The Speed of the Market Reaction to Pre-Open versus Post-Close Earnings Announcements

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Abstract

We examine whether the timing of earnings announcements relative to regular trading hours affects how quickly equity investors react to earnings information. We hypothesize that pre-open (before the opening bell, PO) earnings announcements provide less time for investors to process the information before the beginning of trading, leading to a slower market response to the earnings news than post-close (after the closing bell, PC) announcements. Consistent with this prediction, we find greater abnormal volatility and trading volume in the days after PO versus PC announcements. We also document a slower incorporation of earnings news into prices for PO versus PC announcements. These findings cannot be explained by firm and earnings characteristics. We also find that option trading strategies based on PO versus PC announcements yield economically large returns, suggesting that options traders do not exploit this predictable pattern of differential volatility.

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We will ... continu(e) our practice of publishing financial reports late on Friday, well after the markets close, or early on Saturday morning. That will allow you maximum time for analysis and give investment professionals the opportunity to deliver informed commentary before markets open on Monday.

Warren Buffett (2017)

1. INTRODUCTION

In this study, we examine how the timing of earnings announcements relative to regular trading hours is related to the market reaction to the earnings news. Using a large sample of earnings announcements with precise timestamps from 2006 to 2015, we find that approximately 48 percent of the after-hours announcements occur in the pre-open (between midnight and the opening bell, or PO) and 52 percent in the post-close (between the closing bell and midnight, or PC).[1] Consistent with the assertion above from Warren Buffett's 2017 letter to shareholders that earnings announcements made further from the start of regular trading hours allow investors more time to process the earnings news, we hypothesize that PC announcements are associated with a quicker reaction to the earnings news than PO announcements.[2]

Because stock return volatility is tightly linked to information processing and the market reaction to news (e.g., Engle and Ng, 1993; Pástor and Veronesi, 2009; Ross, 1989), we expect that the timing of the earnings announcement affects stock return volatility around the announcement. We argue that, all else equal, as investors process information and revise their beliefs, they engage in trade which moves prices and induces stock return volatility. Therefore, we investigate whether PO earnings announcements are associated with a longer period of enhanced stock return volatility after the announcement than PC announcements.

[1] As of December 2015, approximately 96 percent of publicly traded firms announce earnings outside of regular trading hours.

[2] While the quote from the Buffett (2017) shareholder letter suggests that Friday evening announcements provide the most investor processing time, we note the the number of firms that actually announce during that time is relatively small (approximately 1.1 percent as reported by Michaely et al., 2016).We therefore apply the same intuition to the more common PO versus PC announcements.

Consistent with our prediction, we find that PO earnings announcements are associated with significantly higher abnormal stock return volatility in the days after the announcement than those announced in the PC. Remarkably, this higher abnormal return volatility persists for at least four trading days after the announcement. We find that the difference in abnormal volatility that we document is highly predictable and cannot be explained by a large set of determinants of volatility such as firm size, profitability, earnings surprises, stock returns, volume, spreads, or historical volatility.

In addition, we find that PO announcements are associated with significantly higher abnormal trading volume in the days after the announcement than PC announcements. We also find that earnings news is incorporated into stock prices in a less timely manner for PO versus PC announcements. Specifically, we find a muted stock return reaction to earnings on the first trading day after PO earnings announcements relative to PC announcements and a more pronounced reaction to earnings in the two to five days after PO announcements relative to PC announcements. In addition, using an intraperiod timeliness (IPT) metric, we find that the information in earnings is more slowly impounded into prices in the five days after the earnings announcement for earnings announced in the PO versus PC.

Consistent with slower information processing of earnings news by various intermediaries for PO versus PC announcements, we find that PO announcements are associated with significantly slower reaction in terms of analyst revisions, EDGAR downloads, and news stories in the days after the earnings announcement than PC announcements. In addition, after controlling for the relation between these activities and stock return volatility, we continue to find greater volatility in the days after PO announcements relative to PC announcements.

We perform a battery of robustness tests to ensure that these results are not driven by alternative explanations. Since the timing of earnings announcements may be an endogenous choice by the firm, we examine whether our findings are robust to propensity score matching based on the determinants of the decision to issue earnings in the PO

versus PC. We also perform two placebo tests to ensure that the results we document are not driven by firm characteristics. Moreover, we document that the differences are not driven by the timing of the associated conference call, the time zone in which the firm is headquartered, the lead time for the earnings announcement, or busy earnings announcement days. We also note that when we remove advanced or delayed announcements from our sample (e.g., Bagnoli et al., 2002; So and Weber, 2015), our results remain and, if anything, become stronger.

Finally, we examine whether option markets anticipate the differential volatility in the days after PO versus PC earnings announcements. That is, we examine whether an options (volatility) trading strategy based on the timing of the earnings announcement earns significant abnormal returns. We construct two option-based trading strategies with payoffs that are directly linked to future stock return volatility: delta hedged returns (Bakshi and Kapadia, 2003) and straddle returns (Coval and Shumway, 2001; Goyal and Saretto, 2009). Presumably, if option traders correctly impound the predictable volatility spread between PO and PC announcements into option prices, then returns to these strategies should not be significantly different across PO and PC announcement portfolios. However, we find that both strategies generate economically and statistically significant returns.

Our study supports the assertion by Buffett (2017) that timing earnings announcements to allow investors more time to process the information (i.e., in the PC relative to the PO) affects the speed of the market reaction to the earnings news. Our study contributes to the growing literature that examines whether the timing of earnings announcements affects the market reaction to the earnings news. Prior research suggests that investors may under-react to information (Hong and Stein, 1999) because of inattention to, or distraction from, the information (Hirshleifer and Teoh, 2003, Hirshleifer et al., 2009, deHaan et al. (2015)). For example, Hirshleifer et al. (2009) suggest an under-reaction to earnings announcements on days when many firms announce earnings and deHaan et al. (2015) suggest an under-reaction to earnings announcements released

in the post-close relative to those released in the pre-open or during regular trading hours. Our findings offer new insights to this stream of research (e.g., Bagnoli et al., 2002; de-Haan et al., 2015) by documenting that the timing of earnings announcements impacts the amount of time investors have to process the information and therefore the speed of the reaction to the earnings news.

Our study also contributes to the literature on volatility and options-based trading strategies. Understanding the behavior of volatility itself is of interest because it is a key input variable for portfolio selection, derivative pricing, and virtually all asset pricing models. Given that news is a major driver of volatility (e.g., Engle and Ng, 1993), understanding how the timing of news relates to volatility is important. Moreover, there now exists an active market for traded volatility that represents a large asset class in the modern economy (Bollerslev et al., 2009; Carr and Wu, 2009; Drechsler and Yaron, 2011). By using forward-looking option contracts to construct trading strategies based on earnings announcement times, we provide evidence that options traders do not exploit the predictable differential volatility after PO versus PC earnings announcements. These results shed new light on option traders' beliefs about whether earnings announcements are processed differently by equity investors depending on the timing of the announcement.

The remainder of this paper is organized as follows. Section 2 reviews the prior literature. Section 3 discusses data and variable construction. Empirical results on the market reaction to PO versus PC announcements and returns to options trading strategies based on PO versus PC announcements are discussed in Sections 4 and 5 respectively. Section 6 concludes.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

There has been a gradual shift in the timing of earnings announcements over time. Earlier studies document a large proportion of firms announcing earnings during regular trading hours. For example, Patell and Wolfson (1982; 1984) examine earnings announcement timing and the associated price reaction to the announcement in the late 1970's and

document that a large number of announcements took place during regular trading hours. However, recent studies show that, since at least the late 1990's, more than 90 percent of firms announce earnings outside of regular trading hours. Consistent with this, we document that between 2006 and 2015, approximately 96 percent of firms announce outside of regular trading hours with a near 50-50 split between PO (48 percent) and PC (52 percent) announcements. The reason for this shift is not entirely clear and rarely has been discussed in the prior literature.

A potential explanation is that earnings announcement timing has changed in response to changes in the financial markets. Electronic day-trading by individuals has become common which could affect a firm's choice of earnings announcement timing. Michaely et al. (2014) argue that Regulation Fair Disclosure (Reg FD) and the Sarbanes-Oxley Act (SOX), which mandate material disclosure to all market participants to allow equal access to information and to help reduce accounting-related fraud, may have played a role in the reduction of regular trading hours announcements. The legislation promoted corporate governance, which Michaely et al. (2014) find is significantly associated with moving earnings announcements to the after hours. In addition, Electronic Communication Networks (ECNs) and other Alternative Trading Systems (ATSs) have proliferated allowing after-hours trading to become more accessible and prevalent, particularly for sophisticated investors. Indeed Barclay and Hendershott (2003, 2004) examine after-hours trading and find that informed traders dominate the after-hours trading sessions. If firms prefer to announce earnings when the proportion of sophisticated traders is highest, allowing information to be impounded into prices while noise traders are absent, then announcing outside of regular trading hours may both comply with Reg FD and SOX and allow informed traders to process this information before regular hours (Gennotte and Trueman, 1996; Jiang et al., 2012). These factors could help to explain this trend in announcement times. Whatever the reason, it is now a stylized fact that the timing of earnings announcements has changed and that a vast majority of firms now announce earnings outside of regular trading hours.

Prior research has examined how the timing of the earnings announcement interacts with investor attention to affect the market reaction to the news. The literature suggests that investors may under-react to earnings news (Hong and Stein, 1999) because of inattention to, or distraction from, the announcement (Hirshleifer and Teoh, 2003). For example, DellaVigna and Pollet (2009) find an under-reaction to earnings announcements released on Fridays,[3] Hirshleifer et al. (2009) find an under-reaction to earnings news on days with a greater number of earnings announcements (busy days), and Drake et al. (2015) document an under-reaction to earnings announcements during March Madness. Other research examines the effect of investor attention on the market reaction to earnings announcements made outside versus during regular trading hours. Patell and Wolfson (1982) suggest that earnings announced outside of regular trading hours receive less attention because traders are less likely to be at work. Consistent with this argument, deHaan et al. (2015) find that earnings announcements released after market close receive less attention relative to earnings announcements released before or during trading hours.

We extend this literature by examining whether the amount of time investors have to process the earnings news between the earnings announcement and the start of regular trading hours affects the speed of the market reaction to the news. Specifically, we examine whether the speed of the market reaction to earnings announcements differs depending on whether the announcement is made in the PO versus PC.

Patell and Wolfson (1982) argue that the timing of the earnings announcements affects the time investors have to evaluate and interpret the news. This argument is consistent with Buffett's (2017) view in his shareholder letter that announcing earnings further from the open of trade allows "maximum time for analysis and give investment professionals the opportunity to deliver informed commentary before markets open." Consistent with this notion, Kahneman (2011) argues that there are two systems of thinking. One system represents quick thinking, an automatic and almost knee-jerk response to something, while the second system is more deliberate thinking that requires time, effort, and at-

[3]However, deHaan et al. (2015) and Michaely et al. (2016) find evidence inconsistent with an investor under-reaction to earnings announcements made on Fridays.

tention. Earnings announcements are likely to require the latter system of thinking such that the trader requires time and effort to process the earnings news. Given the time required to process earnings news, we hypothesize that earnings announcements made in the PO are associated with a slower market reaction to the earnings news than earnings announcements made in the PC.

We note, however, that there are credible arguments for the null. Namely, there are traders/investors all over the world in different time zones, suggesting that there may be sufficient traders available to process the information in the announcement regardless of its timing. In addition, sophisticated investors likely have systems and procedures in place to process the information in earnings announcements regardless of when the announcement is made. Finally, there has been an increase in the disclosure of the anticipated earnings announcements such that investors are likely aware of upcoming announcements.

3. DATA AND VARIABLE CONSTRUCTION

3.1. Data

Our sample consists of a large panel of publicly traded companies over the period 2006 to 2015. Quarterly earnings announcement dates and times are provided by Wall Street Horizon (WSH). The sample begins in 2006 because this is the earliest year of any WSH dataset. WSH collects precise dates and times of earnings announcements and conference calls for firms that announce over primary source newswires. We use WSH instead of I/B/E/S because our research study requires highly accurate time stamps. Time stamps provided by I/B/E/S and other common sources are often inaccurate (Bradley et al., 2014; Li, 2016; Michaely et al., 2014), while WSH stamps announcements within one second accuracy.

We merge WSH data with Compustat, CRSP, and I/B/E/S, dropping firm-quarters with a market capitalization less than $10 million or with an equity price less than $5.

We also limit the sample to US traded common equity (CRSP share codes 10 and 11). Our final sample consists of 85,875 firm-quarters. In some of our analyses, we include control variables or option contract data from OptionMetrics. For those tests, our sample is reduced because not all firms have the required data or actively traded options.

Figure 1 presents the distribution of the timing of earnings announcements as the fraction of our sample in half hour windows throughout the day. The figure shows that the vast majority of earnings announcements occur in the PO period (from midnight to the market open at 9:30 AM) or the PC (from the market close at 4:00 PM to midnight).[4] In our sample we drop the small fraction of announcements that occur within regular trading hours.[5] In our empirical analyses we use a binary variable, PO, that is equal to one if the earnings announcement occurs in the pre-open, and zero if the announcement occurs in the post-close.

3.2. Variable Construction

Various estimates of volatility have been used extensively as proxies for information around events (e.g., Bushee et al., 2011; Kirk and Markov, 2016; Matsumoto et al., 2011). The basic intuition is straight forward. Consider an investor who applies Bayes rule when setting equity prices. Such an investor makes revisions in beliefs about equity prices as news about future cash flows and discount rates arrives. Value-relevant news causes revisions in beliefs, which leads to revisions in stock prices. Estimated volatility represents a measure of variation in belief revision through time. If an earnings announcement is informative and investors revise their beliefs based on it, then prices change and volatility increases, which is what is observed on average around earnings announcements.

Consistent with this notion, Patell and Wolfson (1979, 1981) examine the behavior of option-implied as well as realized stock return volatility around earnings announcements. They find that implied volatility increases before earnings announcements, in

[4]The distribution of announcement times for our sample is similar to that reported by Michaely et al. (2016).

[5]We find that keeping these small numner of announcements does not materially affect our results regardless of whether we categorize them as PO or PC announcments.

anticipation that earnings news will carry value-relevant information that will increase stock price variability. Patell and Wolfson (1981) use *ex post* realized volatility as a proxy for information and indeed find that volatility increases on average following an earnings announcement. Our empirical tests of the information in the timing of earnings are similarly motivated: if traders react less quickly to PO earnings announcements, then it is expected that volatility will be higher in the days after the announcement for PO versus PC announcements.

Our first empirical tests rely on daily (close-to-close) volatility that is estimated using the Garman and Klass (1980) range-based estimator of volatility.[6] We calculate volatility using the Garman and Klass (1980) estimator because it is a more efficient estimator than common close-to-close based estimators and allows us to incorporate intraday price movements into volatility using only CRSP data. Using CRSP data allows us to maximize our sample size relative to merging with intraday data from TAQ.[7] To control for common trends and persistence in firm-level volatility, we calculate abnormal volatility ($ABVOL$) as the log ratio of current realized volatility to expected volatility multiplied by 100. Expected volatility comes from a state space model that assumes firm specific volatility is composed of a common (market) component, which we proxy for using realized volatility on the S&P500 index, and a firm specific component that follows an ARMA(1,1) process while also incorporating firm-specific day of the week cycles in volatility. We use the state space model to make strictly out-of-sample forecasts for every earnings announcement in our study.[8]

In addition to volatility, we measure abnormal volume and abnormal returns around the earnings announcement. Abnormal volume ($ABVOLUME$) is the log of total trading

[6]We have verified our results using more sophisticated and computationally intensive estimates of volatility, including GARCH-based estimates from daily data and volatility estimates using high frequency data.

[7]If we use TAQ-based estimates of abnormal volatility, we find that our results hold, despite the smaller sample size.

[8]To ensure our volatility forecasting model is a credible proxy for expected volatility, we regress future realized volatility on volatility forecasts during non event days and find that the intercept is indistinguishable from zero and that the slope coefficient almost unity and highly significant. Using a simple historical average as a proxy for expected volatility produces a much weaker predictor.

volume from CRSP deflated by total shares outstanding, normalized using the same approach as $ABVOL$. Abnormal returns ($ABRET$) are calculated daily using market adjusted returns from CRSP.

In Table 1 we present summary statistics for the full sample. Daily variables ($ABVOL$, $ABVOLUME$, and $ABRET$) are presented as the sum of the four day period from t+2 to t+5 where day t+1 is the first full trading day immediately following the release of earnings. For PO announcers, day t+1 is the same calendar day that earnings are announced, but for PC announcers, it is the following trading day. Mean abnormal volatility is 104.01, indicating volatility following the earnings announcement increases by approximately 104 percent compared to its historical volatility on the same days of the week. Likewise, average volume increases by 132 percent and average abnormal returns are indistinguishable from zero.

Unexpected earnings (or earnings surprise) (UE) is calculated as the earnings per share (EPS) minus the mean analyst forecast from I/B/E/S, scaled by the stock price at the end of the prior quarter, and multiplied by 100. The mean UE is 0.02. $NEGUE$ is an indicator equal to one if UE is negative, and zero otherwise. The mean for the variable suggests that 34 percent of the earnings announcements are associated with a negative earnings surprise. We measure the announcement reporting lag ($REPLAG$) as the natural log of the number of days between the quarter end date and the earnings announcement date. $SIZE$ is the natural log of the market capitalization of the firm (share price times total shares outstanding from CRSP). The book-to-market ratio of the firm (BM) is calculated as the natural log of book value of equity divided by the market value of equity. Return on equity (ROE) is the natural log of one plus the firm's net income divided by its book value of equity. LEV is calculated as total liabilities divided by total assets. IO is calculated quarterly as the percentage of shares owned by institutions required to make 13-f filings. The mean (median) analyst following ($ANALYSTS$) is 12.77 (10.00). Analyst dispersion ($DISP$) is the standard deviation of EPS forecasts that are used to calculate the consensus in I/B/E/S. We also calculate the historical

volatility ($LAGVOL$) as the log of the average daily volatility over the prior six months and historical returns ($LAGRET$) as the average returns over the prior six months. All variables are winsorized at 1%.

Table 1, Panel B presents the fraction of the sample for PO and PC announcements by time zone. The descriptive statistics show that PO firms are more likely to be headquartered in the Eastern time zone than PC firms while PC firms are more likely to be headquartered in the Pacific time zone than PO firms. Table 1, Panel C presents the fraction of the sample for PO and PC announcements by industry classification. The largest difference appears to be in the $BusEq$ industry classification, such that the earnings announcements in this industry are more likely to be in the PC than the PO. In light of the fact that PO versus PC announcements vary by both time zone and industry, we ensure our main empirical tests are robust to both industry and time zone fixed effects. Table 1, Panel D presents a correlation matrix of the variables used in the study. Consistent with our hypothesis, abnormal volatility is positively correlated with abnormal volume and PO.

Panel A of Table 2 presents the descriptive statistics for PO and PC announcements separately. There are statistically significant differences in firm and earnings announcement characteristics based on PO versus PC announcements. While the differences do not appear to be economically significant, we perform analyses with firm fixed effects and propensity score matching in robustness tests. To provide greater insight into whether there is a systematic relation between firm and earnings characteristics and the choice to issue a PO versus PC announcement, we perform an analysis of changes from PC to PO announcements and vice versa. Panel B of Table 2 presents the results of regressions that examine the relation between the quarter over quarter change in PO and the change in firm and earnings characteristics. The results suggest that a move from a PC to a PO announcement is positively related to the reporting lag, suggesting that firms that switch to PO announcements report later after the fiscal period end. No other firm or earnings characteristic variables are associated with the move from PC to PO announcements.

4. EMPIRICAL TESTS

4.1. Abnormal Volatility

Panel A of Table 3 presents the mean difference in $ABVOL$ between PO and PC firm-quarters over days t-5 to t-1 and days t+1 to t+5 , where day t+1 is the first trading day following the announcement. Differences greater than zero indicate PO announcements have higher abnormal volatility than PC announcements on average, and differences less than zero indicate PC announcements have higher volatility than PO announcements. The differences show that PO announcements are associated with lower abnormal return volatility the two days before the announcement, lower abnormal return volatility the day after the announcement, and higher abnormal return volatility the two to five days after the announcement.

While we do not provide a hypothesis regarding the lower abnormal volatility prior to the earnings announcement for PO versus PC announcements, the pre-announcement lower volatility might suggest that investors are aware of the timing of the upcoming announcement and perform less information search in anticipation of PO announcements than PC announcements.[9] The lower volatility the day after the announcement and the higher volatility the two to five days after the announcement supports our hypothesis of a slower market reaction to PO earnings announcements relative to PC earnings announcements. Importantly, PO announcers' abnormal volatility remains above the PC announcers' abnormal volatility for approximately four days following the announcement. This suggests that the slower response to PO earnings news relative to PC earnings news persists for four days after the earnings announcement. Figure 2 provides graphical representation of the findings of the univariate results.

Table 3, Panel B presents a formal multivariate test of the univariate results in Panel A. Specifically, we present the regression with $ABVOL$ as the dependent variable for each

[9]Firms generally schedule their earnings releases in advance; therefore, it is reasonable that investors anticipate the timing of the earnings announcement and that their pre-announcement information search differs based on the anticipated timing of the announcement.

day from t-5 to t-1 and t+1 to t+5, where day t+1 is the first trading period following the earnings announcement. We also include the cumulative daily effect on days t+2 through t+5 as this period captures the total impact of the slower reaction. The variable of interest is PO which tests whether there is differential abnormal return volatility in the days around PO earnings announcements relative to PC announcements. We include year and industry fixed effects in the regressions.

Given our findings in Table 2 of differences in earnings and firm characteristics across PO versus PC announcements, we control for these earnings announcement and firm characteristics because they could also impact stock return volatility. Specifically, we include controls for unexpected earnings (UE), an indicator variable for negative unexpected earnings ($NEGUE$), fourth quarter announcements ($Q4$), and the earnings reporting lag ($REPLAG$). The results show that these earnings announcement controls are significantly associated with abnormal volatility after the announcement.

We also control for firm size ($SIZE$), book-to-market (BM), return on equity (ROE), leverage (LEV), institutional ownership (IO), analyst following ($ANALYSTS$), analyst dispersion ($DISP$), historical volatility ($LAGVOL$), and historical returns ($LAGRET$). Size, book-to-market, return on equity, and leverage are all lagged one quarter, so the data are available prior to the announcement.

The coefficient on PO is negative and significant on days t-3, t-2, t-1, and t+1. Again, the finding of lower pre-announcement volatility for PO relative to PC announcements is consistent with investors performing different pre-announcement information search activities based on the anticipated timing of the announcement. To ensure that these findings are not attributable to firm characteristics for which we fail to control, we perform robustness tests (described in detail in later sections) which (1) include firm fixed effects, (2) examine the change from PO to PC announcements or vice versa, and (3) use a matched sample based on the propensity to announce earnings in the PO versus the PC. In each of these analyses, we continue to find lower pre-announcement volatility for PO announcements. These results suggest that investor pre-announcement information

search and trading activity is affected by the anticipated timing of the announcement.[10] Consistent with our hypothesis that less processing time leads to a slower reaction to the earnings news, we find a positive and significant coefficient on *PO* on days t+2 through t+4. The coefficient is also positive and significant for the cumulative daily volatility over days t+2 to t+5. In terms of economic significance, a firm announcing in the PO has approximately 28% greater cumulative volatility over days t+2 to t+5 compared to firms announcing in the PC.

The analyses above examine abnormal stock return volatility from the close of trading on day t to the close of trading on day t+1; therefore, the abnormal volatility includes the effect of after-hours trading. To assess the effect that after-hours trading has on the differential volatility between PO and PC announcements, we also perform the analyses with abnormal volatility calculated from the open of trading to the close of trading using the exact same method we use for our measure of close-to-close abnormal volatility. The results are presented in Panel C of Table 3. The results are similar to those reported in Panel B with one important exception. The coefficient on *PO* on day t+1 is substantially lower in terms of magnitude and statistical significance when volatility is calculated from open to close of trading. This suggests that the finding of lower volatility for PO announcements on day t+1 when volatility is calculated from close to close of trading is largely attributable to the greater processing in after-hours before the open of trade on day t+1 for PC announcements. This is consistent with investors processing the earnings news prior to the start of trading for PC announcements. When the after-hours trading period is excluded, we find a much smaller difference in volatility on day t+1. Despite this, we continue to find greater volatility in similar magnitude on days t+2 to t+5 for PO announcements relative to PC announcements.

[10]Consistent with this assertion, in untabulated analyses, we examine announcements that were scheduled for the PO (based on the expected announcement time in WSH) but released in the PC versus announcements that were scheduled in the PO and released in the PC. We find lower volatility on days t-5 to t-2 for expected PO announcements even when the actual announcement is made in the PC. These results suggest that investors perform less pre-announcement search activity for expected PO announcements than for expected PC announcements, regardless of the actual announcement time. We think that providing insight into this finding is a fruitful area for future research.

Finally, while we include a number of firm and earnings announcement characteristics in our regression analyses, to ensure that unobserved firm characteristics do not drive our results, in Table 3, Panels D and E we perform the analyses with firm fixed effects and using first differences, respectively. We find consistent results using these alternative tests. Specifically, after including firm fixed effects, we continue to find a significant negative coefficient on PO on days t-1 and t+1, and significant positive coefficients on days t+2 to t+5.

Similarly, when we perform an analysis with the change in abnormal volatility as the dependent variable and the change in announcement timing, $\triangle PO$, as the variable of interest, we find a significant negative coefficient on $\triangle PO$ on days t-2 and t-1 and a significant positive coefficient on $\triangle PO$ on days t+2 to t+5. These results suggest that our main results are not driven by firm characteristics. In robustness tests below, we also perform the analyses using a propensity score matched sample of firms.

4.2. Abnormal Volume

In Table 4, we present regressions with $ABVOLUME$ as the dependent variable for each day from t-5 to t-1 and t+1 to t+5 as an alternative proxy for the market reaction to the earnings announcement, where day t+1 is the first trading period following the earnings announcement. We also present the results for the cumulative daily abnormal volume over days t+2 to t+5. We regress $ABVOLUME$ on PO, including year and industry fixed effects.

As in the analyses in Table 3, we control for earnings announcement and firm characteristics because they could also affect trading volume. The results show that these earnings announcement and firm-level control variables are significantly associated with abnormal volume in the days after the announcement.

We find that the relation between $ABVOLUME$ and PO is similar to the relation between $ABVOL$ and PO. The coefficient on PO is negative and significant on days t-3, t-2, t-1 and t+1 and positive and significant on both days t+2 and t+3 and the

cumulative difference from days $t+2$ to $t+5$ is large and highly significant. In terms of economic significance, a firm announcing in the PO has approximately 6% greater abnormal volume in the two to five days after the announcement than firms announcing in the PC. These results suggest a slower reaction to PO earnings announcements relative to PC announcements and are consistent with the results for abnormal volatility.

To examine whether the difference in abnormal volatility and volume around PO versus PC earnings announcements is potentially driven by other firm announcements, we examine whether abnormal stock returns in the days around the earnings announcement differ between PO and PC announcements. The results are reported in Table 4, Panel B. The dependent variable is the market adjusted abnormal return ($ABRET$) on each day of trading around the earnings announcement. We include the same explanatory variables as in the previous analyses. We note that unexpected earnings related to the announcement is included as a control variable in the regression. We find no evidence of differential abnormal returns between PO and PC announcements in any day around the earnings announcement, suggesting that the differential volatility for PO versus PC announcements does not appear to be related to directional news that is unrelated to earnings.

4.3. Market Return Reaction to Earnings Announcements

To provide additional insight into whether there is a slower investor reaction to earnings announcements released in the PO versus the PC, we examine the association between abnormal stock returns and the earnings surprise, or the earnings response coefficient, on the days around the announcement. We also examine the intra-period timeliness (IPT) of the reaction to earnings news in the one through five days after the announcement. Table 5, Panel A reports the results of tests of differential earnings response coefficients, and Panel B reports the results of differential IPT across PO and PC announcements. For brevity, in the market reaction tests, we combine the returns for days t-5 to t-1 and days t+2 to t+5.

The dependent variable in the market reaction tests is the market adjusted abnormal returns from CRSP for days t-5 to t-1 (columns 1 and 4), day t+1 (columns 2 and 5), and days t+2 to t+5 (columns 3 and 6) around the earnings announcement.[11] We include the same explanatory variables as in the previous analyses. Given that earnings surprises cannot be perfectly measured and may be noisy estimates of true unobservable earnings surprises we report in columns (4) through (6) abnormal returns regressed on the decile rank of unexpected earnings. To test for a muted reaction to announcements released in the PO, we include an interaction term for PO and UE ($PO \times UE$).

Columns (1) and (4) suggest that there is no difference in return behavior about future earnings for PO firms, however, consistent with a muted response to earnings for PO announcements, there is a significant negative coefficient on the $PO \times UE$ term on day t+1 in both columns (2) and (5), suggesting that returns for PO announcements move less with earnings on day t+1. Columns (3) and (6) tell an important story, the positive and significant coefficient on $PO \times UE$ indicates that earnings information is incorporated into returns, but at a slower rate. Over days t+2 to t+5 returns move more with earnings news for PO announcements.

Panel B of Table 5 reports the results of the IPT test. The IPT measure attempts to capture the speed with which information is incorporated into price after controlling for the price response to the information (Twedt, 2016; Butler et al., 2007). The dependent variable is the daily proportion of size-adjusted abnormal returns realized up to and including a given day, starting on day t+1 (the first day of trading after the earnings announcement) and continuing through day t+6.[12] For each day, we calculate the cumulative buy-and-hold return from day t+1 to that day, scaled by the cumulative abnormal return for the entire period. We then estimate the area under this curve for each earnings announcement, where a larger area indicates that the information is more

[11] We measure returns from the market close immediately prior to when earnings are announced to the market close immediately after earnings are announced.

[12] We use a six day window in the IPT test as the final day of the test equals 1 by construction. Thus, the six day window allows the IPT to vary by PO or distance over the five trading days following the announcement, similarly to our main tests.

quickly impounded into price.

We regress the IPT metric on *PO* to test whether the market reacts less quickly to earnings announced in the PO relative to the PC.[13] We include the same control variables as in the previous analyses. Consistent with the results of Table 5 Panel A and a slower reaction to earnings released in the PO, we find a significant negative coefficient on *PO*. This suggests that earnings announced in the PO are associated with a slower response to the earnings news. Overall, these findings provide additional support for a less timely reaction to earnings announcements in the PO relative to the PC.

4.4. Robustness Tests

4.4.1. Propensity Score Matched Sample

Given that earnings announcement timing is an endogenous choice, as an additional robustness test to firm fixed effects and tests using differences, we use a propensity score matched sample. Specifically, we estimate a model to explain whether an announcement is made in the PO versus the PC using all controls from Table 3 in a propensity score model. Panel A of Table 6 reports the results of the propensity model. We find that the PO versus PC choice is significantly positively associated with unexpected earnings, a negative earnings surprise, a fourth quarter announcement, firm size, book to market, leverage, and historical returns, and negatively associated with reporting lag and analyst following.

Panel B reports the differences in the characteristics between the PO and PC earnings announcements for the propensity score matched sample. The results show that the matching achieves co-variate balance for PO versus PC announcements on all the variables except institutional ownership. This difference, though statistically significant, is very small in absolute magnitude. Overall, the matching process appears reasonable and

[13] In this test, we truncate the sample at the top and bottom 1 percent of IPT values, as these observations are primarily firms with net announcement abnormal returns extremely close to zero. In these cases, the IPT measure is greatly inflated or deflated, as the total abnormal returns are the denominator in the measure.

generates groups with similar characteristics.

Table 6 Panel C reports the abnormal volatility results on the propensity score matched sample. The results suggest that despite the reduced sample size, the main findings are robust to propensity score matching.

4.4.2. Placebo Tests

As a robustness test to ensure that our findings are not driven by firm characteristics and differential trading behavior for firms that release earnings in the PO versus the PC, we perform two placebo tests. The first examines the relation between abnormal volatility and *PO* during a non-announcement day which we select as 21 days before the actual earnings announcement day. The results of this pseudo-announcement test are reported in Columns 1-3 of Table 7. The second placebo test examines the relation between abnormal volatility and *PO* around a common news event, Federal Reserve meeting (FED) announcements. The results of this test are reported in Columns 4-6 of Table 7. We include the same explanatory variables as in the previous analyses. If the previous findings are not driven by firm characteristics, we expect no relation between abnormal volatility and *PO*. Consistent with this, in both placebo tests, we find insignificant relations between abnormal volatility and PO versus PC announcements.

4.4.3. Earnings Information Processing

One potential explanation for the differential post-announcement volatility between PO and PC announcements is that investors process PO information more slowly because they have less time from the announcement to the market open. In this section, we test the association between PO announcements and three proxies for information processing to examine whether this proposed explanation is reasonable. deHaan et al. (2015) test for differential attention to earnings announcements made in the PC relative to those made in either the PO or during regular trading hours by examining 8-K downloads, news stories, and the speed of analyst revisions in the days after the earnings announcement. In the

same spirit, we examine whether there is a slower reaction to PO announcements relative to PC announcements by using Edgar downloads, analyst revisions, and news stories around the earnings announcement as a proxy for the processing of the announcement by various intermediaries.[14] Specifically, we examine whether the daily percentage of total analyst revisions, Edgar downloads, and news articles from Ravenpack around the announcement differ for *PO* announcements compared to *PC* announcements, which might be a cause for the differential in stock return volatility around PO versus PC earnings announcements. We define $REVISIONS\%$ as the number of analyst revisions in a given window (t-5 to t-1, t+1, and t+2 to t+5) scaled by the total analyst revisions from t-5 to t+5. $DOWNLOADS\%$ and $NEWS\%$ are defined similarly, where downloads use the number of Edgar downloads for the firm from IP addresses with less than 50 downloads in a given day, and news stories use counts from Ravenpack where the relevance score equals 100 for the firm (Lee et al., 2015).

Table 8, Panel A presents an analysis of the timing of each activity after controlling for firm and earnings characteristics. We present multivariate regression results with the percentage of total revisions (columns 1-3), downloads (columns 4-6), and news stories (columns 7-9) for days t-5 to t+5 as the dependent variable, respectively. We include the same control variables as in the previous analyses. We find significantly lower activity in day t+1 and significantly greater activity in days t+2 to t+5 for PO announcements relative to PC announcements. These results suggest, consistent with our hypothesis, that there is a slower reaction to earnings announced in the PO versus the PC and that this slower reaction is not only reflected in differential abnormal volatility but also in

[14]In untabulated analyses, we examine regression models above with the total number of analyst revisions, Edgar downloads, and news stories around the announcement as the dependent variable, respectively. We find a positive coefficient on *PO* for regressions of EDGAR downloads and news stories. These findings are consistent with those in deHaan et al. (2015) that PO announcements receive more attention than PC announcements. We note that the finding of greater attention to PO versus PC announcements biases against finding a slower response to the earnings announcement, given the findings in Hirshleifer and Teoh (2003) and Drake et al. (2015) of a slower market reaction to earnings announcements made during periods of investor inattention. We also find, however, *PO* is associated with fewer analyst revisions, which would suggest lower attention for PO announcements. We note that deHaan et al. (2015) do not test the number of analyst revisions, but rather proxy for the speed of revisions and find analysts react more slowly.

differential revision, download, and news story activity around the earnings announcement.[15]

In the pre-announcement window from day t–5 to t-1, we find statistically significant coefficients on *PO*, but the magnitude of the coefficients are substantially smaller than the two post-announcement windows. Moreover, the direction of the coefficients is inconsistent; PO announcements have a higher percentage of analyst revisions and news stories prior to the announcement, but a lower percentage of EDGAR downloads. These findings suggest lower investor search activity for PO announcements in the days leading up to an earnings announcement and may explain the lower pre-announcement volatility for PO announcements. Given the positive coefficients on *PO* for revisions and news stories, however, we consider this explanation for pre-announcement volatility inconclusive and in need of further study.

In Table 8, Panel B, we control for the relation between these activities and abnormal volatility in the days around the announcement. Specifically, we control for the number of revisions, the number of downloads, and the number of news stories in our regressions that test for differential volatility for PO versus PC announcements in the days around the announcement. We find a general positive relation between the number of revisions, downloads, and news stories and abnormal volatility. We also find a significant negative coefficient on *PO* for days t-5 to t-1 and day t+1, and a significant positive coefficient for days t+2 to t+5. These results suggest that the finding of a slower reaction to PO earnings announcements relative to PC announcements is robust to the inclusion of these

[15]Our finding that analysts revise more slowly for PO announcements may appear in contrast to deHaan et al. (2015) who argue analysts revise more slowly for PC announcements. In our study, we measure a day from the close of trading on day t to the close of trading on day t+1. As a result, we consider an analyst issuing a revision for a PC announcement at 8:30 AM the morning after the earnings announcement to be of a similar timeliness to an analyst issuing a revision at 8:30 AM the same morning of the announcement for a PO firm; both revisions come an hour before the open of trading and therefore we do not consider the revision for the PC announcement slower than the revision for the PO announcement. deHaan et al. (2015) use calendar days to measure the timeliness, and thus would consider the 8:30 AM revision for the PC announcement to be slower than the 8:30 AM revision for the PO announcement. In untabulated tests, we replicate the deHaan et al. (2015) measure of analyst speed using close-to-close days and find results consistent with our tabulated results, namely that analysts revise more slowly for PO announcements. We consider our measurement reasonable as we believe it is more important how many analyst revisions are issued before or during each regular hours trading period, as opposed to each calendar day.

activity variables.

4.4.4. Other Earnings Announcement Characteristics

We also examine whether the relation between abnormal volatility and *PO* is incremental to other earnings announcement timing characteristics that have been documented in prior research to be associated with the investor reaction to earnings announcements. In Table 9, we report the results of regression analyses after controlling for the timing of the conference call. Given the importance of the relative amount of time between the earnings announcement and the beginning of regular trading hours, we also report the results of analyses that control for the time zone in which the firm is headquartered. In addition, given the finding in deHaan et al. (2015) of greater attention to earnings announcements that receive more advanced warning, we report the results of analyses that control for the earnings announcement lead time. Finally, based on the finding in Hirshleifer et al. (2009) of an investor under-reaction to earnings announcements released on days with a greater number of earnings announcements from other firms, we report the results of analyses that control for the number of concurrent earnings announcements on the same day.

The regression analyses reported in Table 9 examine whether *PO* provides incremental information content for abnormal volatility after controlling for the conference call ($CONFCALL$) in columns 1-3, the US time zone in which the firm is headquartered (EST, CST, MST, and PST) in columns 4-6, the earnings announcement lead time ($LEADTIME$) in columns 7-9, and earnings announcement frequency ($EAFREQ$) in columns 10-12, respectively. $CONFCALL$ is an indicator variable that takes the value of one on the day of the conference call, and zero otherwise.[16] $LEADTIME$ is defined as the logged lead time (in days) between the date on which the firm schedules its earnings announcement date and the earnings announcement date itself. To calculate $EAFREQ$, we measure the number of contemporaneous earnings announcements on each day in

[16]For our sample, the vast majority of conference calls are held on day t+1.

Compustat and define decile cutoffs for the population. $EAFREQ$ is the decile number in which a given earnings announcement day falls.

We report the abnormal volatility for days t-5 to t-1, day t+1, and days t+2 to t+5 in the first, second, and third column of each analyses, respectively. We find that PO continues to be significantly negatively associated with abnormal volatility in days t-5 to t-1 and day t+1 and significantly positively associated with abnormal volatility in days t+2 to t+5 after controlling for $CONFCALL$, time zone, $EAFREQ$, and $LEADTIME$.

In untabulated analyses, we also perform robustness tests to include other characteristics of the earnings announcement that have been shown in prior research to be associated with the market's reaction to the announcement. Specifically, we re-estimate the regressions in Table 3 with an indicator variable for earnings announcements that are released on the same day as the 10-K or 10-Q filing (Li and Ramesh, 2009), an indicator variable for earnings announcements released prior to audit completion (Bronson et al., 2011), an indicator variable for earnings announcements that are released with a management forecast included in the announcement (Anilowski et al., 2007), and a control for the percentage of items in the 10-Q or 10-K that are reported in the earnings announcement (Schroeder, 2015). We find that our main result, namely greater abnormal volatility in the days after the announcement for PO earnings announcements relative to PC announcements, is robust to inclusion of these variables.

5. OPTION-BASED RETURNS

Given the strong relations between abnormal volatility and announcing in the PO versus the PC, we examine whether option markets anticipate the differential volatility response based on PO versus PC announcements. Using option-based tests, we construct two different trading strategies with payoffs that are directly linked to future stock return volatility: delta hedged returns (Bakshi and Kapadia, 2003) and straddle returns (Coval and Shumway, 2001; Goyal and Saretto, 2009). Returns on delta hedge and straddle strategies are calculated as follows:

$$\text{Delta Hedge Return: } R_{t+1}^{DH} = \frac{O_{t+1} - \Delta_t S_{t+1}}{O_t - \Delta_t S_t} - 1, \tag{1}$$

$$\text{Straddle Return: } R_{t+1}^{S} = \frac{C_{t+1} + P_{t+1}}{C_t + P_t} - 1. \tag{2}$$

Here O_t represents the price of an option (a call or a put), C_t is the price of a call option and P_t is the price of a put option. Δ_t represents the option's "delta" and S_t is the price of the stock.

Delta hedge strategies involve going long the option contract while shorting Δ_t units of the underlying stock, which gives exposure to changes in volatility while hedging away changes in the underlying stock price. Straddle positions involve going long puts and calls with the same strike price, the straddle position increases in value if stock return volatility increases. Both strategies are commonly used in academic tests and also in practice to trade on stock return volatility.

All options data are obtained from the IvyDB OptionMetrics database. We select all options that have an expiration at least three days following an earnings announcement. From these, we keep only those options that are closest to at-the-money and have the shortest expiration. For straddles, we construct put-call pairs, where the put and the call have identical expiration and strike prices. The goal of looking at returns to these strategies is to determine if option traders impound the volatility spread based on PO into option prices. If option traders anticipate this difference then returns to these strategies should not be significantly related to PO.

We test this two ways. First, we conduct regressions using both option return strategies as the dependent variable. Second, we form portfolios and determine if the returns to these portfolios are sensitive to firm characteristics. Like our prior tests, our window of interest is from day t+2 to t+5, as this is where we expect and find the strongest results related to abnormal volatility. Thus, the strategy is executed beginning at the close of the first trading day after which earnings are announced and ending at the close of the

fifth trading day after announcement.

Panel A of Table 10 presents return regressions analysis results for both option strategies as well as results for equity returns. For each strategy, we report the coefficient on PO with the same controls as the previous analyses. The panel clearly shows that each option strategy has a strong positive association with PO with an economically meaningful magnitude. For example, the return differntial for a PO earnings announcement over the four day window is approximately 0.24% (about 16% annualized) higher for the delta hedge and 1.74% (about 195% annualized) higher for the straddle. Recall that average stock returns are neither economically nor statistically associated with PO.

To ensure that our regression-based results are not being driven by idiosyncratic noise or the linear structure that is imposed by these tests, we also form portfolios. By forming portfolios, we are able to reduce the potential impact from idiosyncratic noise through the power of diversification and examine how returns to these portfolios vary with certain firm characteristics. Panel B of Table 10 presents portfolio returns of a long position in PO firms and short position in PC firms. To ensure that the returns to the volatility strategy are not clustered among firms with certain characteristics, each of these strategies are sorted on firm characteristics size ($SIZE$) and historical volatility ($LAGVOL$). The results tell a similar story as the regression results presented in Panel A. Returns on each of the option-based strategies are significant and are not sensitive to firm characteristics.

6. CONCLUSION

This paper documents that earnings announcements released in the pre-open (before the opening bell) have higher abnormal volatility in the days following the announcement relative to firms that announce in the post-close (after the bell). The volatility differences persist for at least four trading days following an earnings announcement and are highly predictable. We also find greater abnormal volume in the days after the earnings announcement for the PO versus PC announcements. In addition, we find a muted market response to unexpected earnings on day t+1 after the announcement and

a more pronounced market response to unexpected earnings on days t+2 to t+5 for PO announcements than for PC announcements. We also find a slower incorporation of earnings news into prices over the five days after the announcement for earnings released in the PO versus the PC. Consistent with a slower reaction to the earnings news, we find slower analyst revision, Edgar download, and news story activity after the announcement for PO versus PC announcements. However, after controlling for this differential activity, we continue to find greater abnormal volatility in the days after the earnings announcement for PO versus PC announcements.

In robustness tests, we find that the results are robust to propensity score matching and that the volatility differences cannot be explained by common determinants of volatility such as firm size, profitability, volume, earnings surprises, stock returns, and historical volatility, and is not driven by announcement timing.

These findings are consistent with the intuition that providing more time before the start of trading allows investors more time to process the earnings news and therefore a more efficient response to the earnings announcement, a result that is congruent with Warren Buffett's 2017 letter to shareholders. The findings provide insight to managers, regulators, and investors regarding how the timing of earnings announcements in terms of announcing in the PC versus the PO affect the speed of the market's reaction to the earnings news.

The findings also contribute to academic research on manager's choice of earnings announcement timing as well as the effect of earnings announcement timing on the market. The findings suggest, consistent with the arguments in Patell and Wolfson (1982), that managers may consider the effect of earnings announcement timing not only on investor attention to the announcement but also on the ability of investors to process the news prior to the open of trading. Future research could provide further insights into this trade-off as well as other factors to consider in the earnings announcement timing choice. In addition, our findings suggest that investors react to similar information more slowly when it is announced in the PO versus the PC. We hypothesize that this is due to the

differential amount of time investors have to process the information; however, we cannot fully explain why this differential processing time results in a differential response time to earnings news. Our findings also suggest that investor information search, processing, and trading differ prior to the earnings announcement based on whether the announcement is made in the PO or the PC. Research that can provide a more precise mechanism that can help us to better understand these robust empirical results represents a fruitful area of future work.

Finally, we find that option trading strategies based on PO versus PC announcements yield economically large returns. While our results suggest a predictable slower market reaction to earnings information when earnings are announced in the PO relative to the PC, they also appear to suggest that option traders are either unable to fully unravel this predictable phenomenon or that there exists an announcement timing risk premium priced in equity options that is not present in equities themselves.

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Figures

Figure 1: Sample Distribution of Earnings Announcement Times

Figure 1 plots the distribution of the earnings announcement times as the fraction of the total sample in half hour bins. Vertical dashed lines indicate the market open and close at 9:30 AM and 4:00 PM, respectively.

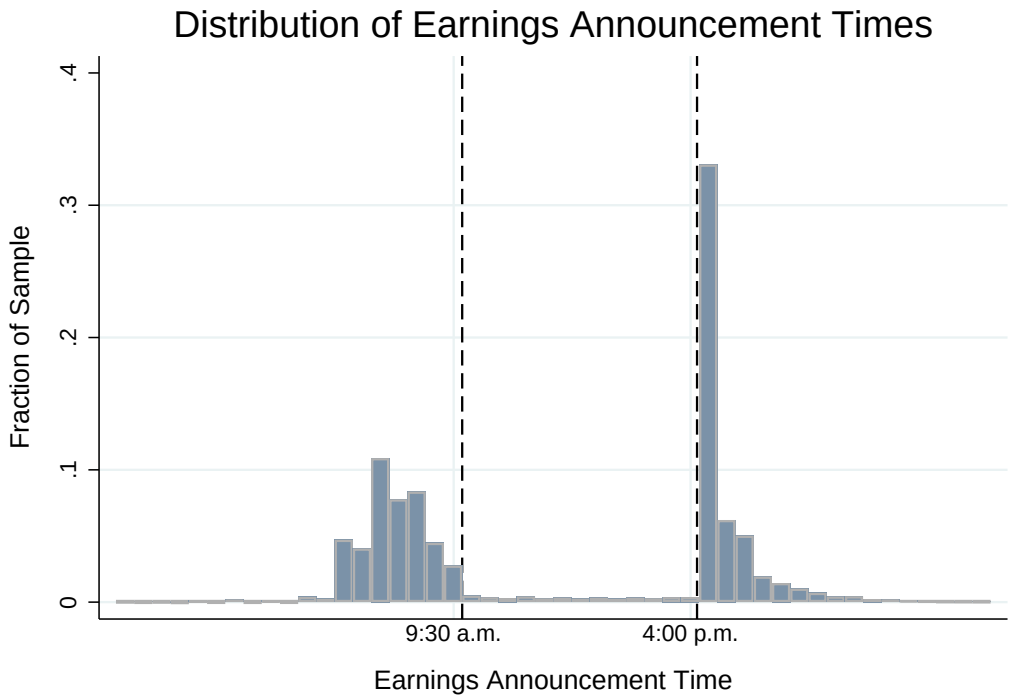
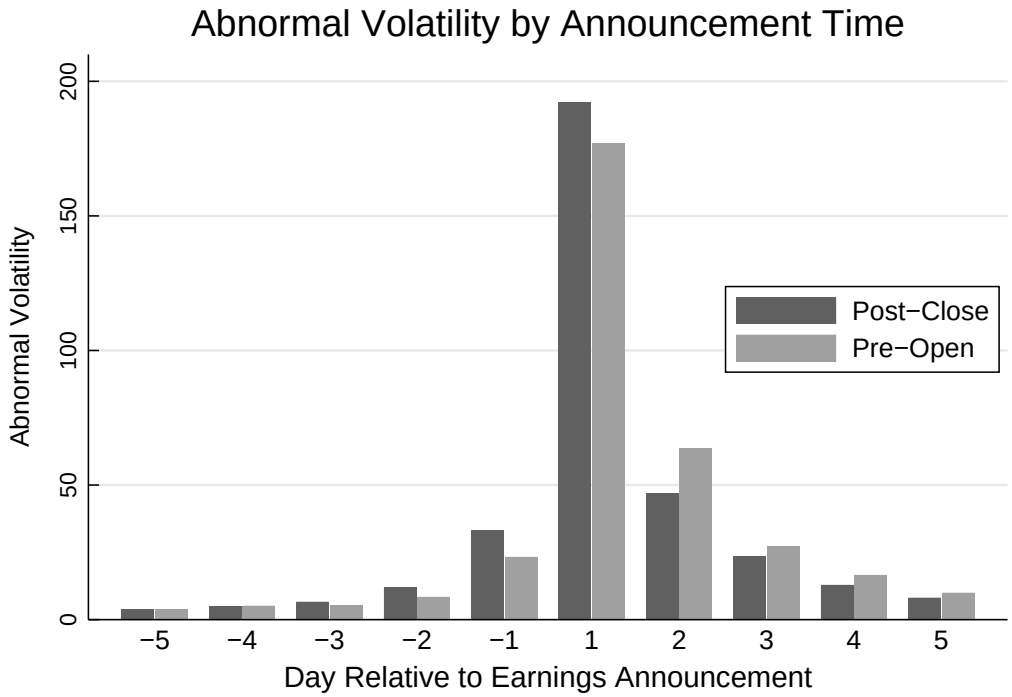


Figure 2: Daily Abnormal Volatility by Announcement Time

Figure 2 plots the daily abnormal volatility by PO and PC announcements from day -5 to +5 around the earnings announcement, where day +1 is the first trading day after the earnings announcement.



Tables

Table 1: Panel A, Summary Statistics

Table 1 presents summary statistics for key variables used in our study. Panel A presents the summary statistics for the full sample. Panel B presents the sample composition by announcement time and time zone of the firm's headquarters. Panel C presents the sample composition by announcement time and industry. Panel D presents the correlation matrix. PO is an indicator equal to 1 if the firm announces in the pre-open period and 0 if the firm announces in the post-close. $ABVOL$ represents abnormal volatility over the four day post-announcement period from day +2 to +5, where day +1 is the first trading day after earnings are announced. $ABVOLUME$ is abnormal volume from day +2 to +5. $ABRET$ is the cumulative abnormal return over day +2 to +5. UE is the unexpected earnings of the firm, calculated as the realized earnings per share less the consensus mean estimate, scaled by the quarter close share price and multiplied by 100. $NEGUE$ is an indicator equal to 1 if UE is negative, and 0 otherwsie. $REPLAG$ is the natural log of the number of days between the fiscal quarter end date and the earnings announcement date. $Q4$ is an indicator equal to 1 if it is the firm's fourth fiscal quarter, and 0 otherwise. $SIZE$ is the natural log of the firm's market value of equity (share price times the common shares outstanding). BM is the natural log of the book value of equity divided by the market value of equity. ROE is the natural log of one plus net income divided by the book value of equity. LEV is the leverage of the firm, calculated as total liabilities divided by total assets. IO is the percentage of the firm's shares owned by institutions required to make 13-f filings. $ANALYSTS$ is the number of analysts following the firm, measured as the number who issue at least one forecast in the year prior to the earnings announcement. $DISP$ is the standard deviation of the analyst EPS forecasts that make up the consensus forecast. $LAGVOL$ is the mean daily volatility from -183 to -7 days prior to the earnings announcement. $LAGRET$ is the sum of the daily log returns over the period -183 to -7 days prior to the earnings announcement.

N=85,875	Mean	StDev	P25	P50	P75
PO	0.48	0.50	0.00	0.00	1.00
$ABVOL$	104.01	227.50	-40.60	91.70	235.23
$ABVOLUME$	131.84	161.55	25.97	117.96	223.43
$ABRET$	0.00	0.05	-0.03	0.00	0.02
UE	0.02	0.88	-0.07	0.06	0.23
$NEGUE$	0.34	0.47	0.00	0.00	1.00
$REPLAG$	3.45	0.30	3.26	3.47	3.64
$Q4$	0.22	0.41	0.00	0.00	0.00
$SIZE$	7.27	1.60	6.09	7.11	8.26
BM	-0.84	0.76	-1.29	-0.76	-0.31
ROE	0.02	0.08	0.01	0.02	0.04
LEV	0.54	0.24	0.35	0.54	0.72
IO	0.70	0.23	0.57	0.74	0.87
$ANALYSTS$	12.77	9.23	6.00	10.00	18.00
$DISP$	0.04	0.05	0.01	0.02	0.05
$LAGVOL$	2.02	2.13	0.81	1.40	2.39
$LAGRET$	0.03	0.20	-0.08	0.03	0.13

Table 1: Panel B, Announcements by Time Zone

	PO	PC
N	41,066	44,809
EST	53.85	39.48
CST	31.07	25.06
MST	3.89	5.11
PST	9.24	29.31
Other	1.95	1.04
Total	100.00	100.00

Table 1: Panel C, Announcements by Industry

	PO	PC
N	41,066	44,809
Non-Durables	6.30	3.16
Durables	3.06	1.48
Manufacturing	11.95	8.15
Energy	5.35	4.22
Chemicals	3.14	2.22
Business Equipment	8.40	22.47
Telecommunications	2.61	1.99
Utilities	4.95	2.64
Shops	12.59	8.69
Healthcare	9.28	9.36
Finance	16.84	17.28
Other	15.51	18.35
Total	100.00	100.00

Table 1: Panel D, Correlation Table

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) PO	1.00																
(2) $ABVOL$	0.06*	1.00															
(3) $ABVOLUME$	-0.00	0.37*	1.00														
(4) $ABRET$	0.00	0.00	0.04*	1.00													
(5) UE	-0.01	-0.02*	0.00	0.08*	1.00												
(6) $NEGUE$	0.01*	0.03*	0.04*	-0.06*	-0.47*	1.00											
(7) $REPLAG$	-0.03*	0.03*	0.04*	-0.01*	-0.04*	0.08*	1.00										
(8) $Q4$	0.02*	-0.04*	0.05*	0.01*	-0.02*	0.00	0.43*	1.00									
(9) $SIZE$	0.18*	-0.05*	-0.08*	0.01*	0.04*	-0.11*	-0.25*	0.05*	1.00								
(10) BM	0.04*	-0.00	-0.04*	0.02*	-0.05*	0.06*	-0.01*	0.00	-0.25*	1.00							
(11) ROE	0.06*	-0.00	0.03*	0.00	0.06*	-0.08*	-0.12*	0.04*	0.22*	-0.10*	1.00						
(12) LEV	0.11*	0.01*	-0.03*	0.01*	-0.03*	0.03*	-0.15*	0.02*	0.15*	0.10*	0.08*	1.00					
(13) IO	0.03*	-0.00	0.02*	0.01*	0.03*	-0.07*	-0.03*	0.03*	0.24*	-0.07*	0.08*	-0.10*	1.00				
(14) $ANALYSTS$	0.06*	-0.07*	-0.07*	0.01*	0.03*	-0.10*	-0.23*	0.06*	0.74*	-0.18*	0.11*	0.03*	0.25*	1.00			
(15) $DISP$	0.08*	-0.00	-0.04*	-0.00	-0.13*	0.10*	0.07*	0.02*	0.11*	0.12*	-0.11*	0.11*	0.06*	0.07*	1.00		
(16) $LAGVOL$	0.03*	-0.01	-0.03*	0.01*	-0.00	-0.03*	-0.06*	-0.02*	0.26*	-0.22*	0.10*	-0.03*	0.10*	0.18*	0.26*	1.00	
(17) $LAGRET$	-0.00	-0.06*	0.02*	-0.01*	0.10*	-0.08*	0.01*	0.03*	-0.06*	0.06*	0.01*	-0.00	-0.01*	-0.01*	-0.03*	-0.00	1.00

* indicates significance at the 5% level.

Table 2: Panel A, Summary Statistics for PO and PC

Table 2, Panel A reports summary statistics for PO and PC announcements separately. Panel B reports regression results of changes in *PO* on changes in various announcement and firm characteristics. See Table 1 for variable definitions. Standard errors are clustered by announcement date and t-statistics are in parentheses in Panel B. *, **, and *** denote two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

	PO (N=41,066)	PC (N=44,809)	Diff	t-stat
$ABVOL$	117.54	91.61	25.93***	10.94
$ABVOLUME$	131.06	132.56	-1.50	-1.13
$ABRET$	0.00	0.00	0.00	0.82
UE	0.02	0.03	-0.01*	-1.69
$NEGUE$	0.34	0.34	0.01**	2.30
$REPLAG$	3.44	3.46	-0.02***	-6.20
$Q4$	0.23	0.21	0.02***	3.75
$SIZE$	7.57	7.00	0.57***	43.87
BM	-0.81	-0.87	0.06***	10.05
ROE	0.02	0.01	0.01***	14.69
LEV	0.56	0.51	0.05***	31.17
IO	0.71	0.70	0.02***	8.94
$ANALYSTS$	13.32	12.26	1.06***	15.77
$DISP$	0.05	0.04	0.01***	20.91
$LAGVOL$	2.08	1.97	0.12***	8.04
$LAGRET$	0.03	0.03	0.00	-0.13

Table 2: Panel B, Regression Analysis on Changes in Earnings Announcement Times

	(1) ΔPO
ΔUE	0.00
	(1.43)
$\Delta NEGUE$	-0.00
	(-1.38)
$\Delta REPLAG$	0.02***
	(3.77)
$\Delta Q4$	-0.00
	(-0.38)
$\Delta SIZE$	0.01
	(0.98)
ΔBM	-0.00
	(-0.51)
ΔROE	0.00
	(0.25)
ΔLEV	-0.01
	(-0.50)
ΔIO	-0.01
	(-0.95)
$\Delta ANALYSTS$	-0.00
	(-0.39)
$\Delta DISP$	-0.01
	(-0.52)
$\Delta LAGVOL$	-0.00
	(-0.99)
$\Delta LAGRET$	-0.00
	(-0.22)
Constant	-0.00
	(-0.78)
# Observations	80,542
R^2	0.00

Table 3: Panel A, Univariate Abnormal Volatility for PO and PC Announcements

Table 3 Panel A presents the univariate daily $ABVOL$ from day -5 to +5, where day +1 is the first trading day after which earnings are announced, by PO and PC. Panel B presents results of daily multivariate regressions of $ABVOL$ on PO and various controls. Panel C presents the same tests as Panel B, but measures $ABVOL$ only during regular trading hours from the market open to the market close. Panel D presents regressions of daily $ABVOL$ on PO with firm fixed effects. Panel E utilizes a first differences model and regresses the change in $ABVOL$ from the same day in the prior quarter on the change in PO and controls. Controls in Panels C through E are the same as those in Panel B. See Table 1 for variable definitions. Standard errors are clustered by earnings announcement date. *, **, and *** denote two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

	PO (N=41,066)	PC (N=44,809)		
	Mean	Mean	Diff	t-stat
$t = -5$	3.82	3.91	-0.09	-0.10
$t = -4$	5.17	4.89	0.28	0.28
$t = -3$	5.44	6.65	-1.21	-1.22
$t = -2$	8.45	11.89	-3.43***	-3.67
$t = -1$	23.32	33.23	-9.91***	-10.24
$t = +1$	176.97	192.25	-15.28***	-10.96
$t = +2$	63.69	46.91	16.78***	16.06
$t = +3$	27.27	23.64	3.63***	3.53
$t = +4$	16.60	12.91	3.69***	3.79
$t = +5$	9.98	8.15	1.83*	1.76
$t = +2 \rightarrow +5$	117.54	91.61	25.93***	10.94

Table 3: Panel B, Multivariate Abnormal Volatility

	(1) $t=-5$	(2) $t=-4$	(3) $t=-3$	(4) $t=-2$	(5) $t=-1$	(6) $t=+1$	(7) $t=+2$	(8) $t=+3$	(9) $t=+4$	(10) $t=+5$	(11) $t=+2 \rightarrow +5$
PO	-0.30	-0.29	-1.84*	-3.88***	-9.50***	-12.50***	18.05***	4.81***	3.76***	1.70	28.32***
	(-0.33)	(-0.30)	(-1.81)	(-4.13)	(-9.65)	(-9.89)	(17.15)	(4.72)	(3.81)	(1.62)	(12.00)
UE	-1.27***	-0.23	-0.10	-0.39	-0.23	2.35***	-0.37	-0.51	-0.71*	-0.64	-2.25*
	(-3.14)	(-0.57)	(-0.24)	(-0.91)	(-0.55)	(4.16)	(-0.86)	(-1.13)	(-1.65)	(-1.39)	(-1.66)
NEGUE	-1.29*	-1.63**	-0.37	0.29	-1.76***	11.33***	3.22***	1.16	1.86**	0.89	7.13***
	(-1.93)	(-2.41)	(-0.55)	(0.45)	(-2.81)	(11.85)	(4.38)	(1.62)	(2.50)	(1.30)	(3.52)
REPLAG	4.74**	2.18	3.32	2.43	1.94	15.90***	8.81***	8.87***	5.78**	4.83**	28.29***
	(2.49)	(1.07)	(1.60)	(1.06)	(0.81)	(5.92)	(3.58)	(3.34)	(2.28)	(2.05)	(3.29)
Q4	-7.44***	-6.78***	-6.42***	-5.09***	-6.90***	-6.46***	-5.84***	-7.96***	-8.23***	-8.85***	-30.87***
	(-5.30)	(-4.77)	(-4.41)	(-3.23)	(-4.01)	(-3.05)	(-3.29)	(-4.07)	(-4.45)	(-4.92)	(-4.83)
SIZE	0.02	0.23	-0.33	-0.74**	-0.61*	1.58***	-1.59***	-1.91***	-1.14***	-0.88**	-5.52***
	(0.07)	(0.73)	(-1.02)	(-2.37)	(-1.80)	(3.93)	(-4.55)	(-5.63)	(-3.43)	(-2.54)	(-5.66)
BM	1.43***	2.03***	1.76***	1.26***	-0.16	-6.21***	0.47	0.27	1.62***	1.79***	4.15***
	(3.11)	(4.38)	(3.83)	(2.77)	(-0.35)	(-9.75)	(0.93)	(0.55)	(3.33)	(3.82)	(2.99)
ROE	-6.55*	-5.68	-1.10	6.91*	8.51**	79.14***	15.08***	5.26	2.96	0.81	24.11**
	(-1.76)	(-1.50)	(-0.29)	(1.93)	(2.28)	(14.36)	(3.54)	(1.30)	(0.74)	(0.21)	(2.14)
LEV	7.13***	2.95**	4.98***	2.33	1.39	-18.34***	5.51***	6.70***	10.79***	9.42***	32.42***
	(4.84)	(2.01)	(3.21)	(1.60)	(0.87)	(-8.38)	(3.21)	(4.19)	(6.93)	(6.15)	(7.22)
IO	-0.12	2.02	1.35	1.00	5.01***	73.89***	12.92***	0.83	-1.22	-2.34	10.19**
	(-0.09)	(1.30)	(0.89)	(0.69)	(3.34)	(39.67)	(7.72)	(0.55)	(-0.81)	(-1.45)	(2.28)
ANALYSTS	-0.02	-0.00	0.08*	0.16***	0.17***	0.36***	-0.25***	-0.20***	-0.21***	-0.11**	-0.77***
	(-0.35)	(-0.02)	(1.68)	(3.30)	(3.39)	(5.41)	(-4.97)	(-4.21)	(-4.30)	(-2.18)	(-5.71)
DISP	-17.34***	-9.76*	-5.06	6.97	-18.01***	-34.02***	-20.44***	-2.83	-2.20	1.76	-23.71
	(-3.03)	(-1.71)	(-0.88)	(1.23)	(-3.22)	(-4.57)	(-3.28)	(-0.46)	(-0.37)	(0.30)	(-1.39)
LAGVOL	1.24***	0.78***	0.53***	0.44***	0.32**	-1.13***	-0.06	0.44**	0.63***	0.39**	1.40***
	(7.49)	(4.60)	(3.17)	(2.70)	(1.98)	(-4.80)	(-0.34)	(2.45)	(3.50)	(2.34)	(2.80)
LAGRET	-22.69***	-23.67***	-19.76***	-20.64***	-18.41***	-10.40***	-17.64***	-10.84***	-18.26***	-18.30***	-65.04***
	(-10.84)	(-11.10)	(-9.63)	(-9.55)	(-7.53)	(-3.65)	(-6.55)	(-3.98)	(-7.21)	(-6.93)	(-7.35)
Constant	-17.65**	-4.39	-3.84	8.83	30.70***	89.05***	25.97***	4.75	-1.36	-5.50	23.86
	(-2.37)	(-0.55)	(-0.49)	(1.06)	(3.30)	(7.90)	(2.72)	(0.46)	(-0.14)	(-0.60)	(0.73)
# Observations	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875
R^2	0.01	0.01	0.01	0.01	0.02	0.14	0.03	0.02	0.02	0.02	0.04
Year and Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3: Panel C, Open to Close Abnormal Volatility

	(1) $t=-5$	(2) $t=-4$	(3) $t=-3$	(4) $t=-2$	(5) $t=-1$	(6) $t=+1$	(7) $t=+2$	(8) $t=+3$	(9) $t=+4$	(10) $t=+5$	(11) $t=+2 \rightarrow +5$
PO	-0.84	-0.17	-1.09	-4.31***	-8.81***	-2.64**	15.81***	5.44***	4.54***	2.15*	27.94***
	(-0.87)	(-0.16)	(-1.01)	(-4.44)	(-8.56)	(-2.24)	(14.88)	(5.21)	(4.45)	(1.93)	(11.32)
# Observations	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875
R^2	0.01	0.01	0.01	0.01	0.02	0.14	0.03	0.02	0.02	0.02	0.04
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3: Panel D, Abnormal Volatility with Firm Fixed Effects

	(1) $t=-5$	(2) $t=-4$	(3) $t=-3$	(4) $t=-2$	(5) $t=-1$	(6) $t=+1$	(7) $t=+2$	(8) $t=+3$	(9) $t=+4$	(10) $t=+5$	(11) $t=+2 \rightarrow +5$
PO	1.04	0.31	-0.54	-1.37	-8.08***	-6.07***	18.58***	5.88***	3.77***	2.47*	30.70***
	(0.77)	(0.23)	(-0.37)	(-1.00)	(-5.43)	(-3.37)	(12.64)	(4.09)	(2.72)	(1.68)	(8.24)
# Observations	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875
R^2	0.08	0.08	0.08	0.08	0.10	0.30	0.12	0.09	0.09	0.09	0.12
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm, Year, and Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3: Panel E, First Differences Abnormal Volatility

	(1) $t=-5$	(2) $t=-4$	(3) $t=-3$	(4) $t=-2$	(5) $t=-1$	(6) $t=+1$	(7) $t=+2$	(8) $t=+3$	(9) $t=+4$	(10) $t=+5$	(11) $t=+2 \rightarrow +5$
ΔPO	-0.32	1.37	0.06	-5.42***	-9.63***	-3.16	19.46***	7.49***	4.90***	3.63*	35.48***
	(-0.17)	(0.72)	(0.03)	(-2.86)	(-4.88)	(-1.35)	(9.45)	(3.81)	(2.61)	(1.85)	(6.63)
# Observations	81,095	81,095	81,095	81,095	81,095	81,095	81,095	81,095	81,095	81,095	81,095
R^2	4,507	4,507	4,507	4,507	4,507	4,507	4,507	4,507	4,507	4,507	4,507
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4: Panel A, Abnormal Volume

Table 4, Panel A presents the results of regressions of $ABVOLUME$ on PO from day -5 to +5, where day +1 is the first trading day after the earnings announcement. Panel B presents the daily regressions of $ABRET$ on PO. Controls represent the same controls used in Table 3, Panel B. See Table 1 for variable definitions. Standard errors are clustered by the earnings announcement date. T-stats are in parentheses. *, **, and *** denote two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) $t=-5$	(2) $t=-4$	(3) $t=-3$	(4) $t=-2$	(5) $t=-1$	(6) $t=+1$	(7) $t=+2$	(8) $t=+3$	(9) $t=+4$	(10) $t=+5$	(11) $t=+2 \rightarrow +5$
PO	0.35	-0.78	-1.97***	-3.42***	-6.63***	-10.85***	2.50***	1.99***	0.75	0.44	5.69***
	(0.69)	(-1.46)	(-3.77)	(-6.66)	(-13.06)	(-18.24)	(4.32)	(3.90)	(1.44)	(0.87)	(4.27)
# Observations	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875
R^2	0.00	0.00	0.01	0.01	0.07	0.14	0.05	0.03	0.02	0.01	0.04
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4: Panel B, Abnormal Returns

	(1) $t=-5$	(2) $t=-4$	(3) $t=-3$	(4) $t=-2$	(5) $t=-1$	(6) $t=+1$	(7) $t=+2$	(8) $t=+3$	(9) $t=+4$	(10) $t=+5$	(11) $t=+2 \rightarrow +5$
PO	-0.00	0.00	-0.00	-0.00	0.00	0.00	0.00	0.00	-0.00	-0.00	-0.00
	(-0.03)	(0.24)	(-0.25)	(-0.15)	(0.87)	(0.89)	(0.57)	(0.22)	(-0.83)	(-0.30)	(-0.24)
# Observations	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875	85,875
R^2	0.01	0.00	0.00	0.00	0.00	0.12	0.01	0.00	0.00	0.00	0.01
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: Market Return Reaction to Earnings Announcements

Table 5 presents two tests on the relation between the market's reaction to the earnings announcement and PO. Panel A regresses the pre-announcement (day -5 to -1), announcement (day +1), and post-announcement (day +2 to +5) abnormal returns ($ABRET \times 100$) on PO, UE, and the interaction of PO and UE. Columns 1-3 use the continuous measure of UE as defined in Table 1. Columns 4-6 use deciles of UE to account for outliers. Panel B regresses the intraperiod timeliness measure (IPT) on PO. See Section 4.3 for further discussion of the IPT measure. Controls represent the same controls used in Table 3, Panel B. See Table 1 for remaining variable definitions. Standard errors are clustered by earnings announcement date. T-stats are in parentheses. *, **, and *** denote two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Announcement Day Abnormal Returns

	$ABRET \times 100$					
	(1) $t=-5 \rightarrow -1$	(2) $t=+1$	(3) $t=+2 \rightarrow +5$	(4) $t=-5 \rightarrow -1$	(5) $t=+1$	(6) $t=+2 \rightarrow +5$
$PO \times UE$	0.09	-0.14**	0.12*			
	(1.28)	(-2.48)	(1.73)			
$PO \times UE^{Decile}$				-0.00	-0.06***	0.07***
				(-0.05)	(-4.71)	(4.65)
PO	0.02	0.03	-0.01	0.02	0.05	-0.00
	(0.40)	(0.79)	(-0.30)	(0.50)	(1.10)	(-0.04)
UE	0.42***	1.81***	0.63***			
	(5.58)	(23.50)	(7.79)			
UE^{Decile}				0.10***	0.68***	0.11***
				(7.49)	(43.70)	(7.78)
$NEGUE$	-0.33***	-3.13***	-0.32***	-0.14	-0.80***	0.52***
	(-7.50)	(-61.01)	(-6.47)	(-1.38)	(-7.43)	(5.26)
$NEGUE \times UE$	-0.32***	-1.41***	-0.43***			
	(-3.20)	(-17.71)	(-4.32)			
$NEGUE \times UE^{Decile}$				-0.03	-0.05	0.16***
				(-0.75)	(-1.27)	(4.37)
# Observations	85,875	85,875	85,875	85,875	85,875	85,875
R^2	0.01	0.12	0.01	0.01	0.14	0.01
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year and Industry FE	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Intraperiod Timeliness of Returns

	(1)	(2)
PO	-0.21***	-0.21***
	(-4.74)	(-4.74)
UE	0.04	
	(1.40)	
UE^{Decile}		0.03**
		(2.57)
# Observations	84,106	84,106
R^2	0.00	0.00
Controls	Yes	Yes
Year and Industry FE	Yes	Yes

Table 6: Panel A, Propensity Model

Table 6 presents the results of the propensity score matching process. Panel A presents the propensity model for PO. CST, MST, and PST are indicators variables for whether the firm's headquarters is in the Central, Mountain, or Pacific time zone, respectively. Panel B presents the covariate balance of the matched sample. Panel C presents the regression results of $ABVOL$ on PO. Controls in Panel C are the same as those in Table 3, Panel B. See Table 1 for variable definitions. Standard errors are clustered by the earnings announcement date. T-stats are in parentheses. *, **, and *** denote two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) PO
UE	-0.00
	(-0.02)
$NEGUE$	0.05***
	(3.12)
$REPLAG$	-0.23***
	(-4.70)
$Q4$	0.14***
	(4.10)
$SIZE$	0.31***
	(35.75)
BM	0.18***
	(14.46)
ROE	0.03
	(0.24)
LEV	0.31***
	(8.34)
IO	-0.05
	(-1.32)
$ANALYSTS$	-0.02***
	(-15.22)
$DISP$	1.43***
	(9.24)
$LAGVOL$	-0.02***
	(-4.60)
$LAGRET$	0.08
	(1.49)
CST	-0.18***
	(-9.99)
MST	-0.53***
	(-15.88)
PST	-1.24***
	(-47.93)
$Constant$	-0.44**
	(-2.36)
# Observations	85,875
R^2	0.10
Industry FE	Yes

Table 6: Panel B, Matched Sample Covariate Balance

	PO (n=30,719)	PC (n=30,719)		
	Mean	Mean	Diff	t-stat
UE	0.012	0.009	0.003	0.47
$NEGUE$	0.353	0.354	-0.001	-0.17
$REPLAG$	3.466	3.462	0.004	1.09
$Q4$	0.218	0.219	-0.001	-0.14
$SIZE$	7.152	7.152	0.000	0.02
BM	-0.807	-0.806	-0.001	-0.10
ROE	0.019	0.019	0.000	-0.58
LEV	0.547	0.550	-0.003	-1.51
IO	0.706	0.702	0.004**	2.20
$ANALYSTS$	12.142	12.067	0.075	1.02
$DISP$	0.042	0.041	0.001	1.40
$LAGVOL$	2.039	2.011	0.028	1.53
$LAGRET$	0.032	0.031	0.001	0.11

Table 6: Panel C, Regression with Propensity Matched Sample of Abnormal Volatility on PO

	(1) $t=-5$	(2) $t=-4$	(3) $t=-3$	(4) $t=-2$	(5) $t=-1$	(6) $t=+1$	(7) $t=+2$	(8) $t=+3$	(9) $t=+4$	(10) $t=+5$	(11) $t=+2 \rightarrow +5$
PO	-0.36	0.04	-1.78*	-3.95***	-9.56***	-10.66***	18.17***	4.97***	3.36***	1.10	27.61***
	(-0.37)	(0.04)	(-1.66)	(-3.90)	(-9.41)	(-8.11)	(16.39)	(4.63)	(3.18)	(1.00)	(10.67)
# Observations	61,438	61,438	61,438	61,438	61,438	61,438	61,438	61,438	61,438	61,438	61,438
R^2	0.01	0.01	0.01	0.01	0.02	0.14	0.03	0.02	0.02	0.02	0.04
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: Non-Earnings Announcement Date Placebo Tests

Table 7 presents the results of non-earnings announcement date placebo tests. Columns 1-3 present the results of regressing preannouncement (days -5 to -1), announcement (day +1), and post-announcement (days +2 to +5) *ABVOL* on *PO* using a placebo date 21 calendar days prior to the actual earnings announcement date. Columns 4-6 replaces the earnings announcement date with a common event, the Federal Reserve meeting announcement dates. Controls represent the same controls used in Table 3, Panel B. See Table 1 for variable definitions. Standard errors are clustered by earnings announcement date. T-stats are in parentheses. *, **, and *** denote two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

	-21 Day Placebo Date *ABVOL*			Federal Reserve Announcement Date *ABVOL*		
	(1) $t = -5 \rightarrow -1$	(2) $t = +1$	(3) $t = +2 \rightarrow +5$	(4) $t = -5 \rightarrow -1$	(5) $t = +1$	(6) $t = +2 \rightarrow +5$
PO	-0.45	0.40	-0.10	-0.32	0.03	-0.30
	(-0.72)	(0.53)	(-0.15)	(-0.46)	(0.04)	(-0.46)
# Observations	82,763	82,763	82,763	154,772	154,772	154,772
R^2	0.05	0.01	0.03	0.04	0.04	0.03
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year and Industry FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 8: Panel A, Speed of Information Processing and Announcement Timing

Table 8, Panel A presents the results of regressions of three information processing speed proxies on *PO* and various controls. The information processing proxies are measured over the pre-announcement (days -5 to -1), announcement (day +1), and post-announcement (days +2 to +5) windows. In columns 1-3, $REVISIONS\%$ is the number of unique analysts issuing a forecast revision over a given window divided by the total number of unique analysts revising from days -5 to +5 around the earnings announcement. In columns 4-6, $DOWNLOADS\%$ is the number of EDGAR downloads over a given window divided by the total number of EDGAR downloads from days -5 to +5 around the earnings announcement. In columns 7-9, $NEWS\%$ is the number of news stories over a given window divided by the total number of news stories from days -5 to +5 around the earnings announcement. Panel B presents the results of regressions of *ABVOL* on *PO* including proxies for information processing as controls. $REVISIONS$ are the number of unique analysts issuing forecast revisions in a given window divided the number of analysts covering the firm ($ANALYSTS$). $DOWNLOADS$ are the abnormal EDGAR downloads in given window, calculated as the sum of daily downloads less the average downloads per day over the prior year (excluding earnings announcement windows). $NEWS$ are the abnormal news stories published in given window, calculated as the sum of daily news stories less the average news stories per day over the prior year (excluding earnings announcement windows). Controls represent the same controls used in Table 3. Controls represent the same controls used in Table 3, Panel B. See Table 1 for variable definitions. Standard errors are clustered by earnings announcement date. T-stats are in parentheses. *, **, and *** denote two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

	$REVISIONS\%$			$DOWNLOADS\%$			$NEWS\%$		
	(1) $t=-5\rightarrow-1$	(2) $t=+1$	(3) $t=+2\rightarrow+5$	(4) $t=-5\rightarrow-1$	(5) $t=+1$	(6) $t=+2\rightarrow+5$	(7) $t=-5\rightarrow-1$	(8) $t=+1$	(9) $t=+2\rightarrow+5$
PO	0.21**	-33.76***	33.54***	-0.46***	-2.62***	3.08***	0.55***	-1.53***	0.98***
	(2.41)	(-117.12)	(110.23)	(-4.03)	(-30.19)	(25.78)	(3.86)	(-8.21)	(6.94)
# Observations	84,307	84,307	84,307	69,769	69,769	69,769	53,344	53,344	53,344
R^2	0.10	0.47	0.44	0.02	0.05	0.03	0.04	0.10	0.07
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 8: Panel B, Abnormal Volatility, Information Processing, and Announcement Timing

	ABVOL		
	(1) $t = -5 \rightarrow -1$	(2) $t = +1$	(3) $t = +2 \rightarrow +5$
PO	-16.95***	-6.93***	11.19***
	(-6.34)	(-4.44)	(3.32)
REVISIONS	1.42***	0.35***	0.52***
	(12.94)	(13.42)	(9.77)
DOWNLOADS	0.04**	0.16***	0.12***
	(2.37)	(9.82)	(6.61)
NEWS	1.39***	1.33***	1.69***
	(10.71)	(23.85)	(10.38)
# Observations	44,726	44,726	44,726
R^2	0.04	0.18	0.05
Controls	Yes	Yes	Yes
Year and Industry FE	Yes	Yes	Yes

Table 9: Robustness Tests

Table 9 presents the results of regressions of $ABVOL$ on PO with controls for possible alternative explanations. Abnormal volatility is measured over the pre-announcement (days -5 to -1), announcement (day +1), and post-announcement (days +2 to +5) windows. In columns 1-3, $CONFCALL$ is an indicator for whether the firm holds a conference call in a given window. In columns 4-6, CST, MST, and PST are indicator variables for whether the firm is headquartered in the Central, Mountain, or Pacific time zones, respectively. In columns 7-9, $LEADTIME$ is the natural log of the number of days between the date on which the firm schedules its earnings announcement and the announcement date. In columns 10-12, $EAFREQ$ is the decile of the number of concurrent earnings announcements on the same day. Controls represent the same controls used in Table 3. See Table 1 for variable definitions. Standard errors are clustered by earnings announcement date. T-stats are in parentheses. *, **, and *** denote two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

	Conference Calls			Time Zones			Announcement Lead Time			Concurrent Announcements		
	(1) $t=-5 \rightarrow -1$	(2) $t=1$	(3) $t=+2 \rightarrow +5$	(4) $t=-5 \rightarrow -1$	(5) $t=+1$	(6) $t=+2 \rightarrow +5$	(7) $t=-5 \rightarrow -1$	(8) $t=1$	(9) $t=+2 \rightarrow +5$	(10) $t=-5 \rightarrow -1$	(11) $t=1$	(12) $t=+2 \rightarrow +5$
PO	-15.83***	-11.16***	28.27***	-15.97***	-12.19***	27.65***	-17.93***	-13.48***	28.28***	-15.23***	-11.52***	28.66***
	(-7.36)	(-8.81)	(12.02)	(-7.24)	(-9.54)	(11.34)	(-8.23)	(-10.71)	(12.06)	(-7.09)	(-9.44)	(12.21)
$CONFCALL$	-4.75	53.43***	2.39									
	(-0.10)	(31.14)	(0.32)									
CST				2.72	5.69***	5.29***						
				(1.42)	(6.37)	(2.83)						
MST				-2.70	1.15	-0.05						
				(-0.70)	(0.66)	(-0.01)						
PST				0.37	4.54***	-3.85*						
				(0.16)	(4.21)	(-1.80)						
$LEADTIME$							-1.49	3.73***	2.46*			
							(-1.20)	(6.56)	(1.95)			
$EAFREQ$										0.72***	-2.45***	1.52***
										(3.53)	(-6.97)	(5.25)
# Observations	85,875	85,875	85,875	84,606	84,606	84,606	77,138	77,138	77,138	85,875	85,875	85,875
R^2	0.03	0.16	0.04	0.03	0.14	0.04	0.03	0.13	0.04	0.03	0.14	0.04
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 10: Panel A: Returns on Volatility Regressions

Table 10, Panel A presents results of regressions of option strategy returns (multiplied by 100) on *PO*. Delta Hedge and Straddle represent the return on a delta hedge and straddle position, respectively, from days 2 through 5, where day 1 is the first trading day after the earnings announcement. Panel B presents portfolio returns on the given strategies sorted by quintiles of size and historical volatility. Controls represent the same controls used in Table 3. See Table 1 for variable definitions. Standard errors are clustered by earnings announcement date. T-stats are in parentheses. *, **, and *** denote two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

	Delta Hedge		Straddle	
	(1)	(2)	(3)	(4)
PO	0.30***	0.24***	2.23***	1.74***
	(7.16)	(5.30)	(8.86)	(6.80)
# Observations	56,273	56,273	51,759	51,759
R^2	0.00	0.01	0.00	0.01
Controls	No	Yes	No	Yes
Year and Industry FE	No	Yes	No	Yes

Table 10: Panel B, Portfolio Sorts of Option Strategy Retuns Based on PO Strategy

PO versus PC Strategy Sorted on Size					
		Delta Hedge		Straddle	
		Mean	t-stat	Mean	t-stat
$SIZE(\downarrow)$	1 (Low)	0.41***	4.57	1.98***	4.62
	2	0.30***	4.50	1.50***	3.34
	3	0.24***	4.25	1.19***	2.60
	4	0.23***	4.43	1.25***	2.67
	5 (High)	0.20***	4.85	2.87***	5.63

PO versus PC Strategy Sorted on Historical Volatility					
		Delta Hedge		Straddle	
		Mean	t-stat	Mean	t-stat
$LAGVOL(\downarrow)$	1 (Low)	0.25***	3.57	1.88***	4.42
	2	0.35***	5.82	2.05***	4.72
	3	0.30***	4.73	2.39***	5.20
	4	0.26***	4.60	1.79***	3.89
	5 (High)	0.29***	4.80	2.78***	5.72