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Trading in the Options Market around Financial Analysts' Consensus Revisions

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Abstract

This article investigates the options market around a revision in the financial analysts' consensus recommendation. The results demonstrate that options investors trade in the correct direction of the upcoming revision approximately 3 days prior to the announcement. We find this behavior in option-implied prices, implied volatilities, and options trading volume. Tests confirm that the options market leads the stock market before the financial analysts' revision. Moreover, using all firms with outstanding options, an out-of-sample analysis produces a profitable zero-cost trading strategy net of transaction costs based on the relative valuations between the synthetic and the underlying equity security.

I. Introduction

The derivatives market is immense both in terms of market value and the trading volume. As an example, the Bank for International Settlements reports that the notional value of outstanding over-the-counter derivatives at the end of 2010 is $601 trillion with a gross market value of $21 trillion. These magnitudes exceed the world's gross domestic product (GDP) in the former and the U.S. GDP in the latter. If justified by no other reason than the sheer size of the market, options must provide financial value. Yet, finance theory shows that with perfect capital markets, derivatives are redundant and offer no informational value.

Clearly, though, capital markets are not perfect. To explain the use of derivatives, three market imperfections seem important: transactions costs, market incompleteness, and asymmetric information. This article investigates potential asymmetric information between investors with private information and the rest of the investing community.

Specifically, we examine trading in the options market around the announcement of a consensus revision by financial analysts.[1] Motivation for our analysis

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[1]Barber, Lehavy, McNichols, and Trueman (2001) introduce the concept of the average or consensus revision since information is impounded into prices using all analysts' recommendations.

stems first from the recent and growing literature examining the informational value of derivatives and informed trading in the options market, and second from the fact that no previous study investigates options trading around revision events. Accordingly, this article offers the first evidence of option-implied stock prices, implied volatilities, and options trading volumes leading the change in the underlying equity prices due to the announcement of a consensus revision.

The literature examining information content in the options market largely concentrates on options trading volume around scheduled corporate events, especially earnings announcements. Few studies investigate unplanned events to control for potential test contamination due to the arrival of new information. An example sample bias is options trading volume changing significantly before a news event due to investors either hedging or speculating on the pending information.

The literature examining unplanned corporate events in the options market is three studies, by Jayaraman, Frye, and Sabherwal (2001), Cao, Chen, and Griffin (2005), and Jin, Livnat, and Zhang (2012). Jayaraman et al. analyze options volume and open interest around mergers and acquisitions. They find increases in call and put trading volumes prior to a takeover. The increase in the open interest suggests that traders take a position in a target firm instead of liquidating established positions.

In one of the first studies to use the information content in the options market to devise a trading strategy, Cao et al. (2005) examine call volume during takeovers and mergers. They find call-volume imbalances are predictive of the pending takeover. Cao et al. also document that takeover targets with the largest increases in preannouncement call imbalance experience the highest announcement-day returns. In an out-of-sample test using all firms trading options on the Chicago Board of Options Exchange (takeovers and nontakeovers) the authors find that call net-buy imbalances, along with large increases in call volume, lead future stock returns.

In addition to examining information content in options around earnings announcements, Jin et al. (2012) include a robustness test examining unplanned corporate events such as board changes, litigation, and strategic alliances. Using implied volatility measures, they find options investors trade in front of the unplanned events, although the effect is not as great as their findings of preannouncement trading on earnings announcements.

The three studies based on unplanned corporate events employ options trading volume and implied volatilities to examine market behavior. We also use these options metrics, but our main test measure investigates the relative relationship between stock and option-implied prices.[2] This is important because, under the law of one price, the synthetic security should trade at close to the same price as the underlying equity, given transaction costs and other market imperfections.

With prices, we find investors generate abnormal option-implied returns at least 3 days prior to a downgrade announcement and 2 days before the revision

[2]It is similar to Lung and Xu (2014).

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for upgrades. We also observe abnormal implied volatilities and options volume at least 3 days prior to the revision announcement for both downgrades and upgrades.

As we isolate the information flow from both the stock and options markets conditional on the revision event, we find the principal information source of the future stock price change is preannouncement innovation from the options market. In contrast, the stock market offers little information flow to the future stock price prior to the announcement day.

Since the options market demonstrates such unique behavior prior to the announcement, we also conduct a more general test. We use return data on all firms, both revision and nonrevision firms, that have options outstanding. We sort them according to the relative stock and option-implied prices. Subsequently, the representative investor holds a long position in the firms with high abnormal option-implied returns and a short position in the firms with low abnormal option-implied returns. The results demonstrate that this zero-cost trading strategy produces statistically and economically significant trading profits net of transaction costs. This broad finding has not been noted previously in the literature.

We also document no ambiguity in the lead-lag relation between stock and options markets, as the results demonstrate that the options market leads the stock market prior to the financial analysts' revision. The more recent price study by Anand and Chakravarty (2007) uses the information share technique of Hasbrouck (1995) to document price discovery in the options and stock markets. Here, too, we extend the literature, as the Hasbrouck information share technique provides a general measure of price discovery. Our study concentrates on a specific information event, which is important because new information should be the fundamental component that causes price movements and facilitates discovery.

Collectively, our findings provide strong evidence of informed trading by options investors and price discovery in the options market. In support of this argument, we document the details of our investigation in the remainder of this article.

II. Research and Sample Design

We use four measures to investigate the options market behavior around the announcement of a revision: option-implied stock price, implied volatility spread, implied volatility skewness, and options-to-stock trading volume.

A. Abnormal Implied Return

In the absence of arbitrage, it is well known that for European options, put-call parity follows

$$S_O = C - P + Ke^{-rT} + D, \tag{1}$$

where S_O is the stock price, C is the call options price, P is the put options price, K is the strike price, r is the continuously compounded risk-free rate, T is the time to maturity, and D is the present value of the dividends during the life of the options. The four components on the right-hand side of equation (1) comprise the synthetic security.

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We investigate American options, thus, we must include the ability to exercise an option prior to expiration. As in Ofek, Richardson, and Whitelaw (2004) and Battalio and Schultz (2006), we account for the early exercise premium (EEP) on both the call and put options, and we rewrite equation (1) as

$$\hat{S}_O = C - P + Ke^{-rT} + D - \text{EEP}_{\text{CALL}} + \text{EEP}_{\text{PUT}}. \tag{2}$$

The EEP is the difference between the American and European prices. We estimate the EEP using Barone-Adesi and Whaley (1986).

Using the option-implied price from equation (2), we compare the return in the stock market with the option-implied return. The benchmark relation for stock i on day t is

$$\widehat{\text{IR}}_{i,t} = \alpha_{i,t} + \beta_i R_{i,t} + \beta_{\text{DELTA}} \text{DELTA}_{i,t} + \beta_{\text{MATURITY}} \text{MATURITY}_{i,t} + \tau_{i,t}, \tag{3}$$

where $\widehat{\text{IR}}_{i,t}$ is the option-implied stock return calculated as $\ln(\hat{S}_{i,t}/\hat{S}_{i,t-1})$, R is the stock return, and τ is an error term. We estimate the options benchmark using a 140-day period from day -150 to day -11.[3] Note that in equation (3) we control for any potential impact on option-implied prices from moneyness and time to maturity. The effect of both of these characteristics should be minimal because, as moneyness or maturity change in equation (2), C, P, as well as the other right-hand side components will adjust to reflect the change. Nevertheless, we include DELTA and MATURITY to address any market imperfections related to these measures.

To obtain the abnormal option-implied return (AIR), we subtract the benchmark in equation (3) from the observed stock price. Accordingly, the abnormal option-implied return for the ith stock from, for example, day -8 to day +8, is

$$\begin{aligned}\text{AIR}_{i,t} = \widehat{\text{IR}}_{i,t} - (&\alpha_i + \beta_i R_{i,t} + \beta_{\text{DELTA}} \text{DELTA}_{i,t} \\ &+ \beta_{\text{MATURITY}} \text{MATURITY}_{i,t}).\end{aligned} \tag{4}$$

B. Volatility Spread and Skewness

Our second and third measures of options market activity examine implied volatilities. Consistent with extant literature, we measure the volatility spread (VS) as the average difference in implied volatility between call and put options with the same strike price and expiration date. Following Cremers and Weinbaum (2010), every day t and for every stock i with put and call options volume on day t, we compute the volatility spread on day t as

$$\text{VS}_{i,t} = \sum_{k=1}^{N_{i,t}} w_{k,t}^{i} \left(\text{IV}_{k,t}^{i,\text{CALL}} - \text{IV}_{k,t}^{i,\text{PUT}} \right), \tag{5}$$

where k refers to pairs of put and call options, $N_{i,t}$ denotes the number of valid pairs of options for stock i on day t, $w_{k,t}^{i}$ is the open-interest weight that is calculated using the average open interest in the call and put options, and IV indicates

[3] We examine the test metrics from day -10 to day +10. We report day -8 to day +8 in our tables because we find no abnormal activity beyond the $\pm$8-day window and thus save table space.

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the implied volatility. We examine the daily abnormal values by comparing the average VS from day −150 to day −11 prior to the event date to the values during the test period.

As in Xing, Zhang, and Zhao (2010), the volatility skewness (SK) is the difference between the implied volatilities of out-of-the-money puts (OTMP) and at-the-money calls (ATMC). The SK value for stock i on day t is

$$\text{SK}_{i,t} = \text{IV}_{i,t}^{\text{OTMP}} - \text{IV}_{i,t}^{\text{ATMC}}. \tag{6}$$

Similar to Xing et al. (2010), out-of-the-money put options are those with deltas between −0.125 and −0.375. At-the-money call options are those with deltas between 0.375 and 0.625. The abnormal volatility skewness is calculated in the same manner as the abnormal volatility spread.

C. Relative Volume in Options and Stock Markets

In examining the ratio of options trading volume to stock trading volume (OS), Roll, Schwartz, and Subrahmanyam (2010) find that post-announcement absolute returns are positively related to preannouncement OS, which suggests that at least part of the preannouncement options trading is informed. Since this result is consistent with price discovery in the options market, we include OS in our analysis. To the extent activity in the stock market can affect options volume, we primarily examine the ratio of volume in the two markets to control for relative activity. The calculation for the abnormal OS is the same as that for VS and SK.

D. Data

Our sample period is from Oct. 2000 through Sept. 2009. We use data from multiple sources. Consensus upgrade and downgrade changes are from the Institutional Brokers' Estimate System (IBES). We obtain options data from OptionMetrics. Our analysis uses the options prices at the midpoint of the bid and ask prices. Stock prices and accounting data are from the Center for Research in Security Prices (CRSP) and Compustat databases, respectively.

To maximize data quality in estimating option-implied stock prices, we apply the following filters: i) We remove options that have zero open interest or an absolute value of delta smaller than 0.02 or greater than 0.98 for each day, which removes thinly traded options; ii) also daily, we remove call and put options that do not have a corresponding put or call option with the same maturity and exercise price; iii) to address the volatility term-structure effect, we remove option pairs with maturities of less than 5 days or greater than 90 days; and iv) we remove option pairs if either the put or call has a bid-ask spread that is greater than 50% of the option price (at the midpoint). This last filter addresses recording errors and options with low liquidity.

Additionally, on any given date and for any given stock, there may be multiple pairs that satisfy moneyness and maturity criteria. If this is the case, we use the average of the implied stock prices from the options pairs on that date. Thus, in the final sample, there is a single estimate for option-implied stock price per

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stock per date. In this way, we find the option-implied prices for each stock on each day in our sample from day −150 to day −11.

Conditional on the above criteria, we begin with every recommendation observation within regular trading hours in the IBES database. We remove 177 duplicates as well as reiterations, since we are examining recommendation revisions. We further control for analysts' herding and piggybacking, which may bias tests in favor of finding significant test results. To screen for the clustering as in Welch (2000), we remove recommendations preceded by another recommendation from a different brokerage firm during the prior 30 days. This filter leaves 18,631 downgrades and 17,939 upgrades.

Using intraday data, Altınkılıç and Hansen (2009) demonstrate that analysts piggyback other analysts' recommendations around public corporate events. Accordingly, we remove recommendations associated with corporate events from 3 trading days before to 3 trading days after the revision date. The remaining sample is slightly more than 12,000 consensus changes, split almost equally between 6,106 upgrades and 6,091 downgrades.[4]

Table 1 reports the statistics for the options pairs in our sample. The distributions of the number of pairs, time to maturity, moneyness, and open interest are quite similar for both call and put options. In our options data sample, on average, we find six pairs of options available for estimating the option-implied stock price per day. The time to maturity is around 48 days, and the average delta is about 0.5.

Table 2 details means of various revision-firm characteristics as well as the revision magnitudes (e.g., from Strong Buy to Sell is a revision of three levels). In Panel A, we observe that both upgrades and downgrades have similar firm

TABLE 1

Option Pairs

Table 1 presents descriptive statistics of the put and call options pairs used to form option-implied prices. The sample period is from Oct. 2000 through Sept. 2009.

	Mean	Medium	25th Percentile	75th Percentile
Panel A. Downgrades				
No. of pairs/day	6	4	2	7
Maturity (days)	48	44	27	66
Moneyness (delta)				
Call	0.52	0.55	0.24	0.81
Put	−0.48	−0.45	−0.76	−0.19
Open interest				
Call	1,799	285	69	1,748
Put	1,567	181	44	815
Panel B. Upgrades				
No. of pairs/day	6	4	2	7
Maturity (days)	47	44	26	66
Moneyness (delta)				
Call	0.53	0.55	0.26	0.81
Put	−0.47	−0.45	−0.74	−0.20
Open interest				
Call	1,788	282	67	1,738
Put	1,523	177	40	801

[4] An Online Appendix (www.jfqa.org) provides tests and confirmation that removal of the herding and piggybacking observations reduces sample bias.

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TABLE 2

Descriptive Statistics

Table 2 presents summary statistics for firms that experience a downgrade or upgrade. Panel A details mean values of various firm characteristics. MOM is return momentum, FREV is analysts' earnings forecast revisions, SUE is scaled unexpected earnings, and ATG is quarterly asset growth. MOM, FREV, SUE, and ATG are in percentages. Panel B presents the percentage of sample firms that experience a revision by the magnitude.

	Downgrades	Upgrades
Panel A. Firm Characteristics		
No. of firms	1,337	1,298
Daily average call options volume	657	668
Daily average put options volume	563	554
No. of analysts covering	12.05	11.21
Size (millions)	2,990	3,198
Stock trading volume (thousands)	814	831
Stock turnover	0.01	0.01
MOM	−0.12	0.16
FREV	0.01	0.02
SUE	2.24	2.28
ATG	1.37	1.41
Panel B. Revision Magnitude		
Downgrade 1 level	0.64	
Downgrade 2 levels	0.31	
Downgrade 3 levels	0.03	
Downgrade 4 levels	0.02	
Upgrade 1 level		0.64
Upgrade 2 levels		0.31
Upgrade 3 levels		0.04
Upgrade 4 levels		0.01

characteristics with respect to the mean number of analysts covering a company, firm size, stock trading volume, and stock turnover.

We also report the firm characteristics that Jegadeesh, Kim, Krische, and Lee (2004) and Cooper, Gulen, and Schill (2008) find can predict cross-sectional returns around analysts' revisions. We use these variables in our regression tests. MOM is return momentum computed as the cumulative market-adjusted return for the preceding 6 months to 10 days before the announcement event. It is negative for downgraded firms and positive for firms that experience an upgrade. FREV is analysts' earnings forecast revisions, which are rolling sums of the preceding 6 months' forecast revisions scaled by price. SUE is scaled unexpected earnings computed as unexpected earnings in the previous quarter scaled by the standard deviation over the eight preceding quarters. ATG is quarterly asset growth. FREV, SUE, and ATG do not exhibit much difference between upgrades and downgrades during our sample period.

Panel B of Table 2 details the revision magnitudes. For both revision types, the magnitudes are quite similar: 64% of the revision firms change by one level, 31% of the firms change by two categories, and the remaining 5% of the sample changes by three or four levels.

III. Event Study Results

We begin the empirical analysis by investigating any daily abnormal returns in the stock (AR) and options (AIR) markets. We use the Fama-French (1993) 3-factor model to determine the benchmark expected stock return. Figure 1 presents the values in the vertical line and the days in the horizontal line.

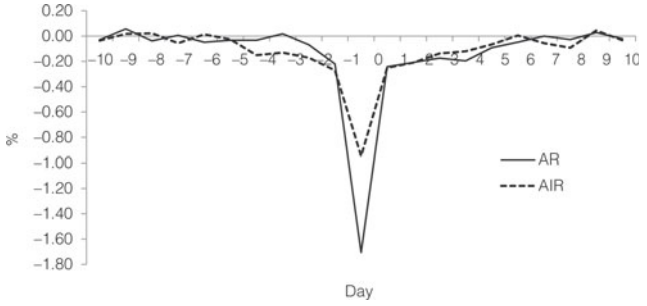
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FIGURE 1

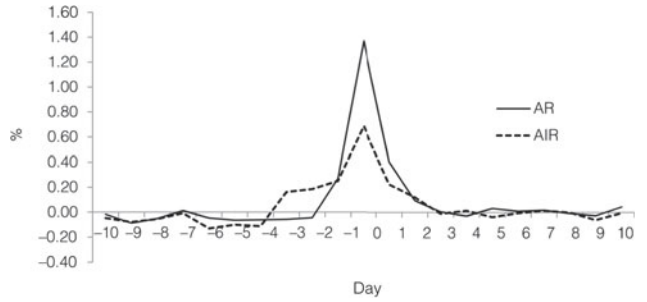
Abnormal Returns

Figure 1 shows daily abnormal stock market returns (AR) and the abnormal option-implied returns (AIR) for a sample of firms that experience a change (day 0) in the consensus analysts' recommendation.

Graph A. Downgrades



Graph B. Upgrades



Both downgrades in Graph A and upgrades in Graph B demonstrate a large absolute AR on event day 0, with somewhat elevated values after the announcement. We also observe the AIR is about half the AR magnitude on day 0 but equal to or greater than the AR on all days immediately preceding the announcement out to approximately day −4. This front running is consistent for both downgrades and upgrades.

Figure 2 presents the VS, SK, and OS ($\times 10^3$) variables in the vertical line and the days in the horizontal line. Regarding implied volatilities, we observe the VS and SK diverging from 0 many days prior to the analysts' revision. There are also abnormal values post-announcement. For downgrades in Graph A, the VS decreases beginning day −6 and maintains negative values until day +3. The greatest negative value is on day −1. The SK reflects a similar predictive behavior to the VS, only in the reciprocal. After increasing considerably on day −6, SK peaks on day −1. For the volume measure, the OS abnormal values diverge from 0 beginning on day −5, which increases until day −1.

The upgrades in Graph B of Figure 2 are consistent with the downgrades. All three measures diverge from 0 beginning on day −5 and increase in divergence magnitude until approximately day −1, at which time the three time series converge back to 0 and exhibit seemingly routine behavior post-announcement.

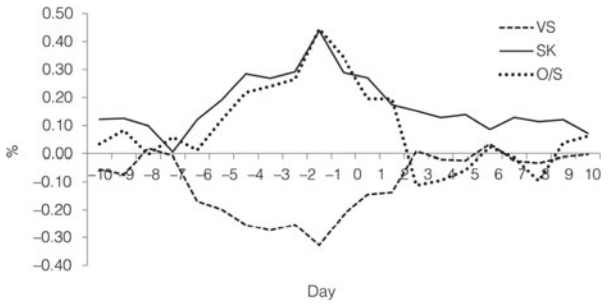
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FIGURE 2

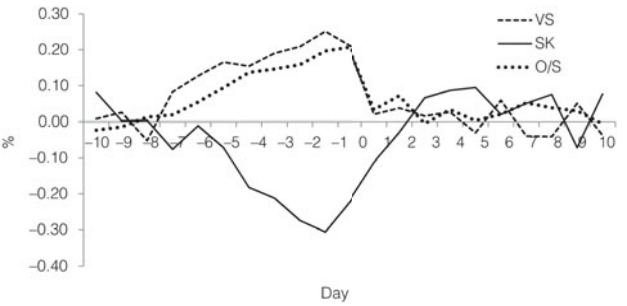
Excess Volatility and Volume

Figure 2 shows daily abnormal volatility spread (VS), skewness (SK), and the ratio of options-to-stock market volumes (OS) for a sample of firms that experience a change (day 0) in the consensus analysts' recommendation

Graph A. Downgrades



Graph B. Upgrades



To determine economically and statistically significant values, we detail the abnormal daily values in Table 3.[5] Panel A presents the market activity around consensus downgrades. We note the large AR on day 0, with some abnormal behavior on day −1, as well as significant returns lingering post-announcement out to 5 days.

With respect to the options measures, the fourth column in Panel A of Table 3 provides the percentages for the AIR around a downgrade. We observe a significant decrease of 16 basis points on day −4 and abnormal negative returns through day 0 until day +4. The two implied volatility measures are similar to the AIR. For downgrades in Panel A, we find significant excess values beginning by day −5. The absolute values generally increase until day −1 and then decrease such that the drift is reduced to insignificant by day +3 for the VS or day +4 for the SK.

Relative volume between the two markets demonstrates a similar pattern. We observe abnormal volume in the options market at day −5, which continues through day +2. There is not as great a post-announcement drift in the OS.

[5]We calculate the test statistic for each of the options market measures as in Boehmer, Musumeci, and Poulsen (1991). They show that the test statistic is not affected by event-induced variance changes. Also, excess VS, SK, and OS are demeaned time series based on the average of these variables during the estimation window from day −150 to day −11.

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TABLE 3

Abnormal Daily Values

Table 3 details the abnormal values for daily stock market return (AR), option-implied return (AIR), volatility spread (VS), skewness (SK), and options-to-stock market volume (OS). ** and * indicate statistical significance at the 1% and 5% levels, respectively, with *t*-statistics in parentheses.

Day	AR		AIR		VS		SK		OS	
Panel A. Downgrades										
−8	−0.04	(−0.11)	0.04	(0.84)	0.02	(0.07)	0.10	(1.58)	0.00	(−0.17)
−7	0.01	(0.07)	−0.05	(−0.81)	−0.01	(−0.09)	0.01	(0.37)	0.06	(1.05)
−6	−0.05	(−0.75)	0.02	(1.36)	−0.17	(−1.92)	0.12	(1.42)	0.01	(0.32)
−5	−0.03	(−1.31)	−0.04	(−0.05)	−0.20**	(−2.78)	0.19*	(2.01)	0.12*	(1.86)
−4	−0.03	(−0.68)	−0.16*	(−2.45)	−0.25**	(−3.16)	0.28**	(2.83)	0.22**	(4.68)
−3	0.02	(0.96)	−0.14*	(−2.22)	−0.27**	(−3.81)	0.27**	(2.71)	0.24**	(3.01)
−2	−0.07	(−0.02)	−0.21*	(−2.04)	−0.25**	(−3.21)	0.29**	(2.84)	0.27**	(3.41)
−1	−0.22**	(−3.01)	−0.29**	(−3.02)	−0.33**	(−4.11)	0.44**	(4.74)	0.45**	(5.97)
0	−1.71**	(−14.65)	−0.92**	(−9.49)	−0.22*	(−2.07)	0.29*	(2.25)	0.34**	(3.94)
1	−0.24**	(−5.95)	−0.23**	(−4.64)	−0.15*	(−1.77)	0.27*	(2.13)	0.20*	(2.20)
2	−0.21**	(−4.55)	−0.20**	(−3.17)	−0.14	(−1.74)	0.17*	(1.98)	0.19*	(2.12)
3	−0.17**	(−4.17)	−0.16**	(−3.77)	0.01	(1.03)	0.15	(1.85)	−0.11	(−1.38)
4	−0.20**	(−4.44)	−0.13**	(−3.36)	−0.02	(−1.62)	0.13	(1.62)	−0.10	(−0.90)
5	−0.09*	(−2.18)	−0.04	(−1.49)	−0.02	(−1.11)	0.14	(1.63)	−0.06	(−0.44)
6	−0.05	(−0.91)	0.01	(0.44)	0.03	(1.10)	0.09	(1.12)	0.02	(0.30)
7	0.00	(−0.65)	−0.05	(−0.75)	−0.03	(−1.24)	0.13	(1.60)	−0.01	(−0.50)
8	−0.03	(−1.11)	−0.07	(−1.35)	−0.03	(−0.74)	0.11	(1.38)	−0.10	(−1.02)
Panel B. Upgrades										
−8	−0.05	(−1.20)	−0.07	(−0.06)	−0.05	(−0.10)	0.00	(0.47)	0.01	(0.05)
−7	0.01	(0.87)	−0.01	(−0.35)	0.08	(0.73)	−0.08	(−0.55)	0.02	(0.00)
−6	−0.05	(−1.30)	−0.03	(−0.56)	0.13	(1.80)	−0.01	(−0.15)	0.05	(0.93)
−5	−0.06*	(−2.01)	−0.07	(−0.34)	0.17*	(2.51)	−0.07	(−0.52)	0.09	(1.63)
−4	−0.06	(−1.82)	−0.09	(−1.36)	0.15*	(2.19)	−0.18	(−1.76)	0.14	(1.91)
−3	−0.06	(−1.31)	0.17*	(2.19)	0.19**	(2.84)	−0.21	(−1.94)	0.15*	(2.35)
−2	−0.04	(−1.19)	0.21**	(2.76)	0.21**	(3.17)	−0.27**	(−2.75)	0.16**	(2.65)
−1	0.27**	(3.54)	0.27**	(3.19)	0.25**	(3.82)	−0.31**	(−3.34)	0.20**	(3.25)
0	1.37**	(18.63)	0.72**	(11.47)	0.21**	(3.20)	−0.22*	(−2.20)	0.21**	(3.85)
1	0.40**	(9.87)	0.23**	(2.56)	0.02	(0.65)	−0.11	(−0.91)	0.03	(0.58)
2	0.10**	(3.09)	0.14*	(2.26)	0.04	(1.05)	−0.03	(−0.08)	0.07	(1.07)
3	0.01	(0.44)	0.04	(1.02)	0.02	(0.51)	0.07	(0.90)	0.00	(0.15)
4	−0.03	(−0.00)	0.02	(1.30)	0.03	(0.30)	0.09	(1.01)	0.03	(0.30)
5	0.03	(0.36)	−0.04	(−0.62)	−0.03	(−0.34)	0.10	(1.16)	0.00	(0.07)
6	0.01	(0.84)	−0.01	(−1.03)	0.06	(1.15)	0.02	(0.12)	0.02	(0.45)
7	0.02	(1.02)	0.02	(0.83)	−0.04	(−1.04)	0.05	(0.50)	0.05	(0.80)
8	−0.01	(−0.48)	0.00	(−0.30)	−0.04	(−1.07)	0.08	(0.96)	0.04	(0.37)

Since the OS is a ratio of volume in two markets, the behavior may be the result of increases or decreases in either component, or both. Accordingly, to better understand the behavior, we decompose turnover in each market. Since the volume levels in each market are relative, we scale trading volume by shares outstanding to standardize across markets. We measure the options turnover for each firm as the average of the daily options turnover 6 months immediately preceding the revision.

Figure 3 details both time series values in the vertical line and the days in the horizontal line. The data demonstrate an increase in options turnover prior to the announcement day, which decreases post-announcement. Alternatively, stock turnover increases mainly after the revision announcement. These results are consistent for both downgrades in Graph A and upgrades in Graph B.

The four test metrics exhibit comparable results for upgrades in Panel B of Table 3. The stock market (AR) recognizes the new information on day 0, but it exhibits less drift in upgrades than downgrades. The AIR demonstrates excess values by day −3. The excess values for the VS, SK, and OS are evident at least

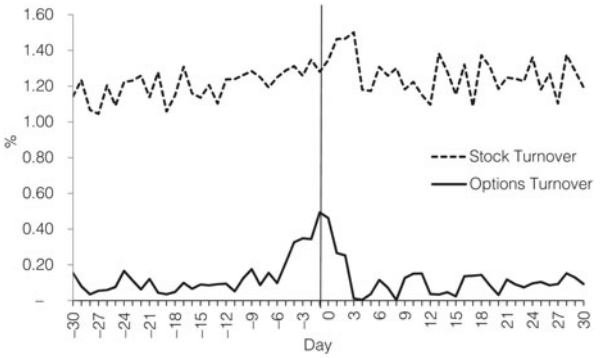
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FIGURE 3

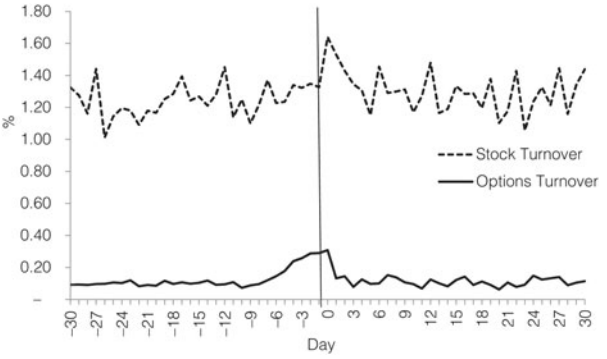
Stock and Options Turnover

Figure 3 decomposes the OS time series into the two respective parts: stock and options turnover. The day of the revision announcement is event day 0.

Graph A. Downgrades



Graph B. Upgrades



4 days prior the revision. However, unlike those abnormal values for downgrades in Panel A, the VS, SK, and OS for upgrades in Panel B do not exhibit a significant drift after day 0.

The remaining point we note in Figures 1 and 2 as well as Table 3 is the direction of each time series. Prices and the implied-volatility measures offer the advantage of a clear signed relationship with the pending revision. All measures demonstrate predictive trading in the correct direction of the pending consensus revision in the options market.

A. Limited Attention

The post-announcement drift we find in the stock market (i.e., AR) is well documented in the literature. However, it is noteworthy that the AIR has a drift past the announcement day extending to day +4 for downgrades and day +2 for upgrades. The same can be said for the post-announcement drift in the VS, SK, and OS, which are muted but still evident. This post-announcement characteristic is somewhat inconsistent with price discovery in the options

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market, since informed trading implies activity prior to an informational event, but should result in little activity post-announcement.

A rationale for the drift is the amount of attention paid by investors. Hou and Moskowitz (2005) find that the firms that experience the greatest delay in impounding public information into the share price are small, volatile, and neglected by market participants. The average delay with which the share price responds to new information decreases for larger and more visible firms. Hou and Moskowitz find that post-earnings announcement drift is increasing in delay and nonexistent in nondelay firms. Gleason and Lee (2003) observe post-announcement price drift associated with analysts' forecast revisions. They find the drift is greater for firms with lower analysts' coverage.

Given the limited attention received by smaller firms, we sort the sample by the mean number of financial analysts covering a firm for the 6 months immediately preceding the revision.[6] Table 4 reports the results. Overall, the subsamples sharpen the previous inferences, and the results support limited attention.

TABLE 4

Limited Attention

Table 4 presents test metrics around the consensus analysts' revision (day 0) using subsamples sorted by financial analysts' coverage. AR measures abnormal daily returns in the stock market and AIR measures the abnormal implied return in the options market. The other two metrics examine implied volatilities: VS measures excess values in volatility spread, and SK examines volatility skewness. Parameter values are in percentages. ** and * indicate statistical significance at the 1% and 5% levels, respectively.

Day	LOW_ COVERAGE	*t*-Stat.	MEDIUM_ COVERAGE	*t*-Stat.	HIGH_ COVERAGE	*t*-Stat.	HIGH – LOW	*t*-Stat.
Panel A. Downgrades								
AR								
−8	−0.03	−0.43	−0.04	−0.33	−0.05	−1.01	−0.02	−0.13
−7	0.05	0.66	−0.01	−0.56	−0.02	−0.61	−0.06	−0.65
−6	−0.07	−1.01	−0.06	−1.12	−0.01	−0.46	0.06	0.50
−5	−0.06	−1.04	−0.01	−1.05	−0.02	−0.95	0.04	0.45
−4	−0.08	−0.77	0.03	0.32	−0.05	−0.52	0.02	0.18
−3	0.07	0.83	−0.03	−0.39	0.02	0.22	−0.05	−0.48
−2	−0.07	−0.81	−0.04	−0.43	−0.09	−1.02	−0.02	−0.22
−1	−0.27	−1.12	−0.21	−0.66	−0.19	−0.47	0.08	0.62
0	−1.45**	−3.10	−1.75**	−5.33	−1.92**	−6.53	−0.47**	−4.99
1	−0.42**	−5.37	−0.20**	−2.52	−0.11	−1.43	0.31**	3.39
2	−0.40*	−2.50	−0.13	−0.62	−0.09	−0.44	0.31**	3.28
3	−0.33*	−2.14	−0.11	−0.68	−0.09	−0.56	0.24*	2.48
4	−0.34*	−2.07	−0.12	−0.61	−0.13	−0.65	0.22*	2.07
5	−0.06	−0.33	−0.12	−0.66	−0.09	−0.48	−0.03	−0.29
6	0.00	−0.06	−0.08	−5.30	−0.06	−3.65	−0.06	−0.67
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	−0.04	−0.63	−0.02	−1.52	−0.02	−1.28	0.02	0.21
AIR								
−8	−0.04	−0.48	0.07	0.82	0.08	1.14	0.12	1.26
−7	−0.08	−1.19	−0.05	−0.40	−0.04	−0.47	0.04	0.43
−6	0.03	0.32	−0.04	−0.60	0.07	0.87	0.04	0.40
−5	−0.08	−1.00	0.00	0.05	−0.04	−0.57	0.04	0.57
−4	−0.12	−0.59	−0.16	−1.37	−0.19*	−2.22	−0.07	−0.94
−3	−0.10	−1.59	−0.16**	−2.62	−0.16*	−2.39	−0.06	−0.68
−2	−0.16**	−2.62	−0.22*	−2.56	−0.23*	−2.24	−0.07	−0.85
−1	−0.21**	−3.43	−0.31**	−3.92	−0.34**	−3.13	−0.13*	−2.15

(continued on next page)

[6]OS is not included in this limited-attention analysis due to endogeneity. Generally, smaller firms will have fewer analysts covering the firm and less trading volume relative to large firms.

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TABLE 4 (continued)

Limited Attention

Day	LOW_ COVERAGE	*t*-Stat.	MEDIUM_ COVERAGE	*t*-Stat.	HIGH_ COVERAGE	*t*-Stat.	HIGH – LOW	*t*-Stat.
Panel A. Downgrades (continued)								
AIR (continued)								
0	−1.78**	−12.82	−0.66**	−3.26	−0.32*	−2.49	1.46**	23.36
1	−0.41**	−4.92	−0.15	−1.28	−0.13	−1.38	0.28**	3.11
2	−0.38**	−4.19	−0.11	−1.55	−0.12	−1.26	0.26**	4.34
3	−0.28	−1.90	−0.12	−0.95	−0.09	−0.38	0.19	1.59
4	−0.20	−2.04	−0.09	−0.39	−0.08	−0.35	0.12	0.40
5	−0.04	−0.87	−0.03	−0.48	−0.04	−0.55	0.00	0.04
6	0.03	0.31	0.03	0.45	−0.03	−0.39	−0.06	−0.68
7	−0.03	−0.31	−0.04	−0.45	−0.09	−1.23	−0.06	−0.94
8	−0.09	−0.81	−0.07	−0.01	−0.07	−0.14	0.02	0.51
VS								
−8	0.01	0.01	0.02	0.05	0.03	0.05	0.02	0.22
−7	0.00	−0.01	−0.01	−0.01	−0.01	−0.03	−0.01	−0.12
−6	−0.18	−0.44	−0.16	−0.36	−0.17	−0.23	0.00	0.04
−5	−0.07	−0.12	−0.27	−0.50	−0.26	−0.48	−0.20	−1.52
−4	−0.17	−1.41	−0.25	−1.26	−0.34	−1.94	−0.17	−1.58
−3	−0.16	−1.89	−0.30**	−3.63	−0.36**	−4.29	−0.21	−1.85
−2	−0.19**	−3.21	−0.27**	−4.51	−0.30**	−4.96	−0.11	−1.69
−1	−0.27**	−3.96	−0.35**	−5.02	−0.37**	−5.21	−0.10	−1.71
0	−0.39**	−6.25	−0.19**	−3.94	−0.08	−1.27	0.31**	3.77
1	−0.25**	−3.16	−0.12*	−2.25	−0.06	−0.78	0.19*	2.14
2	−0.30*	−2.19	−0.07	−0.53	−0.04	−0.27	0.26**	3.27
3	0.02	0.17	0.00	0.04	0.00	0.03	−0.01	−0.16
4	−0.04	−0.25	−0.01	−0.09	−0.01	−0.05	0.03	0.38
5	−0.05	−0.25	−0.02	−0.11	−0.01	−0.04	0.04	0.59
6	0.06	0.14	0.02	0.06	0.02	0.04	−0.04	−0.37
7	−0.03	−0.05	−0.04	−0.06	−0.01	−0.02	0.02	0.27
8	−0.04	−0.05	−0.04	−0.06	−0.02	−0.04	0.02	0.23
SK								
−8	0.08	0.43	0.10	0.55	0.11	0.66	0.03	0.31
−7	0.01	0.04	0.00	0.03	0.01	0.03	0.00	0.03
−6	0.07	0.26	0.15	0.70	0.14	0.57	0.07	0.86
−5	0.12	0.73	0.21	1.26	0.24	1.38	0.11	1.55
−4	0.23	0.26	0.25	1.17	0.37*	2.14	0.14	1.62
−3	0.20	1.75	0.29*	2.46	0.31**	2.63	0.11	1.74
−2	0.21*	2.15	0.32**	3.14	0.34**	3.34	0.13	1.80
−1	0.32**	2.71	0.48**	4.09	0.52**	4.30	0.20	1.73
0	0.57**	10.33	0.19**	3.41	0.11	1.84	−0.47**	−3.52
1	0.41**	3.60	0.26*	2.27	0.14	1.18	−0.27**	−2.73
2	0.33**	2.80	0.12	1.02	0.07	0.58	−0.26**	−2.74
3	0.28*	2.04	0.09	0.68	0.09	0.63	−0.19	−1.82
4	0.18	0.75	0.11	0.44	0.09	0.35	−0.10	−1.03
5	0.21	0.36	0.15	0.20	0.05	0.07	−0.16	−1.48
6	0.11	0.60	0.10	0.78	0.05	0.28	−0.06	−0.49
7	0.12	0.68	0.12	0.58	0.14	1.02	0.02	0.26
8	0.15	1.04	0.12	0.80	0.07	0.51	−0.07	−0.53
Panel B. Upgrades								
AR								
−8	−0.06	−0.77	−0.03	−0.03	−0.08	−0.39	−0.02	−0.67
−7	−0.04	−0.62	0.05	0.22	0.02	0.13	0.06	0.77
−6	−0.09	−1.38	0.02	0.08	−0.06	−0.58	0.03	0.24
−5	−0.08	−1.04	−0.07	−0.33	−0.04	−0.27	0.04	0.52
−4	−0.06	−0.79	−0.08	−0.26	−0.04	−0.14	0.01	0.22
−3	−0.09	−0.59	−0.03	−0.08	−0.05	−0.15	0.04	0.47
−2	−0.06	−0.43	−0.06	−0.15	−0.02	−0.01	0.04	0.52
−1	0.08	0.11	0.34	0.45	0.39	0.41	0.31	1.67
0	0.71**	4.15	1.58**	9.06	1.81**	7.38	1.10**	3.11
1	0.50**	5.60	0.43**	4.67	0.29*	1.91	−0.21	−1.79
2	0.19*	2.03	0.06	0.60	0.04	0.40	−0.16	−1.48
3	0.04	0.71	−0.01	−0.10	−0.02	−0.29	−0.05	−0.45
4	−0.03	−0.30	−0.04	−0.40	−0.02	−0.19	0.01	0.11
5	0.01	0.10	0.02	0.19	0.07	0.58	0.05	0.81
6	0.00	0.06	0.02	0.09	0.01	0.13	0.02	0.19
7	−0.02	−0.25	0.05	0.19	0.02	0.19	0.04	0.36
8	−0.08	−1.37	0.06	0.41	0.00	0.01	0.08	0.78

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TABLE 4 (continued)
Limited Attention

Day	LOW_ COVERAGE	*t*-Stat.	MEDIUM_ COVERAGE	*t*-Stat.	HIGH_ COVERAGE	*t*-Stat.	HIGH – LOW	*t*-Stat.
Panel B. Upgrades (continued)								
AIR								
−8	−0.09	−1.35	−0.08	−0.10	−0.03	−0.04	0.06	1.09
−7	0.00	0.04	0.00	0.01	−0.02	−0.03	−0.01	−0.20
−6	0.01	0.11	−0.10	−0.18	0.00	0.00	−0.01	−0.09
−5	−0.05	−1.10	−0.10	−0.16	−0.06	−0.11	−0.01	−0.18
−4	−0.08	−1.12	−0.10	−0.78	−0.07	−0.87	0.02	0.27
−3	0.15	0.21	0.19	1.11	0.18	1.85	0.03	0.50
−2	0.15*	2.28	0.23**	3.10	0.26**	3.78	0.11	1.73
−1	0.21*	1.98	0.28**	3.03	0.31**	4.03	0.10	1.69
0	1.39**	11.71	0.54**	3.58	0.21	1.59	−1.18**	−24.17
1	0.45**	3.88	0.22**	2.71	0.03	0.31	−0.42**	−7.85
2	0.37**	3.12	0.03	0.31	0.02	0.20	−0.35**	−6.59
3	−0.01	−0.16	0.08	0.10	0.06	0.20	0.06	1.22
4	0.00	−0.07	0.02	0.09	0.03	0.16	0.03	0.63
5	−0.06	−0.35	−0.03	−0.21	−0.03	−0.18	0.03	0.51
6	0.03	0.55	−0.02	−0.03	−0.03	−0.04	−0.05	−0.92
7	0.01	0.11	0.00	0.01	0.04	0.06	0.04	0.66
8	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01
VS								
−8	−0.06	−0.24	−0.05	−0.11	−0.05	−0.15	0.01	0.17
−7	0.11	0.45	0.06	0.23	0.08	0.28	−0.03	−1.02
−6	0.16	0.80	0.11	0.30	0.11	0.34	−0.05	−1.62
−5	0.17	0.67	0.16	0.60	0.16	0.60	−0.01	−0.57
−4	0.15	1.04	0.16	1.06	0.16	1.07	0.01	0.25
−3	0.09	1.01	0.23*	2.41	0.25**	2.68	0.16**	4.93
−2	0.15	1.92	0.23**	2.86	0.25**	3.06	0.10**	3.52
−1	0.20*	2.51	0.26**	3.28	0.29**	3.55	0.09**	3.14
0	0.40**	6.79	0.14[b]	2.36	0.09	1.47	−0.31**	−8.03
1	0.13*	2.39	−0.04	−0.84	−0.02	−0.32	−0.14**	−3.61
2	0.08	0.80	0.02	0.25	0.01	0.13	−0.07*	−2.13
3	0.03	0.36	0.01	0.16	0.01	0.08	−0.02	−0.89
4	0.06	0.68	0.02	0.18	0.00	0.04	−0.06	−1.25
5	−0.05	−0.48	−0.02	−0.19	−0.02	−0.17	0.03	1.19
6	0.07	0.30	0.05	0.14	0.05	0.19	−0.02	−0.64
7	−0.03	−0.17	−0.04	−0.16	−0.04	−0.19	−0.01	−0.26
8	−0.02	−0.06	−0.05	−0.13	−0.05	−0.28	−0.03	−1.04
SK								
−8	0.05	0.29	−0.04	−0.35	0.00	0.03	−0.04	−1.24
−7	−0.05	−0.57	−0.09	−0.66	−0.09	−0.61	−0.04	−1.17
−6	0.00	0.01	−0.01	−0.15	−0.02	−0.12	−0.02	−0.79
−5	−0.04	−0.36	−0.09	−0.71	−0.09	−0.70	−0.04	−1.11
−4	−0.09	−0.32	−0.22	−0.82	−0.24	−0.75	−0.15	−1.51
−3	−0.12	−0.63	−0.24	−1.25	−0.28	−1.17	−0.16	−1.19
−2	−0.18	−1.27	−0.30*	−2.54	−0.34**	−2.66	−0.16	−1.51
−1	−0.21*	−2.09	−0.32**	−2.77	−0.38**	−3.00	−0.17**	−2.19
0	−0.41**	−7.03	−0.15*	−2.53	−0.10	−1.67	0.31**	4.02
1	−0.24**	−4.39	−0.06	−1.14	−0.03	−0.56	0.21**	3.04
2	−0.05*	−2.38	−0.02	−0.87	−0.01	−0.53	0.04	0.49
3	0.10	0.25	0.04	0.11	0.06	0.14	−0.04	−0.56
4	0.09	0.60	0.10	0.29	0.07	0.21	−0.01	−0.16
5	0.10	0.70	0.11	0.42	0.08	0.32	−0.02	−0.25
6	0.03	0.20	0.02	0.18	0.02	0.09	−0.01	−0.15
7	0.04	0.36	0.06	0.60	0.06	0.46	0.02	0.23
8	0.02	0.17	0.10	0.74	0.11	1.19	0.09	0.77

For downgrades in Panel A of Table 4, the firms with LOW_COVERAGE exhibit abnormal stock returns many days after the announcement. The market finds a greater absolute average on the first day for medium firms. However, the HIGH_COVERAGE firms exhibit the greatest decrease on the announcement day. Investors seem to find equilibrium stock prices relatively quickly, as there are no abnormal returns after day 0.

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The significant AR differences between HIGH-LOW portfolios suggest more market efficiency in large firms where information is more readily available. The post-announcement returns by LOW_COVERAGE firms are statistically significant and propose a potential trading strategy. That is, small-firm investors do not appear to impound the revision information into prices until days after the announcement.

The AIR variable suggests significant market efficiency for the HIGH_COVERAGE firms but not the LOW_COVERAGE firms. Unlike stock returns, option-implied returns behave abnormally 2 days prior to the announcement for LOW_COVERAGE firms. Subsequent to the announcement, the returns exhibit market inefficiency with a lingering drift out to day +2.

The MEDIUM_COVERAGE firms do not exhibit a drift. However, 3 days prior to the announcement, options investors cause significant differences in the relative prices between the underlying and the synthetic. Similarly, options investors trade in the HIGH_COVERAGE firms 3 days before the announcement. Indeed, the excess returns imply options traders take the profits by the revision announcement, as the coefficient value decreases on the event day.

The values of VS and SK are consistent with the AIR behavior. For LOW_COVERAGE firms, the VS and SK parameters exhibit divergence at least 2 days prior to the announcement, and a lingering drift. The MEDIUM_COVERAGE firms exhibit abnormal volatility 3 trading days prior to the revision. The implied volatilities of the MEDIUM_COVERAGE firms also exhibit a slight drift.

The HIGH_COVERAGE firms demonstrate abnormal values at least 3 days prior to the announcement. Furthermore, there is no abnormal value on the announcement day. By the time of the revision, options traders appears to have made their investments, and in the correct direction of the upcoming revision.

The upgrades demonstrate the same general conclusions. The AR is the highest on the event day for the HIGH_COVERAGE stocks. There is a drift in AR. The AIR is not significant on the announcement day for the HIGH_COVERAGE firms. We observe that LOW_COVERAGE and MEDIUM_COVERAGE firms exhibit a post-announcement drift. The VS and SK measures for upgrades are similar to downgrades. That is, there is increased activity 2 to 3 days prior to the event, limited to no abnormal values on the revision day, and drift limited to the LOW_COVERAGE firms.

B. Moneyness and Maturity

We include controls for moneyness and maturity in the benchmark relation to compute option-implied returns. To further check that our data filters with respect to moneyness and maturity are not biasing the findings, we extend the time to maturities on the options from 5–90 days to 91–182 days. We also limit the sample to the options with deltas between 0.375 and 0.625, since these at-the-money (ATM) options are most heavily traded. Table 5 reports the AR and AIR magnitudes, which are consistent with previous results. Stock returns exhibit some abnormal trading behavior at day -1. Option-implied returns demonstrate abnormal values at day -4 for downgrades and day -3 for upgrades.

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TABLE 5

ATM Options with Extended Maturities

Table 5 presents robustness checks with respect to moneyness and maturity impacts. The test sample is ATM options with longer maturities of 91–182 days. ** and * indicate statistical significance at the 1% and 5% levels, respectively.

	Panel A. Downgrades				*Panel B. Upgrades*			
Day	AR	*t*-Stat.	AIR	*t*-Stat.	AR	*t*-Stat.	AIR	*t*-Stat.
−8	−0.04	−0.11	0.03	0.89	−0.05	−1.20	−0.03	−0.06
−7	0.01	0.07	−0.03	−0.95	0.01	0.87	0.03	0.46
−6	−0.05	−0.75	0.05	1.03	−0.05	−1.30	−0.01	−0.36
−5	−0.03	−1.31	−0.03	−0.06	−0.06	−2.01	−0.06	−0.84
−4	−0.03	−0.68	−0.16*	−2.13	−0.06	−1.82	−0.05	−1.06
−3	0.02	0.96	−0.15*	−2.32	−0.06	−1.31	0.19*	2.21
−2	−0.07	−0.02	−0.23*	−2.30	−0.04	−1.19	0.19*	2.14
−1	−0.22	−3.01	−0.26**	−2.73	0.27**	3.54	0.29**	3.13
0	−1.71**	−14.65	−0.95**	−10.87	1.37**	18.63	0.84**	11.74
1	−0.24**	−5.95	−0.20**	−5.27	0.40**	9.87	0.25**	2.49
2	−0.21**	−4.55	−0.19**	−3.61	0.10**	3.09	0.12	1.82
3	−0.17**	−4.17	−0.17**	−3.29	0.01	0.44	−0.02	−0.21
4	−0.20**	−4.44	−0.15**	−3.64	−0.03	−0.00	0.01	1.09
5	−0.09*	−2.18	−0.02	−0.82	0.03	0.36	−0.03	−0.59
6	−0.05	−0.91	0.01	0.38	0.01	0.84	−0.01	−0.81
7	−0.00	−0.65	−0.02	−0.88	0.02	1.02	0.02	1.05
8	−0.03	−1.11	−0.05	−1.56	−0.01	−0.48	−0.02	−0.43

IV. Regression Results

The event study results isolate predictive trading in the options market, especially with firms covered by more analysts. We next investigate the strength of the predictive trading by controlling for possible determinants of abnormal stock returns on the announcement day. We first investigate how much of the abnormal values we observe in the event studies is typical information flow between the stock and options markets, since the two are highly dependent, and how much is conditional information specifically due to the revision event. This method addresses an omitted-variable bias caused by excluding information in the stock market leading up to the revision announcement.

A. Conditional Information

To disentangle information flows, we use a two-stage specification similar to Hou and Moskowitz (2005) and Acharya and Johnson (2007). We regress each of the four options market measures on a constant, the contemporaneous and 5 lags of the stock market return, as well as 5 lags of the options metric we are examining.[7] For instance, with AIR as the dependent variable, the specification is

$$\text{AIR}_{i-t} = \alpha + \sum_{k=0}^{5} \beta_{i,t-k}(\text{STOCK_RETURN})_{i,t-k} + \sum_{k=1}^{5} \delta_{i,t-k}(\text{AIR})_{i,t-k} + u_{i,t}. \tag{7}$$

[7]Because the choice of number of lags could be arbitrary, we select 5 lags for stock returns according to the Akaike information criterion (AIC). We also conduct a robustness check using 3 to 8 lags and find similar results.

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As in the prior literature, any remaining information content in the residuals, $u_{i,t}$, is independent news arriving in the options market that is either not pertinent or appreciated by the stock market. Thus, $u_{i,t}$ is innovation in the options market.

In the second stage, we compute a model examining the stock return on the announcement day regressed against the options market innovation from the first stage as well as lagged stock returns. The specification is

$$(8)\quad (\text{STOCK_RETURN})_t = \alpha + \sum_{k=1}^{5} [b_k + b_k^D(D)_t] I_{t-k} + \sum_{k=1}^{5} [c_k + c_k^D(D)_t](\text{STOCK_RETURN})_{t-k} + \varepsilon_t,$$

where D is the event day and I is the options market innovation, b_k measures unconditional information flow from the options market to the stock market not specific to the revision event, and b_k^D is the information from the options market conditioned on D set to unity each of the 5 days prior to the revision event and 0 otherwise. The parameter c_k measures general information content in the stock market that is unconditional, while c_k^D measures any information flow in the stock market conditioned on the revision. By including the stock market variables in the model, we ensure that lag effects are not artifacts of unmodeled dynamics in the stock return itself. We investigate 30 days before to 30 days after a revision.

Table 6 presents the findings. The overall results demonstrate consistent relationships between the stock return on the announcement day and innovation in the options market. With AIR as the dependent variable, the conditional information parameter on $\sum_{k=1}^{5} b_k^D$ for the downgrades sample exhibits a 42% transmission of information in options market innovation to future stock market returns. The coefficient is large in contrast to the other model slope coefficients of 3% to 4%. Given the small magnitude of the other coefficients, the options market exhibits considerable price discovery specific to the revision event.

For upgrades, the conditional information parameter of $\sum_{k=1}^{5} b_k^D$ exhibits a 39% transmission of information in options market innovation to future stock market returns. The magnitudes of the other coefficients are similar to the levels of the downgrades. We note that the stock market information flow specific to the revision event, $\sum_{k=1}^{5} c_k^D$, is insignificant in both the upgrade and downgrade models. This fact suggests that the stock market has little anticipation (or informed trading) of the pending revision.

The test results demonstrate that the options market is leading the stock market with respect to the revision event. The fact that the information transmission in the options market is much greater than in the stock market may not be entirely surprising. To the extent that an investor is informed and has a choice between the stock or options markets to utilize the informational advantage, the trader should use options to maximize the financial reward due to leverage.

Table 6 also shows that implied volatility exhibits information flow from the options market conditioned on the revision event. The VS innovation conditioned on a downgrade exhibits 14% information transmission from the options markets

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TABLE 6

Information Flow between the Options and Stock Markets

$$(8) \qquad (\text{STOCK_RETURN})_t = \alpha + \sum_{k=1}^{5} \left[b_k + b_k^D (D)_t \right] I_{t-k} + \sum_{k=1}^{5} \left[c_k + c_k^D (D)_t \right] (\text{STOCK_RETURN})_{t-k} + \varepsilon_t.$$

As specified in equation (8), Table 6 reports options market innovation on a firm's stock return. Within the options market, b_k^D is the cumulative innovation for 5 days prior to the announcement of the revision, and b_k captures innovation in general and is not conditional on the announcement of the revision event. Within the stock market, c_k is unconditional information, and c_k^D measures the return conditioned on the revision event. ** and * indicate statistical significance at the 1% and 5% levels, respectively, with *t*-statistics in parentheses.

	AIR	VS	SK	OS
Panel A. Downgrades				
$\sum_{k=1}^{5} b_k$	0.04**	0.05**	−0.02**	−0.02**
	(13.18)	(11.41)	(−13.46)	(−15.97)
$\sum_{k=1}^{5} b_k^D$	0.42**	0.14**	−0.17**	−0.08**
	(8.50)	(13.00)	(−7.67)	(−11.62)
$\sum_{k=1}^{5} c_k$	−0.03**	−0.01**	−0.02**	−0.02**
	(−13.37)	(−19.20)	(−19.52)	(−21.46)
$\sum_{k=1}^{5} c_k^D$	0.04	0.17	0.18	0.19
	(0.16)	(1.90)	(1.35)	(1.78)
Adj. R^2	0.02	0.02	0.02	0.02
F-statistic	2,224.34	2,099.08	2,123.59	2,037.36
Panel B. Upgrades				
$\sum_{k=1}^{5} b_k$	0.03**	0.04**	−0.02**	0.01**
	(3.87)	(8.68)	(−4.36)	(35.55)
$\sum_{k=1}^{5} b_k^D$	0.39**	0.06**	−0.08**	0.04**
	(4.79)	(3.74)	(−5.22)	(9.65)
$\sum_{k=1}^{5} c_k$	−0.04**	−0.03**	−0.03**	−0.03**
	(−22.83)	(−21.67)	(−56.06)	(−15.09)
$\sum_{k=1}^{5} c_k^D$	0.04	0.02	0.06	0.02
	(0.29)	(0.02)	(0.63)	(0.03)
Adj. R^2	0.02	0.02	0.02	0.02
F-statistic	2,110.62	2,025.63	2,055.09	1,926.98

to the future stock return on the announcement day. The conditional value for upgrades is a significant 6%.

The SK exhibits behavior consistent with the AIR and VS. For downgrades, the transference of information from the options market specific to the revision event is negative 17%. For upgrades, the conditional options market value is negative 8%. Again, the other coefficients are rather low in magnitude or statistically insignificant. Trading volume also exhibits information content specific to the trade. However, the coefficients on all of the information flows are low.

Overall, the findings of the information flow test demonstrate that the options market provides significant information to the price discovery process of the underlying equity. This information is in addition to the typical information that flows between the markets.

B. Unrestricted Model

Continuing the use of interaction variables to isolate options market behavior prior to the consensus announcement, we specify an unrestricted model that examines the abnormal return in the stock on the announcement date. In separate regressions, we interact the four options market metrics with an event-day dummy

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variable set to 1 on each of the 8 days leading up to the revision announcement, and 0 otherwise.

We include other possible determinants of excess stock returns as controls. We include 8 lags of the abnormal stock return to capture any autocorrelation or information from the stock market. Based upon their predictive behavior in Jegadeesh et al. (2004) and Cooper et al. (2008), we include MOM, FREV, SUE, and ATG. We also control for other characteristics that have been documented to impact asset returns. Leverage is the mean delta of an option divided by the option price. We use stock turnover as the proxy for LIQUIDITY. ATTENTION is as above in the limited attention subsection: the mean number of analysts during the 6 months preceding a revision. We compute ACCRUALS as in Callen and Segal (2004). For financial distress, we use O-score as specified in Ohlson (1980). Thus, the specification using AIR, for instance, is

$$\text{AR}_t = \alpha + (\delta_{t-k} + \gamma_{t-k}D)\text{AIR}_{t-k} + \beta_{t-k}\text{AR}_{t-k} + \sum_{n=1}^{N} \theta_n(\text{CONTROLS}) + \varepsilon_t, \tag{9}$$

where D is the event day and k is from 1 to 8.

Our analysis focuses on γ_{t-k}, as the slope coefficient should show significance if there is informed trading prior to the revision in the options market. The findings in Table 7 document that the γ_{t-k} coefficients exhibit significant

TABLE 7

Abnormal Stock Returns

(9) $\text{AR}_t = \alpha + (\delta_{t-k} + \gamma_{t-k}D)\text{AIR}_{t-k} + \beta_{t-k}\text{AR}_{t-k} + \sum_{n=1}^{N} \theta_n(\text{CONTROLS}) + \varepsilon_t,$

Table 7 details the coefficients (in percentages) and *t*-statistics (in parentheses) from model (9), which explains the abnormal stock return (AR) on event day 0. Day *k* denotes the *k*th lag of AR as well as the options metric of AIR, VS, SK, or OS. ** and * indicate statistical significance at the 1% and 5% levels, respectively.

	AIR	VS	SK	OS
Panel A. γ_{t-k} for Downgrades				
Day −1	0.96**	0.87**	−0.92**	−0.90**
	(3.24)	(4.58)	(−7.85)	(−10.87)
Day −2	0.85**	0.65**	−0.83**	−0.67**
	(3.33)	(3.29)	(−6.44)	(−7.96)
Day −3	0.72*	0.53**	−0.69**	−0.43**
	(2.31)	(2.65)	(−6.26)	(−2.98)
Day −4	0.64	0.44*	−0.51**	−0.41**
	(1.92)	(2.36)	(−4.73)	(−2.84)
Day −5	0.60	0.31	−0.27**	−0.18
	(1.71)	(1.64)	(−3.60)	(−1.59)
Day −6	0.50	0.19	−0.13	−0.03
	(1.56)	(0.95)	(−1.01)	(−0.04)
Day −7	−0.33	0.15	0.09	−0.10
	(−0.82)	(0.91)	(0.54)	(−1.51)
Day −8	−0.38	−0.25	0.02	0.06
	(−0.99)	(−1.09)	(0.88)	(0.67)

(continued on next page)

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TABLE 7 (continued)
Abnormal Stock Returns

	AIR	VS	SK	OS
Panel B. γ_{t-k} for Upgrades				
Day −1	0.84** (3.62)	0.75** (2.99)	−0.68** (−2.49)	0.74** (3.06)
Day −2	0.78** (2.61)	0.69** (2.90)	−0.50* (−2.02)	0.65** (2.78)
Day −3	0.69* (2.30)	0.55* (2.13)	−0.48** (−2.62)	0.53 (1.93)
Day −4	0.45 (1.75)	0.48* (2.10)	−0.48* (−2.21)	0.39 (1.57)
Day −5	0.35 (0.95)	0.35 (1.46)	−0.37 (−1.39)	0.17 (0.67)
Day −6	−0.33 (−0.93)	0.21 (0.62)	−0.33 (−1.92)	0.21 (0.73)
Day −7	0.27 (0.84)	−0.12 (−0.49)	−0.36 (−1.40)	0.24 (0.88)
Day −8	−0.22 (−0.74)	−0.17 (−0.49)	−0.29 (−1.43)	−0.16 (−0.55)

magnitudes at least 3 days prior to the announcement, and in some cases 4 or 5 days prior. Furthermore, the parameter estimates are increasing in absolute value as the revision date nears.

The AIR values in Panel A of Table 7 demonstrate a significant relation with announcement-day abnormal returns beginning 5 days prior to the revision. Implied volatilities and trading volume also exhibit a predictive relation with the abnormal stock return on the announcement day. VS is the implied volatility for the call minus that for the put. Consequently, if there is a relation, the VS values should be positively related to the AR. This is indeed the relation beginning at day −4 for downgrades. Also, the SK variable exhibits significant relation with the AR beginning 5 days prior to the announcement. The OS parameters begin to offer predictive value beginning 4 days before the event.

The test results using upgrades are similar to the downgrades, although the significant relationship between the options market metrics and the pending abnormal return is at times shorter than for downgrades, depending on the model. The AIR, VS, and SK transmit significant information 4 days prior to the announcement, while the OS begins at day −3.

V. Out-of-Sample Applications

Our remaining analyses investigate whether the predictive behavior in the options market yields an economically meaningful result in the form of information content and a possible trading strategy.[8] We begin by selecting all options from the OptionMetrics database including firms both with and without a revision. By expanding the sample to include all firms, we examine the greater information content of the relative relation between the underlying equity and the synthetic security.

[8]We thank the reviewer for the recommendation to include out-of-sample tests.

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We design a zero-cost portfolio that is long (short) in the portfolio with high (low) abnormal option-implied returns. As done previously, we measure the abnormal option-implied return for each stock on each trading day based on equation (4) using a 140-day window from day −150 to day −11.[9] The rationale of this strategy is that if the AIR contains the information about the stock returns in the future, the high AIR firms should be able to outperform the low AIR firms. We sort the stocks into 10 bins according to AIR, from low to high, on each trading day and examine the portfolio's abnormal stock returns for the following 1–4 weeks.

We observe that the abnormal returns increase in AIR monotonically. Panel A of Table 8 reports the returns over multiple holding periods. For a 4-week holding period, for instance, the abnormal stock returns increase monotonically from −1.68% (the Low group) to +1.41% (the High group). The difference, 3.09%, in the High minus Low column is significant at less than the 1% level. This monotonic pattern and the significant difference between High and Low groups confirm the valuable information content in the option-implied prices.

The values in Panel A of Table 8 do not include transaction costs. Consequently, we reexamine the trading profits net of costs. For both the stock and the options securities, the trading costs are $0.01 per stock share.[10] To incorporate the bid-ask spread, we buy stocks and options at the asked quotes and short at the bid quotes. If informed traders forecast the direction of the revision, they should use the options with the highest leverage effect. Thus, the trades use the derivatives with the highest delta-to-price ratio with maturity longer than a month on each trading day.

TABLE 8

Out-of-Sample Tests

Table 8 presents out-of-sample applications. We subsequently sort all the firms by the relative values between the underlying equity price and the option-implied price, that is, AIR is high when the option-implied return is greater than the underlying equity return and vice versa when AIR is low. HIGH − LOW is the return from a zero-cost portfolio that is short the firms with low AIR and long firms with high AIR. Values are in percentages. ** and * indicate statistical significance at the 1% and 5% levels, respectively.

Panel A. Information Content

Holding Period	LOW	2	3	4	5	6	7	8	9	HIGH	HIGH − LOW	*t*-Stat.
1-week	−0.68	−0.17	−0.06	0.04	0.07	0.11	0.22	0.29	0.42	0.59	1.27**	8.24
2-week	−0.96	−0.46	−0.15	0.27	0.33	0.39	0.43	0.47	0.59	0.83	1.79**	7.68
3-week	−1.32	−0.63	−0.32	0.35	0.69	0.64	0.75	0.82	0.91	1.16	2.48**	7.15
4-week	−1.68	−0.71	−0.35	0.46	0.91	1.06	1.03	1.13	1.31	1.41	3.09**	6.69

Panel B. Trading Strategy

	Underlying Stock Equity				Options with Highest Delta				Delta-Adjusted Options Returns			
Holding Period	LOW	HIGH	Profits	*t*-Stat.	LOW	HIGH	Profits	*t*-Stat.	LOW	HIGH	Profits	*t*-Stat.
1-week	−0.11	0.01	0.12*	2.17	−0.32	0.19	0.51**	2.75	−0.11	0.07	0.18*	2.27
2-week	−0.43	0.24	0.67**	5.14	−0.65	0.48	1.13**	5.16	−0.22	0.17	0.39**	5.25
3-week	−0.69	0.47	1.16**	4.53	−1.43	1.04	2.47**	4.80	−0.51	0.36	0.87**	5.43
4-week	−1.01	0.68	1.69**	4.26	−2.28	1.69	3.97**	4.14	−0.79	0.60	1.39**	4.59

[9] As a robustness check, we examine several other estimation windows (i.e., 180 days, 120 days, and 90 days). We find the results are similar.

[10] The trading cost is based on the charges of a leading online trading firm (TradeStation.com).

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Panel B of Table 8 reports the trading returns from a portfolio using the underlying equity versus a portfolio using options. If an investor trades on the information content in option-implied returns using stocks, the results in Panel B indicate that the trading profit will be low (0.12%) after 1 week. The trading profits are significant beginning with a 2-week holding period; however, the magnitudes are minimal at 0.67% to 1.69%.

To obtain better returns, investors naturally should lever using options. The 1-week trading profit in the options market is a significant 0.51%. The trading returns after a 2-week holding period is 1.13%. The 3- and 4-week holding periods exhibit significant returns of 2.47% and 3.97%, respectively. Thus, depending upon the holding period, the zero-investment trading strategy of owning a long position in firms with high AIR along with a short position in firms with low AIR yields an annualized return of 25% or more.

Since returns can be large for deep out-of-the-money options, we compute delta-adjusted options returns (delta $\times$ options returns). The profits after transaction costs are less than the options with the highest delta but are still significant and can produce double-digit returns from a zero-cost portfolio.

VI. Conclusion

This paper examines options trading in firms that experience a revision in their consensus recommendation by financial analysts. This topic lies in the intersection between two prominent studies in finance: the information content in the options markets and the value of the financial analyst recommendations.

We find unique behavior in options market measures days prior to a consensus revision. The option-implied returns, implied volatilities, and options trading volumes consistently demonstrate abnormal values 3 or 4 days prior to the analysts' consensus revision. These findings hold for both upgrades and downgrades. Collectively, the findings demonstrate informed trading by investors and price discovery in the options market.

In out-of-sample tests, we find significant information content in the options market. By sorting all firms with options in our database by the relative values between the option-implied and underlying equity prices, we find zero-cost trading profits from a portfolio long (short) in firms with a high (low) abnormal option-implied return.

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