How Do Investors React Under Uncertainty?

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Abstract

It has long been well-accepted in finance that risk plays an important part in valuation where risk reflects that we do not know future returns but that we do have prior expectations as to their distribution. Knights (1921) introduced the concept of uncertainty where we possess incomplete knowledge about this distribution and so are unable to formulate priors over all possible outcomes. A number of writers (Gilboa and Schmeidler, 1989; Epstein and Schneider, 2003) have developed models that suggest that ambiguity combines with risk to have a negative impact on price. Such models typically assume that investors when faced with uncertainty take a conservative approach and pursue a course of activity based on the worst case scenario (maxmin expected utility).

One area of particular interest is how the market faced with uncertainty reacts to the receipt of new information. The proposition being that under maxmin expected utility, the interpretation that the market will place on any information received will become more pessimistic as uncertainty increases. As a consequence investors will upgrade any bad news and downgrade any good news when there is a high level of uncertainty in the market. Williams (2009) uses changes in the VIX (i.e. implied market volatility) as a measure of market uncertainty in his US study where he evaluates the markets response to the release of earnings news. There is a plethora of evidence going back to Ball and Brown (1968) that the market responds positively to good news and negatively to bad news. Williams finds that this reaction is conditioned by market uncertainty with there being the predicted asymmetric reaction to good and bad news – the negative reaction to bad news increasing with uncertainty and the positive reaction to good news decreasing.

In this study we examine the same issue as the Williams study but using Australian data. One difference in our findings is that it is not only changes in VIX but also the level of VIX that would seem to proxy for uncertainty and play a role in explaining how the market responds to earnings information. We also find some evidence to suggest that particularly at time of high uncertainty, that market sentiment may play a role in counteracting the pessimism associated with uncertainty.

1, Introduction

It is well accepted in economics that risk directly impacts on the returns from investment and the valuation of firms. In a situation of risk, investors are unable to specify exactly the future returns from investing in the firm but they can specify a probability distribution from which they expect that these returns will be drawn. In contrast under a situation of uncertainty, investors face a series of probability distributions for future returns and are uncertain as to which of these will apply (Knight, 1921; Ellsberg (1961)[1]. Therefore, with uncertainty investors are unable to arrive at a unique set of probabilities over the future returns in the absence of which there is no clear direction as to how to price assets.

In order to handle the problem of pricing assets under uncertainty, Gilboa and Schmeidler (1989) propose that investors when faced with uncertainty will follow a course of attempting to maximise expected utility under the worst case outcome (maxmin expected utility). By so doing they effectively reduce a situation of uncertainty to a situation of risk but introduce a pessimistic bias into the pricing process which will increase as uncertainty becomes greater.

This study attempts to provide insights into how investors handle uncertainty and by so doing will enable us to better understand how it best be incorporated (if at all) into asset pricing. We use the markets reaction to earnings announcements as a vehicle for providing insights into whether uncertainty does affect investor decisions. The proposition is that in the absence of uncertainly, bad and good news of an equal magnitude will have an equal absolute impact on market prices. However, as uncertainty increases, investors will become increasingly more pessimistic resulting in them reacting more to bad news than they do to good news.

We find the asymmetric response to earnings announcements when uncertainty is high consistent with maxmin expected utility. However we also find that if uncertainty occurs contemporaneously with high market sentiment, then there is some suggestion that they will serve to off set each other. We also find

[1] Other terms commonly used in the literature to describe uncertainty are model uncertainty, Knightian uncertainty and ambiguity.

some evidence to suggest that investors may penalise good news announcements less in the case of firms whose current market valuation is "cheap" or who also announce a contemporaneous increase in dividends. Finally, we find evidence also withdraw from trading at times of high uncertainly which also is associated with the asymmetric response to earnings announcments at times of high uncertainty.

In Section 2, we further consider the literature on uncertainty and further develop the argument for asymmetric response top information signals. The data and method that we employ are set out in Section 3. Our findings are reported and discussed in Section 4 while we summaries our findings and their implications in Section 5.

2. Background

A common assumption in our asset pricing models is that we can specify the future return from holding an asset by a single probability distribution which typically can be fully specified by an expected value and a standard deviation, with the latter commonly been taken as measuring the **risk** of the investment. Although such models take us some ways down the path of bringing some realism into the pricing of assets by the incorporation of risk, one can question how far? The future benefits that we will acquire from holding an asset (and especially a share in a firm) will be affected by a myriad of factors that themselves will evolve through time. One must ask how realistic is it to assume that individualsxzz believe that they can predict how these myriad of factors will evolve through time with the level of sufficient precision required to be able to describe the future returns by a unique probability distribution.

Kniight (1921) is credited with being the first writer to make the clear distinction between risk and uncertainty when he argued that "Uncertainty must be taken in a sense radically distinct from the familiar notion of Risk, from which it has never been properly separated. . . A *measurable* uncertainty (i.e. risk) . . . .is so different from an *unmeasurable* one that it is not in effect an uncertainty at all."

As Keynes (1937) pointed out there are some situations like playing roulette where the probability can be clearly specified and which are unaffected by past events. However, Keynes goes on contrast this with other events ‘. . .the prospect of an European war is uncertain, or . . the rate of interest 20 years hence . . About these matters there is no scientific basis on which to form any calculable probability whatever. We simply do not know.” Lest one believes that we can use data from the part to resolve the uncertainty about the future, we should recognise that the past represents just one path from a myriad of possible paths and so provides us with a single sample upon which to form our expectations of the future,

Economists and particularly financial economists have been slow to consider the importance of incorporating uncertainty in our explanation of market behaviour. However, this is slowly being corrected and we have seen exponential growth in this area over the last five year. During this period, writers have called upon uncertainty to explain variations in the equity risk premium (Chen and Epstein, 2002; Hansen and Sargent, 2008); trading volume and bid-ask spreads (Epstein and Schneider, 2003; Easley and O’Hara, 2008); the way by which investors process information (Epstein and Schneider, 2008; Caskey, 2008)[2].

Of these papers, Epstein and Schneider (2008) is most pertinent to this paper. These authors 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 possible outcomes that they can perceive (Gilboa and Schneider, 1989), they demonstrate that investors 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 underweighting good news.

[2] Caskey (2008) demonstrates how uncertainty can explain many of the empirical findings of the anomalies literature including under/over reaction and momentum.

It is this proposition of an asymmetric market reaction to good and bad news at times of uncertainty that is the main focus of this paper. Specifically we examine the relationship between our proxy for uncertainty, the implied volatility of the market (VIX) and the asymmetry of the markets response to good and bad earnings announcements. It is noteworthy that the asymmetry postulated by Epstein and Schneider is a direct consequence of their assumption that investors when faced with uncertainty resolve the situation by applying maxmin expected utility. However, Gysler et al. (2002) found evidence to suggest that an individual's response to uncertainty might be affected by their perceived competence and overconfidence. Schroder (2007) proposes a model where overconfident investors will actually take an optimistic view when forecasting the uncertain future which leads to overinvestment. In other words overconfident investors will display a preference for uncertainty by making their decisions with the objective to maximise their utility assuming the best case rather than the worst case outcome.

We do not test the impact of individual investor confidence on the way that that uncertainty impacts on investor reaction to earnings announcements. However, we do examine whether the level of sentiment at both the stock and market level reacts with uncertainty (if at all) in determining the process by which investors incorporate information into pricing. Finally, we introduce trading volume both at the firm-level and the market-level into our analysis to see if our findings align with previous research which suggests that uncertainty will result in lower market volume.

3. Data and Method.

Data

The return data and volume data that we use in this study both for individual stocks and the market are obtained from DataStream, The options data on the ASX200 including prices and contract details which we use to calculate the implied volatility are obtained from SIRCA as is the Aspect accounting data,

Finally, the proxy that we get for market sentiment is the monthly Westpac-Melbourne Institute consumer sentiment index. Our data extends from July 2001 to February 2008.

The two critical pieces of information for the study are:

1) *Unexpected earnings* where expected earnings are defined as last year's earnings standardised for total assets. A positive unexpected earnings (PUE) event occurs when the earnings just announced (again standardised by total assets) exceeds expected earnings. Similarly, a negative unexpected earnings (NUE) event occurs when the earnings just announced (standardised by total assets) fall short of expected earnings.

2) *Uncertainty* which we proxy using the implied volatility form the options market (VIX) as used by Williams (2009) and supported by Drechsler (2009). Williams measures uncertainty daily in terms of changes in the level of VIX whereas we argue that it is not only the change in VIX but the level of VIX that is important in reflecting the level of uncertainty in the market. We classify uncertainty into four categories:

    a. Decreasing VIX at a time when VIX is below its median value (low uncertainty) which we will designate as *ΔVIX-VIXLo*

    b. Increasing VIX at a time when VIX is below it median value which is designated as *ΔVIX+VIXLo*

    c. Decreasing VIX at a time when VIX is above its median value which is designated as ΔVIX-VIXHi

    d. Increasing VIX at a time when VIX is above its median level (high uncertainty) which is designated as ΔVIX+VIXHi

We calculate VIX each trading day using the options on the ASX200 and following the same procedure as Dowling and Muthuswamy (2003). Specifically, we use each day both the two options and two put contracts that are closest to their exercise date and then take as our measure of VIX the average of the four implied volatilities that we have calculated. The VIX values and changes in these values are reported in Figure 1

The only exclusions from our data instances where we gave negative book-to-markets, returns over the announcement period that lie outside of the range of -50% to +50% and NUE is trimmed at the 1st percentile and PUE at the 99th percentile. The final sample after these exclusions was 4,745 announcements. Table 1 reports the statistical properties of this sample divided into the four categories. The absolute values of the NUE an PUE signals are not statistically different, suggesting that the public signals for all four groups are the same.

Method

The steps in our analysis are outlined below:

1) Identify an earnings announcement
2) Classify it as either an negative earnings announcement (NUE) or a positive earnings announcement (PUE)
3) Classify the announcement as occurring at a time of one of the four levels of uncertainty listed above where the level of VIX is determined two days before the announcement and the change in VIX is measured over the two day period encompassing the day before the announcement and the day of the announcement
4) The following basic model is run for each of categories pf uncertainty:

$$R_{it} = \beta_o + \beta_1 NUE_{it} + \beta_2 PUE_{it} + \varepsilon_{it} \quad \text{(Model 1)}$$

where R_{it} is the accumulated excess return over the three-day announcement period which commences the day before the announcement and ends the day after the announcement.

The proposition is that with no (or little) uncertainty the market reaction to NUE and PUE would be equal (i.e $\beta_1 = \beta_2$) but when uncertainty is high, then there will be greater reaction to NUE than there will be to PUE (i.e. $\beta_1 > \beta_2$). We conduct an F-test to determine whether there is any significant difference between β_1 and β_2.

4, Findings

Major Finding

Initially we split up our sample on the basis of the change in VIX (as in Williams) and our main findings are reported in Table 2 when applying Model 1 and incorporating market capitalisation, the level of VIX and the year of the announcement as a fixed effect (which we will refer to as alternatively Model 1 or the basis model). We find that where earnings announcements are made at a time of decreasing VIX (ΔVIX_-), both good and bad news have an equal impact on returns during the announcement period (i.e. their impact is symmetric). However, when the announcement is made during periods of increasing VIX (ΔVIX_+), bad news has a larger impact but good news is now totally dismissed by the market. The F-test confirms the asymmetric response of the market to the release of earnings announcements at a time of uncertainty as indicated by ΔVIX_+.

We now repeat the analysis where we now split up the sample by the level of VIX and these results are reported in Table 3. Again we find that the magnitude of the market reaction to both NUE and PUE is the same when the level of VIX is below its median (VIX Lo) but the same asymmetric response occurs when VIX is above its median (VIX Hi) as we found when we split the sample by the change in VIX. In other words, it would seem that it is not only the change in VIX, but also the level of VIX, that is important in defining the level of uncertainty that exists in the market. In order to further investigate these relationships, we next ranked announcements on the basis of the change in VIX occurring at the time of the information release and used this as the basis to split our sample into terciles. We repeated the exercise but this time ranking

announcements on the basis of the level of VIX at the time of the information release, The coefficients on the NUE and PUE terms for each set of rankings are reported in Figure 2. Although the results are much better behaved when the terciles are derived from the VIX levels, it proves in both instances that the significant asymmetric response to the NUEs and PUEs occurs for the highest ranking tercile

The obvious next step is to combine changes in VIX and the level in VIX into a single measure of uncertainty and then to use this to repeat the analysis. In doing this we created the four categories outlined in the previous section: ΔVIX-VIXLo, ΔVIX+VIXLo, ΔVIX-BVIXHi and ΔVIX+VIXHi. Our findings as reported in Table 4 identify that the significant asymmetric response to earnings announcements is restricted to periods when the earnings announcement occurs at a time when the VIX is increasing from an already high level which we would suggest defines periods when uncertainty is greatest. It is interesting to note that when uncertainty is lowest (i.e. when VIX is decreasing from an already low level), that the reaction to a good news earnings announcement is positive and significant at a time when there is no significant response to bad news earnings announcements. Although the difference between the reaction to NUE and PUE is not significant, this finding does raise the possibility that investors may not follow minmax expected utility consistently across the whole spectrum of uncertainty. It is also worthy of noting that over each of the other three categories (i.e. increasing uncertainty), that it is the reaction to the NUE that is significant and positive while there is no discernible reaction to the PUE.

Testing the Robustness of Our Major Finding

We will next test whether these findings hold for alternative model specifications, the incorporation of dividends and alternative specifications of NUE and PUE. In Table 5, we expand our model to more fully incorporate two characteristics of a firm that influence its valuations: its size and its book-to-market that are included both as a main effect and cross-product terms. Our findings remain unaltered by the introduction of these new variables with the only new term proving significant being BTMV*PUE when ΔVIX_{+} suggesting that

cheap stocks are less effected by the npessimistic view that the market takes of even good news at times of high uncertainty.

` One feature of the Australian market is that firms typically make a dividend announcement at the same time that they make an earnings announcement. This raises the possibility that our interpretation of the previous findings as reflecting the market reaction to good and bad earnings announcements is incorrect as it also encompasses the reaction to a dividend announcement. In order to investigate this we now add to our basic model, cross product-terms with both NUE and PUE where there is a contemporaneous announcement of either an increase or a decrease in dividends. The results reported in Table 6 confirm our previous main finding on the asymmetry of the markets response to earnings news at times of uncertainty. The one additional insight being that a dividend increase at a time of a positive earnings announcement negates some of the pessimistic market reaction to such announcements at times of uncertainty, specifically when the uncertainty is at its highest.

Finally, we used to date last year's earnings standardised by total assets as our measure of expected earnings (e.g Williams, 2009). Therefore, if this year's earnings again standardised by total assets is greater (less) than what it was last year, there has been a positive (negative) unexpected earnings which we will designate as PUE (NUE). One deficiency of this measure is that earnings can increase simply as a consequence of the firm increasing its asset base. In order to account for this we also evaluated ROA as measured by earnings divided by average total assets as the benchmark against which to judge whether earnings has increased or not.. We repeat the analysis now using this new measure for expected earnings and our results as reported in Table 7 indicate that the main results still hold The one further observation worth making is that good news seems to have a slightly more positive effect under this new definition indicating that the previous one was possibly biased towards classifying too many announcement as good news.

Overall, our further analysis confirms our finding first reported in Table 2 for our basis model that uncertainty causes an asymmetric response to earnings announcements suggesting that it is priced along with risk. The one other finding worth noting is that in all but one case our previous finding holds that with low

uncertainty, there is a significant positive reaction to good news earnings announcements but not to bad news announcements. As in no case are the difference in values of these coefficient significant at times of low uncertainty, the evidence is not strong enough to conclude that investors do diverge from minmax expected uncertainty but we will see more about this when we next investigate whether market and/or stocks sentiment plays a role when gauging the market reaction to earnings announcements under uncertainty.

Given that we have found that our results to be robust to the alternative specifications that we have examined, we will confine ourselves to using Model 1 and our initial definition of expected earnings (i.e the basic model) in the rest of our analysis.

Uncertainty and Sentiment

The most obvious explanation other than uncertainty to explain the asymmetric market response to earnings announcements is that reflects 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 (2006) 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. To date we have found strong evidence of asymmetry at one end of the spectrum and occasionally weak evidence at the other end.

Of course, there is the possibility that sentiment can actually combine with uncertainty when investors determine how to respond to a new information release. The most common proposition in the literature is that investors follow maxmin expected utility 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 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 time 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 return momentum of the stock over the five days prior to the announcement which provides a stock specific sentiment measure and (ii) a consumer sentiment measure that is calculated monthly by the Melbourne Institute and Westpac which we use as a proxy for a general market sentiment measure.

We report the results in Table 8 where momentum is used as the sentiment measure in cases where sentiment is measured by both the change in VIX (Panel A) and the level of VIX (Panel B). In both cases we find that the asymmetric response to an earnings announcement still holds at times of high uncertainty in the market with no evidence to suggest that stock-specific momentum influences the way that investors respond to information release. We now introduce consumer sentiment as a market-wide sentiment measure with our results being reported in Table 9. Again there is no discernible difference between how the markets impounds both good and bad news into prices when uncertainty is low while the asymmetric response to good and bad news remains when uncertainty is high. However, it becomes much more interesting when we consider the cross-product terms when uncertainty is high. The general finding is that the uncertainty and sentiment weigh about equally in the minds of investors when contemplating how they react to earnings announcements. The average value for consumer sentiment is 1.1 and at this value, under change in VIX (Panel A), the impact of bad earnings news (0.432 + 1.1 * -0.360) and good earnings news (-0.302 + 1.1 * 0.271) on prices will be almost zero at ties of high uncertainty. In other words, the asymmetric response of investors to earnings announcements only holds when uncertainty is high and sentiment is low. This suggest that market

uncertainty and market sentiment both contribute to how the market reacts to earnings announcements and most importantly they work in the opposite direction, particularly at times of high uncertainty.

Uncertainty and Trading Volume

The basis of uncertainty is that investors lack the relevant information to form unique priors. Dow and Werlang (1992) following a maxmin 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 (2007) confirm that an increase in uncertainty causes investors to withhold trading but that this will reverse when the uncertainty is resolved. This implies that we can use the level of trading in the market as a measure of the speed of uncertainty resolution which will influence the extent of the asymmetric response to earnings announcements. We would expect that the asymmetric reaction to earnings announcements to be greatest when uncertainty is and when trading volume is low.

In order to test this proposition, we extend the basic model to include two measures of trading volume: abnormal trading volume for the specific stocks (AbVol) and abnormal trading volume for the whole market (AbMVol). We calculate AbVol for stock i as the average daily proportion of total stocks outstanding for stock traded over the three day announcement period minus the average daily proportion of stocks outstanding traded over the prior 15 trading days. The stocks are then ranked by this measure with those with a AbVol above the medium being classified as $AbVol_{HIGH}$ while those ranking below the medium being classified as $AbVol_{LOW}$. We then divide our sample of announcements up into those occurring at times of low or high uncertainty (as measured by the change in VIX or the level of VIX) and at time of abnormally low or high trading volume. In other worlds, we split the sample up into four sub-samples to which we individually apply our basic model. A review of the results reported in Table 10 and particularly the F-test in the case of high uncertainty indicates that the asymmetric reaction to earnings announcements during uncertain periods is

clearly greater in the case of those stocks that experience relatively low trading volume at such times.

Abnormal Market Volume (AbMVol) is calculated as volume of stocks traded on the announcement day for the stocks included in the ASX200 minus the average aggregate daily volume for ASX200 stocks over the period, t-40 to t-20 relative to the announcement date. Again the stocks are ranked by this measure and separated into two groups; those that are above median are classified as $AbMVol_{HIGH}$ while that that ranked below medium are classified as $AbMVol_{LOW}$. This market measure is now combined with changes in VIX (and the level of VIX) to form four categories with the basis model being applied to each. The results reported in Table 11 are less supported of the proposition that uncertainty will contribute to a greater asymmetric reaction to earnings announcements at periods of low market trading volume than was the previous case where we used a stock-specific measure of abnormal trading volume. The proposition being confirmed where changes in VIX are used as our uncertainty measure (Panel A) but not when the level of VIX is used as the proxy (Panel B).

Overall the evidence is supported of the proposition that uncertainty leads to lower trading volume which can be used in conjunction with the VIX measure enable us to better identify periods when uncertainty in the market is at high levels.

5. Conclusion

It is proposed that uncertainty, rather than risk, provides a much more realistic representation of the setting that we face when we come to price asset, and particularly corporate equities. We have gone a long way down the path of developing pricing models that incorporate risk (e.g. CAPM, APT, Fama and French three –factor empirical model) but progress has been slow as to what role if any does uncertainty plays in asset pricing. The focus of this paper is to provide some insights into this vexing question. In order for uncertainly to affect pricing, it must have some influence on how investors incorporate information into pricing.

We address this by evaluating whether uncertainty influences the way by which investors react to earnings announcements.

In particular, we evaluate the proposition that investors will follow maxmin expected utility and so will progressively overweight bad news and underweight good news as they become more uncertain. Using VIX as a proxy for market uncertainty and earnings announcements as our information signal, we find that there is an asymmetric response to good and bad earnings news as uncertainty increases which is consistent with uncertainty breeding pessimism in the minds of investors. However, we do find some evidence to suggest investors might have a more optimistic bent than is allowed under maxmin expected utility as indicated by how they react to earnings announcements when uncertainty is at a low. Other factors that we have found to influence the extent of the pessimistic response to information associated with uncertainty are the prevailing level to market sentiment, whether it releases other information signals at the same time (and in particular the announcement of an increase in a dividend) and the existing valuation of the stock as reflected by its book-to-market ratio. All of these finding lead us to question to which investors consistently apply maxmin expected utility when faced with uncertainty. We also find that the level of trading around the announcement date has implications for the market reaction to information signals conditioned by uncertainty. However, in this case, there is good reason to believe that t6he impact of the announcement on volume is also an outworking of uncertainty and, indeed, should be used along with VIX as a measure of the uncertainty associated with a particular announcement.

Much more remains to be done but two matters that we wish to address is are certain firms/industries more susceptible than others to asymmetric response that we have seen to the realise of information and two whether the asymmetry gives rise to exploitable investment opportunities. On this latter, point the evidence suggests that market uncertainty is transitory which suggests that any influence that it has on market prices will ebb and flow. This suggest that investing in stocks who deliver good news at a time of high uncertainty (and low

market confidence) may deliver excess returns but, of course, it is a bet on how long it will tack for this uncertainty (and sentiment) to recover.

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Table 1

Statistical Properties of Major Variables by Four Categories

	Table 1: Descrpitive Statistics							
	∆VIX-				∆VIX+			
	VIX Lo		VIX Hi		VIX Lo		VIX Hi	
Variable	Mean	Stdev	Mean	Stdev	Mean	Stdev	Mean	Stdev
Ret	0.006	0.082	0.009	0.082	0.011	0.082	0.008	0.084
NUE	-0.063	0.141	-0.066	0.130	-0.070	0.146	-0.065	0.141
PUE	0.073	0.193	0.067	0.174	0.067	0.179	0.087	0.208
MV	488.7	2540.2	593.5	2809.4	611.5	3744.2	637.7	3397.5
BTM	0.868	1.0641	0.760	0.794	1.002	1.238	0.999	2.629
VIX	11.9%	1.65%	23.20%	6.46%	12.3%	1.34%	20.7%	5.08%

Table 2

Model 1 by ∆VIX

	Model 1	
Variable	**∆VIX-**	**∆VIX+**
NUE	0.026***	0.044***
PUE	0.025***	-0.008
MV	0.000	0.000
VIXLEVEL	-0.049	0.099
TEST NUE = PUE		
F-stat	0.00	9.16***
Fixed Effects	YES	YES
N=	3127	2676

Table 3

Model 1 by Levels of VIX

		Model1		
		VIX level		
Variable		Vix Lo		VIX Hi
NUE		0.025**		0.045***
PUE		0.015*		0.003
MV		0.000		0.000
VIXLEVEL		0.026		-0.034
TEST NUE = PUE				
F-stat		0.34		5.67**
Fixed Effects		Yes		Yes
N=		2541		2204

Table 4

Model 1 by ΔVIX and Level of VIX

		Model1					
		ΔVIX-				ΔVIX+	
Variable		VIX Lo		VIX Hi		VIX Lo		VIX Hi
NUE		0.013		0.039**		0.043**		0.048**
PUE		0.030**		-0.004		0.020		-0.012
MV		0.000		0.000		0.000		0.047
VIXLEVEL		0.026		0.108		-0.090		0.073
TEST NUE = PUE								
F-stat		0.60		2.52		0.86		5.73**
Fixed Effects		Yes		Yes		Yes		Yes
N=		1360		1181		1203		1001

Table 5

Expanded Model by ΔVIX and Level of VIX

	Expanded Model			
	ΔVIX-		ΔVIX+	
Variable	**VIX Lo**	**VIX Hi**	**VIX Lo**	**VIX Hi**
NUE	0.021	0.022	0.049**	0.051**
PUE	0.018	0.030*	-0.007	-0.031**
MV	0.000	0.000	0.000	0.000
VIXLEVEL	0.041	-0.089	0.103	0.050
Additional variable:				
MV*NUE	0.000	0.000	0.000	0.000
MV*PUE	0.000	0.000	0.000	0.000
BTMV*NUE	-0.011	0.051	-0.010	0.002
BTMV*PUE	0.011	-0.014	0.003	0.004***
TEST NUE = PUE				
F-stat	0.60	3.42*	3.42*	8.96***
Fixed Effects	Yes	Yes	Yes	Yes
N=	1360	1203	1181	1001

Table 6

Model 1 with Dividends by ΔVIX and Level of VIX

	Model 1 with Dividend Changes			
	ΔVIX-		ΔVIX+	
Variable	**VIX Lo**	**VIX Hi**	**VIX Lo**	**VIX Hi**
NUE	0.013	0.036*	0.036***	0.045**
PUE	0.024*	0.015	-0.011	-0.016
MV	0.000	0.000	0.000	0.000
VIXLEVEL	0.039	-0.104	0.123	0.028
Additional variable:				
Div Decrease*NUE	-0.233	0.025	0.122	-0.239
Div Decrease*PUE	0.034	0.037	0.012	0.103
Div Increase*NUE	-0.005	0.152	0.060	-0.025
Div Increase*PUE	0.029	0.159**	0.078	0.144**
TEST NUE = PUE				
F-stat	0.27	0.65	3.85	5.81**
Fixed Effects	Yes	Yes	Yes	Yes
N=	1360	1203	1181	1001

Table 7

Model 1 with Revised Definition of Expected Earnings (ROA)

	Model 1 using ROA as UE			
	ΔVIX-		ΔVIX+	
Variable	VIX Lo	VIX Hi	VIX Lo	VIX Hi
NUE	-0.010	0.028	0.029*	0.052***
PUE	0.024*	0.018	0.004	0.000
MV	0.000	0.000	0.000	0.000
VIXLEVEL	0.019	-0.100	0.125	0.057
TEST NUE = PUE				
F-stat	2.33	0.20	0.95	4.00**
Fixed Effects	Yes	Yes	Yes	Yes
N=	1351	1206	1180	1000

Table 8

Model 1 with Momentum

Panel A (ΔVIX)

		Model 1		
Variable		**ΔVIX-**		**ΔVIX+**
NUE		0.026**		0.044***
PUE		0.027***		-0.009
MV		0.000		0.000
VIXLEVEL		-0.019		0.106
TEST NUE = PUE				
F-stat		0.00		9.32***
Additional variable:				
INDEXMOMENTUM		0.200		0.030
INDEXMOMENTUM*NUE		0.118		0.000
INDEXMOMENTUM*PUE		-0.222		0.335
Fixed Effects		Yes		Yes
N=		2563		2182

Panel B (Level of VIX)

Model 1				
		VIX level		
Variable		**Lo**		**Hi**
NUE		0.019		0.042***
PUE		0.018		0.006
MV		0.000		0.000
VIXLEVEL		0.062		-0.073
Index Mom		0.125		-0.082
Index Mom*NUE		0.174		-0.147
Index Mom*PUE		-0.087		0.176
TEST NUE = PUE				
F-stat		0.00		3.68*
Fixed Effects		Yes		Yes

Table 9

Model 1 with Sentiment

Panel A (ΔVIX)

		Model 1		
Variable		ΔVIX-		ΔVIX+
NUE		0.062		0.432*
PUE		-0.051		-0.302*
MV		0.000		0.000
VIXLEVEL		-0.019		0.092
TEST NUE = PUE				
F-stat		0.29		5.87**
Additional variable:				
SENT		0.032		-0.045
SENT*NUE		-0.033		-0.360*
SENT*PUE		0.068		0.271*
Fixed Effects		Yes		Yes
N=		2563		2182

Panel B (Level of VIX)

Model 1				
		VIX level		
Variable		Lo		Hi
NUE		0.045		0.302
PUE		0.041		-0.407***
MV		0.000		0.000
VIXLEVEL		0.041		-0.054
Sentiment		0.030		-0.079*
Sentiment*NUE		-0.019		-0.243
Sentiment*PUE		-0.022		0.388***
TEST NUE = PUE				
F-stat		0.00		6.54**
Fixed Effects		Yes		Yes
N=		2541		2204

Table 10

Model 1 with Abnormal Volume

Panel A (ΔVIX)

	Model 1			
	ΔVIX-		ΔVIX+	
Variable	$AbVol_{low}$	$AbVol_{high}$	$AbVol_{low}$	$AbVol_{high}$
NUE	0.057***	0.0380	0.083***	0.081*
PUE	0.0212*	0.038**	-0.029*	-0.002
MV	0.000	0.000	0.000	0.000
VIXLEVEL	0.132	-0.117	0.114	0.125
TEST NUE = PUE				
F-stat	1.94	0.00	11.92***	3.60*
Fixed Effects	Yes	Yes	Yes	Yes

Panel B (Level of VIX)

	Model 1			
	Below Med VIX		Above Med VIX	
Variable	$AbVol_{LOW}$	$AbVol_{HIGH}$	$AbVol_{LOW}$	$AbVol_{HIGH}$
NUE	0.035	0.028	0.093***	0.093**
PUE	0.009	0.043***	-0.005	-0.004
MV	0.000	0.000	0.000	0.000
VIXLEVEL	0.304	0.158	0.006	0.039
TEST NUE = PUE				
F-stat	0.86	0.13	11.08***	5.21**
Fixed Effects	Yes	Yes	Yes	Yes
N=	974	1128	1129	973

Table 11

Model 1 with Abnormal Market Volume

Panel A (ΔVIX)

	Model 1			
	ΔVIX-		ΔVIX+	
Variable	$AbMVol_{low}$	$AbMVol_{high}$	$AbMVol_{low}$	$AbMVol_{high}$
NUE	0.061**	0.054**	0.092***	0.062**
PUE	0.024*	0.023*	-0.014	-0.012
MV	0.000	0.000	0.000	0.000
VIXLEVEL	-0.068	-0.125	0.148	0.098
TEST NUE = PUE				
F-stat	1.62	2.52	8.77***	5.53**
Fixed Effects	Yes	Yes	Yes	Yes
N=	1403	1101	913	1215

Panel (Level of VIX)

Model 1			
VIX Lo		VIX Lo	
$AbMktVol_{LOW}$	$AbMktVol_{HIGH}$	$AbMktVol_{LOW}$	$AbMktVol_{HIGH}$
-0.032	0.061***	0.040**	0.068***
0.018	0.033**	-0.024	-0.008
0.000	0.000	0.000	0.000
0.369	-0.110	-0.003	0.050
2.77*	1.11	4.72**	6.77***
Yes	Yes	Yes	Yes
711	871	827	755

Figure 1

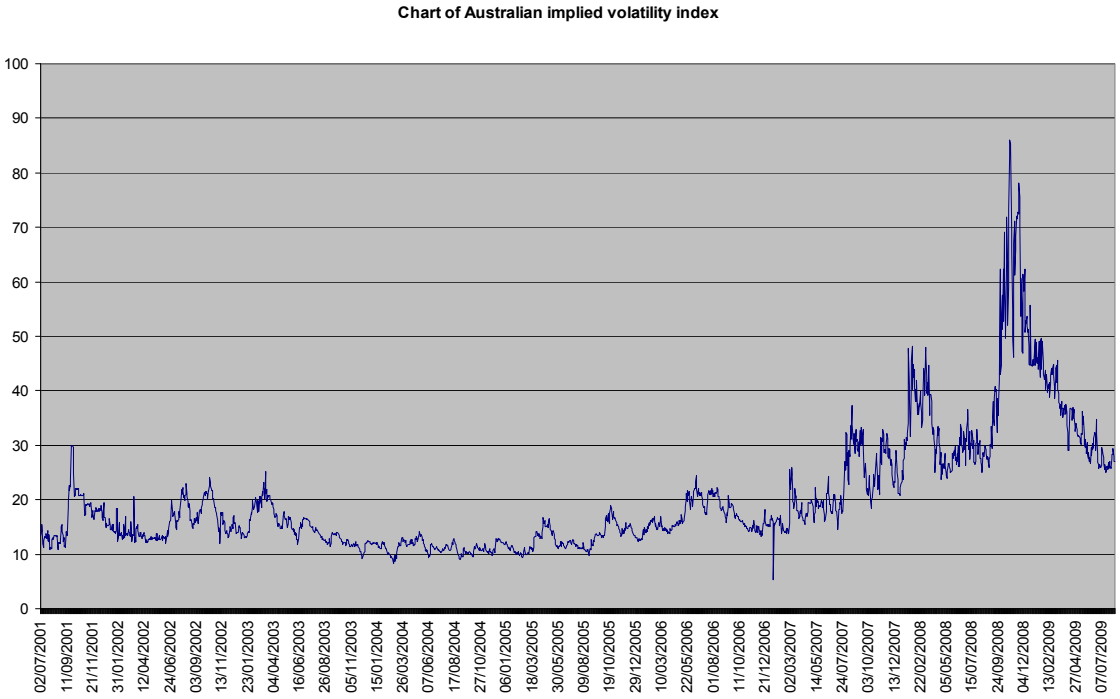


Chart of Australian implied volatility index
100
90
80
70
60
50
40
30
20
10
0
02/07/2001
11/09/2001
21/11/2001
31/01/2002
12/04/2002
24/06/2002
03/09/2002
13/11/2002
23/01/2003
04/04/2003
16/06/2003
26/08/2003
05/11/2003
15/01/2004
26/03/2004
07/06/2004
17/08/2004
27/10/2004
06/01/2005
18/03/2005
30/05/2005
09/08/2005
19/10/2005
29/12/2005
10/03/2006
22/05/2006
01/08/2006
11/10/2006
21/12/2006
02/03/2007
14/05/2007
24/07/2007
03/10/2007
13/12/2007
22/02/2008
05/05/2008
15/07/2008
24/09/2008
04/12/2008
13/02/2009
27/04/2009
07/07/2009

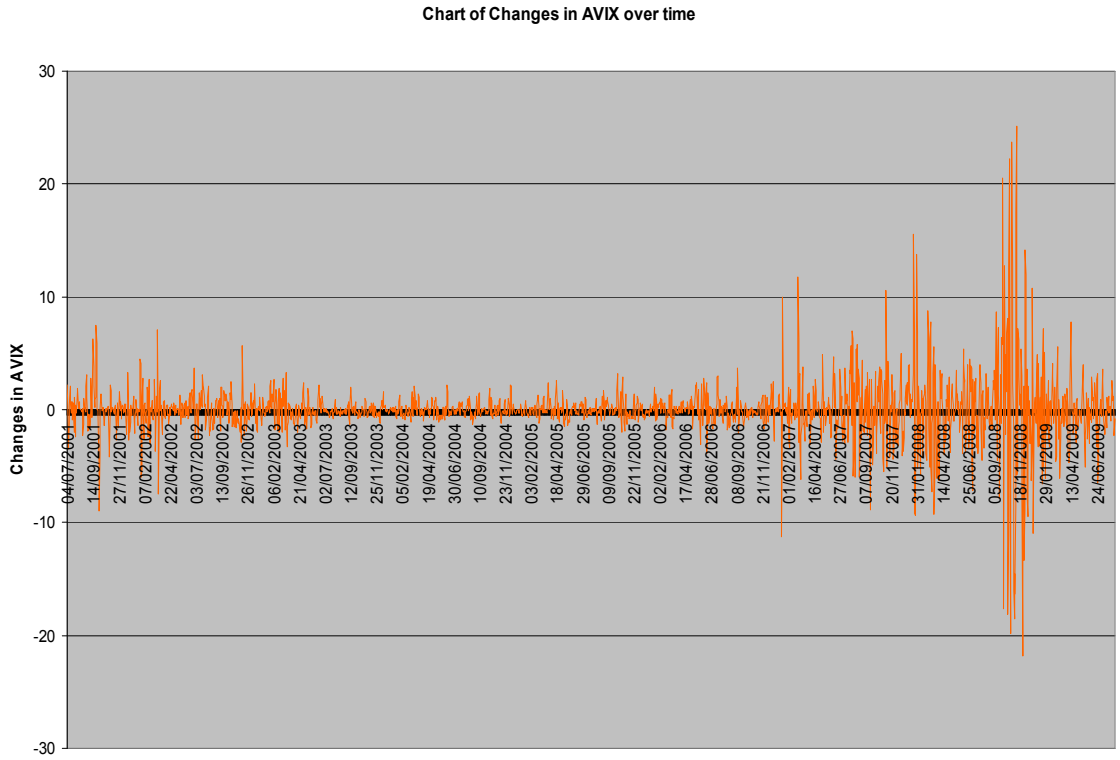
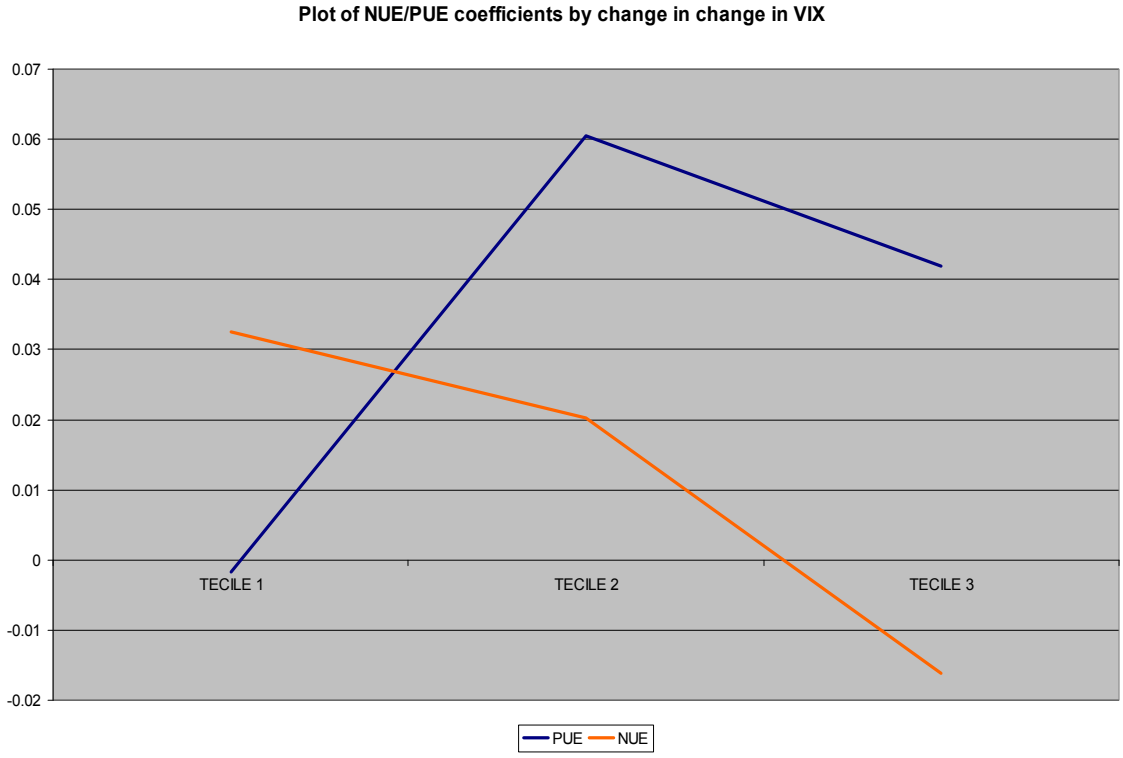
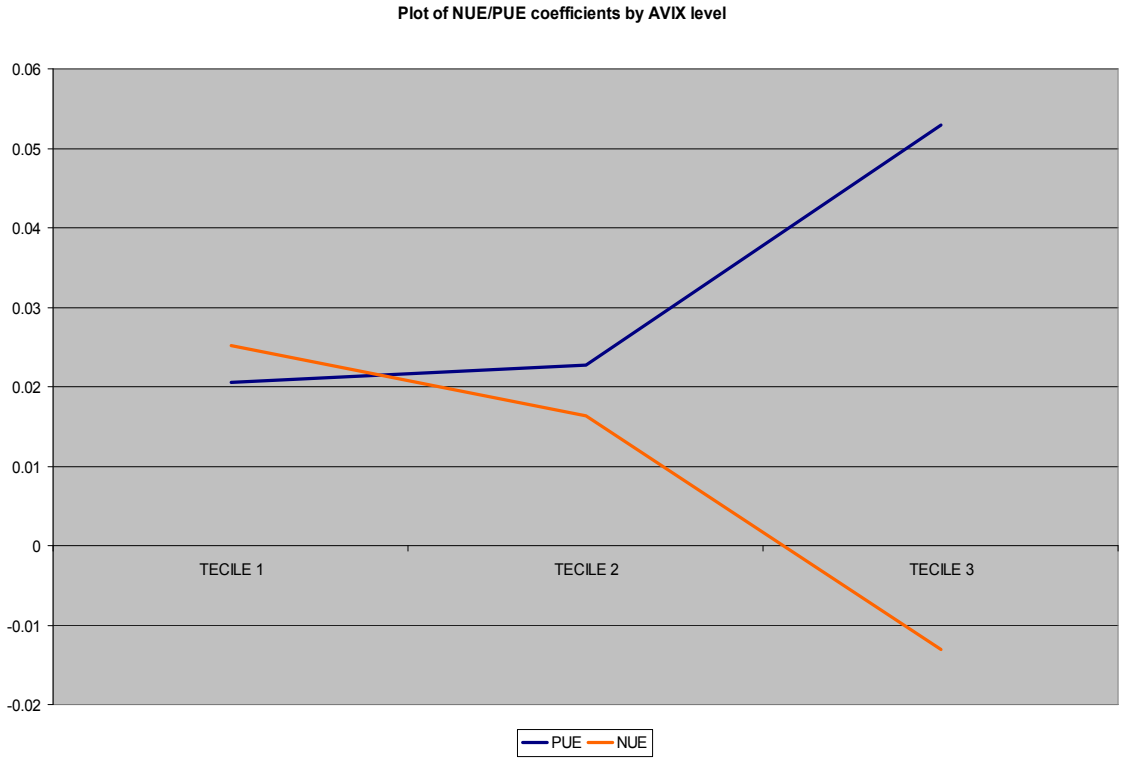


Chart of Changes in AVIX over time
Changes in AVIX
30
20
10
0
-10
-20
-30
04/07/2001
14/09/2001
27/11/2001
07/02/2002
22/04/2002
03/07/2002
13/09/2002
26/11/2002
06/02/2003
21/04/2003
02/07/2003
12/09/2003
25/11/2003
05/02/2004
19/04/2004
30/06/2004
10/09/2004
23/11/2004
03/02/2005
18/04/2005
29/06/2005
09/09/2005
22/11/2005
02/02/2006
17/04/2006
28/06/2006
08/09/2006
21/11/2006
01/02/2007
16/04/2007
27/06/2007
07/09/2007
20/11/2007
31/01/2008
14/04/2008
25/06/2008
05/09/2008
18/11/2008
29/01/2009
13/04/2009
24/06/2009

Figure 2


Plot of NUE/PUE coefficients by change in change in VIX
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
TECILE 1
TECILE 2
TECILE 3
PUE
NUE


Plot of NUE/PUE coefficients by AVIX level
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
TECILE 1
TECILE 2
TECILE 3
PUE
NUE