The relationship between uncertainty and the market reaction to information: How is it influenced by market and stock-specific characteristics? [1]

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Abstract: Numerous empirical studies dating back to Ball and Brown (1968) have investigated how markets react to the receipt of new information. However, it is only recently that authors have focussed on differentiating between, and learning from, how investors react to good and bad news. In this paper we find that investors swing between being optimistic and being pessimistic in their interpretation of the new information driven by not only the prevailing market uncertainty and sentiment but also by a significant number of firm-specific characteristics. Pessimism prevails when uncertainty is high, sentiment is weak and the information is being disseminated by companies that are lowly-valued, have high risk, are thinly traded and/or are small cap stocks. However, investors swing to being optimistic when one reverses some or all of these factors. The conclusion that we draw is that risk, uncertainty and the attitude of investors combine to determine how the markets react to new information and this flows through to asset valuations.

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The Relationship between Uncertainty and the Market Reaction to Information: How is it influenced by Market and Stock-Specific Characteristics?

I. Introduction

Financial assets are priced on the basis of what market participants believe that they are worth which is an assessment that they make based on what they perceive as the relevant information available to them. The essence of an efficient market is that investors quickly incorporate new information into prices in an unbiased way[1]. Over the last 40+ years there have been a plethora of studies that have examined how investors react to numerous information signals process and these studies have highlighted a number of anomalies. However, it is only in recent years that authors have begun to particularly focus *on the factors* that influence how investors assess and so react to new information signals and in particular, what causes them to react differently to good news and bad news.

Williams (2009) demonstrated how the prevailing level of uncertainty impacted on the markets response to earnings announcements while Kim et al. (2010) conducted a similar study where the information source considered was management forecasts. Bird and Yeung (2010) showed that it is not only market uncertainty but also market sentiment that plays a major role in determining how investors react to earnings announcements at the time of their release and Bird et al (2011) extended this study to examine how the same factors influence the post-earnings announcement drift.

In this paper we focus on providing insights into the extent to which firm characteristics influence the market reaction to earnings news after account is taken of the level of market uncertainty existing at the time of the information release. First we use our data to establish a base case as to the impact of market uncertainty on the decision process of investors assimilating earnings news into prices. We then proceed to confirm that the market response to new information is further conditioned by the prevailing market sentiment at the time of the information release. We find that negative (positive) news has a much bigger impact when earnings is released at a time when market uncertainty is

[1] We use good (bad) news to describe an information release that exceeds (falls short of) expectations

high (low) and market sentiment is low (high). Thus we confirm that the optimism or pessimism of the market plays an important role in determining how it interprets and responds to information. In the remainder of the paper, we seek out other factors that also impact on how the market responds and particularly how these factors interact with market uncertainty. We find evidence of several other factors, including valuation, risk, size, trading volume and industry that play a role in determining the extent of investor reaction to new information. Indeed, many of these factors seem to play at least as large a role as uncertainty in this determination. Although the impact of several of these factors comes as no surprise within a traditional setting, others seem to be more consistent with behavioral explanations of investor behaviour rather than economic rationality.

II. Background

It is well recognised in markets that uncertainty has important effect on investor behavior. This is well captured in a recent article that appeared on the Yahoo website at the time of the resolution of the US "debt ceiling" crisis:

> *It's a truism that equity markets hate uncertainty . . . .When bad things happen, or when investors think bad things are going to happen, they sell stocks. When anxiety fades, they buy stocks*[2]

We examine how this description of investor behaviour translates into how they react to information conditioned on the prevailing level of uncertainty existing at the time of the information release. Our main focus is to expand on recent work which suggests that when market uncertainty is high, investors tends to react more to bad news than to good news. In this paper we:

- Examine the generality of the finding that uncertainty always results in an asymmetric response to the release of good and bad information (Williams, 2009).
- Verify that market sentiment works to mitigate the impact of market uncertainty on the way that investors react to information release.

[2] D Gross (2011), Debt Deal Done: What Does It Mean?" appearing on the Yahoo website: http://finance.yahoo.com/blogs/daniel-gross/debt-deal-done-does-mean-063125258.html?sec=topStories&pos=main&asset=&ccode=

- Demonstrate that various firm characteristics play an important role in determining how investors react to information signals.

We can learn very little from economic theory as to how uncertainty will impact on the way that decision makers react to good and bad news. Investors provide a good media for reflecting on this issue as they are continually being subjected with information signals which they incorporate into their decision processes in order to come up with an estimate of what a particular stock is worth. If we follow a standard approach and assume that investors seek to maximise von Norman Morgenstern utility and apply Bayes' rule when updating their expectations, then with log normal utility there will be a equal absolute reaction to the same modicum of good and bad news (i.e. no asymmetric reaction)[3].

Of course the standard models only account for risk and we can get a better theoretical justification for asymmetry once we allow for uncertainty. The main difference being that in an uncertain world one can no longer derive a subjective probability distribution to describe the outcome of one's decisions. With uncertainty, there are a whole series of such distributions with no certainty as to which one will apply. The usual way to deal with an uncertain world where everything is indeterminate is to make some assumption about the behavior of decision makers that allows one to collapse an uncertain situation to a risky situation.

The most quoted assumption in the uncertainty literature is that of Gilboa and Schmeidler (1989) where decision makers faced with uncertainty are assumed to base their decisions on maxmin expected utility (MEU). The intent of this assumption is that those investors faced with multiple priors will take a pessimistic stance and choose that option which they expect to maximize their utility under the worst possible outcome. Hanany and Klibanoff (2007) demonstrate how decision makers apply Bayes' rule under MEU to produce outcomes that are consistent with the stylised facts as identified by Ellsberg (1961). Epstein and Schneider (2008) consider how investors react to information signals where the implications of the signals are uncertain. On the assumption that investors faced with such situations follow MEU, the authors demonstrate that investors

[3] Other forms of utility may lead to an asymmetric response but the exact form of this response cannot be predicted.

will want to be compensated for uncertainty. They highlight in their paper that in situations of uncertainty, investors will react asymmetrically to information: over-weighting bad news and under-weighting good news.[4]

We now turn to the empirical literature to see what we can learn about how decisions makers (investors in our case) react to the release of information. The most relevant being the event study literature which dates back to Ball and Brown (1968). Over the last 40+ years there have been thousands of papers that have provided evidence that the market responds positively to good news but penalises a company on the receipt of bad news. As Berens (2010) points out, a shortcoming in the vast majority of these papers is that they do not separately investigate the market reaction to good and bad news. Up until recently only a handful of studies had separately evaluated the response to good and bad news. Freeman and Tse (1992) were the first to highlight the fact that there is a non-linear response between unexpected earnings and unexpected returns. Conrad et al. (2002), following models developed by Barberis et al. (1998) and Veronesi (1999) show that the magnitude of the market reaction to bad news increases with the strength of the market as does the difference in the response to bad and good news. Francis et al. (2007) argue that investors underreact to all information signals where they are uncertain as to the credibility of the information and then, subsequently adjust their expectations when this uncertainty is resolved.

This leads us to the most recent research where Williams (2009) was the first to establish the link between the level of uncertainty in the market and the greater market response to "bad news" earnings announcements relative to the response to "good news" earnings announcements. The asymmetric response identified by Williams was confirmed by Kim et al. (2009) when he examined the market response to the release of earnings forecasts by management. Bird and Yeung (2010) also found that the market reacted much more strongly to bad news than to good news when it was released at a time when market uncertainty is high and market sentiment is low. However, they found that this asymmetric response reverses when the earnings information is released during a period of low market uncertainty and high market sentiment.

[4] Caskey (2009) demonstrated that under similar conditions uncertainty provided an explanation for many of the market anomalies such as momentum and the post-earnings announcement drift.

III. Research Question, Data and Methodology

This is an investigative project where we are trying to throw more light on the factors that affect the way by which the market responds to the receipt of new information. The focus is first on examining the impact that market uncertainty has on the decision process of investors. There have been several recent empirical papers that have shown that investors become more pessimistic as uncertainty grows which results in them underweighting good news and overweighting bad news. Although this result may hold on average across all information releases, the question we attempt to address is the extent of its generality. We use the data and methodology outlined in this section to examine the impact of several stock-specific characteristics on the market response to new information under various levels of market uncertainty.

Data

The sample period used in this study extends from January 1996 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[5]. The accounting data which includes reported earnings is obtained from the CRSP/COMPUTSTAT merged database which is sourced through WRDS.

To be included in the final sample, we require the firms to have earnings announcements in at least each of the previous five 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 and, in order to reduce the impact of outliers, firm characteristics are trimmed at the 1 and 99th percentile.

In the following section, we provide a brief discussion on the calculation of the two major variables, unexpected earnings and market uncertainty, used in this study and then we introduce measures that we use to reflect both market sentiment and several firm-specific characteristics.

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

Unexpected earnings

Our study revolves around evaluating the stocks returns at the time of the release of an earnings announcement. Central to our analysis is the unexpected component of the earnings announcement which we measure as the difference between changes in earnings per share from the corresponding quarter of the previous year. Therefore, we define expected earnings as being the earnings per share in the corresponding quarter the previous year[6]. An important aspect of our study is that we separately evaluate the market reaction to negative unexpected earnings (NUE) and positive unexpected earnings (PUE). Otherwise we would be ignoring the potential for their being an asymmetric response to NUE and PUE which has been confirmed in several recent studies (Williams, 2009; Bird and Yeung, 2010).

Uncertainty

One of the most challenging aspects of conducting empirical research in this area is the search for a suitable proxy for 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 expects 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) obtained such a measure by aggregating the analysts' earnings forecasts for all firms and used the dispersions in these aggregated forecasts as a quarterly macro-measure of uncertainty. The problem is that Anderson measure cannot be calculated on the daily basis required in this study[7].

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

[6] Our findings were basically unchanged when we used earnings standardised by total assets as our measure of expected earnings (Williams, 2009; Bird and Yeung, 2010).

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

Kim et al. (2010). By using the VIX, we have a measure that is available on a daily basis[8]. 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) provided 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 argued 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 showed through calibration that fluctuations in the variance premium reflect changes in the level of uncertainty.

Market Sentiment

An alternative proposition to market uncertainty providing the explanation for the asymmetric market response to earnings announcements is that it is a reflection of the market sentiment at the time of the announcement. One might expect investor sentiment to erode and for them to abandon markets when they become overly volatile while their sentiment and so their attitude to investing would grow stronger after a period of market stability. Baker and Wurgler (2007) developed a model for measuring the level of investor sentiment towards individual stocks and used this measure to establish that stocks tend to over-react to good news when sentiment is high and over-react to bad news when sentiment is low. This suggests an asymmetric response to announcements when sentiment is both high and low.

Of course, there is the possibility that sentiment can actually combine with uncertainty when investors decide on their response to a new information release. The most common proposition in the literature is that investors follow MEU when faced with uncertainty meaning that they follow a course of action that seeks to maximise their utility under a worse case outcome. This is just what one might expect when market sentiment is low and so investors are taking a pessimistic view. The question is whether investors will always focus on the worst case outcome when uncertainty comes at a time of high market sentiment. The

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

possibility being that at such times their optimism causes them not to focus on the worst case outcome raising the possibility that sentiment might serve to offset uncertainty and so mitigate the previously found asymmetric response to information at times of high uncertainty (Schroder, 2007).

In order to determine whether market sentiment does play a contributing role in what seemingly is an asymmetric response to earnings announcements, we introduce two measures for market sentiment: (i) the Baker and Wurgler (2007) measure which is calculated monthly and (ii) the return momentum of the market over the five days prior to the announcement which provides us with a daily measure of market sentiment.

Stock-Specific Characteristics

We study the impact of several stock-specific characteristics on how the market responds to the release of earnings news chosen on the basis that the literature suggests that they have the potential to influence the decisions made by market participants. These characteristics are briefly discussed below:

Growth/value: The market typically has a positive attitude towards growth stocks and is somewhat disinterested in value stocks. Our objective is to examine whether this attitude feeds through to how investors react to information emanating from growth and value firms. We use two measures of growth/value: the stock's book-to-market and also its price-to-earnings ratio.

Large/small: Small cap stocks are commonly regarded as more risky and less researched which may impact on the way that investors assimilate and react to information. We rank stocks on the basis of their market capitalisation.

Risk: Risk plays a direct role in valuations and we investigate the extent to which this flows through to how investors react to information. We investigate two measures of risk: the stocks' beta measured using the Dimson (1979) method based on the 250 days of trading prior to the announcement date. Our second measure of risk is stocks liquidity as measured by its abnormal returns divided by its average trading volume over the 29 trading days prior to the announcement

Trading volume: A number of studies have found a relationship between abnormal trading volume and market uncertainty which we further investigate in this study. We

measure abnormal volume by dividing the average daily volume over the announcement period by the average daily volume over the previous 26 trading days

Industry sector: There is a wide variation in the nature of industry sectors ranging from the relatively low risk utilities to the much more volatile information technology. We divide the firms up into 10 industries based on their Level 2 GICS classifications.

Methodology

The basic model that we use in our analysis is designed to identify how the market reacts to the release of earnings announcements by companies.

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

where R_{ip} = the accumulated excess return[9] over the announcement period which covers a three-day period which commences on the day before, and ends on the day after the announcement (i.e. t-1 to t+1).

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

We next test the extent to which the market response is affected by the level of uncertainty (VIX) prevailing at the time of the announcement. We measure prevailing uncertainty by the level of VIX at the end of the day immediately prior to the announcement period (i.e. at t-2) which we then include in an expanded version of Equation which becomes our base case for the rest of the analysis conducted in this paper[10]:

$$R_{ip} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 D_1X_1NUE_{it} + \beta_4 D_1X_1PUE_{it} + \beta_5 \log(MV_{it}) + \text{Year Effects} + \varepsilon_{it} \quad (2)$$

where X_1 = the level of VIX of firm i at the end of the day immediately prior to the announcement period (t-2)

D_1X_1 = 1 where the level of VIX of firm i at t-2 is above its median value over our entire sample; otherwise $D_1X_1 = 0$

[9] 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.

[10] We further expand Equation 2 to incorporate not only the level of VIX but also the change in VIX over the announcement period in order to examine the finer gradations that market uncertainty has on the market response to the release of information.

We next further expand our analysis to incorporate other stock and market characteristics into the analysis. Examples of a stocks characteristic is the stock's systematic risk (ß) while an example of a market characteristic is the prevailing measure of market sentiment. We do this by expanding Equation 2 to incorporate each of these factors by introducing them sequentially into the following equation:

$$R_{ip} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 D_1X_1NUE_{it} + \beta_4 D_1X_1PUE_{it} + \beta_5 D_2X_2\ NUE_{it} + \beta_6 D_2X_2\ PUE_{it} + \beta_7 \log(MV_{it}) + \beta_8 \text{ Year Effects} + \varepsilon_{it} \quad (3)$$

where X_2 = is the value of the factor (e.g. the stock's beta) just prior to the announcement (i.e. at the end of t-2)

$D_2X_2 = 1$ if the beta of firm i at t-2 is above the median for all X_2; otherwise $D_2X_2 = 0$

Summary Statistics

Our final sample set consisted of 325,849 observations of quarterly earnings announcements. In Table 1, we report some summary statistics relating to the magnitude of unexpected earnings. We see that good and bad news are of similar magnitude with the average NUE being slightly larger than the average PUE. The major departure being when our sample is split on the basis of the level of VIX with the magnitude of the bad news announcements being much larger when the announcement occurs at a time when VIX is at a high level. When we consider the ten industry sectors, we see quite a degree of variability in the average unexpected earnings although they are all positive. The industries enjoying the best earnings growth over the sample period are information technology (Ind45), consumer durables (Ind25), industrial (Ind20) and health care (Ind35). There was not much variation in the performance of the other industries with the utilities (ind55) and service industries (Ind50) being the worst performers. In no industries were there any obvious association between unexpected earnings and the prevailing level of the VIX.

Refer Table 1

In Table 2, we provide some summary statistics relating to the stock and market characteristics that we examine with respect to how the market responds to earnings announcements during periods of low and high market uncertainty. In particular we are interested in observing the extent to which these characteristics vary with changes in market uncertainty. The most striking and somewhat counter-intuitive finding is that market sentiment is much higher at times of high market uncertainty than it is during periods of low market uncertainty (see both Sentiment and Mom5Day). It also proves that during periods of high uncertainty trading volume and liquidity are higher and that value stocks are more likely than growth stocks to make earnings announcements.

Refer Table 2

IV Discussion of Our Findings

A key aspect of our study is to examine separately the market reaction to good and bad news. In order to capture these two responses we applied Equation 1 to our data and our findings are reported in Table 3, which reflect the extent the market reaction to good and bad earnings announcements in the three days around the announcements date (i.e. t-1, t and t+1). The two things to notice is that there is a significant market reaction to the release of the earnings number over the announcement period but that the extent of that reaction is slightly greater for bad news than it is for good news. This is consistent with the findings in previous studies which find that the market on average has a slight pessimistic bias and that it is more efficient in incorporating bad news into pricing (Bird et al., 2011).

Refer Table 3

Continuing with this theme of pessimism, a number of authors have conditioned the market response to information release based on the prevailing level of market uncertainty. For example, Williams (2009) and Bird et al (2011) both find evidence of a much stronger response by the market to bad news than there is to good news during times of high market uncertainty (above median VIX) than there is during times of low market uncertainty (below median VIX). The proposition being that investors take on a more pessimistic stance when confronted with high market uncertainty which causes

them to overweight bad news and underweight good news. We apply Equation 2 to our data and report our findings in Table 4.

Refer Table 4

Our findings confirm those of previous studies that there is a strong asymmetric reaction to information received during periods of high market uncertainty. However, we find albeit weaker evidence that when market uncertainty is low that investors respond more to the release of good news than it does to the release of bad news. This finding is somewhat at variance with the explanation provided by Williams (2009) who suggests that investors when faced with uncertainty will make decisions based on the objective to maximise expected utility under the worst case outcome and so induce a pessimistic bias into the pricing process which will increase as uncertainty becomes greater. Although this type of behaviour would explain the increases in asymmetry in our findings as markets become more uncertain, they would seem at variance with our finding that at low levels of uncertainty investors actually switch to taking a more optimistic stance where they give greater weight to good news than they do to bad news. We will take the findings as set out in Table 4 as our base case and use them as a point of comparison when we examine the impact that the stock characteristics that we introduce have on the market reaction to the release of earnings news.

Our analysis to date as reported in Table 4 only involves the split of the level of uncertainty into above- and below-median based on the level of VIX. The question is whether our findings will become stronger if we extended further into the tails of the market uncertainty (i.e VIX) distribution. In order to investigate this, we split the levels of VIX into terciles and also introduce changes in VIX during the announcement period as a further differentiating variable. We now define high uncertainty as a period when VIX is increasing (in the top tercile of changes in VIX) from an already high level (i.e. in the top terciles of VIX). Similarly we define low uncertainty as a period when VIX is decreasing (in the bottom tercile of changes in VIX) from an already low level (i.e. in the bottom tercile). Our findings as reported in Table 5 indicate that the optimism demonstrated by investors during periods of low market uncertainty is the equal of the pessimism that they display when market uncertainty is high.

Refer Table 5

This finding runs contrary to much of the conceptual work dealing with uncertainty. For example, Epstein and Schneider (2008) consider how investors react to information signals where the implications of the signals are uncertain. On the assumption that investors faced with such situations follow the course of action that maximises their utility under the worst of the perceived possible outcomes (Gilboa and Schneider, 1989), the authors demonstrate that investors are averse to uncertainty in a similar way that they are averse to risk. Our evidence suggests that uncertainty plays an important role in determining how investors react to information with them displaying optimism when uncertainty is low and pessimism when uncertainty is high. In relation to real investment, Schroder (2007) proposes a model where overconfident investors will actually take an optimistic view when forecasting the uncertain future which ultimately results in overinvestment. This study suggest the possibility that under some circumstances investors faced with uncertainty depart from MEU and by taking a more optimistic view of the likely outcomes. Such behaviour not only explains that high uncertainty could prolong price continuation (Zhang, 2006) but it also implies that even under an uncertain climate, the presence of overconfident investors could result in the development of price bubbles which seem precluded in a model where investor behaviour is described by MEU.

In the remainder of this paper we will condition our findings on several market and stock characteristics in order to gain a better understanding of how uncertainty impacts on the investment decisions of investors and ultimately on market valuations. The first characteristic that we will introduce is market sentiment. If uncertainty has special implications for the level of pessimism in the market, then equally one might expect that market sentiment would play a similar role. Following this we introduce a number of stock characteristics which are thought most likely to influence the impact that uncertainty has on the response of the market to information signals: market valuation (growth or value stock), size (small or large stock), stock specific risk, liquidity, trading volume, and industry group.

Market uncertainty and market sentiment

Market sentiment provides an obvious alternative explanation to uncertainty for the existence of an asymmetric market response to earnings announcements. Baker and Wurgler (2007) developed a model for measuring the level of investor sentiment towards individual stocks and used this measure to establish that stocks tend to over-react to good news when sentiment is high and over-react to bad news when sentiment is low. Of course, there is the possibility that sentiment can actually combine with uncertainty to jointly determine how investors respond to new information signal. The possibility being that sentiment will to some extent offset uncertainty and so mitigate the previously found asymmetric response to information at times of high uncertainty (Schroder, 2007).

We evaluated two measures of sentiment: the Baker/Wurghler measure (Sentiment) and a market derived measure based on the market performance over the five days prior to the announcement (Mom5Day). Using these two sentiment measures, we applied our data to Equation 3 and our results are set out in Table 6.

Refer Table 6

Both measures of market sentiment yield almost exactly the same results. When both uncertainty and sentiment are low, investors respond in an equal fashion to both good and bad earnings announcements. This is a most interesting outcome which suggests that neither uncertainty nor sentiment have much impact when they are at relatively low levels or if they do, they then offset each other. At the other extreme where uncertainty and sentiment are both high, it is clear that pessimism wins out and there is a much stronger market reaction to bad news than there is to good news. Given these findings the outcomes in the other two quadrants are not surprising. When uncertainty is low and sentiment is high, the positive sentiments results in the investors taking on an overall positive stance and reacting more strongly to good news than they do to bad news. However when the reverse is true and uncertainty is high with sentiment being low, then it is the uncertainty that drives the decision process of the investors and they overweight the bad news and underweight the good news. Overall, the findings confirm those in Bird et al (2010) that sentiment serves to offset some of the pessimism introduced into the market due to uncertainty. Our previous finding that the market responds more

to good news than bad news when information is released at times when uncertainty is low would have to be qualified to the extent that it only holds during period when sentiment is high. In contrast, our previous finding that the reaction to bad news is greater than that to good news when the information is released during periods when uncertainty is high, holds irrespective of the prevailing sentiment at the time although it is strongest when sentiment is low.

Stock Characteristics: Growth and value stocks

A general characteristic of growth stocks is that they are in-favour in the market, attracting a relatively high level of market enthusiasm typically following a sustained burst of strong fundamental performance. In contrast, value stocks are out-of-favour and so do not attract much investor interest typically as a consequence of a prolonged period of disappointing performance. We use two common valuation ratios to distinguish between growth and value stocks, the stock's book-to-market ratio and its price-to-earnings multiple. We apply our data again to Equation 3 and report our findings in Table 7. The two measures yield basically the same findings. For growth stocks, there is always a greater market response to good news than there is to bad news irrespective of the prevailing market uncertainty at the time of the announcement. For value stocks, the opposite holds with the response to bad news being much stronger especially when market uncertainty is high at the time of the information release. This finding suggests that it is the market's perception of a company is very important in determining how investors reacts to earnings releases by that company. Indeed, it would appear that this market perception has a stronger influence on the market reaction to an earnings announcement than does the level of market uncertainty. This result may seem a bit surprising in the first instance given the literature on the torpedo effect that applies when investors lose faith in growth stocks (Skinner and Sloan, 2002). However, it has to be remembered that growth stocks will typically have strong momentum qualities and a number of papers have identified that the existence of momentum investors will delay the market impact of any bad news on the value of these stocks (Bird et al., 2004).

Refer Table 7

Stock Characteristics: Small and large cap stocks

Since the identification of the size effect by Banz (1971) it has become accepted that small firms generate higher returns than large firms because they are inherently more risky. The question is whether investors also places less credibility on information provided by smaller firms and so react to it in a different way to the same information issued by larger firms. We again used Equation 3 to condition our findings on small and large firms and our results are reported in Table 8. We see that investors display consistent pessimism when evaluating information released by smaller firms irrespective of the level of uncertainty prevailing at the time. With respect to larger firms, they display what we have previously found to be normal behaviour by overweighting good news when uncertainty is low and overweighting bad news when uncertainty is high. The conclusion that we draw is that irrespective of the level of uncertainty prevailing in the market at the time of the information release, investors seem to be more sceptical of the veracity of information issued by smaller firms and so take on a pessimistic stance when reacting to that information

Refer Table 8

Stock Risk Characteristics: Systematic risk (β) and liquidity

It is well established that investors are averse to risk and many writers suggest that they have a similar aversion to uncertainty. In order to investigate this further, we examine the combined impact of risk and uncertainty on how investors react to new information. We again use Equation 3 with this time the observations divided on the basis of whether the stock's beta is above- or below- median. The results as reported in Table 9 clearly indicate that investors have a greater reaction to good news for low beta stocks and a greater reaction to bad news for high beta stocks. More significantly these results hold irrespective of the prevailing level of uncertainty at the time of the information release. It is clear that risk plays an important role in conditioning how investors react to information. Indeed, the coefficient values suggest that risk as measured by the stock's beta plays a greater role than uncertainty in influencing how investors react as moving

from low to high beta holding uncertainty constant has a greater impact on the market reaction than does moving from low to high uncertainty holding beta constant.

Refer Table 9

There is now a large amount of evidence to suggest that investors also want to be compensated for illiquidity (Pastor and Stambaugh, 2003). As with beta discussed above, we investigate how both liquidity and uncertainty jointly work to impact on how investors react to the receipt of new information. We include our liquidity measure as a dummy variable in equation 3 and our results are reported in Table 9. Our findings confirm that investors take a much more positive stance when evaluating information released by "high liquidity" stocks while taking on a pessimistic stance when reacting to the information released by firms whose stocks are relatively illiquid. Indeed, the results are similar to those reported previously for systematic risk suggesting that liquidity takes on at least as great of importance as uncertainty in explaining how investors react to the receipt of new information.

Stock Characteristics: Trading volume

Dow and Werlang (1992) following a MEU framework show that uncertainty creates a wedge between buyers and sellers in the market and so reduces the incentives for market participation. Epstein and Schneider (2003) confirm that an increase in uncertainty causes investors to withhold trading but that this will reverse when the uncertainty is resolved. We calculated a measure for abnormal trading volume (AbVol) as a first step towards investigating how trading volume jointly impacts with uncertainty on how investors react to information[11]. We would expect that the asymmetric reaction to earnings announcements to be greatest when uncertainty is high and when trading volume is low.

We find the predicted asymmetric results as reported in Table 10 with a much greater reaction to bad news than good news when the trading volume is low at the time of a news release with this finding holding irrespective of the level of market uncertainty

[11] AbVol is calculated as the average daily trading volume over the announcement period divided by the average trading volume over the previous 29 trading days. High trading volume is where AbVol is greater than 1.

prevailing at the time. It is worth noting that this asymmetric result is driven more by the absence of any market reaction to positive earnings surprises during periods of low trading volume rather than by an overreaction to negative earnings news. We find that when trading volume is high there is a very large increase in the market reaction to good news. As a consequence at times of high trading volume and low market uncertainty, we now find an asymmetric reaction of a different kind with investors now reacting more to good news than they do to bad news. Further, high trading volume and high market uncertainty cancel out to the extent that under these conditions investors react equally to good and bad earnings news. Overall, our findings suggest that abnormal trading volume appears as important as, if not more important than, market uncertainty in providing an explanation for an asymmetric reaction by the market to new information. Of course the chain of events may be that it is the uncertainty that is the cause of the level of trading and so is the driving force behind our findings.

Refer Table 10

Stock Characteristics: Industry classification

The final stock characteristic that we evaluate is its industry classification. The proposition being that the impact of uncertainty on the way that the market reacts to the release of new information by a company may depend on the line of business in which a company operates. In order to evaluate this, we divided the sample into 10 industry categories based on the Level 2 GICS classification. Again using Equation 3, we evaluated the impact that uncertainty had on the market reaction to new information across the 10 industries. Our findings are reported in Table 11. From our previous discussion, we have designated our base case as being a slightly greater reaction to good news than bad news when uncertainty is low and a somewhat stronger reaction to bad news than good news when uncertainty is high. None of the industries strictly adhere to this pattern. The closest being the materials and services industries where investors react more to good news than bad news when the information is released during a period of high market uncertainty while reacting equally to bad and good news when uncertainty is low. There are two industries, energy and information technology, where investors always take a conservative stance when reacting to new information irrespective of the prevailing

market uncertainty at the time of information release. At the other end of the spectrum there are two industries, industrials and consumer staples, where investors tend to take an optimistic stance when they evaluate new information irrespective of the prevailing market uncertainty at the time of information release. In addition there are a further three industries (consumer discretionary, financials and utilities) where investors take an optimistic stance when they receive information when uncertainty is low while they react equally to both bad and good news when uncertainty is high. Finally there is the health care industry which reacts equally to both bad and good news irrespective of the prevailing level of market uncertainty.

Refer Table 11

The two observations that we would make regarding the findings are to note the great diversity of findings and the fact that there are a greater number of industries where an optimistic bias prevails. Overall there are five industries where an optimistic bent prevails when evaluating earnings announcements: industrial, consumer discretionary, consumer staples, financial and utilities. There are another four industries where investors typically display a pessimistic bias when evaluating earnings news: energy, materials, information technology and services. We have identified in this paper various factors that are associated with investors taking either an optimistic or pessimistic view when evaluating information. We calculated the average value across our sample for three of these factors by sector in order to see whether these provide us for an explanation for our different findings across industries. We report this information in Table 12. The evidence is mixed as to how well these characteristics explain variation in the attitude of investors when evaluating information emanating from the various industries. It proves that beta tends to be quite good in differentiating between optimistic and pessimistic industries with low beta being a characteristic of most of the industries where the investors are optimistic. However, there is only weak alignment between high market capitalisation and investor optimism which is even weaker for book-to-market largely because the stocks in the utility industry have strong value characteristics which is inconsistent with the strong optimistic stance taken by investors when reacting to earnings news issued by utility companies.

Refer Table 12

How Important is Uncertainty?

The analysis reported above highlights not only that uncertainty and sentiment impact on how investors react to new information but also that it is impacted by several company characteristics including valuation, size, risk, liquidity, trading volume and industry. Indeed, based on our evidence it could be argued that some of these characteristics have a larger effect on investor behaviour than does uncertainty. In order to evaluate this further, we ran a series of further regression where we include each of these firm characteristics as control variables. We report in Table 13 the findings from our final model chosen on the basis that the control variables included are (i) significant, and (ii) are not highly correlated with each other.

Besides confirming that most of the control variables have a significant impact on how investors respond to information signals (the one exception being liquidity), the major finding in the context of this paper is that it confirms the previous finding in relation to uncertainty: (i) the reaction to positive news is greater than that to negative news when uncertainty is low but (ii) this reverses and the reaction to negative news is greater than that to negative news when uncertainty is high. We see this when we compare the coefficient on positive news which is 0.0359 when it is released at times when uncertainty is below the median whereas the coefficient on negative news is 0.0259 at these times (and the difference is significant at the 1% level). However when uncertainty is above the median, the coefficient on negative news is 0.0360 while that on positive news is 0.0322 (with the difference again being significant at the 1% level).

The conclusion that we draw from our findings is that uncertainty is one of a number of factors that impact on how investors react to information signals. They confirm that the reaction is not symmetric with investors reacting more to good news when uncertainty is low and more to bad news when uncertainty is high. This suggests that at any point in time uncertainty plays a role in determining asset pricing which provides a case for its inclusion in asset pricing models.

V. Summary Comments

The focus of this paper is on providing us with a better understanding as to how decision makers react to information in a risky and uncertain environment. Investors reacting to earnings announcements provide an ideal vehicle to examine this issue as via the market we can monitor their reaction and we can separately consider the reaction to good earnings news and bad earnings news. The first study of this reaction was the Ball and Brown (1968) paper that confirmed that market participants do react to the unexpected component of earnings announcements. The study has been repeated numerous times with authors looking at different frequency of reporting, different markets and difference different sub-periods over the event period (e.g. post-earnings announcement period).

One aspect of the market reaction to earnings news that has received almost little attention until recently is the nature of the market reaction to good and bad earnings news, especially where the announcement is conditioned by the level of market uncertainty prevailing at the time of the information release. Williams (2009) provided us with the first of such studies where he postulated and tested that the existence of market uncertainty will cause an asymmetric response with investors reacting more to bad news than to good news. His analysis suggests that investors are always averse to uncertainty which, like risk, will have a negative effect on asset prices. Bird and Yeung (2010) questioned this finding and demonstrated at the low end of the uncertainty spectrum that investors actually take on an optimistic stance and react more strongly to good news than to bad news. This finding brings into question whether investors are always averse to uncertainty and raises the possibility that they may even embrace it at some stages in the market/stock cycle. The implication of these results being that uncertainty when it is at high levels will have a negative impact on stock prices but when uncertainty is low, and especially when market sentiment is high, we are likely to see optimism leading to stock prices being inflated.

We take up this story in this paper and examine whether certain stock characteristics in hand with uncertainty will influence how the market reacts to good and

bad earnings news. We find that there are several characteristics that have a significant effect, some of them a greater effect than uncertainty. We find that the market always takes a negative stance when evaluating earning announcements by high beta, low liquidity and/or small cap stocks irrespective of the level of market uncertainty, while always taking a positive attitude to such announcements from low beta, highly liquid and/or large cap stocks. We also find that investors always take a positive attitude when evaluating earnings announcements emanating from growth stocks and a negative attitude when they are made by value stocks and again these results hold irrespective of the prevailing level of market uncertainty at the time the announcement is made. Growth stocks are more highly priced relative to value stocks which typically suggest that they are perceived to have much greater growth potential. In other words there is a high level of exuberance with respect to these stocks and this is reflected in the way that investors respond to information that they release. Finally we find that abnormally low trading volume is indicative of investors taking a pessimistic stance with respect to a stock which results in them reacting to bad news but largely ignoring good news irrespective of the level of uncertainty existing at the time.

The initial result in this paper is that the level of uncertainty in the market plays an important role in determining how investors react to information. However, the relationship is more complex than many would suggest as once market sentiment is taken into we find that investors switch from being pessimistic to being optimistic when it comes to assessing information. One problem with the William's proposition that investors always suffer from various degrees of pessimism is that it would seem to preclude the situation of markets becoming over-hyped. By showing that investors switch between pessimism and optimism, we are able to accommodate bubbles and implosions in markets.

An important finding is our paper is that there are a number of stock characteristics that consistently impact on how investors view and react to information and we have seen that this extends to industries with investors taking an optimistic stance in relation to approximately half the industries and a pessimistic stance to the others. Stock characteristics that play an important role include the current valuation of the stock,

the risk of the stock and its market cap. The general pessimism associated with periods of high market uncertainty is further entrenched in the case of lowly-valued, high risk, thinly traded and/or small cap stocks. However, an aura of optimism is associated with highly-valued, low risk, highly liquid and/or large cap stocks which often appear to outweigh the pessimism usually associated with markets where uncertainty is high.

The overall conclusion that we draw from our findings is that uncertainty provides an important role along with a number of other factors in determining how investors assess information. Further, it seems that investors bring a state of mind when evaluating a stock which is impacted by the prevailing sentiment both at the market level and also with respect to a particular stock (e.g. they are much more optimistic when evaluating information realised by growth stocks). In summary, the factors that impact on how investors react to good and bad news are numerous with this paper providing an important step in improving our understanding of what is undoubtedly a very complex area.

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Table 1: Summary Statistics for Unexpected Earnings

Variable	Mean (Standard Deviation)	Above Median VIX Mean and (SD)	Below Median VIX Mean and (SD)
NUE	-0.146 (0.463)	-0.170 (0.516)	-0.122 (0.401)
PUE	0.125 (0.360)	0.127 (0.373)	0.124 (0.350)
Energy	0.054 (0.227)	0.053 (0.224)	0.056 (0.230)
Materials	0.056 (0.229)	0.052 (0.22)	0.059 (0.236)
Industrials	0.150 (0.357)	0.145 (0.352)	0.155 (0.362)
Consumer Discretionary	0.179 (0.383)	0.174 (0.379)	0.183 (0.386)
Consumer Staples	0.047 (0.211)	0.045 (0.206)	0.049 (0.216)
Health Care	0.127 (0.333)	0.125 (0.331)	0.130 (0.336)
Financials	0.096 (0.295)	0.095 (0.293)	0.098 (0.297)
Information Technology	0.192 (0.393)	0.198 (0.398)	0.186 (0.389)
Telecommunication Services	0.016 (0.124)	0.015 (0.123)	0.016 (0.126)
Utilities	0.035 (0.184)	0.033 (0.178)	0.037 (0.190)

Notes:

Table 1 reports the mean and standard deviation of the unexpected earnings in our sample. Unexpected earnings (UE) is the difference between earnings per share (EPS) this quarter as compared with the expected earnings which is defined as the EPS in the same quarter of the previous year. PUE relates to earnings announcements where UE is positive and NUE relates to earnings announcements where UE is negative Besides reporting the UE for the whole sample of earnings announcements, we also report them for sub-periods when the market uncertainty as measured by the VIX is above its median value and below its median value. VIX is the implied market volatility calculated on the basis of options traded on the S&P500 index. Finally, we report the UE by industries as classified by the level 2 Global Industry Classification Standard (GICS).

Table 2: Summary Statistics of Stock and Market Characteristics

Variable	Complete sample Mean (Std Deviation)	Above Median VIX Mean and (SD)	Below Median VIX Mean and (SD)
Book to Market Value	1.07 (6.76)	1.165 (6.46)	0.983 (7.04)
PE Ratio	66.417 (220.760)	60.714 (229.546)	72.338 (211.525
Size	3274.52 (30425.15)	3230.98 (29646.93)	3318.11 (31184.76)
Beta	1.11 (0.809)	1.094 (0.80)	1.131 (0.82)
Sentiment	0.21 (0.58)	0.472 (0.68)	-0.027 (0.29)
Ave Vol {t-1,t+1}	664968.80 (3843285)	717039.10 (4537217)	616586.60 (3004853)
Ave Vol {t-30,t-2}	416419.70 (2380411)	471794.60 (2883690)	361033.20 (1734561)
Momentum	0.0008 (0.025)	-0.001 (0.03)	0.003 (0.01)
Liquidity	$1.58*10^{-6}$ ($2.48*10^{-4}$)	$1.74*10^{-5}$ ($3.14*10^{-4}$)	$1.42*10^{-5}$ ($1.56*10^{-4}$)

Notes:

In Table 2, we report the mean and standard deviation of various stock and market characteristics in our sample. Book to market value is measured at 2 days prior to the announcement. Sentiment is measured by the Baker Wurgler Index. PE is the price to earnings ratio as measured 2 days prior to the announcement. Beta is the stock's beta calculated by the Dimson method (1979) and is estimated based on daily data in the 250 trading day prior to announcement. Size is measured by the value of Total Assets at two days prior to the announcement (i.e. t-2) and is measured in millions. We report several measure of trading volume. Firstly, Ave Vol {t-1, t+1} is the average daily volume of stock i in the 3-day announcement period (i.e. one day before announcement to 1 day post announcement). The second measure of trading volume, Ave Vol {t-30, t-2} is the average daily volume of stock i in the 29-day period immediately prior to the announcement period. Momentum is measured by the S&P 500 returns in the 5 day period from 6 days to 2 days prior to the announcement {i.e. t-6, t-2}. Liquidity is the ratio of abnormal returns for announcement period {t-1,t+1} to the average trading volume in the 30 day period prior to the announcement (i.e. t-30 to t-2).

Table 3: Market Reaction to Good and Bad News		
NUE	PUE	Significance test
0.0119***	0.0108***	N>P**

Notes:

In Table 3, we report the results for the following regression:

$R_{ip} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 \log(MVit) + \text{Year Effects} + \varepsilon_{it}$ (Eq. 1)

The dependent variable, R_{it}, is the accumulated excess return over the announcement period which extends from the day before the announcement to the day after (i.e., t-1 to t+1). Unexpected earnings (UE) is the difference between earnings per share (EPS) this quarter as compared with the expected earnings which is defined as the EPS in the same quarter of the previous year. PUE = UE when UE is > 0, otherwise PUE = 0; NUE = UE when UE is < 0, otherwise NUE = 0. MV represents the market capitalisation at the time of the announcement and is measured in $'million. Yearly fixed effects are included but not reported in the results. To compare the reaction to positive and negative earnings surprise, we run a Wald test on the difference between β_1 and β_2. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 4: Market Reaction and Uncertainty

		NUE	PUE	Significance tests
Uncertainty	Low	0.0104 ***	0.0117***	P>N*
	High	0.0129***	0.0101***	N>P***

Notes:

In Table 4, we examine the market reaction to good and bad news for different levels of uncertainty. High uncertainty is where the announcement is made at a time when the level of uncertainty in the market is above the median in our sample. Similarly if an announcement is made when VIX is below the sample median, we classified these announcements as low market uncertainty. We reported the results for the regression:

$R_{ip} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 D_1 X_1 NUE_{it} + \beta_4 D_1 X_1 PUE_{it} + \beta_5 \log(MV_{it}) + \text{Year Effects} + \varepsilon_{it}$ (Eq. 2)

The dependent variable, R_{it}, is the accumulated excess return over the announcement period which extends from the day before the announcement to the day after (i.e., t-1 to t+1). Unexpected earnings (UE) is the difference between earnings per share (EPS) this quarter as compared with the expected earnings which is defined as the EPS in the same quarter of the previous year. PUE = UE when UE is > 0, otherwise PUE = 0; NUE = UE when UE is < 0, otherwise NUE = 0. X_1 is the level of VIX of firm i at the end of the day immediately prior to the announcement period (t-2). D_1X_1 is an indicator variable which is 1 where the level of VIX of firm i at t-2 is above its median value over our entire sample; otherwise $D_1X_1 = 0$. MV represents the market capitalisation at the time of the announcement and is measured in $' million. Yearly fixed effects are included in the regression. For ease of interpretation, we have formatted the above table to show only the main results for the coefficients on the PUE and NUE variables. For example, the displayed coefficient for the reaction to a negative earnings announcement at a time of high uncertainty is 0.0129 (i.e. sum of β_1 and β_3). We run Wald tests of differences on the coefficients to compare the reaction to PUE and NUE under high and low uncertainty. For example, P > N* for low uncertainty means that coefficient on PUE is significantly greater than that on NUE at the 10% confidence level. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 5: Market Reaction and More Extreme Value for Uncertainty

		NUE	PUE	Significance tests
Uncertainty	Low	0.0069 ***	0.0137***	P>N***
	High	0.0145***	0.0088***	N>P***

Notes:

In Table 4 we examined the market reaction to good and bad news under different levels of uncertainty. For table 5, we turn out attention to considering the more extremes value foe uncertainty as measured by both the level of VIX and changes in the level of VIX. Low uncertainty are times where VIX is decreasing (bottom tercile) from an already low level bottom tercile) while high uncertainty are times when VIX is increasing (top tercile) from an already high level (top tercile). Log Market Value and yearly fixed effects are included but not reported in the results. For ease of interpretation, we have formatted the above table to show only the main results for the coefficients on the PUE and NUE variables. For example, the displayed coefficient for the reaction to a negative earnings announcement at a time of high uncertainty is 0.0145. We run Wald tests of differences on the coefficients to compare the reaction to positive and negative earnings surprise under high and low uncertainty. For example, P > N** for low uncertainty indicates that the coefficient on PUE is significantly greater than that on NUE at the 5% significance level. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 6: Market Reaction: Uncertainty and Sentiment

		NUE		PUE		Significance tests	
		Uncertainty		Uncertainty		Uncertainty	
		Low	High	Low	High	Low	High
Sentiment	Low	0.0109***	0.0140***	0.0110***	0.0085***	n.s	N>P***
	High	0.0095***	0.0126***	0.0132***	0.0107***	P>N**	N>P**
Mom 5 Day	Low	0.0108***	0.0132***	0.0113***	0.0097***	n.s.	N>P***
	High	0.0101***	0.0125***	0.0120***	0.0104***	P>N***	N>P***

Notes:

In Table 6, we examine the market reaction to good and bad news for different levels of uncertainty. We reported the results for the regression:

$R_{ip} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 D_1X_1 NUE_{it} + \beta_4 D_1X_1 PUE_{it} + \beta_5 D_2X_2\ NUE_{it} + \beta_6 D_2X_2\ PUE_{it} + \beta_7 \log(MV_{it})$

Year Effects + ε_{it} (Eq. 3)

The dependent variable, R_{it}, is the accumulated excess return over the announcement period which extends from the day before the announcement to the day after (i.e., t-1 to t+1). Unexpected earnings (UE) is the difference between earnings per share (EPS) this quarter as compared with the expected earnings which is defined as the EPS in the same quarter of the previous year. PUE = UE when UE is > 0, otherwise PUE = 0; NUE = UE when UE is < 0, otherwise NUE = 0. X_1 is the level of VIX of firm i at the end of the day immediately prior to the announcement period (t-2). D_1X_1 is an indicator variable which is 1 where the level of VIX of firm i at t-2 is above its median value over our entire sample; otherwise $D_1X_1 = 0$. MV represents the market capitalisation at the time of the announcement and is measured in millions. We incorporate the 2 measures of sentiment: Sentiment and Momentum into our analysis. Sentiment is measured by the Baker Wurgler Index of investor sentiment. Momentum is measured by the S&P 500 returns in the 5 day period from 6 days to 2 days prior to the announcement {i.e. t-6, t-2}. These variables are included in the regression as X_2 in separate regressions of equation 3. So X_2 is the value of the relevant factor (e.g. Sentiment) just prior to the announcement (i.e. at the end of t-2). D_2X_2 is an indicator variable which is equal to 1 if the sentiment measure (e.g. Sentiment) at t-2 is above the median for all X_2; otherwise $D_2X_2 = 0$. Log Market Value and yearly fixed effects are included but not reported in the results. For ease of interpretation, we have formatted the above table to show only the main results for the coefficients on the PUE and NUE variables. For example, the displayed coefficient for the reaction to a negative earnings announcement at a time of high uncertainty and high sentiment is 0.0126 (1.e. $\beta_1 + \beta_3 + \beta_5$). We run Wald tests of differences on the coefficients to compare the reaction to positive and negative earnings surprise under high and low uncertainty. For example, N > P** for high uncertainty and high sentiment indicates that the coefficient on NUE is significantly greater than that on PUE at the

5% level. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 7: Market Reaction: Uncertainty and Valuation

		NUE		PUE		Significance tests	
		Uncertainty		Uncertainty		Uncertainty	
		Low	High	Low	High	Low	High
Book-to-market	Growth	0.0061***	0.0080***	0.0123***	0.0107***	P>N***	P>N***
	Value	0.0120***	0.0139***	0.0115***	0.0099***	n.s.	N>P***
Price-to-earnings	Growth	0.0072***	0.0091***	0.0149***	0.0136***	P>N***	P>N***
	Value	0.0121***	0.0139***	0.0097***	0.0084***	N>P**	N>P***

Notes:

In Table 7, we examine whether the market reaction to good and bad news under uncertainty differs for Growth and Value stocks. We reported the results for the regression:

$$R_{ip} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 D_1 X_1 NUE_{it} + \beta_4 D_1 X_1 PUE_{it} + \beta_5 D_2 X_2\ NUE_{it} + \beta_6 D_2 X_2\ PU$$

$$\beta_7 \log(MV_{it}) + \beta_8 \text{ Year Effects} + \varepsilon_{it} \qquad \text{(Eq. 3)}$$

We incorporate into our analysis the 2 measures of stock valuation: namely Book to Market value and Price to earnings ratio. These variables are included in the regression as X_2 in separate regressions of equation 3. So X_2 is the value of the relevant factor (e.g. Price-Earnings ratio) just prior to the announcement (i.e. at the end of t-2). D_2X_2 is an indicator variable which is equal to 1 if the stock's factor (e.g. Price-Earnings ratio) at t-2 is above the median for all X_2; otherwise $D_2X_2 = 0$. For ease of interpretation, we have formatted the above table to show only the main results for the coefficients on the PUE and NUE variables. For example, the displayed coefficient for the reaction to a negative earnings announcement at a time of high uncertainty for above-median price-to-earnings stocks is 0.080 (1.e. $\beta_1 + \beta_3 + \beta_5$). We run Wald tests of differences on the coefficients to compare the reaction to positive and negative earnings surprise under high and low uncertainty. For example, P > N*** for high uncertainty and high price-to-earnings stocks indicates that the coefficient on PUE is significantly greater than that on NUE at the 1% level. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 8: Market Reaction: Uncertainty and Size

		NUE		PUE		Significance tests	
		Uncertainty		Uncertainty		Uncertainty	
		Low	High	Low	High	Low	High
Total Assets	Small	0.0227***	0.0250***	0.0195***	0.0176***	N>P**	N>P***
	Large	0.0065***	0.0098***	0.0086***	0.0067***	P>N**	N>P***

Notes:

In Table 8, we examine whether the market reaction to good and bad news under uncertainty differs for small and large stocks. We reported the results for the regression:

$$R_{ip} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 D_1X_1NUE_{it} + \beta_4 D_1X_1PUE_{it} + \beta_5 D_2X_2\ NUE_{it} + \beta_6 D_2X_2\ PU$$

$$\beta_7 \log(MV_{it}) + \beta_8 \text{ Year Effects} + \varepsilon_{it} \quad \text{(Eq. 3)}$$

We incorporate into Total Assets as the measure for firm size. So X_2 is the Total Asset of the firm just prior to the announcement (i.e. at t-2). D_2X_2 is an indicator variable which is equal to 1 if the stock's Total Assets at t-2 is above the median for all X_2; otherwise $D_2X_2 = 0$. For ease of interpretation, we have formatted the above table to show only the main results for the coefficients on the PUE and NUE variables. For example, the displayed coefficient for the reaction to a negative earnings announcement at a time of high uncertainty for large (i.e. above-median size stocks is 0.0098 (1.e. $\beta_1 + \beta_3 + \beta_5$). We run Wald tests of differences on the coefficients to compare the reaction to positive and negative earnings surprise under high and low uncertainty. For example, N > P*** for high uncertainty and large stocks indicates that the coefficient on NUE is significantly greater than that on PUE at the 1% level. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 9: Market Reaction: Uncertainty and Risk

		NUE		PUE		Significance tests	
		Uncertainty		Uncertainty		Uncertainty	
		Low	High	Low	High	Low	High
Beta (β)	Low	0.0085***	0.0107***	0.0142***	0.0126***	P>N***	P>N**
	High	0.0122***	0.0144***	0.0094***	0.0078***	N>P**	N>P***
Liquidity	High	0.0138***	0.0163***	0.0188***	0.0169***	P>N***	n.s.
	Low	0.0079***	0.0104***	0.0069***	0.0050***	n.s.	N>P***

Notes:

In Table 9, we examine whether the market reaction to good and bad news under uncertainty differs for stocks with differing risk characteristics. We reported the results for the regression:

$R_{ip} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 D_1 X_1 NUE_{it} + \beta_4 D_1 X_1 PUE_{it} + \beta_5 D_2 X_2\ NUE_{it} + \beta_6 D_2 X_2\ PU$ $\beta_7 \log(MV_{it}) + \beta_8$ Year Effects $+ \varepsilon_{it}$ (Eq. 3)

We incorporate into our analysis the 2 measures of risks: namely Beta and Liquidity. Beta is the stock's beta calculated by the Dimson method (1979) and is estimated based on daily data in the 250 trading day prior to announcement. Liquidity is the ratio of abnormal returns for announcement period {t-1, t+1} to the average trading volume in the 30 day period prior to the announcement (i.e. t-30 to t-2). These variables are included in the regression as X_2 in separate regressions of equation 3. So X_2 is the value of the relevant factor (e.g. Liquidity) just prior to the announcement (i.e. at the end of t-2). D_2X_2 is an indicator variable which is equal to 1 if the stock's factor (e.g. liquidity) at t-2 is above the median for all X_2; otherwise $D_2X_2 = 0$. For ease of interpretation, we have formatted the above table to show only the main results for the coefficients on the PUE and NUE variables. For example, the displayed coefficient for the reaction to a negative earnings announcement at a time of high uncertainty for stocks with high liquidity is 0.0163 (1.e. $\beta_1 + \beta_3 + \beta_5$). We run Wald tests of differences on the coefficients to compare the reaction to positive and negative earnings surprise under high and low uncertainty. For example, P > N*** for low uncertainty and stocks with high liquidity indicates that the coefficient on PUE is significantly greater than that on NUE at the 1% level. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 10: Market Reaction: Uncertainty and Abnormal Trading Volume

		NUE		PUE		Significance tests	
		Uncertainty		Uncertainty		Uncertainty	
		Low	High	Low	High	Low	High
Abnormal Trading Volume	Low	0.0076***	0.0101***	0.0008	0.0003	N>P***	N>P***
	High	0.0119***	0.0144***	0.0159***	0.0155***	P>N***	n.s.

Notes:

Previous studies have shown that uncertainty tends to form a wedge between buyers and sellers in the financial market and thus reduce the level of market participation at times of high uncertainty. In Table 10, we examine whether trading volume interact with market uncertainty (VIX levels) impact on the market reaction to unexpected earnings announcements. We reported the results for the regression on eq:

$R_{ip} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 D_1X_1NUE_{it} + \beta_4 D_1X_1PUE_{it} + \beta_5 D_2X_2\ NUE_{it} + \beta_6 D_2X_2\ PUE_{it} + \beta_7 \log(MV_{it}$

Year Effects + ε_{it} (Eq. 3)

We incorporate into our analysis a measure of abnormal volume, AbVol which is calculated as the average daily trading volume for stock i over the announcement period divided by the average trading volume of stock i over the previous 29 trading days. We sort the abnormal volume parameter across the entire sample to form a new indicator variable (D_2X_2 in our equation). High trading volume is where AbVol is greater than 1 (i.e. $D_2X_2 = 1$). When AbVol is less than 1 (i.e. Low trading Volume), D_2X_2 is equal to 0. For ease of interpretation, we have formatted the above table to show only the main results for the coefficients on the PUE and NUE variables. For example, the displayed coefficient for the reaction to a negative earnings announcement at a time of high uncertainty for stocks experiencing above-median abnormal trading volume is 0.0144 (1.e. $\beta_1 + \beta_3 + \beta_5$). We run Wald tests of differences on the coefficients to compare the reaction to positive and negative earnings surprise under high and low uncertainty. For example, P > N*** for low uncertainty and stocks with high abnormal trading volume indicates that the coefficient on PUE is significantly greater than that on NUE at the 1% level. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 11: Market Reaction: Uncertainty and Industry Classification

Industry	NUE		PUE		Significance tests	
	Uncertainty		Uncertainty		Uncertainty	
	Low	High	Low	High	Low	High
Energy	0.0113***	0.0136***	0.0082***	0.0069***	N>P**	N>P**
Material	0.0093***	0.0116***	0.0094***	0.0081***	n.s.	N>P*
Industrials	0.0099***	0.0122***	0.0159***	0.0146***	P>N***	P>N*
Consumer Disc.	0.0104***	0.0127***	0.0141***	0.0128***	P>N**	n.s.
Consumer Staples	0.0098***	0.0121***	0.0182***	0.0169***	P>N***	P>N*
Health Care	0.0124***	0.0147***	0.0134***	0.0121***	n.s.	n.s.
Financials	0.0089***	0.0112***	0.0177***	0.0164***	P>N**	n.s.
Info. Technology	0.0137***	0.0160***	0.0107***	0.0094***	N>P**	N>P**
Services	0.0063***	0.0086***	0.0037	0.0024	n.s.	N>P**
Utilities	0.0059***	0.0082***	0.0087***	0.0074***	P>N*	n.s

Notes:

In Table 11, we consider the proposition that the market reaction to good and bad news may be dependent on the line of business that a company operates. In order to evaluate this, we classified the sample of announcements in to 10 broad industry sectors according to the Level 2 Global Industry Classification Standard (GICS). We modified equation 3 to include dummy variables that indicate the industry to which the firm making the announcement belongs. The regression results are reported in the above table. For ease of interpretation, we have formatted the above table to show only the main results for the coefficients on the PUE and NUE variables. For example, the displayed coefficient for the reaction to a negative earnings announcement at a time of high uncertainty for stocks in the energy sector is 0.0136. We run Wald tests of differences on the coefficients to compare the reaction to positive and negative earnings surprise under high and low uncertainty. For example, N > P** for low uncertainty and stocks in the energy sector indicates that the coefficient on NUE is significantly greater than that on PUE at the 5% level. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.

Table 12: Industry Characteristics

Industry		Book-to-market	Market ($'M)	Beta
Energy	Pessimistic	0.624	347.7	1.0217
Material	Pessimistic	0.672	245.5	0.9953
Industrials	Optimistic	0.633	160.4	0.9963
Consumer Disc.	Optimistic	0.634	184.0	0.9866
Consumer Staples	Optimistic	0.531	207.4	0.6390
Health Care	Neutral	0.346	160.4	1.1236
Financials	Optimistic	0.739	166.5	0.6560
Info. Technology	Pessimistic	0.496	186.7	1.5144
Services	Pessimistic	0.576	335.5	1.2489
Utilities	Optimistic	0.856	1,069.8	0.5419

Notes:

In Table 12, we reported the average characteristics (Book To Market, Market Capitalization and Beta) of firms in the 10 GICS industrial sectors. Based on the coefficients and significance tests in Table 11, we classified each industry into "pessimistic", "optimistic" and "neutral". An industry is classified as "pessimistic", if the coefficient for negative unexpected earnings (NUE) is greater than the coefficient for positive unexpected earnings (PUE). Put simply, there is a tendency for the market to react more to negative announcement than positive unexpected announcement in a "pessimistic" industry. Similarly, an industry is classified as "optimistic", if the coefficient for positive unexpected earnings (PUE) is greater than the coefficient for negative unexpected earnings (NUE). A "neutral" industry is where there is no significant difference between the coefficients for NUE and PUE.

Table 13: Market Reaction: Augmented Control Variables

		NUE	PUE	Significance tests
Uncertainty	Low	0.0259 ***	0.0359***	P>N***
	High	0.0360***	0.0322***	N>P***

Notes:

In Table 13, we examine the market reaction to good and bad news for different levels of uncertainty. High uncertainty is where the announcement is made at a time when the level of uncertainty in the market is above the median in our sample. Similarly if an announcement is made when VIX is below the sample median, we classified these announcements as low market uncertainty. We reported the results for and expanded version of the following the regrssion:

$R_{ip} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \beta_3 D_1 X_1 NUE_{it} + \beta_4 D_1 X_1 PUE_{it} + \beta_5 \log(MV_{it}) + \text{Year Effects} + \varepsilon_{it}$ (Eq. 2)

The dependent variable, R_{it}, is the accumulated excess return over the announcement period which extends from the day before the announcement to the day after (i.e., t-1 to t+1). Unexpected earnings (UE) is the difference between earnings per share (EPS) this quarter as compared with the expected earnings which is defined as the EPS in the same quarter of the previous year. PUE = UE when UE is > 0, otherwise PUE = 0; NUE = UE when UE is < 0, otherwise NUE = 0. X_1 is the level of VIX of firm i at the end of the day immediately prior to the announcement period (t-2). D_1X_1 is an indicator variable which is 1 where the level of VIX of firm i at t-2 is above its median value over our entire sample; otherwise $D_1X_1 = 0$. MV represents the market capitalisation at the time of the announcement and is measured in $' million. Yearly fixed effects are included in the regression. The additional control variables that we have included are: book-to-market, sentiment using the Baker/Wurghler measure, beta and dummies for each of the industries. For ease of interpretation, we have formatted the above table to show only the main results for the coefficients on the PUE and NUE variables. For example, the displayed coefficient for the reaction to a negative earnings announcement at a time of high uncertainty is 0.0129 (i.e. sum of β_1 and β_3). We run Wald tests of differences on the coefficients to compare the reaction to PUE and NUE under high and low uncertainty. For example, P > N* for low uncertainty means that coefficient on PUE is significantly greater than that on NUE at the 10% confidence level. The notations ***, ** and * denotes statistical significance at the 1%, 5% and 10% level respectively.