Market Uncertainty and Sentiment, and the Post-Earnings Announcement Drift[1]

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Abstract

The post-earnings announcement drift (PEAD) was first identified over 40 years ago and seems to be as much alive today as it ever was.. There have been numerous attempts to explain its continued existence. In this paper we provide evidence to support a new explanation: the PEAD is very much a reflection of the level of market uncertainty and sentiment that prevails during the post-announcement period. The finding that uncertainty plays a role in explaining how investors respond to information suggests that it should be included as a factor in our pricing models while the fact that market sentiment also has a role is another instance of the importance of human behaviour in establishing prices.

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1. Introduction

The post-earnings announcement drift (PEAD) is the oldest continuing market anomaly, dating back to the first event study published over 40 years ago (Ball and Brown, 1968). It is brought to the fore by Ball (1978) who notes that at least 20 papers in the decade post-Ball and Brown have also found evidence of a PEAD. If we move forward almost 35 years to the present, empirical studies are still finding evidence of a PEAD with stocks reporting good (bad) news continuing to realise positive (negative) excess returns for an extended period beyond the earnings announcement date (Ali et al., 2008; Konchitchki et al., 2010; Forner et al., 2009). A number of authors have suggested that the PEAD (along with momentum) represents the most serious challenge to the Efficient Market Hypothesis (EMH) because it has been proved robust across time, across markets and across methodologies (e.g., Fama, 1998; Kothari, 2001).

Since Ball (1978) there has been a continuing stream of authors who have attempted to explain the PEAD either within a rational expectations framework or by appealing to behavioural explanations. Explanations proposed include arbitrage risk (Mendenhall, 2004), liquidity risk (Sadka, 2006), and unsophisticated investors (Bartov et al., 2000). However, the explanation that has gained most attention in recent years has been information uncertainty (Francis et al., 2007). The starting point in their argument is that high uncertainty with respect to an information release (because of the information's perceived low quality) translates into a smaller reaction at the time of the announcement. The proposal then is that it is the subsequent resolution of this uncertainty that results in the full implications of the information being impounded into prices resulting in the drift in returns that has come to be known as the PEAD. Francis et al. (2007) derive a proxy for accounting quality based on accruals and demonstrate that companies with perceived lower quality information experience greater PEAD.

There is another line of recent research that has also investigated the impact of uncertainty on returns in a slightly different context. These studies examine the impact of market uncertainty, as distinct from uncertainty pertaining to a specific information release, on the returns of a specific stock at the time of the release of an earnings announcement. The studies find evidence of an asymmetric response at the time of information release with the market reacting more to bad news than to good news which is attributed to the pessimism that uncertainty induces in uncertainty-averse investors (Williams, 2009; Bird and Yeung, 2010; Kim et al., 2010). However, Bird and impacting on the market response to information. Bird and Yeung find that the asymmetric response is greatest when uncertainty is high and sentiment is low but disappears at times when uncertainty is low and sentiment is high.

In this paper we maintain the theme of Bird and Yeung (2010) by proposing that it is the level of market uncertainty and market sentiment prevailing over the post-announcement period that are major determinant of the returns realised on a stock over this period. The proposition is that uncertainty and sentiment condition the market response to information not only at the time of the information release but also over an extended period subsequent to its release. The results strongly support this proposition in that we find evidence that (i) the strongest downward drift after a bad earnings announcement occurs when uncertainty is highest over the post-announcement period and (ii) the strongest upward drift following good news announcements occurs during periods when uncertainty is low during the post-announcement period. Further, we find that low sentiment during the post-announcement period has a downward impact on the level of PEAD experienced. Indeed, the impact of low sentiment on the post-earnings adjustment to the receipt of good news is sufficient to produce a downward drift during the post-announcement period.

As a subplot to our findings, our results provide some evidence that relevant to the efficiency of the market in its immediate response to an information release. Our findings confirm a PEAD and so are consistent with previous evidence that markets initially underreact to most information sources including both “good news” and “bad news” earnings announcements (Kadiyala and Rau, 2005). Such a conclusion is at variance with that in other studies that have interpreted evidence of a greater initial response to bad news than good news at times of high uncertainty as suggesting that investors take a pessimistic view at such times and so underreact to good news but overreact to bad news (Williams, 2009; Kim et al., 2010) Such a finding is consistent with several economic models largely based on the presumption that investors follow maxmin expected utility (MEU) and so base their decisions on the worst case outcomes at times of high uncertainty (Gilboa and Schmeidler, 1989).

We do find evidence consistent with MEU that during the announcement period there is a larger downward drift after bad news than an upward drift after good news and that this asymmetry increases with higher uncertainty. However, we also find that a higher proportion of the market adjustment to good news earnings announcements over the 60-trading day period after the announcement occurs at the time of the announcement than is the case for the market adjustment to bad news earnings announcement. In other words we find evidence to support both an underreaction and an asymmetric response to information at the time of its release and that both of these findings are strengthened when the information is realised at a time of high market uncertainty. These two seemingly inconsistent findings can coexist because it appears that per unit of news that there is a much greater overall adjustment to bad news than there is to good news.

The remainder of the paper is structured as follows: Section 2 addresses the PEAD literature with concentration on the explanations that have been developed to explain its existence. Section 3 sets out the data and methodology employed in the study. Section 4 reports and discusses the findings. Section 5 gives a concluding remark and discusses possible future work in the area.

2. Literature Review on Post-Earnings Announcement Drift

Information efficiency implies that markets quickly impound information into prices but evidence suggests otherwise with much empirical evidence indicating that the adjustment process can be quite slow extending over several months, or in some cases, several years. The first evidence of the continuing drift in returns subsequent to an announcement (i.e., the PEAD) dates back to the first-published event study evaluating the market reaction to earnings announcements (Ball and Brown, 1968). Although the PEAD is evident in the Ball and Brown results and in many subsequent studies, it does not become a focus of attention for another decade (Ball, 1978). Ball argues that the observed PEAD is not a market anomaly but rather a consequence of omitted variables or some other misspecification in the model used to calculate the excess returns.

The PEAD remains with us today as evidenced by recent studies by Ali et al. (2080), Konchitchki et al. (2010) and Forner et al. (2009). Further, a post-announcement drift is not restricted to earnings but extends to numerous other corporate announcements such as stock splits, takeovers, new share issues and stock repurchases. The other side of the coin to a post-announcement drift is the initial underreaction to the announcement. Kadiyala and Rau (2005) provide a good summary of the empirical evidence on underreaction and some evidence of their own on how it works out with respect to multiple announcements. Hong and Stein (1999) and Barberis et al. (1998) and others have developed models to explain this underreaction.

The PEAD has been apparent to us for over 40 years and so classified as one of the major market anomalies. Kothari (2001) concludes his survey paper by saying that "the PEAD anomaly poses a serious challenge to the efficient markets hypothesis. It has survived a battery of tests and many attempts to explain it away." Not surprisingly then, we continue to see a stream of papers whose focus is on explaining the PEAD with many others such as Ball (1978) arguing that it does not necessarily represent a departure from the EMH. One explanation for the phenomenon is that "good" news companies are inherently more risky than "bad" news companies (Bernard and Thomas, 1989). The authors conclude that at best risk could explain only a small proportion of the PEAD and this conclusion has gone largely unchallenged. Another line of explanation dating back to Ball (1978) argues that the PEAD is just an artefact of the methodology and/or the data employed to calculate the abnormal returns rather than an indication of any market inefficiency (Jones and Litzenberger, 1970; Jacob et al., 2000). However, the results have remained robust to numerous alternative methodologies and the data problems are no longer a concern. Another possibility is that difficulties in implementation and/or transaction costs could mean that it is impossible to profit from the perceived profits available from exploiting the PEAD. This seems unlikely as Bernard and Thomas (1989) demonstrate how it can be exploited following a very low turnover strategy. However, more recent studies have suggested that the PEAD may at least be partially explained by the high costs of arbitrage (Medenhall, 2004) and liquidity related risk (Sadka, 2006).

All of the explanations for PEAD discussed to date are attempts to reconcile the evidence on PEAD with the efficient markets hypothesis. One proposal suggestive of inefficiencies in markets is that investors just get it wrong and consistently underreact to both good and bad earnings news. Bernard and Thomas (1990) suggest that investors take a very naïve approach when evaluating new earnings numbers and fail to recognise their full implications for future earnings. This explanation is consistent with the possibility that it is the less sophisticated investors who might be driving the PEAD. Bartov et al. (2000) provide some support for this premise when they find a negative relationship between the level of institutional holdings (sophisticated investment) and the level of PEAD. Other authors have taken a more behavioural approach and attempted to explain the PEAD on the basis of one or more of the cognitive biases attributed to investors. Examples of this include Frazzini (2006) who demonstrates a link between PEAD and the disposition effect and Barberis et al. (1998) who explain it in terms of conservative and representiveness biases.

One thing of which we can be sure is that we are far from achieving closure as to what are the factors that drive the continued existence of the PEAD and so resolutions as to whether it is evidence of a market anomaly. One recent explanation that we are yet to consider is that the PEAD is driven by investor uncertainty as to how to interpret the information. The argument being that it is investor uncertainty as to the quality of an information signal will cause them to underreact at the time of the release of the information. The argument continues that as this uncertainty is resolved, we will begin to see the full reaction to the information and so the PEAD is created[1]. A number of studies have provided empirical support for this proposition by confirming that information uncertainty is positively related to the magnitude of the PEAD (Zhang, 2006; Francis et al., 2007; Anderson et al., 2007; Angelini and Guazzarotti, 2010).

We take up this story in this article but in a slightly different way. The studies to date have considered uncertainty at the firm level basing their measure of uncertainty on factors such as

[1] The conceptual argument for this proposition can be found in Caskey (2009).

the company's use of accruals, its size, its return volatility and the dispersion of analyst earnings forecasts. Another stream of research has developed which also focuses on examining the impact of uncertainty on the market response to information but using a market, rather than a firm-specific, measure of uncertainty. The value of a company at any time is contingent on the resolution of thousands of factors which impact on the future profitability and risk characteristics of the firm. The ability of investors to cope with all of these factors varies significantly through time and becomes extremely difficult in the aftermath of certain events such as the 911 disaster, the collapse of Lehman Brothers, and the threats to the viability to the European Economic Union. The thesis in this paper is that the interpretation that the market places on any information is conditioned by the prevailing level of market uncertainty at the time of, and subsequent to, the information release.

There is a relatively new but burgeoning literature on the impact of uncertainty on asset valuation. A number of writers (e.g., Gilboa and Schmeidler, 1989; Epstein and Schneider, 2003) have developed models that suggest that uncertainty, like risk, has a negative impact on valuation. The most common approach taken in these models is to assume that investors take a conservative approach when faced with uncertainty and base their decisions on obtaining the best outcome under the worst case scenario (maxmin expected utility). The implications of this being that investors apply a very pessimistic overlay when interpreting information that arrives at a time of high uncertainty while being relatively more optimistic when it arrives at times when uncertainty is benign. An important implication of this is that there will be an asymmetric response to information at times of uncertainty with investors overreacting to bad news and underreacting to good news (Epstein and Schneider, 2008). Williams (2009), Bird and Yeung (2010), and Kim et al. (2010) have all found evidence to support this asymmetric response[2]. One important insight coming from this line of research is that we should separately examine the market's response to good and bad news rather than bundling them together (Berens, 2010).

Caskey (2009) proposes that persistent mispricing is consistent with the existence of uncertainty-averse (pessimistic) investors and that it is the existence of such investors that plays

[2] This contrasts with the research based on information quality which presumes that the market will always underreact to low quality information.

an important role in explaining several market anomalies including the PEAD. The focus in this paper is on testing this claim by examining the association between the level of market uncertainty prevailing during the post-announcement period and the PEAD during this period. Just as the level of uncertainty prevailing at the time of the information release impacts on the market response at that time, the proposition is that the response during the post-announcement period is also conditioned by the level of uncertainty prevailing during the post-announcement period.

Bird and Yeung (2010) find that it is not only market uncertainty but also market sentiment that influences how investors respond to information. Baker and Wurgler (2007) demonstrate the influence that sentiment has on prices and Livnat and Petrovitis (2009) extend this to the PEAD. The proposition presented in this paper is that the PEAD is significantly influenced by both the market uncertainty and market sentiment that prevails over the post-announcement period. Our empirical findings support this proposition with this finding giving partial credence to both the rational and behavioural explanations for the existence of the PEAD.

3. Data and Methodology

The research question to be evaluated in this paper is that the level of both market uncertainty and market sentiment prevailing over the post-announcement period will impact on the price behaviour of the stock during this period (i.e., the PEAD). Specifically, we will evaluate the following hypotheses:

Hypothesis 1: High market uncertainty during the post-announcement period will increase the downward drift associated with a bad news announcement but mitigate the upward drift associated with a good news announcement.

Hypothesis 2: High market sentiment during the post-announcement period will serve to nullify any PEAD associated with bad news stocks and magnify any PEAD associated with good news stocks.

We will address these hypotheses by examining the relationship between market uncertainty and market sentiment over the 60 trading insights into a number of other important questions:

- whether the initial response of the market to new information is consistent with market efficiency
- whether the initial market response to new information is an under reaction or an overreaction and the extent to which this differs between bad news and good news
- whether there is an asymmetric response to bad and good news during the post-announcement period.
- whether the market is better at quickly incorporating one type (bad or good) of information into prices than it is the other.

Data

The sample period used in this study extends from January 1986 to September 2009. We use three types of data: data from the equity market, data from the options market, and accounting data. The return data from the equity market are obtained from CRSP through WRDS. Our measure of market uncertainty is the Implied Volatility Index (or VIX) from CBOE[3]. The accounting data which includes reported earnings are obtained from the CRSP/COMPUTSTAT merged database which is sourced through WRDS. Finally information on actual earnings and financial analysts earnings forecasts are sourced from the IBES summary.

To be included in the final sample, we require the firms to have earnings announcements in at least the past 5 quarters. We also require information on firm characteristics (such as book-to-market and firm size), VIX and company returns at the time of the earnings announcements. Consistent with standard practice, we remove any observations with either a negative book to market value or negative market value. Finally, in order to reduce the impact of outliers, firm characteristics are trimmed at the 1st and 99th percentiles.

[3] For a detailed explanation of the calculation of the PEAD, see Williams (2009).

In the following section, we provide a brief discussion on the calculation of the three major variables used in our study: (i) unexpected earnings, (ii) market uncertainty, and (iii) market sentiment:

(i) Unexpected earnings (UE)

Our study revolves around evaluating the stocks returns in the period after the release of an earnings announcement. More specifically, we are studying how uncertainty and sentiment plays vital roles in determining the PEAD. Central to our analysis is the unexpected component of the earnings announcement which we measure as the difference between the actual EPS and the consensus earnings estimate in the month immediately prior to announcement (Han and Wild 1990, Francis et al., 2007 and Kaestner 2006) . So the unexpected portion of the earnings announcement of firm i can be expressed as:

$$Unexpected\ Earnings_i = Actual\ EPS_i - Consensus\ EPS\ Estimate_i$$

Consistent with the literature (Kaestner 2006), we scaled the unexpected earnings by the absolute value of reported EPS to arrive at our final measure of unexpected earnings[4]. So the scaled unexpected earnings measure is as follows:

$$UE_i = \frac{Actual\ EPS_i - Consensus\ EPS\ Estimate_i}{Actual\ EPS_i}$$

The scaling of the unexpected earnings standardises earnings surprises across our sample and thus this will us to examine the influence of news on the returns of the firms[5]. A positive unexpected earnings (PUE) event occurs when the earnings just announced exceeds expected earnings. Similarly, a negative unexpected earnings (NUE) event occurs when the earnings just announced falls short of expected earnings.

(ii) Market uncertainty

[4] We also tried several other measures of unexpected earnings including the unscaled unexpected earnings and SUE the unexpected earnings standardised by the standard deviation of analysts estimates with similar findings.

[5] Both Williams (2009) and Bird and Yeung (2010) adopted a similar methodology to standardise earnings surprises prior to analysing the impact of uncertainty on investors' behaviour.

One of the most challenging aspects of conducting empirical research in this area is the search for a suitable proxy for market uncertainty. Uncertainty in the context that we are considering relates uncertainty as to how to interpret the implications of a particular piece of information. This has been modelled in a number of ways with some using the quality of information emanating from a firm as indicated by its use of accruals to proxy for uncertainty (Francis et al., 2007) while others use disagreement among experts such as analysts as a measure of the difficulty that market participants had in interpreting the implications of the information (Barron et al., 1998; Zhang, 2006). However, all of these proxies are designed to measure uncertainty at the firm level whereas we require a market-wide measure of uncertainty. Anderson et al. (2009) obtain such a measure by aggregating the analysts' earnings forecasts for all firms and use the dispersions in these aggregated forecasts as a quarterly macro-measure of uncertainty. The problem is that Anderson et al.'s measure cannot be calculated on the daily basis required in this study[6].

We have chosen to measure uncertainty by the implied volatility from the options market (VIX) as used by Williams (2009), Drechsler (2009), Bird and Yeung (2010) and Kim et al. (2010). By using the VIX, we have a measure that is available on a daily basis[7]. Although some critics have suggested that VIX provides an estimate of risk rather than uncertainty, we believe recent studies have suggested otherwise. A number of studies have found that the option generated implied volatility is too large to be a reasonable forecast of the future returns variance (Eraker 2004; Carr and Wu 2009). Moreover Drechsler (2009) provides further support for VIX through a general equilibrium model that incorporated time-varying Knightian uncertainty. The model is able to explain the large hedging/variance premium that is evidenced in the markets. He argues that the large time-varying option premium (which is reflected in the implied volatility) is consistent with investors using options for protection against uncertainty (and time-variation in uncertainty). To support his view, Drechsler shows through calibration that fluctuations in the variance premium reflect changes in the level of uncertainty.

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[6] Another problem with the uncertainty proxy used by Anderson et al. (2009) is that it can be affected by a number of other factors such as the heterogeneous beliefs of the analysts.

[7] VIX is calculated continually through the day but we use the level of VIX as at the end of each day.

(iii) Market sentiment

As well as times of high uncertainty in markets that can cause investors to take a pessimistic view when evaluating new information, equally there are times when investor sentiment is high which has the potential to mitigate some of the negative effect of uncertainty. Baker and Wurgler (2007) develop a model for measuring the overall level of investor sentiment and use this measure to establish that investors take an overly optimistic stance to pricing stocks when sentiment is high while being much more subdued when sentiment is low. The problem for us using the Baker and Wurgler sentiment index is that it cannot be calculated with sufficient frequency to allow us to capture short-term variations in sentiment through time. As we are trying to capture sentiment at the market level we resort to a very direct measure by using as our proxy the market returns realised over the post-announcement period. We base our measure of market returns on the S&P 500 index.

Methodology

The basic model that we use in our analysis to establish the association between the PEAD and unexpected earnings is:

$$R_{it} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 \log(MV_{it}) + \beta_4 BTMV_{it} + \text{Year Effects} + \varepsilon_{it} \quad (1)$$

where R_{it} = the accumulated excess return[8] over the post-announcement period which commences on the second day after the announcement and ends on the 60th trading day after the announcement (i.e., t+2 to t+60)[9]. NUE = UE if UE < 0; else NUE = 0 PUE = UE if UE > 0; else PUE = 0

MV_{it} = the market capitalisation of firm i at the announcement day, t

$BTMV_{it}$ = the book-to-market ratio of firm i at the announcement day, t

[8] The excess return is calculated on a daily basis as the difference between the daily return on a particular stock and that on the S&P500 index.

[9] We also undertook the same analysis using a post-announcement period extending from the second day after the announcement to the 30th trading day after the announcement. As the findings were the same we only report our findings for the longer post-announcement period.

With no drift, the coefficients β_1 and β_2 will not be significantly different from zero.

We next test the extent to which the level of PEAD is affected by the level of uncertainty (VIX) at the time of the announcement and the extent to which uncertainty changes (ΔVIX) over the post-announcement period. In order to do this, we determine the level of VIX at the time of each announcement and the change in VIX over the post-period. We expand Equation 1 to incorporate these two additional variables into the following regression equation:

$$R_{it} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 X_1 NUE_{it} + \beta_4 X_1 PUE_{it} + \beta_5 X_2 NUE_{it} + \beta_6 X_2 PUE_{it} + \beta_7 X_3 NUE_{it} + \beta_8 X_3 PUE_{it} + \beta_9 \log(MV_{it}) + \beta_{10} BTMV_{it} + \text{Year Effects} + \varepsilon_{it} \quad (2)$$

where

NUE = UE if UE < 0; else NUE = 0.

PUE = UE if UE > 0; else PUE = 0.

X_1 = 1 where firm i makes an earnings announcement at time t and the level of VIX at time t *ranks in the second tercile* where all level of market uncertainty (VIX) are ranked from low to high; otherwise X_1 = 0.

X_2 = 1 where firm i makes an earnings announcement at time t and the level of VIX at time t *ranks in the third tercile* where all level of market uncertainty (VIX) are ranked from low to high; otherwise X_2 = 0.

X_3 = 1 where there is an increase in the level of VIX increase over the post-announcement period (as measure by the difference between the level of VIX at the time of announcement, VIX_t and the level of VIX 60 days post announcement, VIX_{t+60}); otherwise X_3 = 0.

In this case we will define high uncertainty as being where the level of VIX is in the top quartile at the time of the announcement and increases over the post-announcement period. Similarly we define low uncertainty as being where the level of VIX is in the bottom quartile at the time of the announcement and decreases over the post-announcement period.

We next expand our analysis to incorporate market sentiment into the analysis. We do this by introducing as an additional variable the momentum over the post-announcement period. Our expanded regression equation is set out below:

$$R_{it} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 X_1 NUE_{it} + \beta_4 X_1 PUE_{it} + \beta_5 X_2 NUE_{it} + \beta_6 X_2 PUE_{it} + \beta_7 X_3 NUE_{it} + \beta_8 X_3 PUE_{it} + \beta_9 X_4 NUE_{it} + \beta_{10} X_4 PUE_{it} + \beta_{11} X_5 NUE_{it} + \beta_{12} X_5 PUE_{it} + \beta_{13} \log(MV_{it}) + \beta_{14} BTMV_{it} + \text{Year Effects} + \varepsilon_{it} \quad (3)$$

where

X_4 = 1 if the return on S&P 500 Index from t+2 to t+60 *ranks in the second tercile* where all S&P 500 Index {t+2, t+60} are ranked from low to high; otherwise $X_4 = 0$.

X_5 = 1 if the return on S&P 500 Index from t+2 to t+60 *ranks in the third tercile* where all S&P 500 Index {t+2, t+60} are ranked from low to high; otherwise $X_5 = 0$.

Summary Statistics

Our final sample set consists of 325,888 observations of quarterly earnings announcements. Some statistics for our final sample are reported in Table 1. We see that the magnitude of bad news is approximately twice as large as it is for good news with this proportion remaining fairly constant across all levels of uncertainty (VIX) and sentiment (MOM). There is only slight variation in the size of the firms making announcements across the various sub-samples with the major departure being that there is a preponderance of smaller firms that make earnings announcements at times when uncertainty is low. Finally, the greatest variation highlighted in Table 1 is that growth stocks are far more likely than value stocks to release their earnings figures during periods when markets are experiencing low uncertainty.

Refer Table 1

4. Empirical Results

In this section, we show that our empirical results affirm the existence of a PEAD in our sample data, confirm that the PEAD is influenced by the level of market uncertainty and market sentiment prevailing over the post-announcement period, that the PEAD for smaller firms is both greater and more volatile than it is for larger firms, and that growth stocks are more impacted by the joint effects of uncertainty and sentiment than are value stocks.

(i) PEAD

The first question that we address is whether there is a post-earnings announcement drift in our data. In order evaluatethis we apply our data to Equation 1:

$$R_{it} = \beta_o + \beta_1 \, NUE_{it} + \beta_2 \, PUE_{it} + \beta_3 \log(MV_{it}) + \beta_4 \, BTMV_{it} + \text{Year Effects} + \varepsilon_{it}$$

The coefficients reported for for β_1 and β_2 in Table 2 are both significant and positive. Our findings thus confirm that there is a post-earnings announcement drift (PEAD) with the expected sign associated with the release of both good and bad earnings news[10]. Perhaps the most interesting finding is that the sign attached to the bad news announcements is significantly larger to that attached to the good news announcements. The implication of our findings being that the market underreacts to both bad and good news earnings announcements but that there is a greater underreaction to bad news than there is to good news. In order to investigate this further we ran the same regression as for Table 2 but this time with excessive return over the three-day announcement variables (i.e. t-1 to t+1) as the dependent variable. We found that the coefficient on both NUE and PUE to be positive and highly significant with there being little difference in their magnitude. By comparing these coefficients to those reported in Table 2, we conclude about half of the reaction of the market to bad news over the 60 trading days inclusive of the announcement period occurred during the announcement period whereas in the case of good news two-thirds of the reaction took place during the announcement period. This evidence is also consistent with a larger underreaction to bad news than good news.

[10] As can be seen from table 2, the coefficients attached to both the control variables are significant. Indeed in all of our egressions there is a positive coefficient attached to the size variable and a significant negative coefficient attached to the value/growth variable. In the interest of clear exposition, we do not report the coefficient for these variables in future tables.

Refer Table 2

(ii) Market Uncertainty at the Time of the Announcement

Although several previous studies have concluded that the way that the market responds to the release of information is impacted by the level of uncertainty prevailing at the time, there is disagreement as to the nature of this impact. Some studies claim that uncertainty causes investors to underreact to both bad and good years with the PEAD reflecting a subsequent adjustment to the information (e.g. Francis et al., 2007) whereas other studies suggest that uncertainty causes investors to take a pessimistic stance and so overreact to bad news and underreact to good news (e.g. Williams, 2009). Although these two explanations both suggest a subsequent upward adjustment to good news, the former would suggest a further downward adjustment following a bad news announcement while the latter suggests a correction with a subsequent drift upwards in price. (e.g., Francis et al., 2007; Williams, 2009; Bird et al., 2011)). We evaluate these proposition by running the following regression which is a reduced form of Equation 2:

$$R_{it} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 X_1 NUE_{it} + \beta_4 X_1 PUE_{it} + \beta_5 X_2 NUE_{it} + \beta_6 X_2 PUE_{it} + \beta_7 \log(MV_{it}) + \beta_8 BTMV_{it} + \text{Year Effects} + \varepsilon_{it}$$

Our findings as reported in Table 3 indicate that there is a significant and positive PEAD associated with both bad and good news when uncertainty is both low and high at the time of the announcement. In the case of both bad and good news, the coefficient attached to unexpected earnings is higher when the announcement is made at times of high market uncertainty but the difference is only significant in the case of bad news. Further the coefficient attached to bad news is always larger than that attached to good news but this difference is only (highly) significant at times when uncertainty is high. There are a number of insights that we can draw from these findings that are summarised below. Perhaps the most important being that we see confirmation of the PEAD with the evidence suggesting that it is higher, particularly for bad, news when it is released at time when market uncertainty is high. Further, we see the same asymmetric response to bad and good news in the post-announcement period that other have noted at the time of the release of the information with the PEAD associated with bad news being significantly greater to that associated with good news when the information is released at times of high uncertainty. Therefore, the evidence supports the proposition that the market underreacts to all information and suggests that this underreaction is greater for bad news, particularly when high uncertainty prevails at the time of the information release. These findings question market efficiency and suggest that investors faced with high uncertainty as to how factors will evolve in the future will fail (even more) to realise the import of new information as is evidenced by the trend that the market follows in the post-announcement period.

Refer Table 3

(iii) Changes in uncertainty over the Post-Announcement Period

We have already seen that the level of uncertainty prevailing at the time of an earnings announcement has implications for the magnitude of any subsequent PEAD. We now progress to examine the extent to which the PWAD may be influenced by the level of uncertainty prevailing over the post-announcement period. In order to evaluate this issue, we applied our sample data to Equation 2:

$$R_{it} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 X_1 NUE_{it} + \beta_4 X_1 PUE_{it} + \beta_5 X_2 NUE_{it} + \beta_6 X_2 PUE_{it} + \beta_7 X_3 NUE_{it} + \beta_8 X_3 PUE_{it} + \beta_9 \log(MV_{it}) + \beta_{10} BTMV_{it} + \text{Year Effects} + \varepsilon_{it}$$

In table 2, we saw that the coefficient on NUE was 0.0151 indicating a significant downward drift after bad news announcements. We see from Table 4 that there is a significantly lower drift (0.0080) during the post-announcement period when uncertainty is low over this period (i.e. VIX starts low and decreases). In contrast, there is a significantly higher drift (0.0221) during the post-announcement period when uncertainty is high during the post-announcement period (i.e. VIX starts high and increases). Further, the magnitude of the downward drift is greater where uncertainty is low at the time of the announcements but increases over the post-announcement period than where it is high at the time of the announcement and subsequently decreases over the post-announcement period. These findings highlight that it is the level of uncertainty over the post-announcement period that is critical in determining the magnitude of the PEAD after a bad news announcement. One clear indication that we do get from Table 3 is that there is a downward drift after a bad news announcement irrespective of the level of uncertainty prevailing over the post-announcement period. This provides a strong indication that there is an underreaction to the information at the time of its release. If one accepts based on this evidence that markets are inefficient, then one would have to accept that the full adjustment process may still be incomplete even 60 trading days after the announcement. This being the case, one cannot rule out the possibility of a prolonged period of high uncertainty during the post-announcement period resulting in an eventual overreaction to the bad news announcement and a prolonged period of low uncertainty during this period resulting in the full price adjustment remaining incomplete.

Refer Table 4

Again in table 2, we saw that the coefficient on PUE was 0.0091 indicating a positive post-announcement drift following the release of good earnings news. We see from Table 4 that the level of uncertainty over the post-announcement period has an even greater impact on PEAD after a good news announcement than after a bad news announcement. When uncertainty is low during this period (i.e. VIX starts low and decreases), there is indeed a large upward drift over the post-announcement period (coefficient = 0.0236) with the correction to an initial underreaction unmitigated by the negative impact that high market uncertainty can have on investor behaviour. It is when we examine the PEAD after a good news announcement over a period when market uncertainty is high (i.e. VIX starts high and increases) that we see the most interesting result that the usual upward drift is replaced by a downward drift (coefficient = -0.0124). In other words, the negative impact that high uncertainly can have on investor behaviour is sufficient to offset the normal upward drift associated with a correction to an initial underreaction to the good news announcement. Indeed, the importance of the level of uncertainty prevailing during the post-announcement is highlighted by the fact that there is a downward drift after good news announcements at such times irrespective of the level of uncertainty prevailing at the time of the announcement. Overall, our findings highlight that the path that the price that a stock follows after an initial underreaction to a good news announcement is even more impacted by the prevailing uncertainty during this period than was the case for bad earnings news.

We have previously found that investors underreact to both good and bad news announcements especially when the announcement is made at a time of high market uncertainty. We have now found that the PEAD associated with a correction to the initial underreaction is very much impacted by the level of uncertainty that prevails over the post-announcement period. In the case of a bad news announcement, the impact of uncertainty is to slow down the typical downward drift. However, in the case of a good news announcement, the impact of uncertainty is to turn the more typical upward drift to a downward drift during the post-announcement period.

(iv) Market Sentiment

Our second proposition is that market sentiment will serve to offset uncertainty in terms of its impact on the PEAD. We further divide our sample on the basis of the level of sentiment prevailing over the post-announcement period with high (low) sentiment being when market momentum is strong (weak). In order to evaluate this proposition, we apply our sample data to Equation 3:

$$R_{it} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 X_1 NUE_{it} + \beta_4 X_1 PUE_{it} + \beta_5 X_2 NUE_{it} + \beta_6 X_2 PUE_{it} + \beta_7 X_3 NUE_{it} + \beta_8 X_3 PUE_{it} + \beta_9 X_4 NUE_{it} + \beta_{10} X_4 PUE_{it} + \beta_{11} X_5 NUE_{it} + \beta_{12} X_5 PUE_{it} + \beta_{13} \log(MV_{it}) + \beta_{14} BTMV_{it} + \text{Year Effects} + \varepsilon_{it}$$

Refer Table 5

The first thing that we note based on the information contained in Table 5 is that there is always a downward drift after a bad news earnings announcement irrespective of the level of market uncertainty and market sentiment prevailing over the post-announcement period. We have already noted that the greatest downward drift occurs when high uncertainty prevails over the post-announcement period and this can be seen from the information provided in Table 5. However, the new information that can be gleaned from table 5 is that the PEAD after bad news is also greater when low sentiment prevails (with the difference between high and low sentiment being significant at the 10% level). The combined effect can be seen when we compare the coefficient attached to NUE when uncertainty is high and sentiment is low (0.0234) with the coefficient when uncertainty is low and sentiment is high (0.0064). The difference is significant at the 1% level and highlights the extent to which both uncertainty and sentiment impact on the PEAD after bad news with the negative drift when uncertainty is high and sentiment is low being four-times that which occurs when uncertainty is low and sentiment is high.

The findings with respect to PEAD after a good news announcement are similar, but more complicated, than those reported above for bad news announcements. As with bad news, high uncertainty during the post-announcement period has been shown to have a negative impact on investors which translate into a lower , indeed negative, PEAD. We can now see from the information presented in Table 5 that sentiment has a larger impact on the markets response to good news than it does to bad news. In fact, now there is always an upward drift after a good earnings announcement when market sentiment is strong over the post-announcement period irrespective of what level of market uncertainty prevails. Perhaps even more interesting is that the drift during the post-announcement period after the release of good news is always negative when market sentiment is low, again irrespective of the prevailing level of uncertainty. The combined effect of uncertainty and sentiment can be seen when we compare the extent of the upward drift following a good news announcement when uncertainty is low and sentiment is high (coefficient = 0.0267) with the extent of the downward drift when uncertainty is high and sentiment is low (coefficient = -0.0161). The difference is significant at the 1% level and highlights that the combination of uncertainty and sentiment have a much greater impact on the PEAD after good news than they do on the PEAD after bad news.

(v) Stock Characteristics

The evidence provided to date confirms that the level of the prevailing market uncertainty and market sentiment over the post-announcement period play a critical role in explaining the PEAD phenomena. The issue that we pursue here is whether our findings are sensitive to certain characteristics of the firm making the announcement. The two characteristics that we evaluate are the firm's market capitalisation and its book-to-market ratio as both of these have been found to have a major influence on a firm's market returns (Fama and French, 1992). In both cases we split our sample in half and so produce a sub-sample of large and small stocks, and of value and growth stocks. We then repeat the regression as set out in Equation 3 for the large and small sub-samples and report our findings in Table 6.

Small Cap and large Cap

We divided our sample into small and large cap stocks and then applied Equation 3 to each sub-sample. In Table 6 we repeat the information provided in Table 5 but this time separately for large cap and small cap stocks. There are both similarities and differences in terms of the PEAD behaviour of large cap and small cap stocks. The similarities are that they retain most of the main features discussed previously relating to the whole sample: (i) the downward drift following a bad news announcement is largest when the prevailing market uncertainty is high and the prevailing market sentiment is low, (ii) the upward drift following a good news announcement is largest when the prevailing uncertainty is low and the market sentiment is high, and (iii) there is always a downward drift associated with bad news announcements irrespective of the prevailing market uncertainty and market sentiment but the drift associated with good news announcements swings between an upward drift and a downward drift largely determined by the level of market sentiment prevailing during the post-announcement period..

Refer Table 6

The PEAD associated with small cap stocks is almost always larger than the PEAD associated with large cap stocks. One instance being for any given level of market uncertainty and sentiment, the downward drift over the post-earnings announcement period is always greater for small cap stocks than it is for large cap stocks after the release of a bad earnings report. There are variations in the importance of the contribution that market uncertainty and market sentiment make to the PEAD experienced by large cap and small cap stocks after the release of bad news. During the post-announcement period, market sentiment has no material impact on the PEAD for large cap stocks but it does have for small cap stocks. In contrast, market uncertainty is more important in influencing the PEAD after the release of bad news by large cap stocks than it is for small cap stocks.

As has been typically the case throughout this paper, the examination of the drift after a good news announcement proves to be the most interesting. Irrespective of the market uncertainty experienced over the post-announcement period, a prevailing low sentiment always results in both large and small cap stocks experiencing a downward drift. The difference being that this downward drift is rarely significant in the case of small cap stocks whereas in the case of large cap stocks it is nearly always significant. In contrast, both large cap and small cap stocks always experience an upward drift in excess returns when sentiment is high over the post-announcement period irrespective of the market uncertainty prevailing over this period. The magnitude of this upward drift is fairly similar for both large and small cap stocks when market uncertainty at the time of the announcement was low but the drift is very much greater for small cap stocks when uncertainty was high at the time of the announcement.

Growth and Value Stocks

In Table 7 we present a summary of our findings where we repeat the analysis reported above for large cap and small cap stocks, this time dividing the stocks up into growth and values stocks as indicated by each stock's book-to-market ratio. As with large and small cap stocks there is a clear difference between the PEAD behaviour of growth and value stocks with the variation of the drift for growth stocks over the post-announcement period being much larger than it is for value stocks. Again we find consistency with previous findings re the PEAD behaviour of both growth and value stocks (i) the downward drift following a bad news announcement is largest when the prevailing market uncertainty is high and the prevailing market sentiment is low, (ii) the upward drift following a good news announcement is largest when the prevailing uncertainty is low and the market sentiment is high, and (iii) there is always a downward drift after bad news announcements irrespective of the prevailing market uncertainty and market sentiment but the direction of the drift associated with good news announcements swings changes depending on the prevailing market sentiment during the post-announcement period.

Refer Table 7

However, there are several significant differences with respect to the PEAD behaviour of growth stocks and value stocks. For instance, the level of downward drift for growth stocks after a bad news announcement is twice as large as it is for value stocks during a post-announcement period when uncertainty is high and sentiment low. This result is largely driven by the fact that the valuation of growth stocks is very much dependent on the maintenance of investor confidence which is likely to be eroded when a disappointing earnings report is combined with a period of high market uncertainty and low market confidence (Skinner and Sloan, 2002).

There is a similar result when it comes to good news with the upward drift for growth companies being almost twice as great as that for value companies during periods when uncertainty is low and sentiment is high. This reflects the euphoria associated with a growth stock which is being fuelled by both a favourable earnings report and a positive market environment. We previously found evidence of a downward drift after the release of good news at times of high market uncertainty and low market confidence and the information provided in Table 7 enables us to identify that this downward drift is largely confined to growth stocks reflecting the brittleness in the pricing of such stocks to the level of prevailing market uncertainty and sentiment. On the other hand the valuation of value stocks are much less dependent on confidence and so are less affected by earnings news, market uncertainty and market confidence.

(vi) Profitable Investment Strategies

Previous discussion has provided us with some useful insights as to factors that will impact on the PEAD experienced by a stock. This raises the question as to whether the insights might be sufficient to give rise to an implementable investment strategy. At this time it is appropriate to point out that some of the factors identified such as the prevailing market uncertainty and sentiment over the post-announcement period cannot be foreseen by investors at the time of the information release. However, factors that are known at this time include the nature of the information released (whether it was good news or bad news), the market uncertainty and sentiment prevailing at the time of the information release, the size of the company and whether it was at the time a growth stock or a value stock. Therefore, we examined how all of these variables could be used to predict the future performance of the stock over the post-announcement period and our results are reported in Table 8.

Refer Table 8

First examining the full sample, we see that it is the stocks that have experienced a positive earnings surprise at times when both market uncertainty and market sentiment are high that have the largest positive coefficient attached to their PUE and so are most likely to experience the largest positive PEAD. At the other end of the spectrum, the greatest potential downward post-announcement drift would seem to be associated with stocks that have made a bed news announcement when VIX is high and sentiment low. The strategy this suggests is to buy stocks shortly after they have made a good news earnings announcement at a time of high market uncertainty and sentiment and short stocks shortly after they have made a bad news earnings announcement at a time of high market uncertainty of low market sentiment[11]. Further, it would appear that this strategy could be further enhanced by restricting the purchases to small cap stocks and the shorts to growth stocks.

5. Concluding Remark

Our findings provide support for the suggestion that it is this state of mind of investors in concert with the clarity with which they interpret the information that work together to determine how they respond to an earnings signal in the weeks immediately after that signal is made public. At one extreme, we have a situation of high market uncertainty and low market sentiment which means that investors have difficulty in interpreting the implications of the earnings announcement for the value of the firm at a time that a negative tone overlays all of their investing. It is not surprising that at such times investors react more to bad news resulting in a negative drift after the release of both bad and good news. At the other extreme, we have a situation of low market uncertainty and high market sentiment prevailing during the post-announcement period which is a period where there is greater clarity as to the implications of any new information coinciding with a time when investors are somewhat euphoric with respect to their investing. Again, it is not surprising that at such times investors' respond to new information in a much more positive way resulting in an upward drift after the release of good

[11] Preliminary analysis suggests that such strategies would add about 4% over the post-announcment period which equates with an annualised return of about 17%

news and a significantly lower downward drift after bad news. We find that the major findings hold when we divide our sample both by size and also value/growth. However, the PEAD for small cap (and growth) stocks is more volatile than it is for large cap (and value) stocks.

Of course, there could not be a PEAD if markets fully reflected new information within a very short period of time of its release. Therefore, our findings extend the evidence of the market being quite slow in incorporating information into prices. There are two other aspects of our findings that are worthy of further comments. First, it would appear that on average the market incorporates more bad news than good news into pricing at the time of the information release. Indeed, the impression is that the market is much more efficient in incorporating bad news into prices than it is good news. This can be seen when one observes the large positive drift following good news announcements at times of low uncertainty viz-viz no trend following bad news announcements at these times. Second, it would appear that the overall reaction to bad news is greater than it is to good news. The simplest way to see this is by looking at Table 2 where we see that the drift following bad news is twice that following good news. We would propose uncertainty provides a major explanation for why the market is more responsive to bad news than good news. The market is always subject to some uncertainty when trying to interpret information which means that there is always a tendency towards an asymmetric reaction by the market to bad news and good news. Of course, we have also seen that sentiment sometimes works to offset this asymmetric response and even at times to reverse it.

We believe that we have validated in this paper the importance of the role that market uncertainty and market sentiment plays in explaining the existence of a PEAD. Undoubtedly they, like many of the other factors identified, do not provide the complete explanation. The opportunity remains for future researchers to provide a more complete and integrative explanation for the PEAD but we believe in this paper that we have made a significant contribution towards making this possible.

References

Ali, A., X. Chen and T. Yu (2008), 'Profiting from the Post Earnings Announcement: Mutual Fund Trades, Market Frictions, and Efficiency' Working paper (University of Texas).

Angelini, P., and G. Guazzarotti (2010), 'Information Uncertainty and the Reaction of Stock Prices to News' Banca D'Italia Research Paper No. 765.

Anderson, K., J. Harris and E. So (2007), 'Opinion Divergence and Post-Earnings Announcement Drift'. McDonough School of Business Working Paper

Anderson, E.W., E. Ghysels and J.L. Juergens (2009), 'The impact of risk and uncertainty on expected returns', Journal of Financial Economics 94(2): 233-263.

Baker, M. and J. Wurgler (2007), 'Investor sentiment in the stock market', Journal of Economic Perspectives, No.21(2), pp. 129-151.

Ball, R., and P. Brown (1968), 'An Empirical Evaluation of Accounting Income Numbers', Journal of Accounting Research No.6, pp. 159-177.

Ball, R. (1978), 'Anomalies in Relationships between Securities' Yield and Yield-Surrogates', Journal of Financial Economics, No.6, pp. 103-125.

Barberis, N., A. Shleifer and R. Vishney (1998), 'A model of market sentiment' Journal of Financial Economics, No.49, pp.307-343.

Barron, O., O. Kim, S. Lim and D. Stevens (1998), 'Using analysts' forecasts to measure properties of analysts' information environment'. The Accounting Review 73: 421−433.

Bartov. E., S. Radhakrishnan and I. Krinsky (2000), 'Investor Sophistication and Patterns in Stock Returns after the Earnings Announcements' The Accounting Review, No.75, pp. 43-63.

Berens. M. (2010), 'The Asymmetry of Market Efficiency for Positive and Negative Earnings Surprises', Working Paper (University of Cologne).

Bernard, V. and J. Thomas (1989), 'Post-Earnings-Announcement Drift: Delayed Price Reaction or Risk Premium?' Journal of Accounting Research, No. 27, pp. 1-36.

Bird, R. and D. Yeung (2010), 'How Do Investors React Under Uncertainty?', Working paper (Paul Woolley Centre for the Study of Market Dysfunctionality, University of Technology Sydney).

Carr, P., and L. Wu (2009), 'Variance Risk Premia', Review of Financial Studies, No.22(3), pp. 1311-1341.

Caskey, J. A. (2009), 'Information in Equity Markets with Ambiguity Averse Investors', Review of Financial Studies, No.9, pp. 3583 – 3627

Drechsler, I. (2009), 'Uncertainty, Time-Varying Fear, and Asset Prices', Working Paper (The Wharton School).

Epstein, L. G. and M. Schneider (2003), 'Recursive multiple-priors', Journal of Economic Theory, No.113, pp.1-31.

Epstein, L. G. and M. Schneider (2008), 'Ambiguity, Information Quality and Asset Pricing', Journal of Finance, No.63, pp.197-228.

Eraker, B., (2004), 'Do Equity Prices and Volatility Jump? Reconciling Evidence from Spot and Option Prices', Journal of Finance, No.56 (3), pp. 367-1403.

Fama, E. and K. French (1992), 'The Cross Section of Expected Stock Returns', Journal of Finance, No.47 (2), pp. 427 – 465.

Fama, E. (1998), 'Market efficiency, long-term returns, and behavioural finance', Journal of Financial Economics, No. 49, pp. 283-306.

Frazzini, A. (2006), 'The Disposition Effect and the Underreaction to News', Journal of Finance, No.61, pp. 2017-2046.

Forner, C., S. Sanabran and J. Marhuenda (2009), 'Post-earnings announcement drift: Spanish evidence', Spanish Economic Review, No.11, pp. 207-241.

Francis, J., R. Lafond, R. Olsson and K. Schipper (2007), 'Information Uncertainty and the Post-Earnings-Announcement Drift' Journal of Business Finance and Accounting, Vol.34, pp. 403-433.

Gilboa, I. and D. Schmeidler (1989), 'Maxmin Expected Utility with Non-Unique Prior', Journal of Mathematical Economics, Vol. 18, pp. 141-153.

Hong. H. and J. Stein (1999), 'An Unified Theory of Underreaction, Momentum Trading and Overreaction in Asset Markets', Journal of Finance, Vol. 54, pp. 2143-2184.

Jones, C.P. and R.H. Litzenberger (1970), 'Quarterly Earnings Reports and Intermediate Stock Price Trends', The Journal of Finance, Vol. 25, No. 1, pp. 143-148.

Jacob, J., T. Lys and J. Sabino (2000), 'Autocorrelation Structure of Forecast Errors from Time-Series Models: Alternative assessments of the Causes of the Post-Earnings Announcement Drift', Journal of Accounting and Economics, Vol. 28, pp. 329-358.

Kadiyala, P., and R. Rau (2005), 'Investor Reaction to Corporate Event Announcements: Underreact or Overreaction?', Journal of Business, Vol. 77, pp. 357-386.

Kaestner, M. (2006), 'Investors' Misreaction to Unexpected Earnings: Evidence of Simultaneous Overreaction and Underreaction', Working paper (Centre for Research in Finance, Montpellier University).

Kim, K., S. Pandit and C. Wasley (2010), 'Aggregate Uncertainty and Management earnings Forecasts', Working paper (UIC College of Business Administration).

Konchitchki, Y., X. Lu, G. Sadka and R. Sadka (2010), 'On the Predictability of Analyst Forecast Errors and the Post-Earnings-Announcement Drift', Working Paper (Marshall School of Business).

Kothari, S. (2001), Capital markets and research in accounting', Journal of Accounting and Economics, Vo. 31, pp. 105-231.

Livnat, J., and C. Petrovitis (2009), 'Investor Sentiment, Post-earnings Announcements Drift, and Accruals' Working paper (Stern School of Business).

Mendenhall, R. (2004), 'Arbitrage Risk and the Post-earnings-Announcement Drift', Journal of Business, Vol. 77, pp. 875-894.

Sadka, R. (2006), 'Momentum and Post-Earnings-Announcement Drift: The Role of Liquidity Risk', Journal of Financial Economics, Vol. 80, pp. 309-349.

Skinner, D., and R. Sloan. 2002. "Earnings Surprises, Growth Expectations, and Stock Returns or Don't Let an Earnings Torpedo Sink Your Portfolio" Review of Accounting Studies, Vol. 7, pp.289-312.

Tang, M. (2009), 'Asymmetric Forecast Revision in Response to Earnings Announcement under Information Uncertainty', Working Paper (Simon School of Business).

Williams, C.D. (2009), 'Asymmetric Responses to Earnings News: A Case of Ambiguity' Working Paper (University of North Carolina).

Yan, J.C.Y. and J.J. Wild (1990), 'Unexpected Earnings and Intraindustry Information Transfers: Further Evidence', Journal of Accounting Research, Vol. 28, No. 1,pp. 211-219.

Zhang, X. (2006), 'Information Uncertainty and Stock Returns' Journal of Finance, Vol 61, No. 1, pp. 105-136.

Table 1
Summary Statistics

	Full sample		VIX Lo		VIX Hi		ΔVIX-		ΔVIX+	
Variable	**Mean**	**Stdev**	**Mean**	**Stdev**	**Mean**	**Stdev**	**Mean**	**Stdev**	**Mean**	**Stdev**
NUE	-0.534	0.790	-0.490	0.751	-0.570	0.815	-0.541	0.791	-0.527	0.789
PUE	0.247	0.468	0.228	0.431	0.270	0.516	0.256	0.479	0.237	0.454
MV	1941.7	4933.5	1563.4	4116.4	1809.4	4744.45	1877.4	4771.2	2018.5	5119.8
BTMV	0.677	0.775	0.515	0.535	0.824	0.984	0.715	0.819	0.630	0.715
	Full sample		**MOM Lo**		**MOM Hi**		**MOM Lo Post**		**MOM Hi Post**	
Variable	**Mean**	**Stdev**	**Mean**	**Stdev**	**Mean**	**Stdev**	**Mean**	**Stdev**	**Mean**	**Stdev**
NUE	-0.534	0.790	-0.538	0.792	-0.540	0.799	-0.517	0.779	-0.548	0.794
PUE	0.247	0.468	0.250	0.475	0.252	0.487	0.244	0.471	0.258	0.481
MV	1941.7	4933.5	1933.0	4943.2	1938.8	4960.4	2108.2	5229.7	1766.3	4605.4
BTMV	0.677	0.775	0.704	0.828	0.685	0.784	0.688	0.859	0.700	0.774

Notes:
The sample contains earnings announcements from January 1986 to September 2009. Company information data are sourced from CRSP/COMPUTSTAT Merged database. Returns data are gathered from CRSP. The measure of market uncertainty is the Implied Volatility Index from CBOE. ΔVIX- (and ΔVIX+) represents a decrease (increase) in the level of VIX measured between the announcement date and 60 days after the announcement. VIX Lo represents the sample of announcements made when the level of volatility is in the lowest tercile when all announcements in the sample are ranked by the level of uncertainty. Similarly VIX Hi Lo represents the sample of announcements made when volatility level falls in the highest tercile. MOM Lo represents the sample of announcements where the S&P 500 Index returns in the 5 days prior to the announcement ranks in the lowest tercile. Similarly MOM Hi represents the sample of announcements where the S&P 500 Index returns in the 5 days prior to the announcement ranks in the highest tercile. *Mom Lo Post* includes all announcements where the S&P 500 Index returns in the post announcement period (which commences on the second day after the announcement and ends on the 60^{th} trading day after the announcement) falls within the lowest tercile in the sample. Similarly Mom Hi Post represents announcements by firms where the market (as measured by S&P 500 index) exhibited the highest returns for the post announcement period {t+2, t+60}. PUE are events where the announced earnings are greater than the expected earnings where *expected earnings* are defined as last year's earnings. PUE is calculated by multiplying the unexpected earning by a dummy variable which takes the value of 1 if there is positive earnings surprises and 0 otherwise. Similarly, a negative unexpected earnings (NUE) event occurs when the earnings just announced fall short of expected earnings. MV represents the market capitalisation at the time of the announcement and is measured in millions. BTMV measures the Book to Market value of the firm making the announcement.

Table 2 **Analysis of Post earnings announcement drift (PEAD)**	
	Coefficient†
NUE	0.015083***
PUE	0.009143***
Ln(MV)	-0.002192***
BTMV	0.007926***
Test of Difference	NUE>PUE***

Notes:

The above table reported the basic results for the basic regression (or *equation 1*) :

$$R_{it} = \beta_o + \beta_1 \, NUE_{it} + \beta_2 \, PUE_{it} + \beta_3 \log(MV_{it}) + \beta_4 \, BTMV_{it} + \text{Year Effects} + \varepsilon_{it.}$$

The dependent variable, R_{it}, is the accumulated excess return over the post-announcement period which commences on the second day after the announcement and ends on the 60^{th} trading day after the announcement (i.e., t+2 to t+60). The unexpected portion of an earnings announcement is defined as the difference between the actual earnings and the consensus earnings estimate in the month immediately prior to announcement. We scaled the unexpected portion of the earnings announcement by the actual earnings announced to arrive at our final measure of unexpected earnings. PUE are events where the announced earnings are greater than the expected earnings where *expected earnings.* PUE is calculated by multiplying the unexpected earning by a dummy variable which takes the value of 1 if there is positive earnings surprises and 0 otherwise. Similarly, a negative unexpected earnings (NUE) event occurs when the earnings just announced fall short of the consensus analysts forecast earnings. PUE are events where the announced earnings are greater than the expected earnings where median analysts forecast earnings. PUE is calculated by multiplying the unexpected earning by a dummy variable which takes the value of 1 if there is positive earnings surprises and 0 otherwise. Similarly, a negative unexpected earnings (NUE) event occurs when the earnings just announced fall short of expected earnings. MV represents the market capitalisation at the time of the announcement and is measured in millions. BTMV measures the Book to Market value of the firm making the announcement. Yearly fixed effects are included but not reported in the results. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 3
The impact of uncertainty levels on the Post earnings announcement drift

	Coefficient†		Test of Difference	
	VIX Lo	VIX Hi	VIX Lo	VIX Hi
NUE	0.0124***	0.0163***	N>P	N>P***
PUE	0.0072***	0.0083***		

Notes:
The above table reported the results for the regression :

$$R_{it} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 X_1 NUE_{it} + \beta_4 X_1 PUE_{it} + \beta_5 X_2 NUE_{it} + \beta_6 X_2 PUE_{it} + \beta_7 \log(MV_{it}) + \beta_8 BTMV_{it} + \text{Year Effects} + \varepsilon_{it}$$

The dependent variable, R_{it} is the accumulated excess return over the post-announcement period which commences on the second day after the announcement and ends on the 60th trading day after the announcement (i.e., t+2 to t+60). The unexpected portion of an earnings announcement is defined as the difference between the actual earnings and the consensus earnings estimate in the month immediately prior to announcement. We scaled the unexpected portion of the earnings announcement by the actual earnings announced to arrive at our final measure of unexpected earnings. PUE are events where the announced earnings are greater than the expected earnings where *expected earnings.* PUE is calculated by multiplying the unexpected earning by a dummy variable which takes the value of 1 if there is positive earnings surprises and 0 otherwise. Similarly, a negative unexpected earnings (NUE) event occurs when the earnings just announced fall short of the consensus analysts forecast earnings. X_1 is an indicator variable which is equal to 1 where firm i makes an earnings announcement at time t and the level of VIX at time t *ranks in the second tercile* where all level of market uncertainty (VIX) are ranked from low to high; otherwise $X_1 = 0$. Similarly X_2 is equal to 1 where firm i makes an earnings announcement at time t and the level of VIX at time t *ranks in the third tercile* where all level of market uncertainty (VIX) are ranked from low to high; otherwise $X_2 = 0$. For ease of interpretation, we have formatted the above table to show only the results directly related to VIX levels. For example, the displayed coefficient for VIX Hi and negative earnings surprise (NUE) is 0.0225 (i.e. sum of β_1 and β_3). To test for asymmetry in responses to NUE and PUE, we conduct Wald test on the coefficients, the results are reported in the last 2 columns of the table. Yearly Control variable including Book to Market values, Market capitalisation and yearly fixed effects are included but not reported in the results. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 4
The impact of uncertainty levels and changes in uncertainty on PEAD

	NUE		PUE			Test of Difference	
	VIX Lo	**VIX Hi**		**VIX Lo**	**VIX Hi**	**VIX Lo**	**VIX Hi**
↓ΔVIX	0.0085***	0.0147***	**↓ΔVIX**	0.0236***	0.0154***	P>N***	P>N
↑ΔVIX	0.0158***	0.0220***	**↑ΔVIX**	-0.0043	-0.0124***	N>P***	N>P***

Notes:

In table 4, we examine the combined impact of uncertainty level and changes in uncertainty on PEAD. Changes in uncertainty are defined as the difference between the level of uncertainty on the day of the announcement and the level of uncertainty 60 days post announcement. We rank the changes in uncertainty across the sample of announcement. ↓ΔVIX represents the sample of announcements that falls within the first tercile in terms of changes in uncertainty (i.e. announcements that are followed by decrease in market uncertainty in the post announcement period). ↑ΔVIX represents the sample of announcements that reregistered that ranks in the third tercile (i.e. announcements follow by the increase in uncertainty level). Then we run the following regression (or equation 2) :

$$R_{it} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 X_1 NUE_{it} + \beta_4 X_1 PUE_{it} + \beta_5 X_2 NUE_{it} + \beta_6 X_2 PUE_{it} + \beta_7 X_3 NUE_{it} + \beta_8 X_3 PUE_{it} + \beta_9 \log(MV_{it}) + \beta_{10} BTMV_{it} + \text{Year Effects} + \varepsilon_{it}$$

The dependent variable, R_{it} is the accumulated excess return over the post-announcement period (i.e., t+2 to t+60). PUE are events where the announced earnings are greater than the expected earnings where *expected earnings.* PUE is calculated by multiplying the unexpected earning by a dummy variable which takes the value of 1 if there is positive earnings surprises and 0 otherwise. Similarly, a negative unexpected earnings (NUE) event occurs when the earnings just announced fall short of the consensus analysts forecast earnings. X_1 is an indicator variable which is equal to 1 where firm i makes an earnings announcement at time t and the level of VIX at time t *ranks in the second tercile* where all level of market uncertainty (VIX) are ranked from low to high; otherwise $X_1 = 0$. Similarly X_2 is equal to 1 where firm i makes an earnings announcement at time t and the level of VIX at time t *ranks in the third tercile* where all level of market uncertainty (VIX) are ranked from low to high; otherwise $X_2 = 0$. X_3 is equal to 1 where there is an increase in the level of VIX increase over the post-announcement period (as measure by the difference between the level of VIX at the time of announcement, VIX_t and the level of VIX 60 days post announcement, VIX_{t+60}); otherwise $X_3 = 0$. For ease of interpretation, we have formatted the above table to show only the results directly related to VIX levels. For example, the displayed coefficient for VIX Hi and negative earnings surprise (NUE) is the sum of β_1 and β_3. Yearly fixed effects are included but not reported in the results. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 5
The effect of Uncertainty and Sentiment on the Post Earnings Announcement Drift

Total Sample

NUE			Post Announcement Sentiment			PUE			Post Announcement Sentiment	
	Levels	**Trend**	**Lo**	**Hi**			**Levels**	**Trend**	**Lo**	**Hi**
Uncertainty	**Lo**	**↓ΔVIX**	0.0101***	0.0062***		**Uncertainty**	**Lo**	**↓ΔVIX**	-0.0037	0.0267***
	Lo	**↑ΔVIX**	0.0168***	0.0129***			**Lo**	**↑ΔVIX**	-0.0133***	0.0172***
	Hi	**↓ΔVIX**	0.0167***	0.0128***			**Hi**	**↓ΔVIX**	-0.0065**	0.0239***
	Hi	**↑ΔVIX**	0.0234***	0.0195***			**Hi**	**↑ΔVIX**	-0.0161***	0.0143***

Notes:

In table 5, the impact of momentum is introduced into the analysis. Momentum refers to market momentum and is measured by the S&P 500 index returns in the period 2 days to 60 days after the announcement (i.e. t+2 to t+60). The above table reported the results for the regression (or equation 3):

$$R_{it} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 X_1 NUE_{it} + \beta_4 X_1 PUE_{it} + \beta_5 X_2 NUE_{it} + \beta_6 X_2 PUE_{it} + \beta_7 X_3 NUE_{it} + \beta_8 X_3 PUE_{it} + \beta_9 X_4 NUE_{it} + \beta_{10} X_4 PUE_{it} + \beta_{11} X_5 NUE_{it} + \beta_{12} X_5 PUE_{it} + \beta_{13}\log(MV_{it}) + \beta_{14} BTMV_{it} + \text{Year Effects} + \varepsilon_{it}$$

The dependent variable, R_{it} is the accumulated excess return over the post-announcement period (i.e., t+2 to t+60). PUE and NUE represent positive and negative earnings surprise respectively. X_1 is an indicator variable which is equal to 1 where firm i makes an earnings announcement at time t and the level of VIX at time t *ranks in the second tercile* where all level of market uncertainty (VIX) are ranked from low to high; otherwise $X_1 = 0$. Similarly X_2 is equal to 1 where firm i makes an earnings announcement at time t and the level of VIX at time t *ranks in the third tercile* where all level of market uncertainty (VIX) are ranked from low to high; otherwise $X_2 = 0$. X_3 is equal to 1 where there is an increase in the level of VIX increase over the post-announcement period (as measure by the difference between the level of VIX at the time of announcement, VIX_t and the level of VIX 60 days post announcement, VIX_{t+60}); otherwise $X_3 = 0$. $X_4 = 1$ if the return on S&P 500 Index from t+2 to t+60 *ranks in the second tercile* where all S&P 500 Index {t+2, t+60} are ranked from low to high; otherwise $X_4 = 0$.$X_5 = 1$ if the return on S&P 500 Index from t+2 to t+60 *ranks in the third tercile* where all S&P 500 Index {t+2, t+60} are ranked from low to high; otherwise $X_5 = 0$. For ease of interpretation, we have formatted the above table to show only the results directly related to the impact of VIX levels and the Post announcement sentiment level. For example, the table indicates where there is low level of Uncertainty at announcement followed by high sentiment but also an increase in uncertainty (VIX↑) in the post announcement period, the coefficient associated with NUE is 0.00129 (i.e., $\beta_1 + \beta_7 + \beta_{11}$). Control variables such as market capitalisation, book to market value and yearly fixed effects are included but not reported in the results. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 6

The effect of Uncertainty and Sentiment on the Post Earnings Announcement Drift by Market Capitalisation

Panel A: Large Cap Sample

NUE					PUE				
			Post Announcement Sentiment					Post Announcement Sentiment	
	Levels	Trend	Lo	Hi		Levels	Trend	Lo	Hi
Uncertainty	Lo	↓ΔVIX	0.0024	0.0007	Uncertainty	Lo	↓ΔVIX	-0.0087	0.0223***
	Lo	↑ΔVIX	0.0085**	0.0068		Lo	↑ΔVIX	-0.0126***	0.0184***
	Hi	↓ΔVIX	0.0094***	0.0077**		Hi	↓ΔVIX	-0.0257***	0.0053
	Hi	↑ΔVIX	0.0155***	0.0138***		Hi	↑ΔVIX	-0.0296***	0.0014

Panel B: Small Cap Sample

NUE					PUE				
			Post Announcement Sentiment					Post Announcement Sentiment	
	Levels	Trend	Lo	Hi		Levels	Trend	Lo	Hi
Uncertainty	Lo	↓ΔVIX	0.0145***	0.0096***	Uncertainty	Lo	↓ΔVIX	-0.0043	0.0260***
	Lo	↑ΔVIX	0.0192***	0.0142***		Lo	↑ΔVIX	-0.0125***	0.0179***
	Hi	↓ΔVIX	0.0161***	0.0112***		Hi	↓ΔVIX	0.0031	0.0335***
	Hi	↑ΔVIX	0.0208***	0.0158***		Hi	↑ΔVIX	-0.0050	0.0253***

Notes:

In table 6, we examine whether the impact of uncertainty and Sentiment on the post earnings announcement drift differs for firms of different sizes. To do so, we split our sample by market capitalisation into subsamples of small cap firm and large cap firms. We then repeat the analysis as set out in equation 3. *Panel A* display the regression results for the sample of large cap stocks. The results for the sample of small cap stocks are displayed in *Panel B*. For ease of interpretation, we have formatted the above table to show only the results directly related to the impact of VIX levels and the Post announcement sentiment level. For example, the panel B of the table indicates where there is low level of Uncertainty at announcement followed by high sentiment but also an increase in uncertainty (VIX↑) in the post announcement period, the coefficient associated with NUE is 0.0142 (i.e., $\beta_1 + \beta_7 + \beta_{11}$). Yearly fixed effects are included but not reported in the results. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 7

The effect of Uncertainty and Sentiment on the Post Earnings Announcement Drift by Growth/Value Stocks

Panel A: Growth Stocks (Low book-to-market)

NUE						PUE				
			Post Announcement Sentiment						**Post Announcement Sentiment**	
	Levels	**Trend**	**Lo**	**Hi**			**Levels**	**Trend**	**Lo**	**Hi**
Uncertainty	**Lo**	**↓ΔVIX**	0.0112**	0.0081**		**Uncertainty**	**Lo**	**↓ΔVIX**	-0.0113*	0.0360***
	Lo	**↑ΔVIX**	0.0212***	0.0181***			**Lo**	**↑ΔVIX**	-0.0249***	0.0224***
	Hi	**↓ΔVIX**	0.0272***	0.0241***			**Hi**	**↓ΔVIX**	-0.0208***	0.0265***
	Hi	**↑ΔVIX**	0.0372***	0.0341***			**Hi**	**↑ΔVIX**	-0.0344***	0.0129***

Panel B: Value Stocks (High book-to-market)

NUE						PUE				
			Post Announcement Sentiment						**Post Announcement Sentiment**	
	Levels	**Trend**	**Lo**	**Hi**			**Levels**	**Trend**	**Lo**	**Hi**
Uncertainty	**Lo**	**↓ΔVIX**	0.0117***	0.0071**		**Uncertainty**	**Lo**	**↓ΔVIX**	0.0028	0.0200***
	Lo	**↑ΔVIX**	0.0157***	0.0111***			**Lo**	**↑ΔVIX**	-0.0038	0.0134***
	Hi	**↓ΔVIX**	0.0136***	0.0091***			**Hi**	**↓ΔVIX**	0.0043	0.0215***
	Hi	**↑ΔVIX**	0.0176***	0.0131***			**Hi**	**↑ΔVIX**	-0.0023	0.0149***

Notes:

In table 7, we examine whether the impact of uncertainty and Sentiment on the post earnings announcement drift differs for firms of different characteristics. To do so, we split our sample by book to market ratio into Value and Growth firms. We then repeat the analysis as set out in equation 3. *Panel A* display the regression results for the sample of Growth stocks (or Low book-to-market stocks). The results for the sample of *Value stocks* (or high book-to-market stocks) are displayed in *Panel B*. For ease of interpretation, we have formatted the table to show only the results directly related to the impact of uncertainty and the Post announcement sentiment level. For example, the panel B of the table indicates where there is low level of Uncertainty at announcement followed by high sentiment but also an increase in uncertainty (VIX↑) in the post announcement period, the coefficient associated with NUE is 0.0111 (i.e., $\beta_1 + \beta_7 + \beta_{11}$). Yearly fixed effects are included but not reported in the results. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 8
The impact of announcement time Uncertainty levels and Sentiment on PEAD

	Full Sample		Large Cap		Small Cap		Growth Sample		Value Sample	
	NUE		NUE		NUE		NUE		NUE	
	Pre Announcement Sentiment		Pre Announcement Sentiment		Pre Announcement Sentiment		Pre Announcement Sentiment		Pre Announcement Sentiment	
	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi
VIX Lo	0.0112***	0.0099***	0.0084**	0.0122***	0.0114***	0.0091***	0.0148***	0.0129***	0.0093***	0.0084***
VIX Hi	0.0155***	0.0142***	0.0106**	0.0144***	0.0134***	0.0111***	0.0284***	0.0265***	0.0113***	0.0104***
	PUE		PUE		PUE		PUE		PUE	
	Pre Announcement Sentiment		Pre Announcement Sentiment		Pre Announcement Sentiment		Pre Announcement Sentiment		Pre Announcement Sentiment	
	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi
VIX Lo	0.0000	0.0053	0.0044	-0.0015	-0.0015	0.0068	-0.0048	0.0081*	0.0029	0.0023
VIX Hi	0.0040	0.0093***	-0.0071*	-0.0130***	0.0127***	0.0210***	-0.0041	0.0089**	0.0108***	0.0102***

Notes:

In table 8, we examine whether the level of uncertainty and Sentiment (at the time of the announcement) can influence the post earnings announcement drift. To do so we run the following regression:

$$R_{it} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 X_1 NUE_{it} + \beta_4 X_1 PUE_{it} + \beta_5 X_2 NUE_{it} + \beta_6 X_2 PUE_{it} + \beta_7 X_6 NUE_{it} + \beta_8 X_6 PUE_{it} + \beta_9 X_7 NUE_{it} + \beta_{10} X_7 PUE_{it} + \beta_{11} \log(MV_{it}) + \beta_{12} BTMV_{it} + \text{Year Effects} + \varepsilon_{it}$$

The dependent variable, R_{it} is the accumulated excess return over the post-announcement period which commences on the second day after the announcement and ends on the 60th trading day after the announcement (i.e., t+2 to t+60). The unexpected portion of an earnings announcement is defined as the difference between the actual earnings and the consensus earnings estimate in the month immediately prior to announcement. We scaled the unexpected portion of the earnings announcement by the actual earnings announced to arrive at our final measure of unexpected earnings. PUE are events where the announced earnings are greater than the expected earnings where *expected earnings.* PUE is calculated by multiplying the unexpected earning by a dummy variable which takes the value of 1 if there is positive earnings surprises and 0 otherwise. Similarly, a negative unexpected earnings (NUE) event occurs when the earnings just announced fall short of the consensus analysts forecast earnings. X_1 is an indicator variable which is equal to 1 where firm i makes an earnings announcement at time t and the level of VIX at time t *ranks in the second tercile* where all level of market uncertainty (VIX) are ranked from low to high; otherwise $X_1 = 0$. Similarly X_2 is equal to 1 where firm i makes an earnings announcement at time t and the level of VIX at time t *ranks in the third tercile* where all level of market uncertainty (VIX) are ranked from low to high; otherwise $X_2 = 0$. $X_6 = 1$ if the return on S&P 500 Index (i.e., momentum) over the five-days prior to an earnings announcement (i.e., t-6 to t-2) *ranks in the second tercile* where all S&P 500 Index returns {t-6, t-2} are ranked from low to high; otherwise $X_6 = 0$. $X_7 = 1$ if the return on S&P 500 Index (i.e., momentum) over the five-days prior to an earnings announcement (i.e., t-6 to t-2) *ranks in the third tercile* where all S&P 500 Index returns {t-6, t-2} are ranked from low to high; otherwise $X_6 = 0$. For ease of interpretation, we have formatted the above table to show only the results directly related to the impact of VIX levels and the Sentiment (immediately prior to announcement). The table include results for the full sample and the characteristic based subsamples. Yearly fixed effects are included but not reported in the results. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.