Behavioural Models of Long-Run Returns Reversals: Evidence from Returns Following Profit Warnings

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Abstract

A puzzling feature of stock returns is evidence of returns reversals at horizons of three to five years. One explanation for this evidence comes from behavioural models that assume investors overreact to short runs of recent earnings news. The objective here is to investigate whether the event study methodology can offer further support for these models in the same way that event studies have delivered evidence consistent with behavioural models of underreaction to a single news item.

In order to apply the event study approach we need to identify episodes where there are short runs of earnings outcomes that might cause investors, who are subject to this bias, to overreact. We use profit warnings to mark the start of such runs of data. Although profit warnings normally refer explicitly to just one quarterly earnings announcement we argue that they typically precede a number of quarterly earnings outcomes that are disappointments compared both to investors' model of earnings before the warning was issued, and also to their expectations immediately after the warning.

We test whether there is any evidence that investors overreact to this sequence of negative earnings surprises by tracing abnormal returns on stocks purchased either six, nine, or twelve months after a profit warning and held for the next twelve months. Our principle result is that buying stocks at any of these dates yields significant positive abnormal buy-and-hold returns in the subsequent twelve months. For example buying stocks either six or nine months after a profit warning delivers abnormal returns of 7.7% over the following twelve months compared to a reference portfolio of firms matched by size and the book to market value of equity. Investor overreaction is more pronounced for growth stocks than for value stocks. For example purchasing growth stocks nine months after a warning delivers an abnormal return of 11.5% over the next twelve months but value stocks deliver only 0.3% over the same period.

Economic forces that drive a recovery in earnings after a short sharp series of disappointments may include the replacement of senior management and the renegotiation of contracts. This mistake of giving too much weight to a short run of recent data might be interpreted as a consequence of investors under estimating the economic forces that underpin mean reversion in earnings.

Keywords: profit warnings; contrarian strategies; market anomalies.
JEL classification: G11, G14

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1. Introduction

A puzzling feature of stock returns is evidence of momentum at horizons of three to twelve months but reversals at longer horizons of three to five years. For evidence of momentum in US data see Jegadeesh and Titman (1993), Jegadeesh and Titman (2001), and for international evidence see for example Rouwenhorst (1998). For evidence of reversals see DeBondt and Thaler (1985), DeBondt and Thaler (1987) and Jegadeesh and Titman (2001). It is difficult to explain these results as a consequence of time varying risk in the context of standard asset pricing models, for example the capital asset pricing model of Sharpe (1964) and Lintner (1965)[1]. This offers both an opportunity and a challenge for behavioural finance. Behavioural models have been developed that can explain both of these results by the assumption that when investors revise their beliefs in response to new information they exhibit biases of the kinds that have been widely reported in experimental psychology. Different biases are brought into play, resulting in either underreaction or overreaction, depending on whether the news is public or private and whether it is an isolated news item or a short run of surprises.

Momentum can be explained if investors are assumed to be subject to biases that cause them to underreact to public news. When they first receive new public information they may underreact because they are initially overconfident of their earlier private information, Daniel et al. (1998), or may exhibit the conservatism bias so that beliefs are initially modified too little in response to the news, Barberis et al. (1998). Providing that stocks are indeed over/under priced when the initial public signals of over/under pricing are received, then the truth will win out over time, and so momentum in returns will be observed. The event study literature provides a valuable corollary for these models. Abnormal returns in the months following public disclosures should be of the same sign as abnormal returns on the announcement day, and a large number of event studies have confirmed this prediction, see for example the evidence surveyed in Daniel et al. (1998).

The objective of this paper is to examine whether the event study methodology can offer similar support for those models that explain return reversals as a result of investors overreacting to short runs of public news about earnings[2]. Two well-known models that assume investors give too much weight to short runs of recent earnings outcomes are those of Rabin (2002) and Barberis et al. (1998). Rabin (2002) explicitly focuses on the reaction of investors to a short run of surprises. He assumes they make the mistake known as the law of small numbers, a term that was coined in psychology to describe the behaviour of subjects in experiments who expected even short runs of data to closely reflect population moments. For example in an experiment where individuals have to predict the colour of the next ball to be drawn (with replacement) from an urn with 50% red and 50% black balls they believe a red ball is more likely immediately after a black

[1] Although there are some notable successes, see for example Berk et al (1999).

[2] The key to this approach is the calculation of abnormal returns following public news and not all models of reversals are amenable to this kind of testing. For example Hong and Stein (1999) explain reversals as a consequence of the interaction between investors with different information sets, and the critical assumption of Daniel et al. (1998) is that investors overreact to private information.

ball has been drawn. Rabin shows that investors who are subject to this bias will underestimate the likelihood of a given company delivering a short run of surprises of the same sign. This will lead them to infer too quickly from a short run of disappointing news that the company has lower earnings potential than they had previously believed.

Barberis et al. (1998) assume investors believe earnings are drawn from either a stationary model or a model with a trend, when they are actually a random walk. Investors assume earnings for a stock are drawn from one model or the other using what is known in experimental psychology as the representativeness heuristic. This states that events are assigned with too much confidence to particular classes based on recent patterns in the data. For example this bias implies that companies with a short record of falling earnings are too quickly assigned to the class of negative growth stocks, despite the fact they may have a long record of good performance. This is closely related to Rabin's model since both models imply investors give too much weight to a short run of poor earnings realisations. A testable implication of both models is that returns reversals are to be expected as future earnings realisations arrive and investors' overreaction becomes evident.

In order to apply the event study methodology to test these models of returns reversals we need to identify "events" where there are short runs of data that might cause investors to overreact if they are subject to these biases. We use profit warnings to date the start of a short run of bad news that we might expect to result in overreaction, if these models are right. Although profit warnings normally refer explicitly to just one quarterly earnings announcement they typically precede a run of quarterly earnings outcomes that are disappointments[3]. The fact that stock prices drop on average 17% at the date of the warning (see Bulkley and Herrerias, 2005) implies that investors expect to observe earnings that are lower than previously expected for several future quarters. We confirm in Section 3 that abnormal returns are negative and significant for up to eight months following the warning. This implies that subsequent earnings announcements appear to be on average disappointments, even relative to revised expectations after the warning. This suggests that at least two or three disappointing earnings announcements follow a profit warning, and therefore we may use profit warnings to identify a short run of bad news that plays a key role in these behavioural models.

The negative abnormal returns in the months immediately following the warning are consistent with other evidence of underreaction to single news items surveyed in Daniel et al. (1998). The question that we are interested in here though is whether the investors overreact after they have updated their beliefs in the light of subsequent earnings announcements. Models of reversals do not specify a length in calendar time of the short run of data that determines the overreaction, nor the number of earnings announcements that it takes for the overreaction to become evident. We therefore report abnormal returns that are calculated on stocks purchased six, nine, and twelve months after a profit warning and held for the next twelve months. This holding horizon might be expected to span the time when information starts to arrive about underlying earnings beyond the shock that necessitated the warning.

[3] Managers have considerable scope to smooth earnings between adjacent quarters through either accounting methods or movement of cash flows, and so it is unlikely that an isolated shock to just one quarter would necessitate a profit warning.

Our principle result is that buying stocks either six, nine, or twelve months after a profit warning yields significant positive abnormal buy-and-hold returns in the subsequent twelve months. We find evidence that overreaction is more pronounced for growth stocks than for value stocks. This suggests that the higher are growth expectations the more sensitive are investors to any disappointments.

The reminder of the paper is organised as follows. Section 2 describes profit warnings data and the methodology used for the analysis, Section 3 reports results for abnormal returns, including results for extreme quintiles of stocks sorted by size and the ratio of the book to the market value of equity, and Section 4 concludes.

2. Profit Warnings Data and Methodology

A profit warning is a description given by analysts and journalists to announcements by companies that future earnings will be below current market expectations. Not all firms that have bad news issue warnings and for an examination of the reasons why firms issue profit warnings see for example Skinner (1994), Kasznik and Lev, (1995). The vast majority of warnings relate to the next quarterly scheduled earnings announcement. Some warnings simply advise that earnings will be below current expectations and others include specific forecasts, either a point estimate or a range. Our data set consists of 2,031 daily corporate statements identified by CNN as "profit warnings" or "earnings warnings", issued by US companies trading on NYSE, AMEX or NASDAQ stock exchanges in the period February 1998-December 2000. The data were downloaded from CNN financial web page http://money.cnn.com/[4]. This web page is updated several times per day and it contains every profit warning issued over the last thirty days. The data is also available in several financial pages in the Internet such as Yahoo Finance, MSN Money, and FT.com. Specialized financial databases and news agencies like Bloomberg and Reuters announce profit warnings even sooner than free services. Therefore, institutional traders and financial analysts are able to access the information in real time.

We identify the months following a profit warning as the event where there is a run of disappointing earnings news. We evaluate whether investors overreact to this episode by testing if a trading strategy of purchasing stocks after this event yields positive abnormal returns. The theoretical models do not suggest a length of calendar time that corresponds to the short run of bad news so we experiment with buying stocks six, nine, and twelve months following the profit warning. It is common for companies to issue more than one warning and if there are multiple warnings we date our strategy from the time of the first warning. Stocks are then held for twelve months following each start date.

A point estimate of buy-and-hold abnormal returns, BHARs, has to be calculated from daily returns data. A number of papers (see, e.g., Kothari and Warner, 1997; Lyon, Barber, and Tsai, 1999; Datar and Naik, 1998) identify biases that can arise under the different methodologies that are employed to evaluate the significance of measures of long-term abnormal performance. Lyon, Barber, and Tsai (1999) (LBT) show that these biases can be minimized by working with buy-and-hold abnormal returns, BHARs, calculated using reference portfolios. The point estimate of the BHAR measure is calculated from daily data as the buy-and-hold return on the event stock minus the buy-and-hold return on a

[4] http://money.cnn.com/markets/IRC/warnings.html . In the US "profit warnings" are referred as "earnings warnings".

reference portfolio that consists of firms whose characteristics match those of the event firm. It is well known that long-term returns are skewed and therefore the statistical significance of long-term BHARs are assessed using the skewness-adjusted *t*-statistic.

Although compounding has the merits described by LBT, and may best reflect the profitability of a potential trading strategy, it does suffer from one problem, noted by Fama (1998). If we have the wrong model for expected returns then it will also compound model error. Therefore we also report cumulated abnormal returns, CARs, in order to give a perspective on the robustness of our results. However, we consider BHARs our primary results, since they have the other advantages described by LBT[5].

The reference portfolios employed for calculating abnormal returns are fifty size/book-to-market portfolios constructed as follows. The reference portfolios are formed with non-event firms in two stages in July of each year *t* following Fama and French (1992) procedure. First, every NYSE firm is ranked on the basis of its size measured in June of each year by market value of equity. Size deciles are then created based on this ranking for all NYSE firms. NASDAQ and AMEX firms are placed in the appropriate NYSE size decile, based on their June market value of equity. At the second stage, within each size decile, firms are divided into quintiles based on their book-to-market ratios in December year *t*-1. A firm's book-to-market ratio in year *t*-1 is measured as the book value of common equity (COMPUSTAT CEQ or data item 60) reported in the firm's balance sheet for year *t*-1 divided by the market value of common equity in December of year *t*-1. Stocks experience a substantial change in market value after the warning and are therefore matched to reference portfolios using their size measured two days after the warning. If a stock is delisted during the holding period it is assumed that the investor places the proceeds from delisted firms in the reference portfolio. If a member of a reference portfolio is delisted, or otherwise missing returns data on any day, the missing return is replaced by the average daily return on the remaining stocks in the same portfolio.

Buy-and-hold returns on the reference portfolio for a particular horizon are calculated as follows. We first compound the buy-and-hold returns on each stock in the reference portfolio for that same horizon and then average across all stocks in the reference portfolio. If firm *i* issues a profit warning its abnormal return is calculated as the buy-and-hold return on that stock minus the buy-and-hold return on the reference portfolio. That is $BHAR_{i,s,\tau}$, over horizon τ-*s*, starting on day *s* is calculated as

$$BHAR_{i,s,\tau} = \prod_{t=s}^{\tau}\left(1+R_{i,t}\right) - \frac{1}{n}\sum_{j=1}^{n}\left[\prod_{t=s}^{\tau}\left(1+R_{j,t}\right)\right] \qquad (1)$$

where $R_{i,t}$ is the daily return on security *i* on day *t*.

The average return on the *m* warning stocks over horizon τ-*s*, starting on day *s*, $BHAR_{s,\tau}$, is calculated as

[5] Loughran and Ritter (2000) survey the debate about the relative merits of CARs and BHARs

$$BHAR_{s,\tau} = \frac{1}{m}\sum_{i=1}^{m}\left[BHAR_{i,s,\tau}\right] \qquad (2)$$

The cumulative abnormal return, $CAR_{s,\tau}$, on a portfolio of *m* warning stocks, each subscripted by *i*, and each held from day *s* until day τ is calculated as

$$CAR_{s,\tau} = \frac{1}{m}\sum_{i=1}^{m}\sum_{t=s}^{\tau}\left[R_{i,t} - RF_t\right] \qquad (3)$$

where RF_t is the mean return on the securities in the reference portfolio for warning stock *i* on day *t*.

3. Do investors overreact to the run of bad news following a profit warning?

Profit warnings herald not just an isolated earnings disappointment, but also a short run of earnings outcomes that are lower than were expected before the warning. The expectation of a series of earnings disappointments is evident from the 17% price decline at the announcement, Bulkley and Herrerias (2005). In fact we see in Table 1 below that subsequent news over the following eight months actually brings on average further disappointments, even relative to the substantial downward revisions in expectations at the time of the warning. If investors overreact to this short run of bad news then a strategy of buying stocks some months after the warning, and holding them until new information arrives about the firms longer-term earnings potential, should be profitable.

The models are silent on the calendar time that might correspond to a short run of bad news, and also on the time it might take for sufficient new earnings outcomes to arrive for investors to realize that they have overreacted. We therefore report abnormal returns to a strategy of purchasing stocks either 6, 9, or 12 months after a profit warning and holding the stocks for a further twelve months. The choice of start date reflects a trade-off between delaying too long after the profit warning, so that prices start to increase as news about longer-term earnings starts to arrive, and investing too soon when other investors are still lowering their expectations.

We start by reporting abnormal returns on stocks over the twelve months immediately following the first profit warning in order to confirm that the expectation of a run of bad news, implicit in the 17% price fall when the warning is issued, is not quickly contradicted. It may also be useful to see our contrarian strategy in a wider context.
In Table 1 we report abnormal returns on stocks purchased 2 days after the warning and held for successive months.

Table 1. Abnormal Returns from two days after the warning

Monthly Buy and Hold Abnormal Returns ($BHAR_{s,\tau}$) and Cumulated Abnormal Returns ($CAR_{s,\tau}$) starting two days after the profit warning was issued and to the end of each month until 12 months after the warning. Numbers are the mean $BHAR_{s,\tau}$ and mean $CAR_{s,\tau}$ across firms in the sample. The sample consists of 2031 firms that issued profit warnings between February 1998 and December 2000. Abnormal returns are the difference between the return delivered by the event firm minus the average return of the corresponding reference portfolio. Reference portfolios were created considering firm size measured with market capitalisation and book to market value of equity of control firms that did not issued any profit warning during the analysed period. Abnormal returns are subsequently compounded or cumulated. Standard Deviation, Standard t-Statistics and Skewness Adjusted t-Statistics are reported for $BHAR_{s,\tau}$ and $CAR_{s,\tau}$..*, **, and ***, are based on Skewness Adjusted t-Statistics and denote 10%, 5% and 1% significance level respectively Skewness adjusted t-Statistics are computed as

$$t_{SA} = \sqrt{n}\left(S + \hat{\gamma}S^2 + \frac{1}{6n}\hat{\gamma} \right), \text{ where } S = \frac{\overline{BHAR_\tau}}{\sigma\left(\overline{BHAR_\tau}\right)}, \text{ and } \hat{\gamma} = \frac{\sum_{i=1}^{n}\left(BHAR_{i\tau} - \overline{BHAR_\tau}\right)^3}{n\sigma\left(\overline{BHAR_\tau}\right)^3}$$

Months after the Warning	$BHAR_{s,\tau}$				$CAR_{s,\tau}$			
	Mean	*St. Dev*	*T-stat*	*S.A. T-stat*	*Mean*	*St. Dev*	*T-stat*	*S.A. T-stat*
1	0.10%	21.51%	0.21	0.22	0.01%	20.87%	0.03	0.03
2	-1.26%	27.06%	-2.09	-2.06 **	-1.31%	27.91%	-2.10	-2.11 **
3	-3.60%	34.56%	-4.67	-4.43 ***	-3.54%	35.46%	-4.48	-4.51 ***
4	-2.87%	43.36%	-2.97	-2.84 ***	-2.64%	40.87%	-2.90	-2.91 ***
5	-3.19%	56.22%	-2.54	-2.28 **	-3.12%	45.70%	-3.07	-3.06 ***
6	-3.82%	56.24%	-3.04	-2.85 ***	-3.52%	50.46%	-3.13	-3.14 ***
7	-3.04%	61.07%	-2.36	-2.29 **	-1.91%	52.64%	-1.62	-1.65 *
8	-3.02%	66.27%	-2.05	-2.01 **	-2.18%	57.65%	-1.70	-1.72 *
9	-2.85%	76.60%	-1.67	-1.64	-3.05%	62.93%	-2.18	-2.20 **
10	-2.04%	86.87%	-1.05	-0.95	-2.71%	65.42%	-1.86	-1.87 *
11	-1.05%	98.40%	-0.48	-0.53	-2.56%	69.27%	-1.66	-1.68 *
12	-1.48%	99.69%	-0.67	-0.58	-2.56%	72.52%	-1.58	-1.56

It can be seen in Table 1 that there are significant further price falls in the eight months following the warning. This may be explained in terms of the above models as a consequence of investors further revising down their model of earnings in response to repeated earnings outcomes that fall below earlier expectations. The critical issue, if we are to provide event study support for these models of reversals, is that the sum of the downward revisions, starting from the date the warning was issued, constitute an overreaction. This is judged by the abnormal returns to a strategy of purchasing stocks after this run of disappointing outcomes.

Table 2, panels A, B, and C, report the abnormal returns to a strategy of purchasing stocks six, nine, or twelve months after a profit warning respectively.

Table 2. Abnormal Returns from six, nine and twelve months

Monthly Buy and Hold Abnormal Returns ($BHAR_{s,\tau}$) and Cumulated Abnormal Returns ($CAR_{s,\tau}$) starting 6, 9 and 12 months after the profit warning was issued and to the end of each month until 18, 21 and 24 months after the warning respectively. Panel A contains results starting in month 6, panel B in month 9 and panel C in month 12 after the profit warning was issued. Numbers are the mean $BHAR_{s,\tau}$ and mean $CAR_{s,\tau}$ across firms in the sample. The sample consists of 2031 firms that issued profit warnings between 1998 and 2000. Abnormal returns are the difference between the return delivered by the event firm minus the average return of the corresponding reference portfolio. Reference portfolios were created considering firm size measured with market capitalisation and book to market value of equity of control firms that did not issued any profit warning during the analysed period. Abnormal returns are subsequently compounded or cumulated. Standard Deviation, Standard t-Statistics and Skewness Adjusted t-Statistics are reported for $BHAR_{s,\tau}$ and $CAR_{s,\tau}$.*, **, and ***, are based on Skewness Adjusted t-Statistics and denote 10%, 5% and 1% significance level respectively Skewness adjusted t-Statistics are computed as

$$t_{SA} = \sqrt{n}\left(S + \hat{\gamma}S^2 + \frac{1}{6n}\hat{\gamma} \right), \text{ where } S = \frac{\overline{BHAR_\tau}}{\sigma\left(\overline{BHAR_\tau}\right)}, \text{ and } \hat{\gamma} = \frac{\sum_{i=1}^{n}\left(BHAR_{i\tau} - \overline{BHAR_\tau}\right)^3}{n\sigma\left(\overline{BHAR_\tau}\right)^3}$$

Panel A. $BHAR_{s,\tau}$ and $CAR_{s,\tau}$ starting 6 months after the warning

Months after the Warning	*$BHAR_{s,\tau}$*					*$CAR_{s,\tau}$*				
	Mean	*St. Dev*	*T-stat*	*S.A. T-stat*		*Mean*	*St. Dev*	*T-stat*	*S.A. T-stat*	
7	1.74%	23.33%	3.34	3.51	***	1.61%	21.38%	3.39	3.45	***
8	1.67%	33.07%	2.27	2.36	***	1.34%	29.90%	2.01	2.02	**
9	1.08%	42.42%	1.14	1.18		0.47%	37.86%	0.56	0.56	
10	1.92%	55.16%	1.56	1.68	*	0.81%	43.44%	0.84	0.85	
11	2.17%	63.50%	1.54	1.66	*	0.96%	47.83%	0.90	0.91	
12	1.78%	67.64%	1.18	1.26		0.96%	51.71%	0.83	0.84	
13	1.28%	68.52%	0.84	0.88		1.42%	55.49%	1.15	1.16	
14	2.14%	78.40%	1.22	1.29		1.97%	58.44%	1.51	1.52	
15	3.60%	86.62%	1.87	2.01	**	2.89%	63.24%	2.05	2.08	**
16	4.79%	103.43%	2.08	2.32	**	3.19%	66.19%	2.17	2.19	**
17	7.25%	119.82%	2.72	3.14	***	4.64%	70.33%	2.96	3.00	***
18	7.74%	125.62%	2.77	3.14	***	4.36%	74.94%	2.61	2.64	***

Panel B. $BHAR_{s,\tau}$ and $CAR_{s,\tau}$ starting 9 months after the warning

Months after the Warning	*BHAR*					*CAR*				
	Mean	*St. Dev*	*T-stat*	*S.A. T-stat*		*Mean*	*St. Dev*	*T-stat*	*S.A. T-stat*	
10	0.36%	23.86%	0.68	0.72		0.35%	21.57%	0.72	0.74	
11	0.46%	33.00%	0.62	0.66		0.49%	29.00%	0.76	0.77	
12	0.31%	38.33%	0.36	0.38		0.49%	34.31%	0.64	0.65	
13	0.44%	43.99%	0.45	0.46		0.95%	40.21%	1.07	1.07	
14	0.75%	52.48%	0.65	0.67		1.50%	44.55%	1.51	1.51	
15	2.00%	62.03%	1.45	1.64		2.42%	50.24%	2.16	2.19	**
16	2.90%	73.43%	1.77	1.87	*	2.73%	53.59%	2.28	2.31	**
17	5.48%	88.94%	2.76	2.95	***	4.17%	58.45%	3.20	3.24	***
18	5.37%	92.17%	2.61	3.01	***	3.89%	63.49%	2.75	2.78	***
19	7.66%	109.56%	3.14	3.79	***	4.71%	66.59%	3.18	3.21	***
20	8.01%	107.05%	3.36	3.75	***	4.99%	69.67%	3.21	3.25	***
21	7.65%	111.81%	3.07	3.40	***	4.14%	72.83%	2.55	2.57	***

Panel C.$BHAR_{s,\tau}$ and $CAR_{s,\tau}$ starting 12 months after the warning										
Months after the Warning	*BHAR*					*CAR*				
	Mean	*St. Dev*	*T-stat*	*S.A. T-stat*		*Mean*	*St. Dev*	*T-stat*	*S.A. T-stat*	
13	0.66%	24.06%	1.23	1.28		0.33%	21.99%	0.67	0.68	
14	0.96%	32.06%	1.34	1.38		0.87%	29.23%	1.34	1.35	
15	1.87%	41.64%	2.01	2.13	**	1.80%	37.30%	2.16	2.23	**
16	2.01%	47.99%	1.88	1.99	**	2.10%	41.59%	2.27	2.32	**
17	3.88%	60.55%	2.87	3.17	***	3.55%	47.51%	3.35	3.43	***
18	3.96%	68.15%	2.61	2.85	***	3.27%	52.69%	2.78	2.84	***
19	5.21%	73.66%	3.17	3.55	***	4.09%	56.05%	3.27	3.33	***
20	6.07%	81.14%	3.36	3.70	***	4.37%	59.29%	3.30	3.36	***
21	6.41%	88.29%	3.26	3.57	***	3.52%	63.61%	2.48	2.50	***
22	6.14%	95.40%	2.89	3.21	***	3.13%	65.70%	2.14	2.15	**
23	6.20%	100.51%	2.77	3.07	***	3.27%	68.52%	2.14	2.15	**
24	5.03%	104.22%	2.16	2.35	***	2.29%	70.35%	1.46	1.47	

It can be seen in Table 2 that the strategy of purchasing stocks either six, nine, or twelve months after a profit warning delivers a buy-and-hold abnormal return over the next twelve months of 7.74%, 7.65%, and 5.03% respectively, all statistically significant at the 1% level.

It has often been found that anomalies are more pronounced for smaller firms than for larger firms. For example this was reported in the case of abnormal returns following earnings announcements, Bernard and Thomas (1989) and new issues (IPOs or SEOs), Loughran and Ritter (1995) and Brav et al. (2000). In Table 3 we report results where the sample is divided into size quintiles, based on NYSE breakpoints.

Table 3. Abnormal Returns by Size Quintiles

Monthly Buy and Hold Abnormal Returns ($BHAR_{s,\tau}$) for firms belonging to the smallest and largest quintile according to their size. Holding periods start 6, 9 and 12 months after the profit warning was issued and end each month until 18, 21 and 24 months after the warning respectively. Panel A contains results starting in month 6, panel B in month 9 and panel C in month 12 after the profit warning was issued. Numbers are the mean $BHAR_{s,\tau}$ and mean $CAR_{s,\tau}$ across firms in the smallest and largest quintiles measured by market capitalisation. Abnormal returns are the difference between the return delivered by the event firm minus the average return of the corresponding reference portfolio. Reference portfolios were created considering firm size measured with market capitalisation and book to market value of equity of control firms that did not issued any profit warning during the analysed period. Abnormal returns are subsequently compounded or cumulated. Standard Deviation, Standard t-Statistics and Skewness Adjusted t-Statistics are reported for $BHAR_{s,\tau}$. *, **, and ***, are based on Skewness Adjusted t-Statistics and denote 10%, 5% and 1% significance level respectively Skewness adjusted t-Statistics are computed as

$$t_{SA} = \sqrt{n}\left(S + \hat{\gamma}S^2 + \frac{1}{6n}\hat{\gamma} \right), \text{ where } S = \frac{\overline{BHAR_\tau}}{\sigma\left(\overline{BHAR_\tau}\right)}, \text{ and } \hat{\gamma} = \frac{\sum_{i=1}^{n}\left(BHAR_{i\tau} - \overline{BHAR_\tau}\right)^3}{n\sigma\left(\overline{BHAR_\tau}\right)^3}$$

Panel A. $BHAR_{s,\tau}$ starting 6 months after the warning for firms in the smallest and largest size quintiles

Months after the Warning	*Smallest Firms*				*Largest Firms*				*T-Stat for the difference between means*
	Mean BHAR	*St. Dev*	*T-stat*	*S.A. T-stat*	*Mean BHAR*	*St. Dev*	*T-stat*	*S.A. T-stat*	
7	0.47%	26.07%	0.40	0.56	2.02%	22.17%	1.76	2.05 **	0.47
8	0.92%	36.61%	0.57	0.65	1.28%	30.92%	0.80	0.91	0.09
9	1.04%	51.58%	0.45	0.52	0.85%	35.37%	0.47	0.73	-0.04
10	0.03%	56.97%	0.01	0.06	2.07%	65.72%	0.61	0.82	0.38
11	-0.01%	68.96%	0.00	0.10	1.98%	65.82%	0.58	0.70	0.36
12	-0.30%	75.37%	-0.09	0.11	2.11%	68.13%	0.60	0.67	0.42
13	-1.34%	76.10%	-0.40	-0.30	2.46%	71.34%	0.67	0.86	0.65
14	-1.16%	91.56%	-0.28	0.01	3.17%	78.34%	0.78	0.98	0.69
15	1.57%	101.28%	0.35	0.61	3.02%	80.64%	0.72	0.76	0.22
16	3.89%	125.73%	0.69	0.92	4.09%	82.37%	0.96	1.02	0.03
17	8.11%	168.47%	1.08	1.14	4.89%	83.02%	1.14	1.29	-0.43
18	7.41%	163.16%	1.02	1.13	4.75%	82.92%	1.11	1.27	-0.36

Panel B. $BHAR_{s,\tau}$ starting 9 months after the warning for firms in the smallest and largest size quintiles

Months after the Warning	*Smallest Firms*				*Largest Firms*				*T-Stat for the difference between means*
	Mean BHAR	*St. Dev*	*T-stat*	*S.A. T-stat*	*Mean BHAR*	*St. Dev*	*T-stat*	*S.A. T-stat*	
10	0.23%	28.34%	0.18	0.26	-0.04%	25.15%	-0.03	-0.06	-0.08
11	0.44%	43.68%	0.23	0.31	0.42%	29.64%	0.27	0.31	-0.01
12	-0.45%	47.43%	-0.21	-0.06	0.43%	34.20%	0.24	0.33	0.20
13	-1.70%	47.79%	-0.80	-0.93	0.51%	38.01%	0.26	0.49	0.50
14	-3.66%	54.79%	-1.50	-1.67	0.71%	43.81%	0.31	0.36	0.92
15	-1.67%	64.39%	-0.58	-0.62	0.45%	46.56%	0.19	0.44	0.42
16	-0.96%	74.71%	-0.29	-0.40	1.16%	47.67%	0.47	0.72	0.40
17	2.38%	106.29%	0.50	0.60	2.11%	50.06%	0.81	1.07	-0.05
18	1.89%	105.99%	0.40	0.69	2.97%	56.73%	1.01	1.28	0.18
19	6.18%	120.42%	1.15	1.29	3.04%	62.94%	0.93	1.06	-0.49
20	7.22%	130.76%	1.24	1.34	3.34%	66.57%	0.97	1.12	-0.59
21	7.24%	135.99%	1.20	1.43	2.80%	74.66%	0.72	0.79	-0.65

Panel C. $BHAR_{s,\tau}$ starting 12 months after the warning for firms in the smallest and largest size quintiles

Months after the Warning	*Smallest Firms*				*Largest Firms*				*T-Stat for the difference between means*
	Mean BHAR	*St. Dev*	*T-stat*	*S.A. T-stat*	*Mean BHAR*	*St. Dev*	*T-stat*	*S.A. T-stat*	
13	-0.05%	26.33%	-0.04	-0.12	-0.03%	15.88%	-0.03	-0.04	0.01
14	-0.96%	35.15%	-0.61	-0.85	-0.25%	24.28%	-0.20	-0.31	0.19
15	0.87%	52.29%	0.38	0.57	-0.27%	28.69%	-0.18	-0.22	-0.27
16	0.56%	59.27%	0.21	0.48	0.87%	31.91%	0.52	0.57	0.07
17	2.30%	84.41%	0.61	0.87	2.00%	36.47%	1.06	1.19	-0.06
18	3.36%	95.30%	0.79	0.87	1.83%	39.39%	0.90	1.21	-0.28
19	5.98%	100.53%	1.34	1.38	1.31%	43.20%	0.59	0.97	-0.83
20	6.97%	105.39%	1.48	1.63	1.83%	47.64%	0.74	0.79	-0.89
21	8.04%	110.08%	1.64	1.65 *	0.89%	52.18%	0.33	0.57	-1.20
22	7.04%	111.54%	1.42	1.53	-0.86%	53.44%	-0.31	-0.42	-1.31
23	6.97%	111.69%	1.40	1.41	-1.87%	53.58%	-0.67	-0.74	-1.46
24	3.16%	110.62%	0.64	0.87	-3.13%	56.34%	-1.07	-1.15	-1.03

It can be seen in Table 3 that the point estimates of abnormal returns after twelve months are larger for small firms than for large firms for all three portfolio formation dates and this is consistent with other work that has reported that anomalies are more pronounced for small firms. However although this is suggestive of a larger overreaction for small than for large firms the low level of statistical significance means that this inference is at best preliminary. The smaller number of stocks in the quintile portfolios may explain the result that results are never statistically significant at conventional levels. However there is no evidence that small stocks drive the results for the whole sample, with the point estimates of abnormal returns for the largest quintile of 4.8% and 2.8% over twelve months for portfolios formed six and nine months respectively after the profit warning.

Another issue is whether there are any systematic differences in the reaction of investors to disappointments from growth stocks and value stocks. One might conjecture that when a larger proportion of stock value lies in the future, and is therefore more dependent on the realisation of growth expectations, that investors might be more sensitive to any disappointments. If investors overreact more to a short run of disappointments from growth stocks this should imply greater positive abnormal returns on growth stocks bought after the run of news. Evidence on this is reported in Table 4 where we report abnormal returns for the quintiles of highest and lowest book-to-market stocks.

Table 4. Abnormal Returns by Book-to-Market Quintiles

Monthly Buy and Hold Abnormal Returns ($BHAR_{s,\tau}$) for firms belonging to the lowest and highest quintile according to their book to market value of equity. Holding periods start 6, 9 and 12 months after the profit warning was issued and end each month until 18, 21 and 24 months after the warning respectively. Panel A contains results starting in month 6, panel B in month 9 and panel C in month 12 after the profit warning was issued. Numbers are the mean $BHAR_{s,\tau}$ and mean $CAR_{s,\tau}$ across firms in the lowest and highest quintiles measured by book to market ratio. Abnormal returns are the difference between the return delivered by the event firm minus the average return of the corresponding reference portfolio. Reference portfolios were created considering firm size measured with market capitalisation and book to market value of equity of control firms that did not issued any profit warning during the analysed period. Abnormal returns are subsequently compounded or cumulated. Standard Deviation, Standard t-Statistics and Skewness Adjusted t-Statistics are reported for $BHAR_{s,\tau}$. *, **, and ***, are based on Skewness Adjusted t-Statistics and denote 10%, 5% and 1% significance level respectively Skewness adjusted t-Statistics are computed as

$$t_{SA} = \sqrt{n}\left(S + \hat{\gamma}S^2 + \frac{1}{6n}\hat{\gamma} \right), \text{ where } S = \frac{\overline{BHAR_\tau}}{\sigma\left(\overline{BHAR_\tau}\right)}, \text{ and } \hat{\gamma} = \frac{\sum_{i=1}^{n}\left(BHAR_{i\tau} - \overline{BHAR_\tau}\right)^3}{n\sigma\left(\overline{BHAR_\tau}\right)^3}$$

Panel A. $BHAR_{s,\tau}$ starting 6 months after the warning for firms in the lowest and highest book to market quintiles

Months after the Warning	*Low BM Firms*				*High BM Firms*				*T-Stat for the difference between means*
	Mean BHAR	*St. Dev*	*T-stat*	*S.A. T-stat*	*Mean BHAR*	*St. Dev*	*T-stat*	*S.A. T-stat*	
7	1.32%	25.02%	1.37	1.72 *	3.37%	31.12%	1.50	1.65 *	0.46
8	1.01%	36.93%	0.71	0.83	3.64%	41.63%	1.21	1.31	0.50
9	1.09%	52.49%	0.54	0.69	1.65%	44.76%	0.51	0.70	0.10
10	1.99%	57.68%	0.89	1.22	3.88%	91.24%	0.59	0.77	0.25
11	2.20%	70.24%	0.81	0.96	4.50%	90.14%	0.69	0.92	0.30
12	2.56%	74.61%	0.89	1.07	4.38%	91.84%	0.66	0.91	0.24
13	1.45%	72.44%	0.52	0.52	4.67%	96.28%	0.67	0.96	0.41
14	0.14%	75.61%	0.05	0.24	6.44%	108.05%	0.83	1.03	0.77
15	2.79%	87.35%	0.83	1.14	5.43%	110.23%	0.68	1.08	0.31
16	3.40%	97.16%	0.91	0.95	6.08%	110.93%	0.76	0.78	0.32
17	5.95%	113.23%	1.36	1.48	5.55%	112.95%	0.68	0.98	-0.05
18	6.35%	115.56%	1.42	1.56	3.64%	106.14%	0.48	0.68	-0.32

Panel B. $BHAR_{s,\tau}$ starting 9 months after the warning for firms in the lowest and highest book to market quintiles

Months after the Warning	*Low BM Firms*				*High BM Firms*				*T-Stat for the difference between means*
	Mean	St. Dev	T-stat	*S.A. T-stat*	Mean	St. Dev	T-stat	*S.A. T-stat*	
10	1.80%	28.66%	1.63	1.69 *	-1.34%	31.78%	-0.58	-0.49	-0.69
11	1.30%	41.70%	0.81	0.87	-0.19%	36.78%	-0.07	0.08	-0.30
12	2.23%	46.14%	1.25	1.65 *	0.86%	43.72%	0.27	0.65	-0.25
13	2.36%	49.30%	1.24	1.53	2.15%	52.04%	0.57	0.69	-0.03
14	0.91%	54.46%	0.44	0.58	2.12%	56.91%	0.52	0.78	0.20
15	3.07%	63.87%	1.25	1.46	1.40%	59.42%	0.33	0.40	-0.26
16	3.78%	70.75%	1.39	1.77 *	1.72%	60.05%	0.40	0.72	-0.32
17	7.35%	90.64%	2.10	2.12 **	0.58%	60.44%	0.13	0.24	-1.01
18	5.71%	88.96%	1.66	1.69 *	1.04%	62.63%	0.23	0.30	-0.69
19	8.23%	94.65%	2.26	2.59 ***	3.48%	72.66%	0.66	0.95	-0.66
20	10.91%	114.24%	2.48	2.62 ***	3.31%	72.51%	0.63	0.75	-1.03
21	11.48%	119.70%	2.49	2.84 ***	0.28%	73.23%	0.05	0.20	-1.50

Panel C. $BHAR_{s,\tau}$ starting 12 months after the warning for firms in the lowest and highest book to market quintiles

Months after the Warning	*Low BM Firms*				*High BM Firms*				*T-Stat for the difference between means*
	Mean BHAR	*St. Dev*	*T-stat*	*S.A. T-stat*	*Mean BHAR*	*St. Dev*	*T-stat*	*S.A. T-stat*	
13	1.19%	25.46%	1.21	1.56	0.31%	20.13%	0.21	0.37	-0.23
14	0.77%	35.16%	0.56	0.88	-0.38%	31.08%	-0.17	-0.25	-0.25
15	2.60%	48.27%	1.40	1.47	-1.18%	35.36%	-0.46	-0.55	-0.75
16	3.28%	56.32%	1.51	1.58	-0.72%	38.75%	-0.26	-0.35	-0.75
17	6.05%	75.74%	2.07	2.23 **	-0.39%	45.76%	-0.12	-0.23	-1.09
18	5.11%	82.53%	1.60	1.63	-1.51%	41.75%	-0.50	-0.62	-1.13
19	6.24%	85.32%	1.90	2.01 **	-0.16%	45.70%	-0.05	-0.11	-1.06
20	8.32%	98.74%	2.19	2.36 ***	-0.05%	47.86%	-0.01	-0.04	-1.33
21	9.29%	104.52%	2.30	2.43 ***	-2.96%	48.25%	-0.85	-0.96	-1.92 *
22	8.63%	109.37%	2.05	2.11 **	-1.91%	52.56%	-0.50	-0.61	-1.60
23	8.19%	109.41%	1.94	2.27 **	-1.44%	53.63%	-0.37	-0.43	-1.45
24	7.95%	123.68%	1.67	1.83 *	-3.27%	52.01%	-0.87	-0.96	-1.66 *

It can be seen in Table 4 that there is evidence that overreaction is more significant for growth stocks than value stocks. For start dates of nine and twelve months after the warning there is evidence of significant positive abnormal returns for growth stocks, but not for value stocks. For example buying growth stocks nine months after a warning yields statistically significant abnormal profits of 11.5% over the next twelve months but value stocks deliver only an insignificant 0.3% over the same horizon. This suggests that investors overreact more to a short series of disappointments from growth stocks than from value stocks, resulting in stronger abnormal returns as subsequent earnings news arrives.

4. Summary and Conclusion

Behavioural models of momentum have benefited from support from event studies that suggest the market indeed underreacts to a single public news announcements. In this paper we use the event study methodology to test behavioural models that explain returns reversals as a consequence of investors overreacting to short runs of recent earnings news. We identify a period when investors receive a short run of earnings disappointments as the window of six to twelve months following a profit warning. We report that purchasing stocks after this run of disappointing news and holding them for twelve months yields significant positive abnormal returns. We infer that the cause of these positive abnormal returns is that investors overreacted to the short run of bad news heralded by the profit warning. This overreaction became evident as further earnings news arrived that reflected the longer-run earnings potential of the company. Evidence that abnormal returns are more significant for growth stocks than from value stocks suggests that investors are more sensitive to earnings disappointments from growth stocks.

This result could be described as evidence of more long-run mean reversion than investors anticipate in the sense that stocks revert more than is anticipated to the performance expected of them before the profit warning was announced. The results reported here are consistent with those of Lakonishok, Shliefer and Vishny (1994) who investigate why value stocks deliver superior returns. They find that the out-performance of value stocks can also be explained by investors extrapolating a few years of poor past

earnings growth too far into the future. In other words they also find, using a rather different methodology, that there is more mean reversion in growth rates than the market expects so that stocks with poor recent growth become under-priced and deliver good future returns.

This mistake of giving too much weight to a short run of recent data can be described as a failure to recognize the factors that underpin mean reversion in earnings. Investors appear to underestimate the economic forces that drive a recovery in earnings after a short sharp series of disappointments. When earnings fall so far short of expectations that a profit warning needs to be issued this can provide a stimulus to internal changes that address the cause of the disappointments. For example the severity of the problem may galvanize the board into replacing senior managers or give a firm the bargaining power to renegotiate contracts, for example to convince unions to accept changes in pay or working practices that would otherwise be unacceptable. It is the power of these forces that drive mean reversion that limit the weight that investors should give to short runs of disappointing earnings news.

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