim by Conrad and Kaul (1993) that the apparent overreaction effect reported in De Bondt and Thaler (1985) is *at least* in part due to bias in the method used in computing returns and, in particular, that a significant proportion of the positive post-formation cumulative abnormal returns on past loser portfolios is spurious. In any case, any overreaction effect under the latter methodology is unlikely to be exploitable in the UK because of transaction costs incurred in building and rebalancing monthly long positions in past loser stocks as discussed above.

5. Decomposing the Size Effect from the 'Winner-Loser' Effect and Assessing its Relationship to Alternative Market Cycles

Prior studies in the UK and US document a relationship between 'winner-loser' and 'small-size' effects (Zarowin, 1990; Campbell and Limmack, 1997; Dissanaike,

2002). The picture emerging from these studies is that the overreaction effect does not appear to be subsumed by the size effect even though both contrarian and small size investment strategies share common risk characteristics and common assets due to the association between past negative performance and current low market values. Nonetheless, under the recent findings documented in Dimson and Marsh (1999) regarding the non-stationary nature of the 'small size' premium in the UK in the 1990s, it is interesting to re-address this relationship. At the same time, by decomposing the excess returns reported earlier for the 'loser' portfolios from their size-related component, we would be able to assess the true magnitude of the 'winner-loser' effect in recent years. To do so, we adopted the methodology introduced in Lakonishok *et al*. (1994) for estimating size-adjusted returns and combined it with the *BHARs* methodology examined earlier.

According to results reported in Table 5, adjusting the *BHARs* of all k-month portfolios for the size component has a large impact on post-formation performance and especially on the returns of past-loser portfolios. For the k=12 and k=24 holding periods in Panels A and B, adjusting for size magnifies the previously reported momentum effect. For the remainder of the k-month holding periods, the size adjustment again has an asymmetric impact on the returns from all portfolios. Although the reduction in the size component to the post-formation returns of prior winners has a marginal impact, prior losers' portfolio returns are severely affected in both magnitude and change of direction. The end-of-period *BHARs* difference between winners and losers remains negative and follows a similar direction as before. However, these excess negative returns are drastically reduced. The size-adjusted *BHARs'* difference between prior winners and losers for the k=36, 48 and 60 months are reported as -4.38, -3.50 and -11.30 percent, results which are statistically insignificant at all of the conventional acceptance levels. In terms of the impact of size component on these k-month holding periods, the worst affected is k=48 reported in Panel E, where the losers' premium is reduced by almost 72 percent (71.95 percent).

The relationship between these two effects is also illustrated in Figure 5. Adjusting post-formation returns for size will explain a large proportion of the

Table 5: Pre- and post-formation average size-adjusted average buy-and-hold returns ($BHAR^{sa}_{W-L,k}$) on momentum deciles during the period 1987-2007.

Panel A: Size-adjusted ABHRs for momentum deciles based on 12 months pre-formation BHRs

	d1 (W)	*d2*	*d3*	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	126	126	126	126	126	126	
k=[-12,0]	1.084	0.334	0.164	-0.271	-0.394	-0.623	1.706***
k=[0,+12]	0.042	0.029	0.018	-0.031	-0.041	-0.043	0.085*

Panel B: Size-adjusted ABHRs for momentum deciles based on 24 months pre-formation BHRs

	d1 (W)	*d2*	*d3*	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	123	123	123	123	123	123	
k=[-24,0]	1.982	0.505	0.205	-0.481	-0.623	-0.856	2.838***
k=[0,+12]	0.017	0.014	0.016	-0.022	-0.016	-0.016	0.034
k=[0,+24]	-0.000	0.008	0.015	-0.004	-0.026	-0.068	0.068

Panel C: Size-adjusted ABHRs for momentum deciles based on 36 months pre-formation BHRs

	d1 (W)	*d2*	*d3*	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	120	120	120	120	120	120	
k=[-36,0]	2.868	0.665	0.216	-0.666	-0.839	-1.047	3.915***
k=[0,+12]	-0.005	0.019	-0.000	-0.017	-0.006	-0.015	0.010
k=[0,+24]	-0.041	0.032	-0.008	-0.002	0.006	-0.030	-0.012
k=[0,+36]	-0.083	0.015	0.006	-0.024	0.027	-0.040	-0.044

Panel D: Size-adjusted ABHRs for momentum deciles based on 48 months pre-formation BHRs

	d1 (W)	*d2*	*d3*	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	116	116	116	116	116	116	
k=[-48,0]	3.954	0.835	0.225	-0.902	-1.061	-1.256	5.210***
k=[0,+12]	-0.016	0.013	0.001	0.015	0.015	-0.016	0.000
k=[0,+24]	-0.043	0.006	-0.019	0.031	0.036	-0.040	-0.004
k=[0,+36]	-0.081	0.004	-0.029	0.027	0.024	-0.038	-0.043
k=[0,+48]	-0.108	0.001	-0.048	0.037	0.044	-0.073	-0.035

Panel E: Size-adjusted ABHRs for momentum deciles based on 60 months pre-formation BHRs

	d1 (W)	*d2*	*d3*	*d8*	*d9*	*d10 (L)*	$Diff_{d1-d10}$
N	113	113	113	113	113	113	
k=[-60,0]	5.057	1.060	0.234	-1.125	-1.323	-1.499	6.555***
k=[0,+12]	-0.018	-0.002	-0.012	-0.002	0.033	-0.028	0.009
k=[0,+24]	-0.050	-0.026	-0.018	0.031	0.041	-0.048	-0.002
k=[0,+36]	-0.095	-0.041	-0.010	0.048	0.060	-0.077	-0.018
k=[0,+48]	-0.123	-0.062	0.012	0.081	0.069	-0.091	-0.032
k=[0,+60]	-0.153	-0.096	-0.018	0.048	0.073	-0.040	-0.113

Notes: This figure illustrates the size-adjusted buy-and-hold abnormal returns ($BHAR^{sa}_{W-L,k}$) between past winners and losers for all *k=12,24,…,60 months* holding periods. These returns are computed using the methodology introduced in Lakonishok et al. (1994). All *t-statistics* are estimated using the Fama and MacBeth (1973) procedure and are adjusted for the relevant *k*th order autocorrelation. *indicates significance at the 10% level, **indicates significance at the 5% level, *** indicates significance at the 1% level.

previously reported overreaction effect. In addition, as the figures for the k=36, 48 and 60 holding periods illustrate, the *BHARs*' difference for the winner-loser portfolios after adjusting for the size effect is almost eliminated in the first twenty-seven post-formation months for k=36 and k=48, while for the k=60 months' investment horizon prior-losers start to consistently outperform prior-winners only after month thirty-nine.

Overall, compared to prior UK studies, the results reported so far give evidence of a weak presence of a 'winner-loser' effect during the 1990s. Although the effect has not reversed completely, it appears to be considerably more inconsistent than in previous decades. This finding gives most support to the argument that the effect may be associated with time-varying risk or with market cycles as argued by Chen and Sauer (1997) in their study of the US market. To assess this possible explanation we compare the 'winner-loser' return differential to that of the market premium for a similar time period.

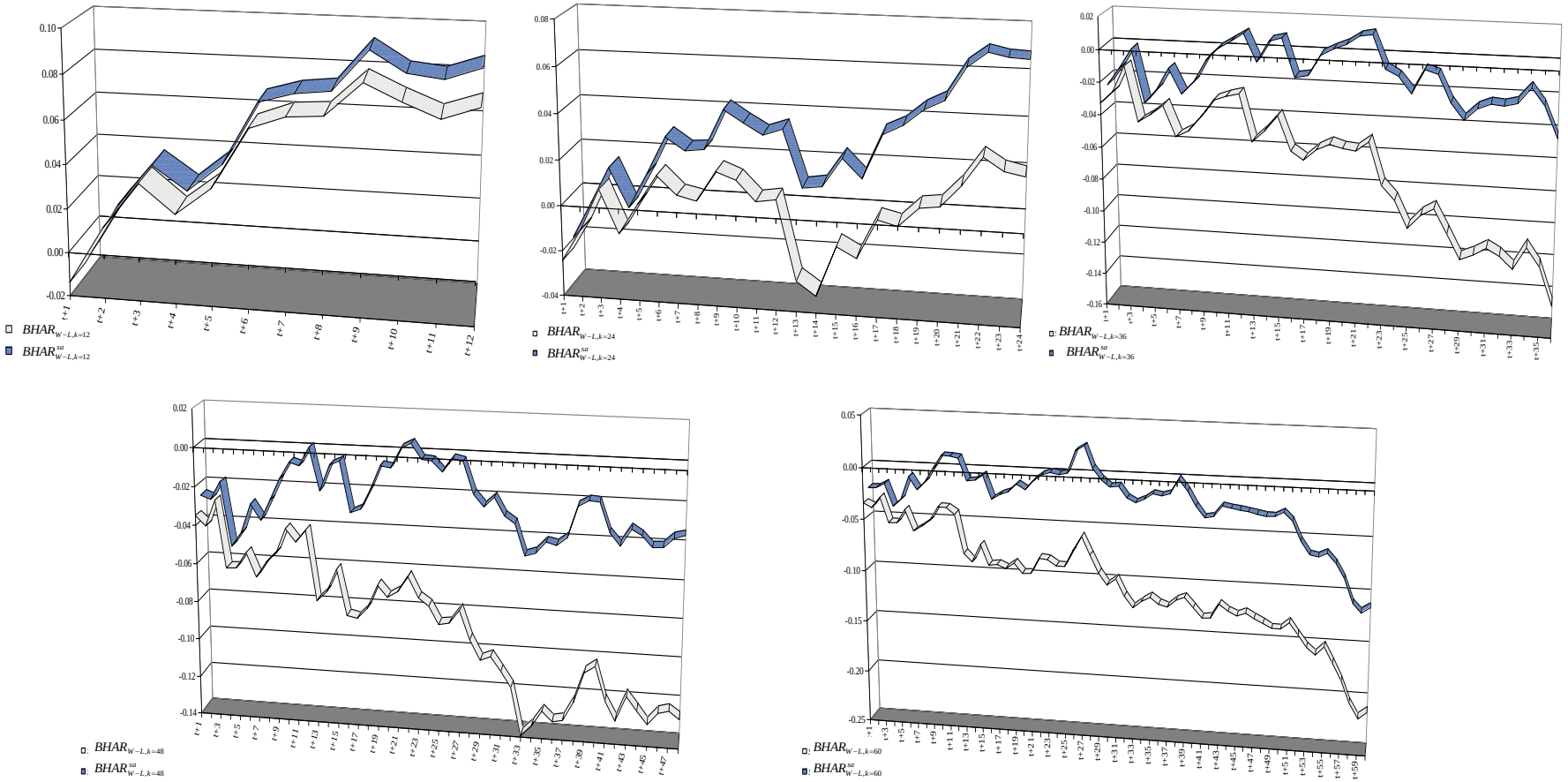
Analytically, following Chen and Sauer's (1997) methodology we estimated the returns on an arbitrage portfolio consisting of taking a long position in the loser portfolio while shorting the winner portfolio for the entire period under examination. Monthly excess returns on the arbitrage portfolio are estimated as the difference in the monthly average abnormal returns between the extreme loser and extreme winner portfolios or $AAR_t^{L-W} = AAR_t^L - AAR_t^W$. *T*he estimation of the market risk premium is calculated as the difference between the monthly raw returns of the FTSE All-share index (r_m) and the returns on one-month treasury gilts (r_f).

Finally, to compare the two return series on an annual basis over the entire examined period 1987-2007, we compute annual risk premium as

$$CRR_{RP,k=12} = \sum_{t=1}^{k=12} \left(r_{FTSE,t} - r_{f,t} \right) \tag{11}$$

where $CRR_{RP,k=12}$ are the annual cumulative returns, $r_{FTSE,t}$ is the monthly return on the FTSE All-share index and $r_{f,t}$ is the monthly return on one-month treasury gilts.

Figure 5: Average *BHARs* and average size-adjusted *BHARs* difference between 'winners' and 'losers' for all *k=12,…,60* months holding periods.



In a similar manner, annual cumulative abnormal returns on the arbitrage portfolio are estimated as the sum of the monthly abnormal returns on the arbitrage portfolio averaged across the different portfolio formation periods so as to accommodate the effect of overlapping periods for the *k=60* months post-formation performance, or

$$CAR_{L-W,k=12} = \sum_{t=1}^{k=12}\left[\frac{1}{h}\sum_{h=1}^{5}\left(ARR_{L,h,t} - ARR_{W,h,t}\right)\right] \qquad (12)$$

where $ARR_{L,h,t}$ and $ARR_{W,h,t}$ are the abnormal returns on the prior *"loser"* and *"winner"* portfolios for formation *h* and for month *t* and $CAR_{L-W,k=12}$ is the annual cumulative abnormal returns on the arbitrage portfolio. For example, the cumulative abnormal returns on the arbitrage portfolio for the year 1993 is estimated as the sum of the average abnormal monthly returns between losers and winners across all portfolio formations i.e. k=1,…,12 for December 1992, *k=13,…,24* for the December 1991 and so on. Figure 6 illustrates the relationship between the two series for the entire period 1987 to 2007.

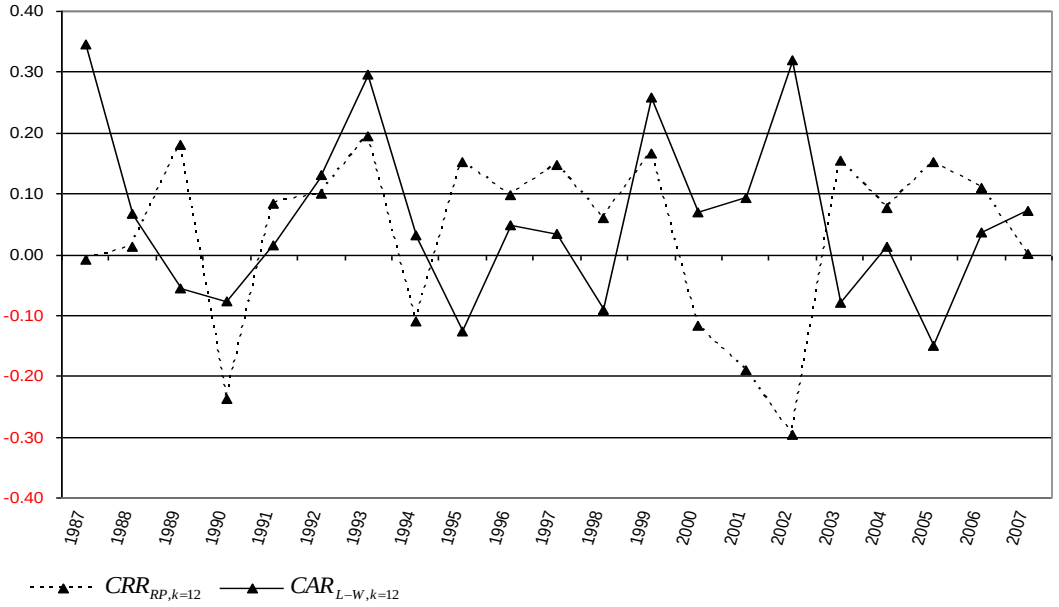
For most of the examined period, the relationship between the overreaction effect and the risk premium appears to be positive. Apart from isolated periods, such as the years 1987-1989 and post 2001, for the majority of the 1990s, the average *CARs* differential for prior losers is evidently related to the movements of the market risk premium. In the post dot.com era, the relationship has reversed dramatically and may be related to i) the continuous and periodic reduction in the UK's interest rates thus increasing further the market risk premium and/or ii) a possible change in the investment preferences of institutional and large private investors following the collapse of the internet bubble. Overall, the 'winner-loser' effect is more evident during periods of financial and/or economic recovery such as the years of 1987-1988, 1993-1994, 1997 to 2002 and post 2006.

To validate the above argument and test the statistical significance of both the relationship between the "winner-loser" effect with the a) "size" effect and b) the market risk premium we consider the following two-factor regression model

$$\left(ARR_t^W - ARR_t^L\right) = a_0 + a_1 BMS_t + a_2\left(r_{mt} - r_{ft}\right) + u_t \qquad (13)$$

where $\left(ARR_t^W - ARR_t^L\right)$ is the difference in monthly abnormal returns between the "winner" and the "loser" portfolios, BMS_t is the monthly average abnormal returns between the large- and small-size portfolios and $\left(r_{mt} - r_{ft}\right)$ is the market risk premium. To accommodate the effect of heteroscedasticity and autocorrelation in the data, all coefficients are estimated using the Newey-West (1987; 1994) procedure.

Figure 6: Average annual *CARs* for the arbitrage portfolio *vs.* the market risk premium



Notes: This figure illustrates the annual return differential between the arbitrage portfolio and the market risk premium. The returns on the arbitrage portfolio consist of taking a long position in the loser portfolio while shorting the winner portfolio for the entire period under examination. Monthly excess returns on the arbitrage portfolio are estimated as the difference in the monthly average abnormal returns between the extreme loser and winner portfolios or $AAR_t^{L-W} = AAR_t^L - AAR_t^W$. The estimation of the market risk premium is calculated as the difference between the monthly raw returns of the FTSE All-share index (r_m) and the returns on one-month treasury gilts (r_f). Annualised returns for the market risk premium are estimated as the cumulative raw returns on the monthly *ARRs*; while, for the arbitrage portfolio, annualised *CARs* are estimated as $CAR_{L-W,k=12} = \sum_{t=1}^{k=12}\left[\frac{1}{h}\sum_{h=1}^{5}\left(ARR_{L,h,t} - ARR_{W,h,t}\right)\right]$ where $ARR_{L,h,t}$ and $ARR_{W,h,t}$ are the abnormal return on the prior *"loser"* and *"winner"* portfolios for formation *h* and for month *t*.

According to evidence presented in Table 6, both explanatory variables selected are different from zero and the coefficients have the predicted signs. Nonetheless, only the size-effect variable *(BMS)* can reliably explain the returns on the arbitrage portfolio. As the average coefficient suggests, every 1 percent increase in the excess returns on the large capitalisation portfolio will result in an increase of 0.49 percent in the arbitrage portfolio's returns (t-statistic of 4.77,4 significant at the

10 percent level). The relationship between the arbitrage portfolio's returns and market risk premium suggests a negative relationship indicating that decreases in the market risk premium will lead to increases in the excess returns for prior winners compared to prior losers. However, the coefficient is very small (a_2 = -0.1207) and not statistically significant (t-value of -0.9082, p.0.1920).

Table 6: OLS Regression of the *ARRs* difference between *"winner"* and *"loser"* portfolios for the *k=60* months post-formation ranking period with the *ARRs* difference of large- and small-size portfolios and the market risk premium.

	Intercept	*BMS*	*Risk Premium*	R^2*Adjusted*
Coefficient Estimates	0.0001	0.4857	-0.1207	
t-statistic[#]	(0.5595)	(4.7737)	(-0.9082)	0.4340
F-Statistic	29.4521[***]			
Durbin-Watson Statistic	1.9623			

Notes: This table reports the results from the statistical examination of the relationship between the "winner-loser" effect with the a) "size" effect and b) the market risk premium. The regression estimation is formulated as $\left(ARR_t^W - ARR_t^L\right) = a_0 + a_1 BMS_t + a_2\left(r_{mt} - r_{ft}\right) + u_t$ where $\left(ARR_t^W - ARR_t^L\right)$ is the difference in monthly abnormal returns between the "winner" and the "loser" portfolios; BMS_t is the monthly average abnormal returns between the large- and small-size portfolios, and $\left(r_{mt} - r_{ft}\right)$ is the market risk premium. To accommodate the effect of heteroscedasticity and autocorrelation in the data, all regression coefficients are estimated using the Newey-West (1994) procedure.

The most plausible explanation for such small values on the residual might be the change in the relationship between the two variables in the post-2001 period discussed earlier. The intercept term *(* a_0 coefficient) is very close to zero (0.000051) and it is not statistically significant. According to the adjusted R^2 results, the model explains only approximately 43% *(* $\overline{R}^2$ *=0.4340)* of the total variation in the endogenous variable. Overall, these results confirm the link between "winner-loser" effect and 'size-effect' by corroborating the findings of Dissanaike (2002) that size can only partially explain the former return differential, while providing weak support to the arguments of Chen and Sauer (1997) that excess-returns for prior-losers are associated with market cycles.

6. Conclusion

Dissanaike (1997, 2002) investigated the overreaction effect in the UK market for the period 1979 to 1988. These studies are substantially free from the main sources

of bias discussed in the literature on 'winner-loser' effect and, in particular, from survivorship and look-ahead bias. The research presents convincing evidence that a statistically and economically significant overreaction effect existed in the UK market for the studied period. The overreaction effect was apparent for large liquid stocks in the FTSE 500 Index, the universe of stocks under investigation. This is remarkable in that it is often claimed that any market inefficiencies that do exist are more likely to be found amongst small, illiquid or neglected stocks. Thus, restricting the studies to the large, liquid stocks that are followed by analysts would presumably have the effect of biasing the research towards finding no evidence of overreaction.

The present study examines the overreaction hypothesis for the UK market for the later period January 1987 to December 2007. Again, the research is largely free from the most commonly discussed sources of bias. The main difference between this and the previous UK studies, apart from the time period covered, is that the universe of stocks is far wider, covering all fully-listed UK stocks (excluding investment trusts and investment companies). In this case, the inclusion of many small, illiquid stocks should, if anything, bias the research towards finding evidence for the overreaction effect. The results suggest that evidence for the "winner-loser" effect, even if still present in the UK during the last decade, appears to be weaker and inconsistent. From all the alternative *k-months* holding periods under examination, only the k=60 appears to provide statistically significant results.

Taking these studies together provides strong evidence that an overreaction effect did indeed exist in the UK from 1975 to around the late 1980s, but weakened considerably thereafter. These results are therefore consistent with the US literature on long-term returns (Chen and Sauer, 1997), where it is shown that the overreaction effect in the US has been non-stationary during the time period 1926 to 1992. The accumulating evidence of the time-varying nature of the overreaction effect supports the efficient markets' explanations that the overreaction premium is compensation for time-varying risk and that it can partially be explained by the other popular anomaly in finance literature the 'small-size' effect.

From the perspective of the behavioral finance research paradigm, further corroboration of the time non-stationarity of the overreaction effect may require non *ad hoc* revisions to the basic overreaction hypothesis, i.e. revisions that are well-

motivated in terms of the underlying behavioral theories and not proposed merely to evade falsifying empirical evidence.

Author Information: Panagiotis Andrikopoulos, the corresponding author, is a Principal Lecturer in the Department of Accounting and Finance, Leicester Business School, De Montfort University, UK. Tel: +44(0)1162506331; Email: pandrikopoulos@dmu.ac.uk. Arief Daynes is a Senior Lecturer in the Department of Accounting and Finance, Portsmouth Business School, University of Portsmouth, Portsmouth, UK. Tel: +44(0)2392844182; Email:arief.daynes@port.ac.uk. Paraskevas Pagas is a Senior Lecturer in the Department of Accounting and Finance, Portsmouth Business School, University of Portsmouth, Portsmouth, UK. Tel: +44(0)2392844721; Email:paraskevas.pagas@port.ac.uk.

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