THE OPTION MARKET'S ANTICIPATION OF INFORMATION CONTENT IN EARNINGS ANNOUNCEMENTS

Mary Billings - New York University
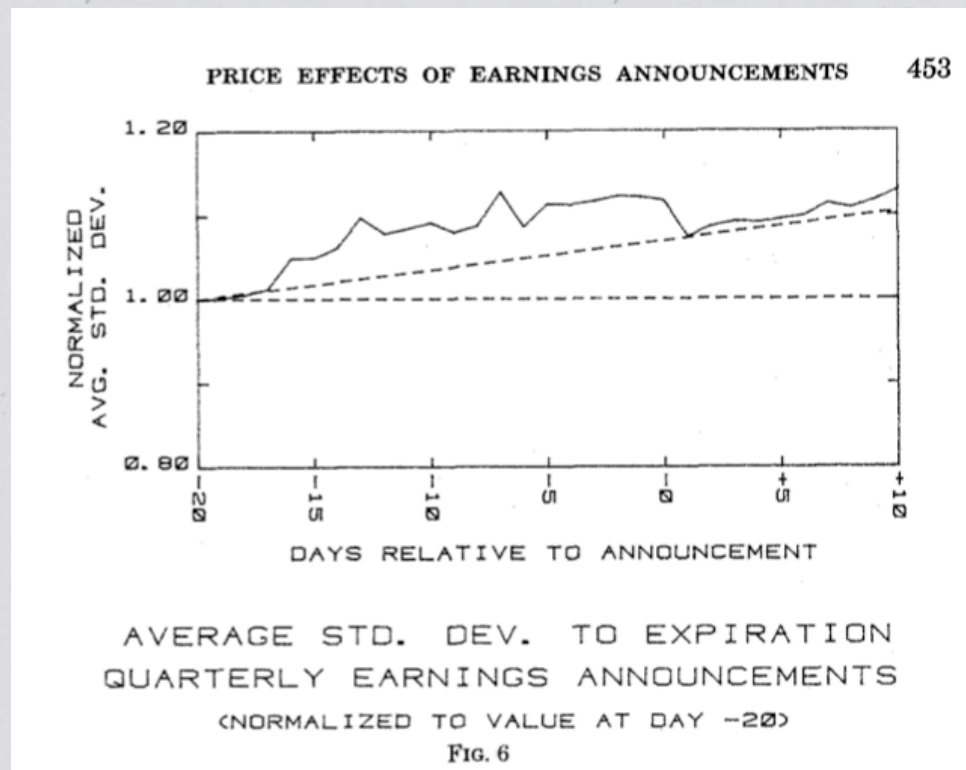**Robert Jennings - Indiana University**

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Research question

* **How does information content in earnings announcements manifest in the option market?**

Earnings announcements increase stock price volatility (Beaver, 1968).

(Patell and Wolfson, 1981)

PRICE EFFECTS OF EARNINGS ANNOUNCEMENTS   453

AVERAGE STD. DEV. TO EXPIRATION
QUARTERLY EARNINGS ANNOUNCEMENTS
(NORMALIZED TO VALUE AT DAY -20)
FIG. 6

The option's implied volatility reflects this.
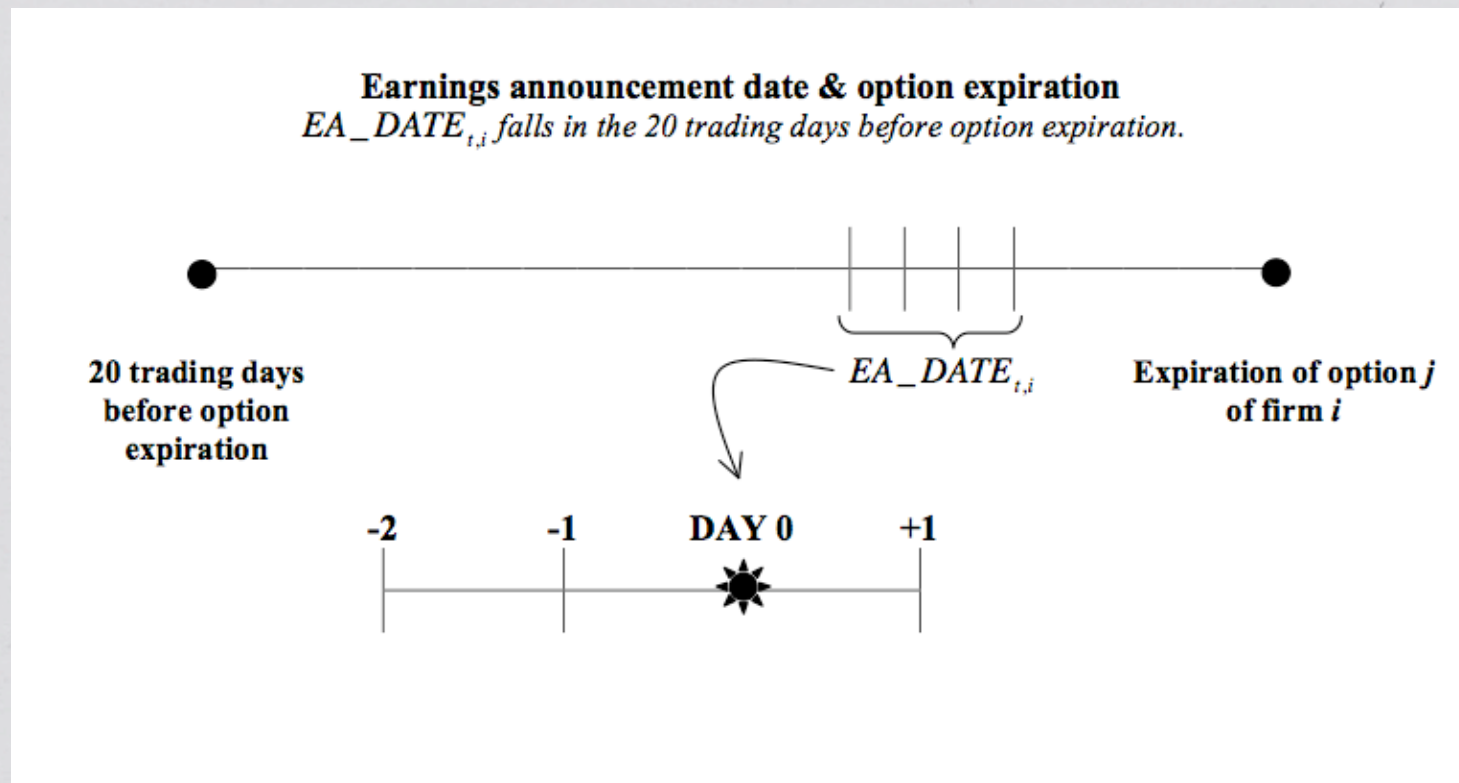
Research question
(rephrased)

* **Does the option market's anticipation of volatility-induced spikes in stock prices reflect sophistication beyond simply noting that the uncertainty surrounding earnings releases increases stock price volatility?**

Potential contributions

* **We develop a volatility-driven measure of anticipated information content (the AIC) that separates the effect of earnings uncertainty from the stock price's sensitivity to earnings news**

* **In so doing, we offer researchers a frequently available, *ex ante*, firm- and quarter-specific approach to studying information content**

* **Our option-market approach facilitates the study of information content in new settings**

Which options do we study?

We study: 1) short-dated (i.e., within 20 days of expiration), 2) at-the-money options that 3) expire soon after an anticipated earnings announcement

Earnings announcement date & option expiration
$EA\_DATE_{t,i}$ falls in the 20 trading days before option expiration.

20 trading days before option expiration

$EA\_DATE_{t,i}$

Expiration of option *j* of firm *i*

-2   -1   DAY 0   +1

Absent a volatility-increasing event, short-dated, ATM options should be virtually worthless.

➡ **Yet, evidence suggests that these options trade for non-trivial market values if they expire soon after an anticipated earnings announcement**

452   J. M. PATELL AND M. A. WOLFSON
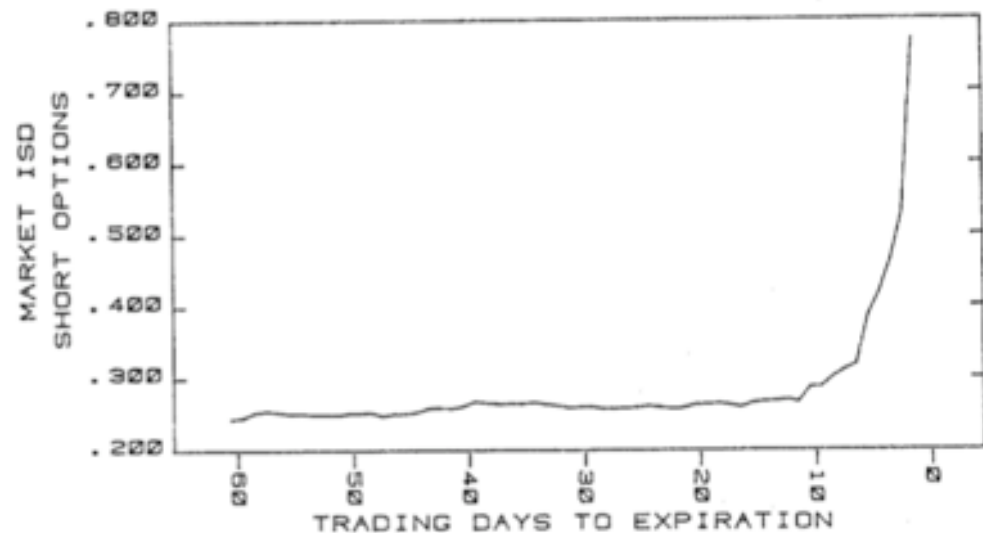
IMPLIED STANDARD DEVIATIONS
NEAR EXPIRATION DATES

FIG. 5

Example

Current stock price   = $50 per share.

Strike price   = $50.

Time-to-expiration   =   2 days.

Normal volatility   =   25% per year (1.58% per day).

Interest rate   =   4% per year.

PUT = ~36 cents.

CALL = ~37 cents.

Now, assume that the market expects an earnings announcement tomorrow that has the potential to cause a one-day, absolute (i.e., +/-) 3-sigma movement in stock price.

New option value   =   ~$2.37 (=$50*1.58%*3).

$$AIC \equiv \frac{\text{OPTPRC}}{\text{STDEV}}$$

of analysts' forecasts

Why deflate by STDEV?

NOTE: OPTPRC equals the pre-earnings-announcement price of an option expiring after the market might reasonably expect a quarterly earnings announcement

STDEV serves as our *ex ante* measure of earnings uncertainty

* **Kinney, Burgstahler and Martin (2002) demonstrate that the standard deviation of analysts' forecasts strongly correlates with *ex post* earnings surprise**
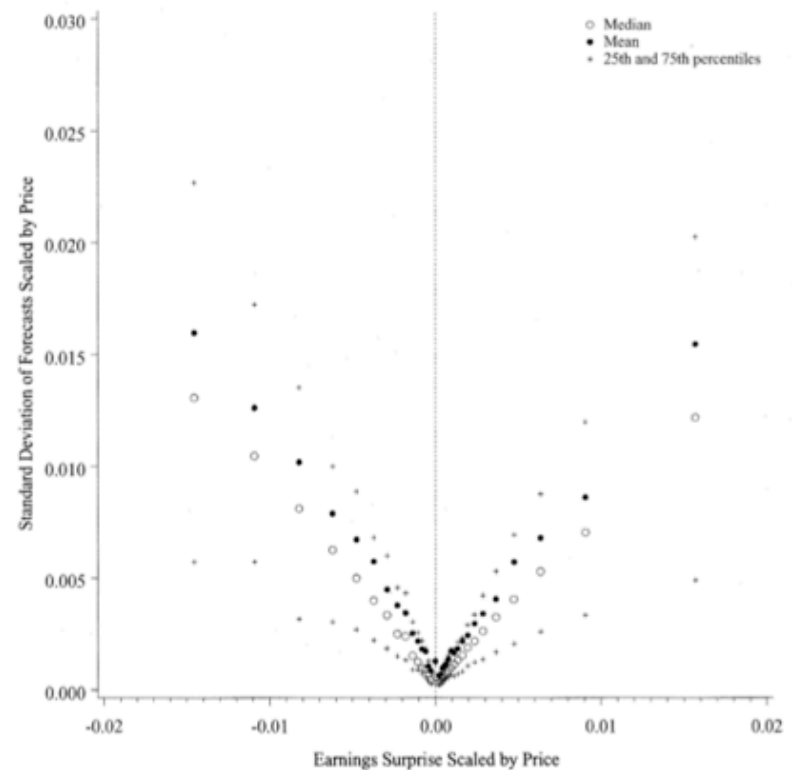
FIG. 3.—Distributions of standard deviation of forecasts for price-scaled earnings surprise portfolios of 500 observations.

A similar relation exists in our data

Earnings surprise and standard deviation of forecasts AIC sample
(by decile of surprise)

Legend: ○ MEAN ● MEDIAN

Y-axis: **Standard deviation of forecasts** *(STDEV)*, from 0.00 to 0.10

X-axis: **Earnings surprise** *(SURPRISE)*, from -0.25 to 0.30
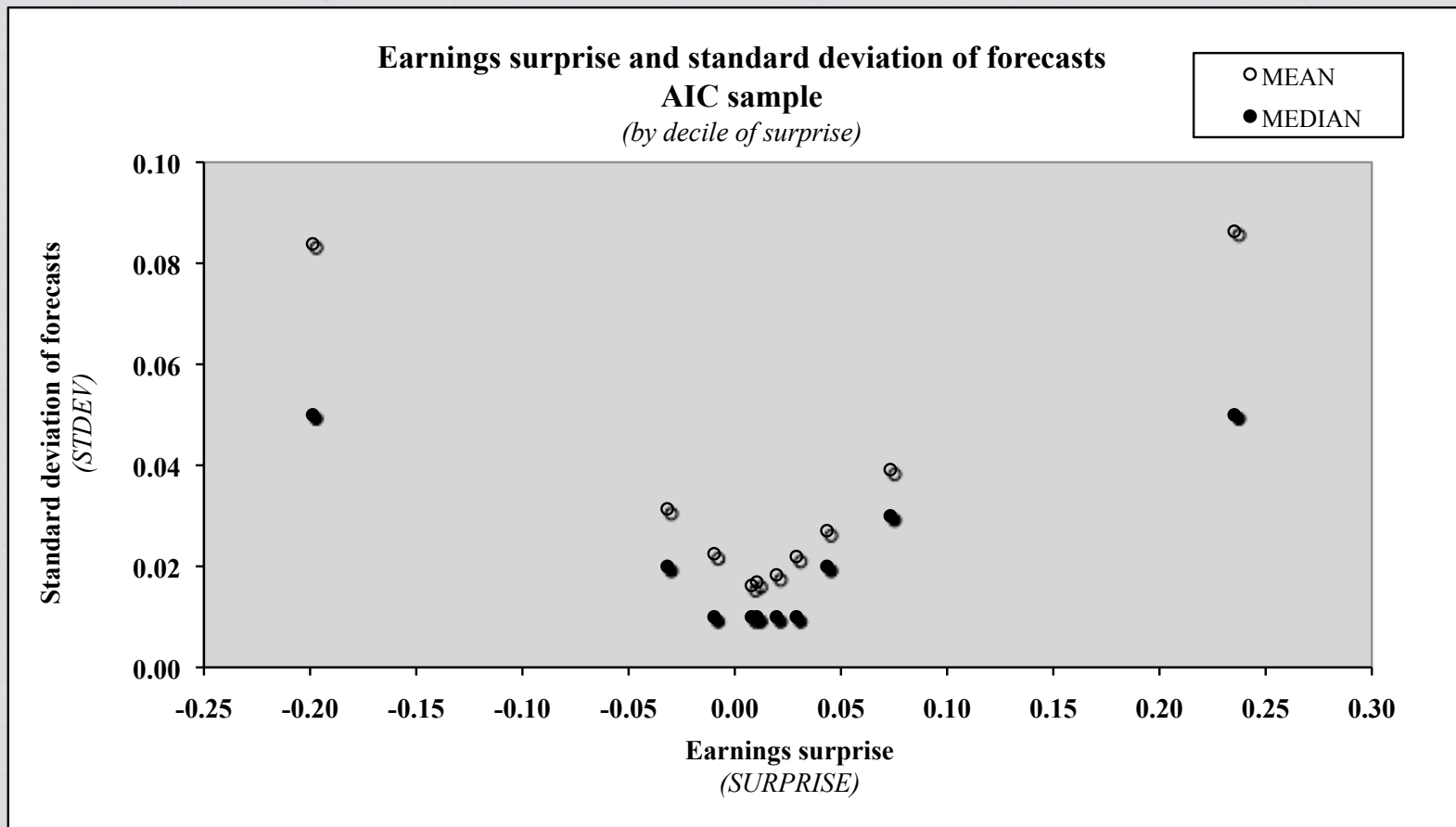
After forming portfolios based on earnings surprise, we observe a <u>0.54</u> correlation between STDEV and |SURPRISE|.

$$AIC \equiv \frac{\text{OPTPRC}}{\text{STDEV of analysts' forecasts}}$$

a ratio that reflects the fact that for any given level of earnings uncertainty, the option price should increase with the forecasted elasticity of the stock market's response to earnings information.

$$\frac{\text{Market Reaction}}{\text{Earnings Uncertainty}}$$

similar to an ERC . . .

NOTE: OPTPRC equals the pre-earnings-announcement price of an option expiring after the market might reasonably expect a quarterly earnings announcement

Traditional ERC

RETURN = *a* + *b* UNEXPECTED EARNINGS + *e*.

* measured as an estimated slope coefficient in the regression of a measure of returns on a measure of earnings

* requires averaging

    1. across firms (cross-sectional regression)

    2. across time (time-series regression)

    3. both (pooled regression)

The AIC represents an *ex ante* measure of the stock price response per given level of uncertainty.

AIC	Market Reaction	ERC *a slope coeff. that represents:*
OPTPRC		**Return Response**
STDEV of analysts' forecasts		**SURPRISE**
	Earnings Uncertainty	

similar to an ERC . . . yet, *different* . . .

Notable differences between the AIC and the ERC

* Although both measure information content of earnings, volatility drives the AIC. In addition:

   ➡ The AIC responds to forecasted volatility associated with the *entire* **earnings announcement**

   ➡ The **firm- and quarter-specific nature** of the AIC calculation differs fundamentally from the traditional, pooled regression approach to estimating an ERC

   ➡ The option-market focus (along with the need for analyst forecast data) cause a study of the AIC to focus on a sample of firms that operate in **particularly rich information environments**

Data

* We combine data from OptionMetrics and I/B/E/S (from 1996 through 2006) to obtain option and analyst forecast data for all options with an earnings announcement within the last month of an option's life

➡ **4,363 firms / 55,936 firm-quarters / 651,811 options**

* On a relative basis, at-the-money options' prices are most affected by the phenomenon we are studying. Thus, we restrict this sample to options having strike prices within 5% of the current stock price.

➡ **3,327 firms / 18,214 firm-quarters / 39,443 options**

* To estimate our cross-sectional regressions, we require additional data from Compustat and CRSP

➡ **2,757 firms / 14,907 firm-quarters / 30,641 options**

Does the AIC correlate with the magnitude of the *ex post* stock market reaction to unexpected earnings?

TABLE 3, PANEL A	# of Obs.	AIC:ERC Correlation	Confidence Level
Without Averaging	33,111	0.1512	<.0001
Averaging variable:			
CUSIP	2,860	0.1824	<.0001
Fama-French	49	0.3194	0.0253
DNUM	360	0.3423	<.0001
SIC	65	**0.5800**	<.0001

ERC = a firm-specific ERC calculated following Teets and Wasley (1996).

Does the AIC exhibit cross-sectional and time-series differences similar to those documented in the traditional ERC literature?

Earnings growth	**MB**	**+**
Firm systematic risk	**BETA**	**-**
Interest rates	**I**	**-**
Earnings persistence	**THETA**	**+**
Information environment	**NUM**	**? (+)**

Acknowledging that our sample includes the "Bubble" period.

TABLE 5	Pred. Rel.	(1) Coeff.	(1) Pr>|t|	(2) Coeff.	(2) Pr>|t|	(3) Coeff.	(3) Pr>|t|	(4) Coeff.	(4) Pr>|t|
Intercept		30.308	0.1329	35.092	0.0025	50.622	<.0001	-7.856	0.2116
Dbubble		-36.515	0.0843	-42.948	0.0036	--		--	
Year effects		Yes		No		Yes		No	
MB	+	63.516	<.0001	67.141	<.0001				
MB*Dbubble		-35.307	<.0001	-39.449	<.0001				
MB (post-Bubble)	+	28.209	<.0001	27.692	<.0001	28.210	<.0001	27.692	<.0001
Beta	-	49.973	<.0001	40.154	<.0001				
Beta*Dbubble		-49.669	<.0001	-43.133	<.0001				
Beta (post-Bubble)	-	0.304	0.8507	-2.979	0.0612	0.303	0.7855	-2.979	0.0069
I	-	-10.993	0.0002	-9.561	<.0001				
I*Dbubble		7.698	0.0470	16.302	<.0001				
I (post-Bubble)	-	-3.295	0.1808	6.741	0.0001	-3.295	0.0567	6.742	<.0001
Theta	+	-14.542	0.0002	-6.837	0.0885				
Theta*Dbubble		28.190	<.0001	21.080	<.0001				
Theta (post-Bubble)	+	13.648	<.0001	14.243	<.0001	13.648	<.0001	14.242	<.0001
NUM	?	2.298	<.0001	3.017	<.0001				
NUM*Dbubble		-1.504	<.0001	-2.265	<.0001				
NUM (post-Bubble)	?	0.794	<.0001	0.752	<.0001	0.794	<.0001	0.752	<.0001
Adj. R^2		0.1948		0.1625		0.0755		0.0654	

We report significance levels for two-tailed tests. All results hold if we include IVOL_PRE -- indeed they strengthen.

Can we exploit characteristics of the AIC to study *changes* in the anticipated sensitivity to earnings?

* Firms with higher levels of institutional ownership experience higher levels of trading volume and greater return volatility surrounding earnings announcements (Potter 1992; Kim et al. 1997; Lang and McNichols 2007)

* We investigate whether the option market anticipates an increased sensitivity for firms that are expected (based on ownership structure) to experience more intense trading

TABLE 6, Panel B *(Bushee Classifications)*	Pred. Rel.	(1) - LEVELS Coeff.	Pr>|t|	(2) - LEVELS Coeff.	Pr>|t|	(3) - CHANGES Coeff.	Pr>|t|
Intercept Dbubble		Included					
Year effects		Yes		No		Yes	
MB	+	Included					
Beta	-						
I	-						
Theta	+						
NUM	?						
%TRAN	+	210.385	<.0001	282.953	<.0001	155.766	<.0001
%TRAN*Dbubble		-122.75	<.0001	-172.17	<.0001	-109.2	<.0001
%TRAN (post-Bubble)	+	87.638	<.0001	110.782	<.0001	46.569	0.0025
%DED	+	48.291	<.0001	-4.971	0.6210	-59.608	0.0018
%DED*Dbubble		-49.986	<.0001	25.229	0.1243	81.100	0.0113
%DED (post-Bubble)	+	-1.695	0.8964	20.258	0.1153	21.492	0.4023
%QIX	+	-61.315	<.0001	-69.939	<.0001	-18.687	0.2649
%QIX*Dbubble		106.619	<.0001	69.209	<.0001	27.857	0.2347
%QIX (post-Bubble)	+	45.304	<.0001	-0.730	0.9260	9.170	0.5757
Adj. R^2		0.2135		0.1857		0.0311	
We report significance levels for two-tailed tests. All results hold if we include IVOL_PRE -- indeed they strengthen.							

Summary

* We shift attention from studying how earnings news influences stock prices to considering the role that earnings information plays in shaping option-market behavior

* We suggest an alternative approach to measuring the stock price *sensitivity* to earnings information using option prices

Potential contributions
(revisited)

* **We offer researchers a 1) frequently available, 2) *ex ante*, 3) firm- and quarter-specific approach to studying information content, which facilitates studies of:**

   ➡ **changes in (as opposed to levels of) information content**

   ➡ **the anticipation of versus reaction to an event**

   ➡ **asymmetries in the effect of information**

   ➡ **short-term versus long-term effects of news**

ANTICIPATED QUESTIONS

Firm- and quarter-specific, *ex ante* approach?

"Ahead of **GOOGLE**'s 3Q earnings release this afternoon, we discuss owning short-term October options given an implied move that looks slightly low relative to recent earnings moves and heightened investor expectations."

"Over the company's last four earnings releases, shares have seen a one-day absolute earnings move on average of +/- ~6%. Currently, it appears as if the options market is pricing in a move slightly less than the average, just over ~4%."

Figure 1. GOOG Earnings Volatility

Date	Event	One-Day Move
7/15/2010	GOOG 2Q10	-7.0%
4/15/2010	GOOG 1Q10	-7.6%
1/21/2010	GOOG 4Q09	-5.7%
10/15/2009	GOOG 3Q09	3.8%
Average (Absolute)		6.0%
Median (Absolute)		6.3%
At-the-Money Straddle		~4%

Source: Bloomberg

Firm- and quarter-specific, *ex ante* approach?
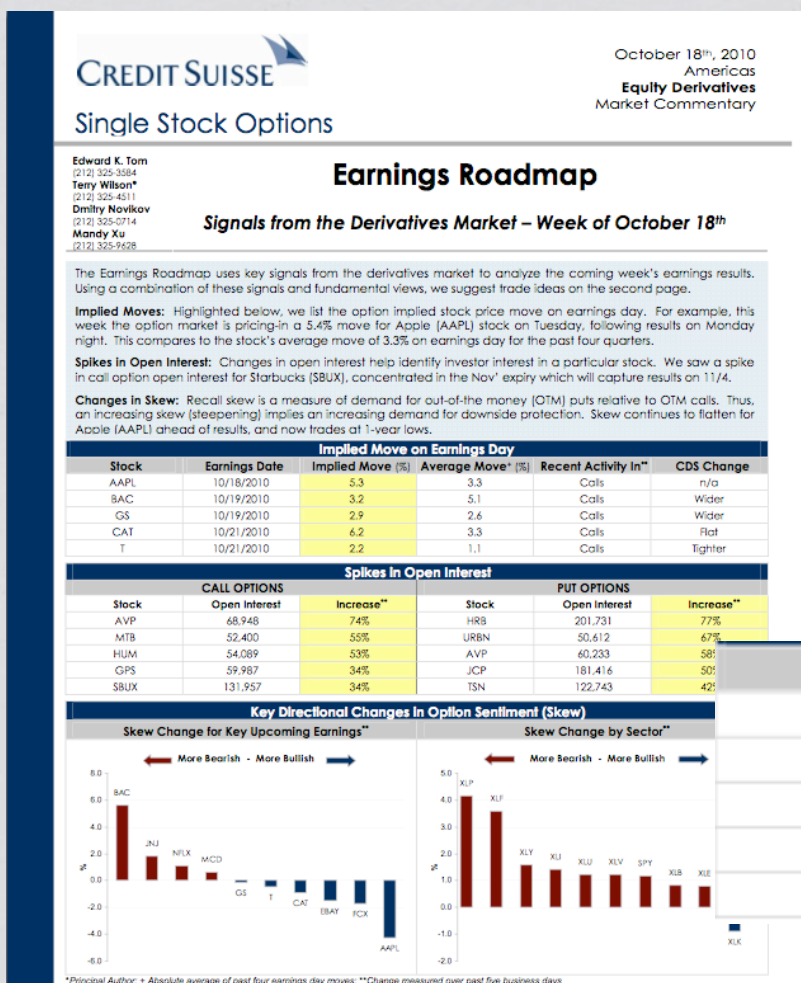
"[T]his week the option market is pricing-in a 5.4% move for **APPLE** [AAPL] stock on Tuesday, following results on Monday night. This compares to the stock's average move of 3.3% on earnings day for the past four quarters."

Stock	Earnings Date	Implied Move (%)
AAPL	10/18/2010	5.3
BAC	10/19/2010	3.2
GS	10/19/2010	2.9
CAT	10/21/2010	6.2
T	10/21/2010	2.2

What "information content" does the AIC capture?

✳ Because earnings announcements include additional information (above and beyond current earnings), the AIC will include the implications of *all* information in an earnings release

✳ Yet, for this information to influence the AIC, it must be

➡ **anticipatable** (i.e., traders can forecast both content and timing of delivery)

➡ **value-relevant** (i.e., information for which an impact on stock price is expected)

➡ **unsigned** (i.e., information to which traders cannot assign a direction)

What about OTM options?

What if it's an __OTM__ call with strike equal to $55?

Current stock price = $50 per share.	
Strike price = $55.	
Time-to-expiration = 2 days.	**CALL = $0.**
Normal volatility = 25% per year (1.58% per day).	
Interest rate = 4% per year.	

Now, assume that the market expects an earnings announcement tomorrow that has the potential to cause a one-day, absolute (i.e., +/-) 3-sigma movement in stock price.

New option value = $0 (=MAX[$0,($50*1.58%*3)-($55-$50]).

What about ITM options?

What if it's an <u>ITM</u> call with strike equal to $45?

Current stock price = $50 per share.

Strike price = $45.

Time-to-expiration = 2 days.

Normal volatility = 25% per year (1.58% per day).

Interest rate = 4% per year.

CALL = ~$5.01

Now, assume that the market expects an earnings announcement tomorrow that has the potential to cause a one-day, absolute (i.e., +/-) 3-sigma movement in stock price.

New option value = $7.37 (=MAX[$0,($50*1.58%*3)+($50-$45)]).

$5.00 from moneyness **+** $2.37 from EA-induced volatility spike

Can we include ITM (in addition to ATM) options?

AIC	=	MB	BETA	I	THETA	NUM
		+	-	-	+	? (+)

Yes. But, we'd need to either:

Adjust the numerator for the portion of the OPTPRC that stems from moneyness

$$\frac{\text{OPTPRC} - \$M}{\text{STDEV}}$$

Add in a measure of moneyness to control for the portion of the OPTPRC that stems from moneyness

$M
+

All of our results remain if we use either approach to controlling for moneyness; further, if we limit M to fall between 0.99 and 1.01, results do not change.

Do we introduce noise by studying total volatility, not just the spike?

AIC	=	MB	BETA	I	THETA	NUM
		+	-	-	+	? (+)

The AIC's numerator (OPTPRC) reflects the LEVEL of normal IVOL, as well as the anticipated earnings-induced spike.

In other words, doesn't $0.37 of the ATM option price stem from normal volatility, not the anticipated spike?

Current stock price = **$50 per share.**

Strike price = **$50.**

Time-to-expiration = **2 days.**

Normal volatility = **25% per year (1.58% per day).**

Interest rate = **4% per year.**

PUT = ~36 cents.

CALL = ~37 cents.

Now, assume that the market expects an earnings announcement tomorrow that has the potential to cause a one-day, absolute (i.e., +/-) 3-sigma movement in stock price.

New option value = ~$2.37 (=$50*1.58%*3).

$0.37 from normal volatility **+** **$2.00 from EA-induced volatility spike**

Do we introduce noise by studying total volatility, not just the spike?

AIC =	MB	BETA	I	THETA	NUM
	+	-	-	+	? (+)

The AIC's numerator (OPTPRC) reflects the LEVEL of normal IVOL, as well as the anticipated earnings-induced spike.

The focus on short-dated, ATM options that should trade for very little, absent the EA should mitigate this concern

Nonetheless, if we include a measure of pre-announcement, "normal" volatility

IVOL_PRE
+

All results remain

Substituting the standard deviation of daily stock returns for the prior quarter yields the same results.

Do we introduce noise by studying total volatility, not just the spike?

AIC	=	MB	BETA	I	THETA	NUM
		+	-	-	+	? (+)

The AIC's numerator (OPTPRC) reflects the LEVEL of normal IVOL, as well as the anticipated earnings-induced spike.

The focus on short-dated, ATM options that should trade for very little, absent the EA should mitigate this concern

Nonetheless, if we include a measure of pre-announcement, "normal" volatility interacted with days to expiration

IVOL_PRE*DAYS_EXP
+

All results remain; indeed, results strengthen and R^2 increases

Does the CS variation in AIC stem from our denominator (i.e., STDEV)?

AIC	=	MB	BETA	I	THETA	NUM
		+	-	-	+	? (+)

Pearson CORRELATIONS

	AIC	OPTPRC	STDEV
MB	3%	4%	1%
BETA	9%	15%	6%
I	12%	12%	-1%
THETA	2%	6%	5%
NUM	12%	11%	-3%

Does the CS variation in AIC stem from our denominator (i.e., STDEV)?

AIC =	MB	BETA	I	THETA	NUM
	+	-	-	+	? (+)

Adjust to only use OPTPRC as DV

OPTPRC

Control for uncertainty by including STDEV

STDEV
+

All results remain, with comparable R²

Does the AIC correlate with the magnitude of the *ex post* stock market reaction to unexpected earnings?

* For nearly 45% of the individual firm-quarter RESPONSE ratios, a positive (negative) SURPRISE meets a negative (positive) market reaction. Focusing on the positive RESPONSE ratios:

TABLE 3, PANEL B	|RESPONSE|	AIC	+ RESPONSE	- RESPONSE
|RESPONSE|	1	0.4742	N/A	N/A
AIC		1	0.4677	-0.4991
+ RESPONSE			1	N/A
- RESPONSE				1

RESPONSE = market reaction on EA date ÷ SURPRISE, where SURPRISE = (ACT- MEANEST).