Is PEAD a consequence of the presence of the cognitive bias of self-attribution in investors' expectations regarding permanent earnings? Evidence from Athens Stock Exchange

Degiannakis, Stavros and Giannopoulos, George

Department of Economics, Portsmouth Business School, University of Portsmouth, Richmond Building, Portland Street, PO1 3DE, UK, Department of Business Administration, Athens University of Economics and Business, 76 Patision Street, GR 104-34, Athens, Greece

2009

Is PEAD a consequence of the presence of the cognitive bias of *self-attribution* in investors' expectations regarding permanent earnings? Evidence from Athens Stock Exchange

Stavros Degiannakis

Department of Economics,
Portsmouth Business School,
University of Portsmouth,
Richmond Building, Portland Street,
PO1 3DE, UK
E-mail: sdegia@aueb.gr

George Giannopoulos*

Department of Business Administration,
Athens University of Economics and Business,
76 Patision Street, GR 104-34,
Athens, Greece
and
Department of Regional Economic Development,
University of Central Greece,
L. Katsoni Square, GR 32-100,
Livadia, Greece
E-mail: gyiannopoulos@hotmail.com
*Corresponding author

Abstract: The main objective of the paper is to test whether post-earnings announcement drift (PEAD) is a consequence of the presence of *self-attribution* bias in investors' expectations, regarding permanent earnings. This is the first study to examine empirically this issue, in the sample of Athens Stock Exchange firms. *Self-attribution* bias implies that the investors respond asymmetrically to confirmations and negations of their prior expectations, regarding permanent earnings, which are based on *private information*. Confirmations of prior expectations, which are based on private information, lead to increases in investors' confidence in their expectations, regarding permanent earnings. On the other side, negations of prior expectations, which are based on private information, fail to diminish investors' confidence, regarding permanent earnings. The study provides evidence that *self-attribution* bias does not drive PEAD in Athens Stock Exchange firms.

Keywords: post-earnings announcement drift; PEAD; *self-attribution* bias; asymmetric response; private information; forecast revision; forecast error; Athens Stock Exchange; earnings announcement; computational economics.

Reference to this paper should be made as follows: Degiannakis, S. and Giannopoulos, G. (2009) 'Is PEAD a consequence of the presence of the cognitive bias of *self-attribution* in investors' expectations regarding permanent earnings? Evidence from Athens Stock Exchange', *Int. J. Computational Economics and Econometrics*, Vol. 1, No. 1, pp.89–110.

Biographical notes: Stavros Degiannakis is a Research Fellow in the Business School of University of Portsmouth and Adjunct Lecturer in Athens University of Economics and Business. He has an extensive number of publications in international journals in the areas of applied economics, econometrics and statistics. He also serves as member of the Editorial Board and referee in international journals.

George Giannopoulos is an Adjunct Lecturer in the Athens University of Economics and Business and Adjunct Assistant Professor in the University of Central Greece.

1 Introduction

An extensive literature exists on the presence and causes of post-earnings announcement drift (PEAD)[1]. Rival models have emerged to aid understanding of how PEAD might occur in competitive financial markets (see Daniel et al., 1998; Barberis et al., 1998; Hong and Stein, 1999). Strangely, empirical work seems to largely proceed without reference to emerging theory. In order to assist this process, Mendenhall's (1991) study is revisited in light of Daniel et al. (1998) theoretical model of what causes PEAD in competitive markets.

The paper is structured as follows. The next section provides the theoretical framework and develops the appropriate hypotheses under investigation. The third section describes the empirical framework. In particular, Mendenhall's (1991) method is described in Section 3.1, and in Section 3.2, it is revisited in the light of the Daniel et al.'s (1998) model of the origins of PEAD. A fourth section extends Mendenhall's test to investigate for the effects of *self-attribution* in driving PEAD. A fifth section describes the data collection procedure. In the sixth section, the resulting amended empirical model is tested on a sample of Greek companies in the mid-to-late 1990s. In some sense, evidence of market imperfections is sought where they are most likely to be found, within the context of a loosely regulated emerging economy in the grips of a speculative bubble. A final section concludes the paper.

2 Theoretical framework

The study focuses on the effect of the *self-attribution* bias on investor response to confirmations, or negations, of prior expectations regarding permanent earnings. Daniel et al. (1998) have advanced a general model of stock market response to company news. This model incorporates the possibility of both overreaction and consequent secular underreaction, of the type it is observed in the PEAD context. The model envisages two types of investors, informed and uninformed, trading a risky asset over four dates. Informed investors are overconfident in the sense that they overestimate the precision of private (not public) signals. At date 0, each agent receives an endowment. At date 1, only the informed agent receives a noisy private signal about the value of the asset. At date 2, a second noisy signal arrives. Finally, at date 3, the value of the asset is revealed by the receipt of conclusive public information.

Initially, Daniel et al. (1998) investigated their model with constant confidence. They implemented the idea of *self-attribution* bias in their model when they allowed for confidence to be outcome-dependent.

Self attribution bias has been characterised as having an attitude 'heads I win, tails it is chance'[2]. Good news (i.e., consistent with prior expectations) gives the decision-maker courage to act, whereas bad news (i.e., inconsistent with prior expectations) is not seen as having much information about decision-making ability. In some sense, investors overestimate the degree to which they are responsible for their own success – as people do it in general – subsequently, successful investors may grow overconfident and this may cause them to overestimate the precision of their knowledge as suggested by the calibration literature[3]. In Gervais and Odean (2001), this *self-enhancing* bias causes wealthy investors, who are in no danger of being driven from the market place to be overconfident. It is not that overconfidence makes them wealthy, but the process of becoming wealthy contributes to their overconfidence. An old Wall Street adage: 'do not confuse brains with a bull market' warns traders of the danger of becoming overconfident during a market rally.

The present study investigates the effects of *self-attribution* bias in driving PEAD, as implied by the calibration theory[4], through the lens of Daniel et al.'s (1998) model, by reinterpreting the Mendenhall's (1991) empirical framework. In particular, Daniel et al. (1998) stressed biases in the interpretation of private, rather than public information. Assume that investors do some research on their own to try to determine a firm's permanent earnings. Daniel et al. (1998) assumed that investors are overconfident about their expectations, regarding permanent earnings, which are based on private information, received at date 1. If this is the case, private information may cause investors to overestimate the probability that there is a shift, if any, in the permanent earnings stream. As a result, the market overreacts upon the arrival of private information signals. At date 2, when subsequent public signal arrives (earnings announcement), investors update their expectations, regarding permanent earnings, in an asymmetric fashion; public news (earnings news announcement) which confirm investors' previous expectations, which are based on their private information, increase investors confidence in their expectations, regarding permanent earnings. Disconfirming public news (earnings news announcement) though, is given less attention, and investors' confidence fails to diminish. If this is the case, confirmatory rather than negatory earnings news announcements may cause investors to continue overestimating the probability that there is a shift in the permanent earnings stream. This asymmetric response means that initial overreaction is on average followed by even greater overreaction, generating momentum. Under this setting, PEAD arises as a manifestation of continued overreaction to earnings announcements. The above framework implies that investors respond asymmetrically to confirmations and negations, by a public signal (earnings announcement), of their prior expectations, regarding permanent earnings, which are based on private information. Confirmations of prior expectations, which are based on private information lead to increases in investors' confidence in their expectations, regarding permanent earnings. Negations of prior expectations, which are based on private information, fail to diminish investors' confidence, regarding permanent earnings. Moreover, any resulting investors' overconfidence in their expectations, regarding permanent earnings, is likely to induce PEAD.

The present study tests this proposition, by revising and augmenting the empirical model of Mendenhall (1991). Mendenhall's (1991) method is described next and then revisited in light of the Daniel et al. (1998) model of the origins of PEAD.

3 Empirical framework

3.1 The Mendenhall's (1991) framework

Mendenhall (1991) investigated the possibility that analysts underestimate the persistence of earnings forecast errors. The failure to fully recognise the persistence of earnings is hypothesised to underlie PEAD. Further, investors might try to judge the persistence of forecast errors from observing analysts' revisions of their earnings forecasts. Finally, if investors both underestimate the persistence of forecast errors at earnings announcements and re-evaluate the persistence when forecasts are revised, then they may underestimate the persistence of earnings forecasts errors signalled by forecasts revisions. In other words, investors may underweight the information in both earnings announcements and earnings forecast revisions. In the present study, Mendenhall's (1991) investigation is extended towards the following direction:

If investors evaluate the permanent component of earnings innovations when forecasts are revised, then the information environment within which a firm's forecasts revisions are announced may affect investors' assessment of the permanent component of earnings innovations.

For firms where private information is expected to be rife around the revisions announcements, the probability that these revisions are processed into private information is at its highest, since the informed investors are able to produce superior assessments about firms' earnings performance. Mendenhall (1991) investigated the cycle of forecasts revisions represented by the time line of Figure 1.

Figure 1 Cycle of earnings announcement and forecast revision

1st forecast		1st actual		2nd forecast		2nd actual
$t = F_1$		$t = A_1$		$t = F_2$		$t = A_2$
$\hat{E}_{1,1}, \hat{E}_{2,1}$	$\longrightarrow$	E_1	$\longrightarrow$	$\hat{E}_{2,2}$	$\longrightarrow$	E_2

The cycle begins with an initial forecast of earnings made in the first year for one-year-ahead and two-years-ahead earnings. These forecasts are issued simultaneously at date F_1. These forecasts are termed $\hat{E}_{1,1}$ and $\hat{E}_{2,1}$, respectively. Here, the first subscript denotes the earnings announcement being predicted, while the second one denotes the date the forecast is estimated. Following the announcement of actual earnings for the first year of the cycle, E_1, at date A_1, a second forecast of earnings is issued, $\hat{E}_{2,2}$, at date F_2. The cycle closes and recommences with the announcement of year 2 earnings, E_2, at date A_2. Two variables are used to examine the forecast revision cycle and its relation to stock prices. These are the forecast revision and the forecast error, both of which are scaled by price.[5] Thus:

$$ERR_{i,n} = \frac{E_{i,n} - \hat{E}_{i,j,n}}{P_n} \tag{1}$$

where

- $ERR_{i,n}$ is the price deflated forecast error for the ith earnings announcement (i = 1, 2) for the prediction made at the jth forecast date for the nth observation.[6]
- $E_{i,n}$ is the EPS reported on the ith announcement date for the nth announcement.
- $\hat{E}_{i,i,n}$ is the prediction of $E_{i,n}$ made on the jth forecast date (i = 1, 2) for the nth observation.
- P_n is the closing stock price ten days before the first of the two sequential earnings announcements (i.e., $A_1 - 10$).

The tests require only the two most recent one-year-ahead forecast errors and the most recent forecast revision of the 2nd earnings announcement:

i.e., $ERR_{1,n} = \frac{E_{1,n} - \hat{E}_{1,1,n}}{P_n}$, $ERR_{2,n} = \frac{E_{2,n} - \hat{E}_{2,2,n}}{P_n}$ are the most recent forecast errors of the one-year-ahead forecast for the 1st and 2nd earnings announcements, respectively.

The most recent earnings forecast revision for the nth observation is the change in the forecast of $E_{2,n}$ from F_1 to F_2, scaled by price:

$$REV_n = \frac{\hat{E}_{2,2,n} - \hat{E}_{2,1,n}}{P_n} \tag{2}$$

Hence, in order to undertake the Mendenhall (1991) tests, data are required on two consecutive earnings announcements (E_1, E_2) and three forecasts at two different dates. At date F_1, the most recent forecast $\left(\hat{E}_{1,1,n}\right)$ for the 1st earnings announcement and the forecast $\left(\hat{E}_{2,1,n}\right)$ for the 2nd earnings announcement in the cycle. At date F_2, the most recent forecast $\left(\hat{E}_{2,2,n}\right)$ for the 2nd of the two sequential earnings announcements. To control for outliers, the results presented in this study are based on tests carried out after variables are winsorised[7].

Daily abnormal return ($AR_{n,t}$) is given by one of the two following benchmarks:

$$AR_{n,t}^{MA} = R_{n,t} - R_{m,t} \tag{3}$$

or

$$AR_{n,t}^{FF} = R_{n,t} - \left(a_0 + a_1 R_{m,t} + a_2 SmB_t + a_3 HmL_t\right), \tag{4}$$

where

- $AR_{n,t}$ is the daily abnormal return for the *n*th observation, at time *t*.
- $AR_{n,t}^{MA}$ denotes the daily market-adjusted abnormal return for the *n*th observation, at time *t*.
- $AR_{n,t}^{FF}$ denotes the Fama and French (1996) estimate of the daily abnormal return for the *n*th observation, at time *t*.
- $R_{n,t}$ is the daily raw return for the *n*th observation, at time *t*.
- $R_{m,t}$ is the daily mean-return on a value-weighted market index, at time *t*.
- SmB_t is the daily difference in return between a portfolio of the smallest and biggest stocks, ranked by market value.
- HmL_t is the daily difference in return between a portfolio of the highest and lowest book to market ratio stocks.

Within this structure, Mendenhall (1991) tested three related hypotheses:

1 H_1^M: A regression-based test where the successive forecast errors are related:

$$ERR_{2,n} = a_0 + a_1 ERR_{1,n} + e_n, \text{ for } e_n \sim N\left(0, \sigma^2\right). \tag{5}$$

Under the assumption of forecast rationality, the null hypothesis that $a_1 = 0$ is implied, i.e., analysts fully understand the persistence of earnings innovations. Conversely, if analysts underweight the information that current earnings have for future earnings levels (i.e., if they underestimate the persistence of forecast errors), then the consecutive forecast errors will be positively related, or $a_1 > 0$.

2 H_2^M: After controlling for the forecast revision, there is no systematic relation between abnormal returns around the forecast revision and the most recent forecast error. The related issue tested is whether investors use analysts' earnings forecast revisions to reassess the persistence of the most recent forecast error. Mendenhall (1991) tested this by the following regression:

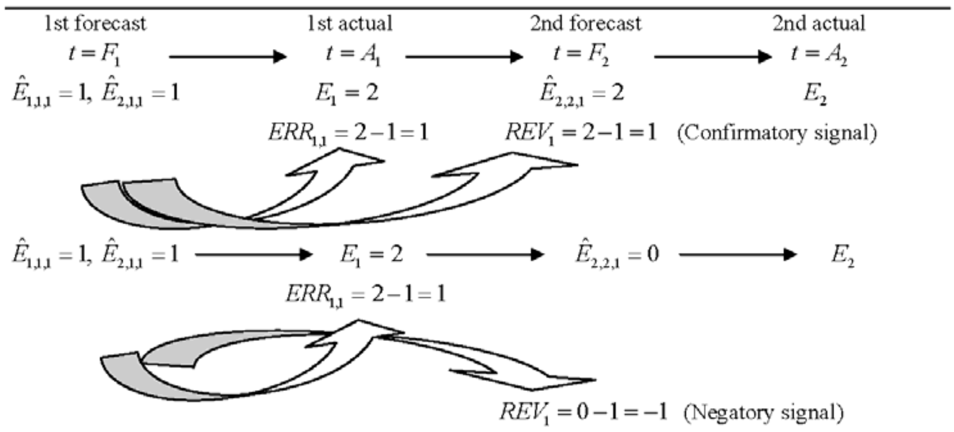
$$CAR_n\left(F_2 - 1, F_2 + 3\right) = a_0 + a_1 REV_n + a_{2s} S_n ERR_{1,n} + a_{2d}\left(1 - S_n\right) ERR_{1,n} + e_n, \quad e_n \sim N\left(0, \sigma^2\right). \tag{6}$$

For $S_n = 1$, if REV_n and $ERR_{1,n}$ are of same sign and $S_n = 0$ if REV_n and $ERR_{1,n}$ are of different sign. Abnormal returns are summed over $t = t_1$ to $t = t_2$ to obtain a cumulative abnormal return, $CAR_n\left(t_1, t_2\right) = \sum_{t=t_1}^{t_2} AR_{n,t}$. If investors revaluate the information in earnings announcements by examining subsequent forecast revisions, the market response to these revisions should be positively (negatively) $a_{2s} > 0$ $(a_{2d} < 0)$ correlated with the most recent forecast error, when the forecast revision and the forecast error are of the same (different) sign. The intuition underlying this hypothesis is based on the analyses of Easton and Zmijewski (1989) and Freeman and Tse (1989).

Figure 2 provides an illustrative example. Consider a stock whose price remains fixed at one. Suppose earnings are forecasted to be one this year and next year, $\left(\hat{E}_{1,1,1} = \hat{E}_{2,1,1} = 1\right)$, but actually turn out to be two, i.e., investors receive *good news* about earnings at A_1. So, $ERR_{1,1}$ takes the value (2 – 1)/1 = 1. In response to this, analysts upgrade their forecast of next year's earnings to remain at two $\left(\text{so, } \hat{E}_{2,2,1} = 2\right)$.

So, the forecast revision in response to earnings is (2 – 1)/1 = 1. So, $ERR_{1,1} = REV_1 = 1$ and a confirmatory information signal has been received from the revision of analysts' earnings forecasts. The Mendenhall's (1991) framework predicts a positive price change to the forecast revision in this case because the confirmatory signal increases investors' expectations of the magnitude of the permanent component of the prior good (positive) earnings surprise. Conversely, when earnings are two (despite an expected value of one) and the resulting forecast revision on this occasion is for earnings to fall from two to zero. Here, a negative price change is predicted by Mendenhall (1991). In this second case $ERR_{1,1}$ remains at (2 – 1)/1 = 1, but REV_n now takes a value (0 – 1)/1 = –1. The prior *good* (positive) news about earnings is regarded as transitory and prices fall to reflect this.[8]

Figure 2 Cycle of earnings announcement and forecast revision



3 H_3^M: Finally, Mendenhall (1991) investigated whether there is any systematic relationship between earnings forecast revisions and abnormal returns around subsequent earnings announcement. This is tested by the following regression:

$$CAR_n\left(A_2 - 1, A_2\right) = a_0 + a_1 REV_n + a_2 ERR_{2,n} + a_3 ERR_{1,n} + e_n, \text{ for } e_n \sim N\left(0, \sigma^2\right). \quad (7)$$

Under the null hypothesis of investors' rationality, earning expectations are fully impounded by the stock market and so the market reaction around earnings announcement is solely a function of any unpredicted *earnings surprise*. $ERR_{2,n}$ is included as a control variable. $ERR_{1,n}$ is included as a control variable as according to Freeman and Tse (1989) and Bernard and Thomas (1989), the $ERR_{1,n}$ has explanatory power over the abnormal returns around the subsequent earnings announcement.

3.2 Mendenhall's (1991) framework revisited

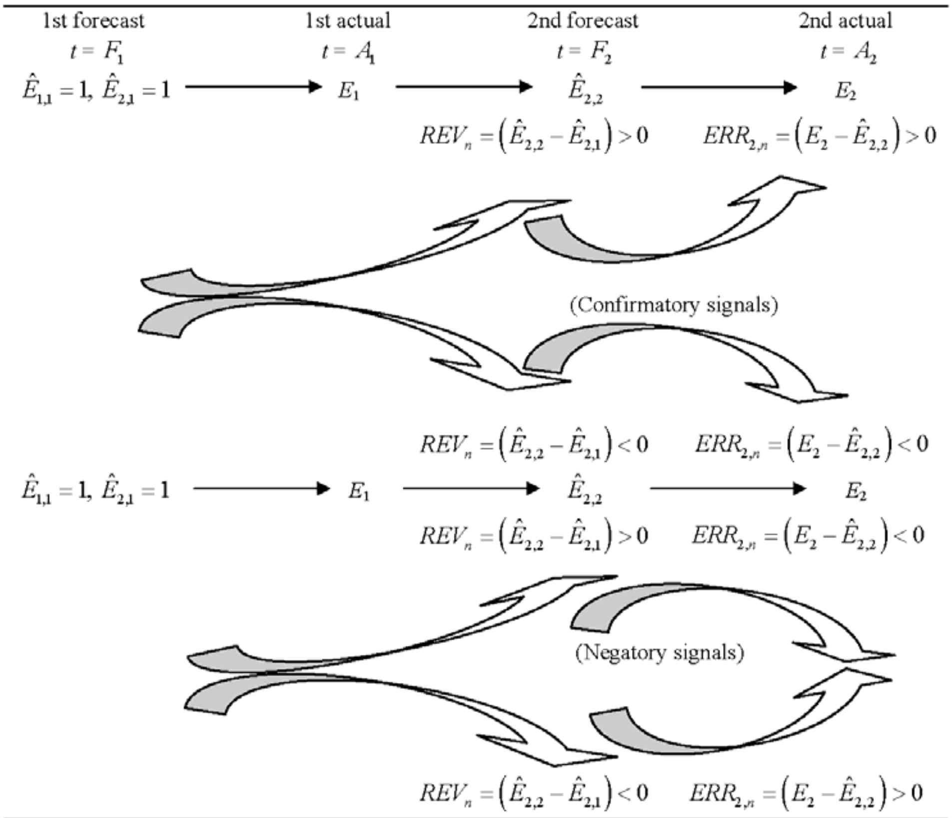
Re-investigating Mendenhall's (1991) tests in the light of the rationalisation of PEAD, one common theme, which stands out is the importance of the distinction between confirmatory and negatory signals about permanent earnings. In the Daniel et al. (1998) framework, confirmation of prior earnings expectations makes investors more confident. Nevertheless, contradictions of prior earnings expectations do not diminish investors' confidence in their ability to interpret earnings information. Daniel et al.'s (1998) predictions relate to PEAD as opposed to price responses to analysts forecast revisions. So, focus is upon PEAD, as opposed to post forecast revision drift. Hence, the importance of the distinction between confirmatory and negatory earnings expectations is in relation to earnings announcements, rather than in relation to revisions announcements. This suggests that a signal is confirmatory (negatory) not when the most recent forecast revision is of the same (different) sign with the prior forecast error, as in the Mendenhall's (1991) second hypothesis test. In the current set-up, it is of interest whether the current forecast error ($ERR_{2,n}$) is of the same or different sign with the most recent forecast revision (REV_n). In other words, it is of interest whether investors' expectations regarding permanent earnings, following an earnings announcement, are consistent or not with their most recent (prior) expectations, regarding permanent earnings.

Figure 3 Confirmatory and negatory signals

	Error at the 2nd announcement date	
Forecast revision	$\left(E_2 - \hat{E}_{2,2}\right) > 0$	$\left(E_2 - \hat{E}_{2,2}\right) < 0$
$\left(\hat{E}_{2,2} - \hat{E}_{2,1}\right) > 0$	Confirm ($S = 1$)	Negate ($S = 0$)
$\left(\hat{E}_{2,2} - \hat{E}_{2,1}\right) < 0$	Negate ($S = 0$)	Confirm ($S = 1$)

An earnings news announcement at date A_2 confirms investors' prior earnings expectations when the most recent consensus forecast revision (REV_n) and the current forecast error ($ERR_{2,n}$) are of the same sign. An earnings news announcement at date A_2 negates investors' prior earnings expectations, when the most recent consensus forecast revision (REV_n) and the current forecast error ($ERR_{2,n}$) are of different sign. An earnings news announcement is negatory in the sense that it refutes prior expectations regarding the permanent component of earnings innovations. An earnings news announcement is confirmatory in the sense that it confirms prior expectations regarding the permanent component of earnings innovations. As a result, investors become more confident about their forecasting ability regarding permanent earnings, as implied by Daniel et al. (1998). The first underlying assumption, in the light of Freeman and Tse (1989), is that a confirmation in sign of the most recent forecast revision (REV_n) by the current forecast error ($ERR_{2,n}$) is an indication whether the earnings' shift is permanent. The second implicit assumption is that investors use analysts' forecasts to assess permanent earnings innovations, as in Mendenhall's (1991) second hypothesis.

Figure 4 Cycle of earnings announcement and forecast revision



So far, the Mendenhall (1991) framework has simply been re-interpreted in the light of Daniel et al. (1998). But Daniel et al.'s (1998) model would not immediately suggest an empirical test of the form that Mendenhall originally proposed. This is because of the importance of private information received by investors, before the earnings announcement, in driving PEAD. Recall that investors are overconfident about private (not public) signals. This introduces another element to the origins of PEAD not accounted for by the test of Mendenhall (1991). In the present study, the informational environment within which a firm's earnings related information is announced, such as the most recent forecast revision, is proxied.

One reason why the informational environment within which a firm's earnings are announced may affect PEAD has already been examined empirically by Bhushan (1994), who related the incidence and magnitude of PEAD to variables capturing the cost for investor's of processing earnings information. PEAD is hypothesised by Bhushan (1994) to be clustered in low priced, low volume stocks. In low priced stocks, bid-ask spreads would constitute a greater proportion of value and so they would constitute a greater disadvantage to arbitrage strategies designed to exploit PEAD. Similarly, low volume stocks are subject to greater liquidity problems[9], causing prices to move against arbitrage traders as they implement counter-PEAD trading strategies.

The relationship between company earnings announcements and the bid-ask spread is now well-documented for the NYSE [Krinsky and Lee (1996) and the NASDAQ (Affleck-Graves et al. (2002)] in the US. In the UK, the issue has been investigated by Gregoriou (2004). These studies confirm that as the earnings announcement draws near market makers extract greater compensation for the risk of dealing with a corporate insider, who may have hidden knowledge about the veracity and reliability of announced earnings information. Such a risk-premium, often termed the adverse selection component of the bid-ask spread, is likely to be largest in low volume[10], illiquid stocks. Such a risk-premium is charged by a market maker faced with the prospect of dealing with someone more able to interpret the earnings announcement than himself. The theoretical background underlying this relies on the typical information model (e.g., Glosten and Milgrom, 1985) which assumes two types of traders; liquidity traders and potential information processors (or informed traders). Informed traders trade because they have private information not currently reflected in prices, while liquidity traders trade for reasons other than superior information. Market makers sustain losses from trading with informed traders and they recover these losses through the bid-ask spread. These models suggest that greater information asymmetry among market participants will lead to wider spreads. If the market maker anticipates a greater probability of facing an informed trader as the earnings announcement draws near, these models predict that the spread, and in particular, the adverse selection component of the spread should widen. Although the effect of these studies document pertains to actual earnings announcements rather than analysts forecast revisions, in the present study, it is hypothesised that the higher the adverse selection component of the spread in low volume[11] firms, at the date forecast revision is released, the higher the probability that investors trade because they possess private information.[12] For these firms where private information is expected to be rife, the probability that forecast revisions are processed into private information is at its highest, since informed investors are able to produce superior assessments about firms' earnings performance.

In the light of the aforementioned analysis, the informational environment within which a firm's most recent forecast revision is announced is proxied by the total quoted bid-ask spread and volume of the firm's stock, at the revision announcement date F_2. Firms operating in a private informational environment are regarded those firms with above median quoted bid-ask spread, as a proportion of price, and below median volume, at the most recent forecast revision announcement date F_2 (illiquid firms henceforth). Firms operating in a public informational environment are regarded those firms with below median quoted bid-ask spread, as a proportion of price, and above median volume, at the most recent forecast revisions announcement date F_2 (liquid firms henceforth). Note that the total quoted bid-ask spread instead of the adverse selection component of the spread, is used to proxy for the informational environment within which a firm's most recent forecast revisions are announced. This is because of adversities in the empirical decomposition of spread in Athens Stock Exchange.

4 Extending Mendenhall's test to investigate for the effects of the *self-attribution* bias in driving PEAD

To capture the effect of *self-attribution* bias in driving PEAD, as implied by the Daniel et al. (1998) model, the Mendenhall's (1991) empirical framework is extended. The next two subsections present a hedge portfolio and a regression-based test, which aim to investigate for the effects of *self-attribution* bias in driving PEAD.

4.1 A hedge portfolio-based test

This subsection considers a hedge portfolio-based test which investigates whether the presence of *self-attribution* bias in investors' expectations, regarding permanent earnings, drives PEAD.

The hedge portfolio-based test incorporates not only the effects of the most recent forecast revisions for firms operating in a private informational environment (illiquid firms), at the revision announcement date F_2, but also the effects of the most recent forecast revisions for firms operating in a public informational environment (liquid firms), at the revision announcement date F_2. This is done in order to test whether the effects of *self-attribution* bias in driving PEAD are stronger for confirmations of prior expectations regarding permanent earnings, which are based on private, rather than public information.

The hedge portfolio-based test generates four hedge portfolios (A, B, C and D) which are formed, using annual tripartite classifications, by taking long (short) positions in observations with positive (negative) sign earnings news, at date A_2, which are of the same or different sign with the most recent forecast revisions. These are forecast revisions for firms operating in a public/private informational environment, at date F_2. Abnormal returns are calculated using Fama-French risk adjustment. Fama-French abnormal returns are accumulated over a 39-day window. Accumulation begins two days after the earnings announcement at date A_2.

This suggests a decomposition of price drift to earnings information as set out in Table 1. The table consists of four panels (A, B, C, D). Each panel represents a hedge portfolio which is formed by the combination of two factors: the informational environment (public or private) within which an earnings related signal such as the most recent forecast revision (REV_n) is received at date F_2 and the nature (confirmatory or negatory) of the subsequent public earnings news signal (earnings news announcement at date A_2).

Table 1 Revising the Mendenhall (1991) framework to test for the effect of *self-attribution* bias in driving PEAD

Nature of earnings news announcements at date A_2	*Information environment at the most recent forecast revision announcement date F_2*	
	Public	*Private*
	Firms which have above median levels of volume and below median levels bid-ask spread	Firms which have below median levels of volume and above median levels bid-ask spread
Confirmatory earnings news announcements ($ERR_{2,n}$ and REV_n are of the same sign)	A	B
Negatory earnings news announcements ($ERR_{2,n}$ and REV_n are of opposing sign)	C	D

The Daniel et al. (1998) framework implies a concentration of PEAD in panel B, where earnings news announcements at date A_2 confirm investors' prior expectations, regarding permanent earnings. These expectations regarding permanent earnings are based on the most recent forecast revisions (REV_n), for firms operating in a private information environment at the revision announcement date F_2. An earnings news announcement confirms investors' prior expectations, regarding permanent earnings, when ($ERR_{2,n}$) and the most recent forecast revision (REV_n) are of the same sign.

The hedge portfolio represented by panel B is formed by taking a long position in observations with positive sign earnings news, at date A_2, which are of the same sign with the most recent forecast revisions, for firms operating in a private informational environment, at date F_2. The position is funded by short-selling those observations with negative sign earnings news, at date A_2, which are of the same sign with the most recent forecast revisions, for firms operating in a private informational environment, at date F_2.

Earnings news at date A_2 are proxied by $ERR_{2,n}$, which is calculated as the difference between the actual reported earnings, at date A_2, and the most recently issued forecast consensus, at date F_2, scaled by the stock price ten days before the announcement of the first of the two sequential earnings announcements[13]. Note that unexpected earnings are not standardised by the standard deviation of the forecast error in the sample years, as in previous studies. Instead, unexpected earnings are standardised by the stock price ten days before the first of the two sequential earnings news announcements. This is done in order to maintain a consistent scaling variable across all variables.[14] Positive (sign) earnings news observations are defined as those where the actual reported earnings exceed the most recently issued forecast consensus. Negative (sign) earnings news observations are defined as those where the actual reported earnings fall short of the most recently issued forecast consensus.

One weakness of the hedge portfolio-based test is that it does not control for the magnitude of the earnings news (surprise) at A_2, which might affect the magnitude of PEAD. Prior studies on PEAD document a positive relation between the quantity of unexpected earnings and the subsequent price drift, e.g., Bernard and Thomas (1989, 1990).

4.2 A regression-based test

This subsection investigates the incremental effect of *self-attribution* bias in driving PEAD, as implied by the Daniel et al. (1998) model, by modifying the Mendenhall (1991) empirical framework. In particular, this subsection examines whether PEAD is a consequence of the presence of *self-attribution* bias in investors' expectations, regarding permanent earnings, which are based on private information, after controlling for the magnitude of the earnings news (surprise) at A_2. In order to test so, a reformulation of the regression-based test of the form of equation (7) rather than equation (6) is suggested.

More specifically, this issue is addressed by means of a regression framework over the 19-day and 39-day periods, following the announcement of earnings news, at date A_2. The regression model includes dummy variables capturing the incremental effects of *self-attribution* bias on cumulative abnormal-returns and a continuous control variable for the magnitude of unexpected earnings, at date A_2. Furthermore, the regression-based test of the form of the following equation focuses on the incremental effects of earnings news announcements which confirm/negate prior expectations, regarding permanent earnings that are based on private signals.

The regression takes the form:

$$CAR_n\left(A_2+2,A_2+k\right)=a_0+a_{NP}NP_n+a_{PP}PP_n+a_{NN}NN_n+a_{PN}PN_n+ a_1ERR_{2,n}+e_n,\ e_n\sim N\left(0,\sigma^2\right). \quad (8)$$

$CAR_n\left(A_2+2,A_2+k\right)=\sum_{t=A_2+2}^{A_2+k} AR_{n,t}$ is the cumulative Fama-French abnormal return or the cumulative market adjusted return, for the *n*th observation, *k* days following the earnings announcement at date A_2, for $k = 20, 40$. Accumulation period begins two days after the earnings announcement date A_2. NP_n, PP_n, NN_n and PN_n are zero-one dummy variables. NP_n equals one if REV_n is of negative sign and $ERR_{2,n}$ is of positive sign, for firms where private information is rife at the most recent forecast revision announcement date F_2; PP_n equals one if REV_n and $ERR_{2,n}$ are both of positive sign, for firms where private information is rife at the most recent forecast revision announcement date F_2; NN_n equals one if REV_n and $ERR_{2,n}$ are both of negative sign, for firms where private information is rife at the most recent forecast revision announcement date F_2; and PN_n equals one if REV_n is of positive sign and $ERR_{2,n}$ is of negative sign, for firms where private information is rife at the most recent forecast revision announcement date F_2. The intercept a_0 is the incremental effect of all other earnings news announcements (earnings news announcements for firms operating in a public information environment at the most recent forecast revision announcement date F_2)[15]. Finally, the continuous variable $ERR_{2,n}$ is included in order to control for the magnitude of unexpected earnings at date A_2. Equation (8) implies that if *self-attribution* bias affects investors expectations, regarding permanent earnings, then it might be expected that positive (negative) confirmatory earnings news announcements, at date A_2, are associated with positive (negative) post-announcement price drift, for firms operating in a private informational environment at date F_2.

5 Data description

In the Mendenhall (1991) study, value line forecasts for quarterly earnings for the US were used. In the present study, monthly consensus forecasts for annual earnings for the Greek economy are used, to allow focus on a context where failures to impound earnings information into prices may be rife. The selection of research period is determined by data availability. In particular, the sample is constructed from a set of Greek firms in the years 1994–1999 for which a complete set of I/B/E/S consensus annual earnings forecasts and matching annual actuals is available and stock price, volume, bid-ask spread and earnings announcement dates could be obtained. Stock price, volume and bid-ask spread data are provided by Athens Stock Exchange. Earnings announcement dates are hand-collected from the Greek financial press.

The sample is constructed of 98 firms, drawn from 21 industries, yielding 336 observations[16]. Construction, metals, and food and household are the major source of the industrial composition of the sample.

Summary statistics for forecast errors and revisions (scaled by price) are given in Table 2. Recall that the forecast error is defined as the actual value minus the forecast one. Thus, the negative average and median value reflect the presence of optimistic errors. The mean (median) forecast error for the one-year-ahead forecasts is –0.003 (–0.003). Note that in the one-year-ahead forecasts, a few optimistic (i.e., negative) forecast errors shifted the forecast error distribution slightly left (skewness is –1.609).

Table 2 Summary statistics for sample forecast errors and revisions

Variable	*Mean*	*Median*	*SD*	*Max*	*Min*	*Skew*	*Kurtosis*	*N*
$ERR_{2,n} / P_n$	–0.003	–0.003	0.071	0.831	–0.742	–1.609	92.664	336
REV_n / P_n	–0.006	–0.003	0.073	0.889	–0.212	8.154	95.632	336

Notes: $ERR_{2,2,n} / P_n$ is the deflated second one-year-ahead forecast error in the cycle, calculated as the difference between the most recent outstanding earnings consensus forecast $\left(\hat{E}_{2,2,n}\right)$ and announced earnings (E_2), scaled by the price ten days before the first of the two sequential earnings announcements (P_n), for the *n*th observation. The deflated earnings consensus forecast revision (REV_n/P_n) is the change in the consensus forecast of the second earnings in the cycle, from the most recent prediction made before the announcement of the first earnings in the cycle $\left(\hat{E}_{2,1,n}\right)$ to the most recent prediction made before the announcement of the second earnings in the cycle $\hat{E}_{2,2,n}$, deflated by the price ten days before the first of the two sequential earnings announcements, for the *n*th observation.

Table 3 Decomposition of sample observations by earnings news and liquidity

	Good	*Bad*	*Total*
Liquid	25 (23.6%)	31 (29.2%)	56 (52.8%)
Illiquid	23 (21.7%)	27 (25.5%)	50 (47.2%)
Total			106 (100%)

Notes: Liquid stocks are defined as those with above the median volume of trade and below median bid-ask spread as a proportion of total price, at the revision announcement date F_2.
Illiquid stocks are defined as those with blow the median volume of trade and above median bid-ask spread as a proportion of total price, at the revision announcement date F_2.
Good news observations are defined as those where the difference, between the second of the two sequential actual earnings (E_2) and the most recent forecast consensus, divided the stock price ten days before the announcement of the first of the two sequential earnings announcements, is in the highest third of all observations.
Bad news observations are defined as those where the difference, between the second of the two sequential actual earnings (E_2) and the most recent forecast consensus, divided the stock price ten days before the announcement of the first of the two sequential earnings announcements, is in the highest third of all observations.

The liquidity[17] of a stock, which proxies for the informational environment within which a firm's revisions are announced, is judged by reference to the volume of trade in the stock and the quoted bid-ask spread charged on trades in the stock. For a stock to be classified as liquid in this study, it is required to have above median[18] levels of volume as well as below the median quoted bid-ask spread as a percentage of price at the revision announcement date F_2. Table 3 gives the distribution of the 336 company-years observations across the various combinations of level of liquidity at date F_2 and earnings surprise at date A_2, omitting the middle third of earnings surprises.

It appears that sample observations are well-distributed across liquidity and earnings innovations. In other words, neither firms with liquid stocks nor firms with illiquid stock seek to avoid earnings innovations. Since each firm has both its volume and spread calculated each trading day, any stock can transfer from the liquid to illiquid portfolio in any given year. This is particularly important given the turmoil existing in the Greek market during the sample period.

6 Empirical results

6.1 Results of the hedge portfolio-based test

We seek to investigate whether earnings news announcements, which confirm investors' prior expectations, regarding permanent earnings, should be associated with statistically significant PEAD. The Daniel et al. (1998) framework implies a concentration of PEAD in hedge portfolio (B), where earnings news announcements at date A_2 confirm investors' prior expectations, regarding permanent earnings, for firms operating in a private informational environment, at date F_2.

Figure 5 Plot of CARs for the hedge portfolios formed by taking long (short) positions in observations with positive (negative) sign earnings news, at date A_2, which are of the same/different sign with the most recent forecast revisions (see online version for colours)

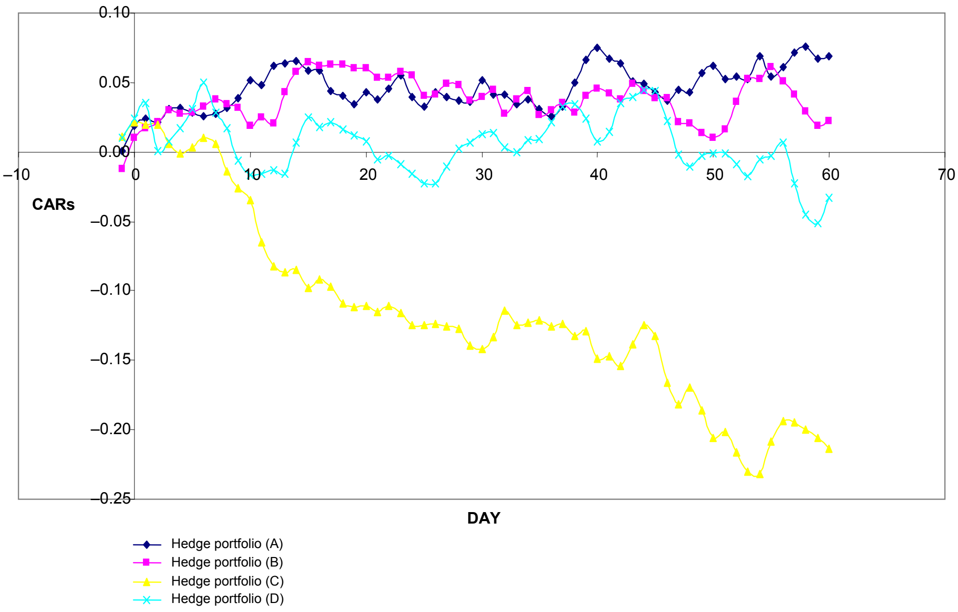


Figure 5 plots the mean CARs associated with the four hedge portfolios, over the sample years 1994–1999, calculated using the Fama-French abnormal returns benchmark. Note that if any resulting investors' overconfidence, because of *self-attribution* bias, is particularly likely to induce PEAD, is in firm/year observations with positive (negative) sign earnings news, which are of the same, rather than different sign with the most recent forecast revisions. These are forecast revisions for firms operating in a private informational environment, at date F_2, hedge portfolio (B).

Table 4 CARs for hedge portfolios formed by taking long (short) positions in observations with positive (negative) sign earnings news, at date A_2, which are of the same/different sign with the most recent forecast revisions

	(A)	*(B)*
	Long (short) position in positive (negative) sign earnings news which are of the same sign with the most recent revisions. These are forecast revisions for firms operating in public informational environment.	Long (short) position in positive (negative) sign earnings news which are of the same sign with the most recent revisions. These are forecast revisions for firms operating in private informational environment.
CAR window		
(+2, +10)	0.052*	0.018
(+2, +20)	0.043	0.061
(+2, +30)	0.052	0.040
(+2, +40)	0.075	0.046
	(C)	*(D)*
	Long (short) position in positive (negative) sign earnings news which are of different sign with the most recent revisions. These are forecast revisions for firms operating in public informational environment.	Long (short) position in positive (negative) sign earnings news which are of different sign with the most recent revisions. These are forecast revisions for firms operating in private informational environment.
(+2, +10)	–0.035	–0.017
(+2, +20)	–0.111	0.007
(+2, +30)	–0.142	0.013
(+2, +40)	–0.149	0.007

Note: *denotes 10% level of significance

On the contrary ,the hedge portfolio average CARs, reported in Table 4, are insignificant for all post-earnings announcement windows for hedge portfolios (B), where forecast revisions are announced in a private informational environment. There are three potential interpretations of this result, which are discussed next.

a The failure of the hedge portfolio (B) to generate significant CARs suggests that *self-attribution* bias as implied by the Daniel et al. (1998) model may not explain PEAD.[19] More specifically, such a finding does not support the hypothesis that PEAD is a consequence of the presence of *self-attribution* bias in investors' earnings expectations, regarding permanent earnings.

b The failure of the hedge portfolio (B) to generate significant CARs may be a manifestation of the chosen proxy for private informational environment (illiquidity). As a result, *self-attribution* bias as implied in Daniel et al.'s (1998) model may not be correctly captured.

c The failure of the hedge portfolio (B) to generate significant CARs may be a manifestation of the failure of the magnitude of the earnings news (surprise) to offer any valid insights regarding PEAD in the Greek sample. As already mentioned, one weakness of the hedge portfolio-based test is that it does not control for the magnitude of the earnings news (surprise) at A_2, which might affect the magnitude of PEAD. The empirical evidence based on Athens Stock Exchange firms suggests that the traditional *earnings-surprise*-based stories are not satisfactorily explanations of PEAD in the Greek sample; see Forbes et al. (2006). To resolve the issue whether the magnitude of the earnings news (surprise) or the failure of the *self-attribution* bias hypothesis to explain PEAD, underlies the failure of hedge portfolio (B) to generate significant PEAD, the next subsection considers another statistical test.

6.2 *Results of the regression-based test*

This subsection presents the regression-based test attempts to capture whether PEAD is a consequence of the presence of *self-attribution* bias in investors' expectations, regarding permanent earnings, after controlling for the magnitude of the earnings news (surprise) at A_2. The regression-based test focuses on the incremental effects of confirmatory earnings news announcements for firms where private information is rife at the announcement date of the most recent consensus forecast revision (REV_n). This is done in order to satisfy the condition in Daniel et al. (1998) model that investors are overconfident about their assessments based on private information.

Whether PEAD is a consequence of the presence of *self-attribution* bias in investors' expectations, regarding permanent earnings, after controlling for the magnitude of the earnings news, is tested by the regression-based test of the form of equation (8). The pooled cross-sectional time series regression estimates of equation (8) are reported in Table 5.

To pick up the PEAD, abnormal returns are accumulated over the 19-day and 39-day periods following the earnings announcement. Accumulation begins two days after the earnings announcement. The primary benchmark for abnormal returns used is the Fama-French abnormal returns. Additionally, abnormal returns are estimated using the market adjustment. According to Table 5, there is no evidence that confirmatory earnings news announcements are associated with significant mean CARs. In particular, for both $k = 20$ and $k = 40$, all the estimated coefficients are statistically insignificant either for the Fama-French risk adjustment model or for the market adjusted model.

In summary, empirical evidence, provided by the hedge portfolio-based test and the regression-based test, of the form of equation (8), is not consistent with the implications of *self-attribution* bias when investigating whether the presence of self-attribution bias in market participants' expectations, regarding permanent earnings, may induce PEAD.

Table 5 Test of the effects of self-attribution bias on PEAD revisiting Mendenhall (1991) empirical framework in the light of Daniel et al. (1998)

$$CAR_n(A_2+2, A_2+k) = a_0 + a_{NP}NP_n + a_{PP}PP_n + a_{NN}NN_n + a_{PN}PN_n + a_1ERR_{2,n} + e_n,$$
$$e_n \sim N(0,\sigma^2)$$

CAR window	a_0	a_{NP}	a_{PP}	a_{NN}	a_{PN}	a_1	R^2
(k = 20)	*Using Fama-French abnormal returns benchmark*						
	–0.025	0.053	0.071	0.010	0.046		0.02
	(–2.86)***	(1.21)	(1.50)	(0.47)	(0.91)		
	–0.024	0.052	0.068	0.011	0.046	0.034	0.02
	(–2.72)***	(1.17)	(1.40)	(0.51)	(0.92)	(0.31)	
	Using market adjusted abnormal returns benchmark						
	–0.044	0.044	0.062	–0.014	–0.002		0.01
	(–5.33)***	(1.07)	(1.37)	(–0.59)	(–0.06)		
	–0.043	0.040	0.055	–0.011	0.000	0.111	0.02
	(–5.00)***	(0.96)	(1.18)	(–0.49)	(–0.01)	(0.98)	
(k = 40)	*Using Fama-French abnormal returns benchmark*						
	–0.033	0.090	0.060	0.014	0.082		0.02
	(–2.42)**	(1.45)	(1.28)	(0.45)	(1.18)		
	–0.033	0.090	0.060	0.014	0.082	0.000	0.02
	(–2.39)**	(1.44)	(1.25)	(0.45)	(1.18)	(0.00)	
	Using market adjusted abnormal returns benchmark						
	–0.068	0.073	0.098	–0.053	–0.002		0.02
	(–5.20)***	(1.34)	(1.56)	(–1.55)	(–0.04)		
	–0.066	0.067	0.087	–0.050	0.001	0.163	0.02
	(–4.98)***	(1.22)	(1.35)	(–1.45)	(0.01)	(0.89)	

Notes: **denotes 5% level of significance and ***denotes 1% level of significance

7 Conclusions and further research

This study recasts Mendenhall's (1991) empirical framework in the light of the theoretical motivation for PEAD outlined by Daniel et al. (1998). More specifically, the main objective of this study is to examine whether PEAD is the result of the presence of *self-attribution* bias in investors expectations, regarding permanent earnings. This is the first study to examine empirically this issue in Athens Stock Exchange firms.

Daniel et al. (1998) assumed that investors are overconfident in their expectations, regarding permanent earnings which are based on private information signals, i.e., the most recent forecast revision, prior to an earnings announcement, for firms where private information is rife at the revision announcement. If this is the case, forecast revisions, for firms where private information is rife, may cause investors to overestimate the probability that there is a shift, if any, in the permanent earnings stream. As a result, the market may overreact to these forecast revisions.

The presence of *self-attribution* bias in investors expectations, regarding permanent earnings, implies that investors respond asymmetrically to confirmations and negations, by a subsequent public signal (earnings news announcement), of their prior expectations. Prior expectations, regarding permanent earnings, are based on the most recent forecast revision, for firms where private information is rife at the revision announcement. Earnings news announcements which confirm investors' prior expectations, regarding permanent earnings, lead to increases in investors' confidence. On the other side, earnings news announcements which negate investors' prior expectations, regarding permanent earnings, fail to diminish investors' confidence to the same extent. Consequently, investors are more overconfident in their expectations regarding permanent earnings, following confirmatory, rather than negatory earnings news announcements. If this is the case, confirmatory rather than negatory earnings news announcements may cause investors to continue overestimating the probability that there is a shift in the permanent earnings stream. Under that setting, PEAD would be expected to arise as a manifestation of continued overreaction to confirmatory rather than negatory earnings news announcements.

Overall, the results of this study suggest that the presence of self-attribution bias in investors' earnings expectations, regarding permanent earnings, may not drive PEAD in Athens Stock Exchange firms. Whether the same results might be observed in more developed markets, using more sophisticated proxies for private information awaits further research.

References

Admati, A. and Pfleiderer, P. (1988) 'A theory of intraday patterns: volume and price variability', *Review of Financial Studies*, Vol. 1, pp.3–40.

Affleck-Graves, J., Callahan, C. and Chipalklatti, N. (2002) 'Earnings predictability, information asymmetry and market liquidity', *Journal of Accounting Research*, pp.501–517.

Barberis, N., Shleifer, A. and Vishny, R. (1998) 'A model of investor sentiment', *Journal of Financial Economics*, Vol. 49, pp.307–343.

Bernard, V. and Thomas, J. (1989) 'Post-earnings-announcement drift: delayed price response or risk premium?', *Journal of Accounting Research*, Vol. 27, pp.1–48.

Bernard, V. and Thomas, J. (1990) 'Evidence that stock prices do not fully reflect the implications of current earnings for future earnings', *Journal of Accounting and Economics*, Vol. 13, pp.305–340.

Bhushan, R. (1994) 'An informational efficiency perspective on the post earnings announcement drift', *Journal of Accounting and Economics*, Vol. 18, pp.45–65.

Brown, L. (1997) 'Earnings surprise research: synthesis and perspectives', *Financial Analysts Journal*, Vol. 53, pp.13–19.

Collins, W. and Hibrar, P. (2000) 'Earnings-based market anomalies: one effect or two?', *Journal of Accounting and Economics*, Vol. 29, pp.101–123.

Daniel, K., Hirshleifer, D. and Subrahmanyam, A. (1998) 'Investor psychology and security market under- and overreactions', *Journal of Finance*, Vol. 53, pp.1839–1885.

DeFond, M. and Park, C. (2001) 'The reversal of abnormal accruals and the market valuation of earnings surprises', *Accounting Review*, Vol. 76, pp.375–404.

Easton, P.D. and Zmijewski, M.E. (1989) 'Cross-sectional variation in the stock market response to accounting earnings announcements', *Journal of Accounting and Economics*, Vol. 11, pp.117–141.

Fama, E. and French, K. (1996) 'Multifactor explanations of asset pricing anomalies', *Journal of Finance*, Vol. 51, pp.55–84.

Forbes, W., Giannopoulos, G. and Skerratt, L. (2006) 'Is overreaction/underreaction chosen by managers? Evidence from Greece', Working paper, Loughborough University, UK.

Foster, D. and Viswanathan, S. (1990) 'A theory of intraday variations in volumes, variances, and trading costs in security markets', *Review of Financial Studies*, Vol. 3, pp.451–489.

Freeman, R. and Tse, S. (1989) 'The multi-period information content of accounting earnings. Confirmations and contradictions of previous earnings reports', *Journal of Accounting Research*, Vol. 27, pp.49–84.

Gervais, S. and Odean, T. (2001) 'Learning to be overconfident', *Review of Financial Studies*, Vol. 14. pp.1–27.

Gleason, G. and Lee, C. (2003) 'Analyst forecast revisions and market price discovery', *Accounting Review*, Vol. 78, pp.193–225.

Glosten, L. and Milgrom, P.R. (1985) 'Bid, ask and transaction prices in a specialist market with heterogeneously informed traders', *Journal of Financial Economics*, Vol. 14, pp.71–100.

Gregoriou, A. (2004) 'Earnings announcements and the components of the bid-ask spread: evidence from the London Stock Exchange', Working paper, Brunel University, UK.

Hong, H. and Stein, J. (1999) 'A unified theory of underreaction, momentum trading, and overreaction in assets markets', *Journal of Finance*, Vol. 54, pp.2143–2184.

Kim, O. and Verrecchia, R. (1994) 'Market liquidity and volume around earnings announcements', *Journal of Accounting and Economics*, Vol. l7, pp.41–67.

Krinsky, I. and Lee, J. (1996) 'Earning announcements and the components of the bid-ask spread', *Journal of Finance*, Vol. 51, pp.1523–1535.

Langer, E.J. and Roth, J. (1975) 'Heads I win, tails it's chance: the illusion of control as function of the sequence of outcomes in a purely chance task', *Journal of Personality and Social Psychology*, Vol. 32, pp.955–961.

Liu, W., Strong, N. and Xu, X. (2003) 'Post-earning announcement drift in the UK', *European Financial Management*, Vol. 9, pp.89–116.

Mendenhall, R. (1991) 'Evidence on the possible-underweighting of earnings-related information', *Journal of Accounting Research*, Vol. 29, pp.170–179.

Miller, D. and Ross, M. (1975) 'Self-serving biases in attribution of causality: fact or fiction?', *Psychological Bulletin*, Vol. 82, pp.213–225.

Odean, T. (1998) 'Volume, volatility, price, and profit when all traders are above average', *Journal of Finance*, Vol. 53, pp.1887–1934.

Taylor, S. and Brown, J. (1988) 'Illusion and well-being: a social psychological perspective on mental health', *Psychological Bulletin*, Vol. 103, pp.193–210.

Vega, C. (2004) 'Are investors overconfident?', Working paper, University of Pennsylvania.

Notes

1 For a review, see Brown (1997) and Liu et al. (2003).

2 See Langer and Roth (1975).

3 See among others, Langer and Roth (1975), Miller and Ross (1975), Odean (1998) and Taylor and Brown (1988).

4 For details about calibration theory, you are referred to Langer and Roth (1975), Miller and Ross (1975) and Taylor and Brown (1988).

5 Analysis without a deflator assumes that the magnitude of the undeflated forecast error and revision are not related to the level of the earnings per share. In contrast, the incorporation of price deflation assumes that the deviation of the actual from forecasted earnings and the difference between the revised from initial earnings forecast depend on the level of earnings per share. Moreover, the price deflation reduces heteroskedasticity.

6 We did not define the price deflated forecast error as $ERR_{i,j,n}$ because, in the rest of the paper, it is not used for $i \neq j$.

7 In particular, all variables are winsorised by setting observations with values greater than ±3 standard deviations from their mean equal to their mean values ±3 standard deviations, respectively.

8 Alternative this may be because analysts do not seem to be learning by their past mistakes. The opposing sign of ERR_1 and REV mean that market discounts the information content of the forecast issued because it does not regard the forecast as isolating a 'trend' in future earnings.

9 In particular, the indirect cost of trading measured by the adverse price impact and the delay in processing the transactions in those stocks is a decreasing function of volume. This suggests that cost of trading increases for stocks which are thinly traded.

10 Implications for the relation between volume and the adverse selection are made by two related articles, Admati and Pfleiderer (1988) and Foster and Viswanathan (1990). Both papers concentrate on the adverse selection faced by a market maker who uses the order flow to infer the informed trader's beliefs and set prices so that they best represent the true value of the asset. Admati and Pfleiderer's (1988) model predicted that trading costs are low (i.e., the adverse selection component of bid-ask spread decreases) when trading volume is high and prices are more volatile, which is the case when earnings are announced. Foster and Viswanathan (1990) suggested that the adverse selection component of bid-ask spread increases when trading volume is low and prices are more volatile.

11 In reality, the relationship between volume of trades and the adverse selection component of the prevailing bid-ask spread may not be so clear if traders with superior ability to interpret earnings information enter, and are expected to enter, the market at the time of an earnings related announcement such as a forecast revision or an earnings announcement (Kim and Verrecchia, 1994). They argue that public disclosure such as earnings announcements stimulates informed judgments among traders who process public disclosure into private information. These informed traders have a comparative advantage over the market maker, since they are able to produce superior assessments of a firm's performance on the basis of earnings announcements. This leaves the market maker at an informational disadvantage with respect to informed traders, resulting in them increasing the bid-ask spread. When such informed traders are significantly active, more trading volume may also result.

12 Gleason and Lee (2003) made a very similar hypothesis. Bernard and Thomas (1989, 1990), among others, documented that the greater the earnings surprise the greater the subsequent price drift. Gleason and Lee (2003) assumed that an earnings revision of greater magnitude will also trigger greater subsequent price drift.

13 Similarly, DeFond and Park (2001) used forecast errors calculated as the actual reported earnings minus the most recent analysts' forecast consensus, scaled by price two days before the earnings announcement, to proxy for unexpected earnings.

14 Similarly, Collins and Hibrar (2000) standardised their proxy for unexpected earnings by the average total assets instead of the standard deviation of the forecast error, in order to maintain a consistent scaling variable across all variables. They also find that their results are not qualitatively influenced by the choice of the scaling variable.

15 For each of the confirmation/negation type, the total price response is the coefficient for the associated dummy variable plus the intercept.

16 Data is not available for each firm and every year.

17 Liquid stocks are generally viewed as those, which accommodate trading with the least effect on price. In the literature, the most common proxy used for liquidity is the bid-ask spread. In the present study, liquidity is judged also by reference to the volume of trade because the effects on stock price for thinly trade stocks are more severe than heavily traded stocks.

18 The computed median volume and spread is based on the Athens Stock Exchange population.

19 Similar Vega's (2004) results suggested that self-attribution bias may not drive PEAD, even though she used a very different research design from the one employed by the present study.