

Night Fever: Investor Inattention and the Timing of Corporate Filings

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ABSTRACT

This paper studies the strategic release of relevant corporate news. Most aspects of relevant news disclosures are regulated, but firms retain flexibility about timing them within the day. We document new stylized facts about investor attention and trading opportunities which create three distinct regimes within the after-trading-hours period. Firms strategically select the regime to release news, leading to sharp discontinuities in news characteristics across sub-periods: (1) big news is released right after market closure allowing for trading opportunities without price feedback, (2) complex news later in the evening when investor attention is maximized, and (3) bad news is more frequent in the overnight period, where an informational blackout generates minimal investor attention.

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I. Introduction

The strategic release of information is a fundamental topic in economics. Agents constantly send and receive information. When disclosing information, senders need to decide when to release and recipients how to allocate attention to information and act accordingly. The interplay between the sender and the recipient shapes the information release and subsequent actions in the presence of asymmetric information, limited attention and conflicts of interest. Understanding this interaction empirically is both central as a fundamental question but also instrumental in many economic applications.

We study the interplay between attention and strategic release of news in the context of the intraday timing of corporate news. Corporate news is a great setting to study the interaction between senders and recipients of information for several reasons. First, regulation requires public firms to disclose relevant news in a standardized way that leaves little freedom in terms of content and format except for the timing of the news release. The timing of news is a good object of interest because it is a strategic decision of the sender, it is well defined empirically and it affects the recipient's response. Second, corporate disclosures are publicly recorded, with rich information about the timing and content of news, characteristics of the sender, as well as actions of recipients. Third, institutional characteristics shape the distribution of attention and the ability to act upon corporate information at different times of the day, resulting into distinctly identifiable regimes.

In this paper, we focus on the timing of news as one major element of information release that affects the interpretation of the message. We focus on the time of the day that firms choose to release official news online. We show that the intra-day timing of news is related to their content and format, as well as with the predisposition of the recipient to process the message and react to it. In order to isolate the decisions of firms from the reaction of investors, we require variation in attention and trading opportunities that is unrelated to the supply of news. We uncover a rich institutional structure within the day that shapes distinct regimes in attention and ability to trade.

These novel stylized facts are interesting themselves because these regimes distinctly shape stock market activity and may explain other phenomena in asset pricing. We use the different intra-day institutional regimes to assess the strategic reaction of firms to different levels of attention and investor activity.

Based on the opening times of the stock market and the SEC reporting system, we show that the after-market hours consist of three periods that differ significantly in terms of attention, opportunities to trade, price formation, and opacity. i) An early period (4.00-4.45pm) in which both investor attention and over the counter (OTC) liquidity is high. ii) A late period (4.45-5.30pm) in which investor attention is high but liquidity is low. iii) An overnight period after the closing of the SEC filing system in which there is an informational blackout from 5.30pm-6am. Filings submitted during that time are stored overnight and become available simultaneously the next day at 6 am. This creates a decrease of information flow throughout the night as well as an information overload on the morning that decreases investors' attention per filing. We are the first ones to document the existence this informational blackout that results in very low investor attention. These regimes translate into different optimal disclosure strategies within the afternoon.

First, we show that attention indeed fluctuates between regimes, using the actual number of downloads of filings. In particular, attention peaks between 4-5.30pm, whereas liquidity in OTC slowly decreases and disappears in the late period (4.45-5.30pm). Unlike the existing literature, we document that attention is higher rather than lower for after-hours filings, with the exception of the overnight filings that become visible in large numbers at the same time the next morning.

Based on the stylized facts we propose that firms release news strategically into the three regimes based on the nature of the news. First, firms with simple but important news can benefit from delayed liquidity and a slow price formation without trading halts or too much price feedback. These firms should disclose news in the early after-hours period (right after 4pm). A second set of firms with news that are difficult to process, long, complex or that require a deep understanding can benefit from more attention and a long delay to the market opening. These firms should

disclose news at the end of the after-hours period (just before 5:30pm), when OTC markets have become illiquid and readers still have a long time until the official market opening. Finally, firms with negative news can benefit from inattention to overnight filings (after 5:30pm) but can only successfully obfuscate if this is part of a mixed strategy in intra-day timing. Therefore, we expect negative information throughout the period as well as overnight.

We find evidence for strategic timing of news within the after-hours. The nature of and reaction to filings in the three slots are distinctly different. i) News disclosed at the beginning of the after-hours period are relevant (i.e. big news) but simple to understand, (ii) news disclosed at the end of the period are more complex, and (iii) negative news are disclosed throughout the whole after-market period, but they are more frequent in the overnight period. The effects are sharply discontinuous at the relevant thresholds. While the effects are similar within and between firms, the time patterns for complexity and relevance are stronger within firm and patterns in predictable negativity stronger in the cross-section. News that seem negative on first inspection but turn out to be not so negative are abnormally represented in the late after-hours period, when attention is high, but prices are not posted simultaneously. These results jointly suggests that firms strategically allocate the timing of their news based on their relevance and complexity; obfuscation, in contrast, seems more prevalent in certain firms.

As trading and information processing speed has accelerated over the recent decades, knowledge of intraday disclosure pattern has become more relevant. Understanding strategic disclosure decisions in the after-market time period is particularly important because the majority of news is released in this time period. Consistent with major news arrivals during the market closure periods, recent literature documents that major return movements happen overnight (Cliff et al., 2008; Lou et al., 2015).

While theoretical literature suggests that there should be differences between trading-hours and after-hours news (Gennotte and Trueman, 1996), previous empirical findings (Doyle and Magilke, 2009; Michaely et al., 2013; Patell and Wolfson, 1982; deHaan et al., 2015; and Niessner, 2015) are

contradictory to each other. We show that these results can be reconciled once we take into account the variation in attention and liquidity between specific sub-periods after-hours. We also depart from the previous literature in the type of news we study. We follow Niessner (2015) and use a sample of news that, unlike earnings announcements are unexpected and not pre-scheduled. Scheduling of announcements can change attention patterns (Boulland and Dessaint, 2015) and as a consequence the impact of the time of day of the announcement itself can become secondary. We use a comprehensive sample of 581,954 8-K filings. These are mandatory disclosure filings of unexpected but material events. Our sample covers the universe of 8-K filings by U.S. firms filed between 2003 and 2012. These filings have more advantages: first, firms have discretion about the timing of disclosure within a week of the event. This makes 8-K filings an ideal sample to study strategic timing decisions. Second, 8-K filings are pre-classified into so-called “items”, which are categories describing their content. Therefore, they do not require our discretion in describing their content.

More generally, understanding how firms strategically chose the timing of disclosure is not only important for after-hours specifically but for the general interpretation of information as a strategic choice. More opacity can keep the valuations of investors more compact in the presence of investor specific preferences for given types of firms (Johnson and Myatt, 2006; Bar-Isaac, Caruana, Cuñat 2012). However, opacity can also generates disagreement that can have price implications (Hong and Stein, 2007).

Besides describing the rich institutional structure of the after-hours period and establishing the motives for strategic timing of news within this period, our results imply that the timing of news is not exogenous. Firms strategically choose when to release news, even within the time periods of one day. Our finding that the timing of disclosure is strategic has implications for this literature as well as the wider literature on news and asset pricing which often takes the arrival of news as exogenous. We hope that our findings will help future research in interpreting the content or reactions to news.

II. The After-Hours

This section describes the institutional background, our sample and data, and establishes stylized facts about the intraday patterns of filing volume, and reading attention.

2.1 Institutional Background

In the U.S., relevant news by publicly listed firms must be filed with the Security Exchange commission (SEC), which provides our setting to study the timing of news. In particular, the differing opening times of trading markets and the SEC's filing system provide us with institutional differences in investor attention, liquidity and price posting within the day. This section introduces the institutional background of these opening times.

Filing times

All public companies in the United States must file periodic statements and reports to the SEC. Starting from 1996, these reports must be filed electronically via the SEC's Electronic Data Gathering, Analysis, and Retrieval system (EDGAR). Since 2003, all those reports are available for download by the general public via the EDGAR website. We crawl the filing and acceptance date for all filings made between January 1, 2003 and December 31, 2012.

The filing system is open to receive filings from 8am to 10pm Eastern Standard Time on working days. All files undergo an automated acceptance review which takes a variable amount of time "no more than a couple of minutes" (Griffin, 2003). The time of acceptance is registered and publicly available at the site of the filing. Filings accepted between 6:00am and 5:30pm are posted in the

EDGAR website immediately. When filings are accepted after 5.30pm, they are temporarily stored and become visible at 6am on the next morning.²

Figure I shows the distribution of the number of filings throughout the day. The dashed line depicts the filings through the hours in which EDGAR is closed: these filings accumulate throughout the night and all become simultaneously visible at 6am. After the posting of overnight filings at 6am, filing volume gradually picks up throughout the day, up to 8,995 filings made in the last ten minutes before 4pm. By 4pm, 52% of all filings have been made.

After the market closes at 4pm, filing volume jumps dramatically, with 26,456 filings made in the first ten minutes, or 4.6% of the total daily volume. Filing volume decreases somewhat in the next hour, to 20,383 filed between 4.50 and 4.59pm. At the start of the Late After-hours shift at 5pm, filing volume increases abruptly again to 27,299 filings in the first ten minutes and stays on that level until EDGAR closes at 5.30pm.

Trading times and markets

Since 1985, the regular hours for trading on stock exchanges in the United States have been between 9.30 am and 4pm Eastern Standard Time (“trading hours”).³ Outside the opening times, shares can be traded over the counter. Over-the-counter (OTC) markets are less liquid and more opaque. Prices are not posted in real-time.⁴ OTC trading outside trading hours is the most liquid in the hours just before (“pre-market”) and after (“after-hours”) trading hours. There are no official

² Filings accepted before 5.30pm become visible first through a provider for paid clients and, after a delay of not more than 10 minutes, to the general public (Jackson et al., 2015). News websites such as Bloomberg or yahoo usually provide access after a short delay. We calculate this delay on a randomly selected subsample of our data and estimated that this process, takes up to 2 minutes.

³ During trading hours, stock exchanges may impose trading halts to allow for even dissemination of information. To plan for trading halts, stock exchanges require firms to notify the exchanges prior to significant news announcements during trading hours.

⁴ For example, the NASDAQ after-hours markets posts prices with a 15 minute delay and only for firms belonging to the NASDAQ100 index.

definitions for which hour constitute pre-market and after-hours trading. NYSE currently requires firms to notify the exchange representative prior to releases of announcement before 5pm; the equivalent time for Nasdaq is 8pm. Many brokers offer after-hours trading to individuals but with differing availability hours.

Although much less liquid than in the main trading hours, pre-market and after-hours trading is often seen as predictive for the next main trading session and therefore important for subsequent price formation. With the emergence of private trading networks in the 2000s, after-hours trading has become increasingly easy to access for professional as well as individual traders. Barclay and Hendershott (2003) report that trading outside market opening times is non-trivial and constituted 4% of overall volume.⁵ Figure I shows the average dollar volume traded and recorded per hour of day for our sample period. After-hours trading starts at 4pm with a sharp decrease in volume. Another sharp decrease follows at 5pm: afterwards trading continues to decrease and flattens out until 8pm. The decrease at 5pm is not confined to NYSE firms but visible across all traded firms.

Because these OTC markets are much less liquid and with lower disclosure requirements than the official markets, price discovery during after-hours is slow and bumpy. Uninformed traders may be reluctant to participate in OTC markets as they have a higher likelihood to trade with informed investors. Nevertheless, such trading may be beneficial for price formation after the dissemination of complex information when traders try to infer information from each other in a cascade. The OTC markets in the after-hours period can contribute to absorb a substantial amount of portfolio re-balancing without a visible price impact.

⁵ OTC price discovery and adjustment to information after market closure is discussed in Barclay and Hendershott (2003, 2008), Jian et al. (2012) and Li (2015).

Classifying Filing Times

The following table combines the information in the previous two illustrates the interaction of the EDGAR system and the trading regimes during different intraday time periods.

We define the following filing periods. i) *Overnight*, refers to the 5.30pm-6.00am, when there is very little OTC trading, no official trading and when filings and postings are not simultaneous. ii) *Pre-market*, refers to the 6.00-9.30am period, when filings and postings are simultaneous, OTC trading is high but there is no official trading. iii) *Trading hours*, refers to the 9.30am-4.00pm period, when official trading is open and EDGAR posting is simultaneous iv) *After-hours*, refers to the 4pm-5.30pm period, when EDGAR posting is simultaneous and official markets are closed. Within this period, we distinguish between the more liquid half directly after market close, which we call *Early After-hours*, and the subsequent 45 minutes, which we call *Late After-hours*. Since the discontinuity at 4.45pm has no institutional driver and seems to be rather a market convention, we try different cut-offs such as 4.30pm, 5.00pm etc., and the results are very similar to the reported ones using these alternative cut-off times.

The definitions of the filing periods studied and the information about their institutional characteristics are summarized in the following table:

Period	Time	EDGAR	Trading
Pre-market	6.00-9.30	Open	Liquid OTC
Trading-hours	9.30-16.00	Open	Main exchange
After-hours	16.00-17.30	Open	-
Early After-hours	16.00-17.45	Open	Liquid OTC
Late After-hours	16.45-17.30	Open	Illiquid OTC
Overnight	17.30-6.00	Closed	Illiquid OTC

2.2 Data description

We use the universe of current reports about material events of US-listed firms from 2003 to 2012, in total 567,103 filings. For these filings, we obtain detailed filing time data and intraday

market reaction data, and we use the actual filings to study their content and complexity. In this section, we describe our sample, data, and variables.

Current reports and Filings

We focus on current reports, or “8-K” filings. Companies must file these with the SEC to announce material events that shareholders should know about. We focus on 8-K reports because they are not scheduled, in contrast to other major filings such as annual reports or proxy filings. Companies have discretion about when exactly to file 8-K forms within four business days after the event.⁶ Our research question focuses on the time of the day when 8-K forms are filed, for which firms have full discretion.

The SEC’s EDGAR website provides an online repository of all filings made since 1984 to today. For filings after January 1, 2003, it includes the actual filing document, its exhibits, as well as the date and time of submission and acceptance. We obtain this information for all 8-K filings filed between 2003 and 2012, in total 567,103 filings. Panel A of Table 1 shows the number of filings per year.

The SEC provides a list of events that it deems material enough to require disclosure. These events are classified by “items”. For example, corporate governance items include “Change in Control of Registrant”, “Departure of Directors”, “Amendment of By-laws” etc. One filing can be classified with multiple items. We use the count of items as a measure of complexity: the more consequences one single event has, the more likely its price impact is to be harder to understand. We also use the item classifications to predict announcement returns (Niessner 2015). The classifications are well-suited for this purpose: they are granular enough to give a quite specific

⁶ There are two exceptions to the four-day deadline: voluntary disclosures, which have no deadline, and disclosures made to satisfy Regulation Fair Disclosure (Reg FD), which have a deadline of 24 hours after a previous disclosure to a restricted set of shareholders. Late filings receive a per diem fine.

description of events as well as providing a sensible number of observations per item to be predictive.

To measure text complexity, we use the Fog index and filing file size (see Loughran and McDonald (2014) for a discussion) The Fog index (Gunning 1952) is

$$\text{Fog} = 0.4 (\text{avg number of words /sentence} + \% \text{ of words with more than two syllables})$$

Lower values of the fog index indicate more readable text. The scaling by 0.4 allows us to interpret the resulting index as the number of years of schooling required to understand a text. To avoid counting pictures as more complex, we use a simple word count instead of the actual file length as suggested by Loughran and McDonald (2014).⁷ Consistent with Loughran and McDonald (2014), the average fog score in our data is 14 (Panel B of Table 1), which indicates that on average, a reader needs 14 years of schooling to adequately understand an average 8-K filing. The average word count of a filing is 4,941.

Downloads

Following Lee, Ma, and Wang (2015), we obtain the download traffic log for the EDGAR website from the SEC to capture attention to filings. This data excludes the small number of clients who subscribe directly to an EDGAR livefeed provided by a third party (Jackson et al., 2015) and users of secondary news providers such as Bloomberg.⁸ To this extent the download data only captures a

⁷ We also do not provide complexity measures for filings that contain fewer than 3 sentences or 50 words. Filings can contain other content that results into biased complexity measures. We follow Loughran and McDonald (2011) and remove tables and capitalized words (except if the majority of words are capitalized).

⁸ We check whether there are any systematic patterns in the downloads data that could be indicative of some selection into the sample and find no relevant results. In particular, we check whether institutional investors commonly download the filings from Bloomberg and thus would not be captured in the data. This does not seem to be the case, many of our IP addresses belong to institutional investors, and many downloads were flagged as algorithmic. Indeed, algorithmic crawlers will probably prefer the EDGAR website to other depositories because it is easy to crawl. In our analysis, we will mostly exclude automated downloads but show that our results are robust to including them.

fraction of the market. For each filing, we count the number of downloads in all five-minute intervals in the first 24 hours after filing. We use two aggregate measures of downloads: the aggregate number of downloads until the next time the market opens (immediately if filed during trading hours or on the morning of the next trading day), and the aggregate number of downloads in the next 24 hours.

We further follow Lee et al to identify search traffic generated by automated scripts that are written to download massive numbers of filings as daily IPs downloading more than 50 unique filings. In Panel A of Table 1, we show the average number of total vs. net downloads per year. As automated scripts have become increasingly popular over the last decade, the fraction of non-robot downloads has been decreasing over time, from an average of 55% in 2003 to 16% in 2012. On average, non-robot downloads during the first 24 hours are 18 (Panel B of Table 1) and total downloads 88.

Intra-day Trading

We obtain intraday trading data from the NYSE's Trade and Quote TAQ dataset. We aggregate all TAQ data for the 24 hours after filing into five minutes increments where relevant. For disclosures before the weekend or bank holidays, we obtain data from the next trading day.

We obtain trading volume and dollar volume as well as the high-low spread from the Trade database.⁹ For trading volume and the dollar volume, we sum up the quantity or the dollar-weighted quantity traded over five-minute periods. For the high-low spread, we obtain the highest and lowest transaction price in each five-minute interval and take the difference. For the returns, we take the log of the last transaction price in each five-minute unit divided by the last transaction

⁹ We follow the microstructure literature in filtering the data for errors (i.e., Bessembinder 2001, Chordia, Sarkar, and Subrahmanyam 2005, Hasbrouk 2010, Cliff, Cooper and Gulen 2008). Trades are required to have correction code 0 or 1 and not condition code A, C, D, N, O, R, or Z.

price in the previous five-minute unit. The average trading volume in the first 24 hours is 37 million and the average high-low spread is \$0.03 (Panel B of Table 1).

Bid-ask spread and trading halts are from the Quote dataset. We follow the algorithm described by Hasbrouk (2010) in determining the best bid and offer prices for the bid-ask spread and then take an average over each five-minute period of the 24 hours after filing.¹⁰ The average bid ask spread in the first 24 hours is 3bp of the average (Panel B of Table 1).

We count trading halts as quotes of TAQ-modes 4, 11, 15, 19, 27, and 28. On average, trading is suspended in the 24 hours after 6% of all filings and for 4 minutes.

2.3 Stylized facts

How does attention and filing behaviour fluctuate across the day, if at all? First, the intraday time periods differ in their proximity to the next opening of the stock market. This affects how much time the public has to read a filing until the next official trading opportunity. Second, we show that download patterns are consistent with the availability to reading before the next trading opportunity. Taken together, these stylized facts show that attention is highest for filings made after-hours and lowest for filings made overnight. The sharp discontinuities in filing density around the beginning and ends of these periods (shown in Figure I) suggest that firms are aware of these regimes and act accordingly.

¹⁰ Following Hasbrouk (2010) and the microstructure literature, we exclude quotes with mode of 4, 7, 9, 11, 13, 14, 15, 19, 20, 27, and 28 since these modes indicate non-reliable quotes (e.g., around trading halts, non-binding quotes etc.) for the bid-ask spread. We discard any quotes with bids below \$0.01 and non-positive offers or quote depth. Last, we discard quotes with spreads above \$5, less than or equal to \$0, or above 40% of the mid-quote.

Time-to-official-trading

The following table illustrates the time from posting to market opening for each of the time periods. While readers of a trading-hours filing can trade upon their interpretation of the filing immediately, the time until the next possible trade differs across the other periods. Most notably, After-hours filings have the longest time to the next stock exchange opening among all other time periods. There is a sharp jump in the reading time from just before market closes before the After-hours period and just after the After-hours period. This heterogeneity has not been explored in the previous literature, which pools the After-Hours period with the Overnight period that have very different characteristics in terms of reading time and opacity.¹¹

Period	Time	Time from posting to first trade
Overnight	17.30-6.00	3.5 hours
Pre-market	6.00-9.30	0 - 3.5 hours
Trading-hours	9.30-16.00	0
After-hours	16.00-17.30	16 – 17.5 hours
Early After-hours	16.00-16.45	16.75 - 17.5 hours
Late After-hours	16.45-17.30	16 – 16.75 hours

Filing density

The intraday variation in filing volume reflects the institutional differences between the filing periods. Figure I shows the distribution of the number of filings throughout the day. There are notable discontinuities around the After-hours period, which attracts most filings. When the market closes at 4pm, filing volume jumps dramatically, with 26,456 filings made in the first ten minutes, or

¹¹ This may explain why previous literature has been divided on the characteristics of non-trading-hours filings (e.g., Grennotte and Trueman 1996; Michaely et al. 2013).

4.6% of the total daily volume. We observe a sudden drop just after the end of the After-hours period.

The large number of filings at the beginning of the after-hours and overnight periods suggests that filers determine filing times strategically. It seems unlikely that the time of the events which are the topic of the filings cumulates just after the closure of the markets. In contrast, the large number of filings at the beginning of the period indicates that firms waited for the market to close before filing.¹²

Attention

How does the market react to the filings in different time periods? In Figure II, we show the number of downloads in five-minute bins relative to posting time (for overnight filings, 6am on the next morning). Download volumes jump up start as soon as filings are online, indicating that some investors follow (or crawl) the feed of the latest filings. The continuous line shows the download volumes for trading-hour filings, our benchmark. For these filings, download volumes increase until three hours after their posting and then flatten out. For the other filings, we mark with “x” the hour when markets open. After-hours start off similar to the Trading-hours filings but accumulate much more downloads by the time their information can be traded on. In contrast, overnight filings do indeed attract less attention compared to both Trading-hours and After-hours filings.

To see whether distraction matters, we relate the overall number of filings (including but not restricted to 8Ks) to the number of downloads in the first five minutes after posting (Figure III). The x-axis shows the percentile of the number of other filings filed in the same five-minute bucket. Download volumes in the first five minute are much higher when there are very few filings at the same time, rapidly decreasing throughout the first 25 percentiles. We exclude the overnight filings

¹² We verify with a filing agent that it is indeed common that firms instruct them to file at a certain time, especially within the After-hour period.

from this graph. Between 6.00 and 6.10am, new filings receive on average 0.82 downloads (2.64 including robots).

Overall, the negative relationship between downloads and the number of filings indicates that reader attention is indeed limited and heterogeneous across periods. As a consequence, firms that aim to hide or accentuate certain filings have an incentive to time their posting.

III. Analytical structure

3.1 – Information and Incentives

We use the setting of corporate disclosures of material events to study the interaction between information disclosure and attention. In our framework, firms send information and (potential) investors decide how to allocate their attention and trade.

In the context of news disclosures, there are two main effects that firms may take into account in order to maximize shareholders' value. First, firms want to avoid swings of the price observed by investors due to volatile price formation. This volatility may be hard to diversify and would hurt stock liquidity and price (Amihud 2002, Shapiro 2002). Towards this end firms can select the intraday timing of news releases according to the level of investor attention, liquidity, and whether prices are posted simultaneously or with a delay. Second, firms may want to delay the reaction to certain news, typically negative news. This may be because they have planned remedial actions in the near future (Cohn et al. 2015) or due to personal motives of executives such as trading plans or career concerns (Niessner 2015, Edmans et al 2015).

Investors as potential recipients of corporate news allocate a limited attention span to the processing of news (Hirshleifer and Teoh, 2003, Peng and Xiong, 2006). News can require processing time because it requires links to other information, because it involves a long argument or many different elements. For example, to understand item 5.02, "Departure of directors or

certain officers” requires knowledge of the departing officer and the circumstances, as well as the characteristics of the expected replacement. Time spent reading and processing information can improve the interpretation and understanding of news but is limited. Investors face a trade-off between speed and precision. Quick trading can capture a fraction of the full returns for an investor. In aggregate, this trade-off between fast and informed trading can lead to disagreement among only partially informed investors and price swings. Such price swings can be exacerbated by price feedback from public price signals (Hong and Stein 1999).

The after-hours following market closure provides an institutional setting to study these objectives. Because prices are not posted instantly after market closure, firms can avoid price feedback and observable price swings by disclosing news after-hours. This has been cited in the previous literature as the main reason why most firms make important announcements such as earnings announcements after-hours (e.g., DellaVigna and Pollet, 2009). In addition, the previous section documents within-period differences: OTC liquidity is high at the beginning of the period and rapidly decreases to almost no trades in the Late After-Hours. Under such a regime, speed is less beneficial and investors have a greater incentive to take more time to process news.

Avoiding public price swings: Big news

To avoid public price swings, firms should disclose non-complex but important news (for example, rating downgrades) in the Early After-Hours period, when liquidity is still rather high, but without contemporaneous price revelation. This enables investors to trade and rebalance their portfolios if needed without showing large public price swings.

Avoiding public price swings: Complex news and big news

Firms that wish to give investors more time for processing news before trading should disclose more complex news (e.g., departure of a director) in the Late After-Hours regime. In this period, there is very little liquidity and no price feedback; investors have the whole night and early

morning to process news before public trading opens. In addition, the downloads data shows that this is a period of high investor attention.

Obfuscating bad news

The previous literature (Patell and Wolfson 1982, Niessner 2015 and deHaan et al. 2015) has also studied the pooled After-Hours-Overnight period as a time to obfuscate the impact of bad news (e.g., news that imply breaking a covenant). However, there are caveats to such a strategy. First, in the After-Hours period, download and volume patterns suggest that investors actually have *more* attention. Attention is only low in the group of overnight filings. The pre-existing literature normally pools this two periods into a single one. Second, if the pattern of when bad news is filed was too predictable, markets would be able to infer that they are bad. Hence, obfuscation must follow some form of mixed strategy. Moments of the day that attract good news and generally have large volumes of news, should also attract bad news, as firms with bad news may want to imitate firms with good news or hide behind other news. Finally, in the presence of automated reading of filings it is not clear that obviously bad news can be obfuscated at all. These caveats not only mean that firms are not likely to embark on an obviously identifiable strategy, but also that for researchers any strategy is not likely to be overtly visible in the data.

Therefore, we do not expect news to be significantly more negative in the whole after-hours period. If firms try to minimize attention by hiding within large volumes of news, the most suitable moment seems to be within the stack of overnight news. Given all these premises, we can expect bad news to be filed in the times of the day that institutionally provide more opacity, most importantly, the *overnight* period. However, the selection of bad news into the more opaque times is likely to be dampened by the other considerations discussed above, so we should expect a small level of sorting.

Period	EDGAR	Trading	Expected news type
Early After-hours	Open	Liquid OTC	Important, not complex
Late After-hours	Open	Almost none	Complex

Overnight	Closed	Almost none	Negative
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In the above Table we summarize our predictions. We expect big news with a large price impact to concentrate on the *early after-hours* period (right after 4pm), complex news to be filed mostly in the *late after-hours* period (right before 5:30pm). Bad news should be more prevalent after the market closes although they should spread out throughout the period and concentrate on the most opaque part of it which is the overnight period (after 5:30pm).

3.2 – Econometric Approach

We run regressions in which each observation represents the filing of an 8k. The dependent variables are proxies for big news, complex news and whether news is good or bad. The main independent variables of interest are indicator variables associated to the timing of the filing of each 8k. In particular we define an indicator variable for each of the intraday time periods. We focus on the relationship of the *Early and late after-hours* periods with the trading hours period and the *Overnight* period. We saturate the regressions with an indicator for the *Pre-market* filings, and the omitted variable is the one corresponding to trading hour, so all the t-statistic should be interpreted as tests on differences in coefficients relative to trading hours. In particular, we estimate

$$y_{fit} = \alpha + \sum_{x \in S} \beta_x + \delta_y + \rho_d + \gamma_m + \lambda_e + \varepsilon_{fit}$$

Where y_{fit} are the characteristics of a filing (f) of firm (i) at time (t). The variables of interest are the different β_x coefficients, with $S = \{Early\ After\ Hours, Late\ After\ Hours, Overnight\}$. All

regressions include controls for year δ_y , month γ_m and day of the week ρ_d . We include a further control λ_e for Pre-Market (i.e. morning) filings.¹³

The first set of regressions focuses on the selection of filings into different filing time slots by pooling all the filings of different firms. However, we can take advantage of the firm-filing panel nature of the dataset to disentangle whether the selection of filings into different time slots operates at a firm level (i.e. firms with given characteristics prefer to regularly file at different times) or it operates within firm (i.e. a given firm prefers to file different news at different times). In order to analyse these issues, in Section 5 we run between groups and fixed effects panel data regressions at a firm level. The between groups regressions are purely cross sectional and focus on the selection of types of firms into types of filing slots. The between groups estimator is a regression of firm means, so the types of firms are therefore defined as the average characteristics of their filings and then regressed against the average fraction of filings that the firm made in each time slot. Alternatively, the firm fixed effects estimator absorbs any time invariant additive effect. It can be interpreted as a pure time-series effect within firm.

The drastic change in the visibility and trading opportunities at different threshold generates interesting discontinuities in the institutional setting at 4pm and at 5:30pm. To see if the reaction of firms is also discontinuous, we run a set non-parametric regressions allowing for jumps at 4pm and at 5:30pm.¹⁴ Although, this non-parametric specification is aimed at measuring sharp discontinuities in institutional settings, the structure is very different from a standard Regression Discontinuity Design (RDD), as, in our application, most of the effect operates via selection, which is precisely the opposite of the sustained assumption in RDD.

¹³ Pre-Market filings are quite different from after-hours filings and outside the scope of the paper. They are also quite different from trading-hours filings, which are the natural benchmark for After-Hours filings.

¹⁴ More specifically, we run local linear regressions with a half-bandwidth of 25 minutes and show 10% confidence intervals. The graphs also plot averages of the dependent variable on 6 minute bins.

IV. Results

In this section we report the main empirical results of the paper either in the form of regressions or non-parametric estimations.

4.1 Sign - Good or bad news:

Much of the existing literature (deHaan et al. 2015, Doyle and Magilke 2009, Dellavigna and Pollet 2009, Patell and Wolfson 1982) has focused on the possible use of after trading hours to release bad news. In Table II we run regressions that tabulate the nature of news and their returns.

Columns 1 and 2 show results regarding cumulative abnormal returns on a one day window and a five day window.¹⁵ The results show, that, on average, firms indeed seem to file bad news after-hours relative to regular trading hours, consistent with previous literature. The difference in average abnormal returns relative to trading hours is statistically significant for all the after hour periods. The economic effect is, however, quantitatively small. In the one day window, the effect ranges between 1.4 basis points and 2 basis points. In the five day window, the effect is a bit more pronounced, ranging between 1.4 and 2.5 basis points. This is not surprising, as the filing of many news is independent of their quality and hence, the selection of bad news into after trading hours may be relevant only for a subset of news. The coefficients may also be dampened by firms using a mixed strategy for bad news, precisely trying to avoid that the time in which news are filed is not too informative about their nature.

The difference between the effect of the *late after-hours* slot and the overnight period is also statistically significant. Overnight news are, on average 3 to 1.5 basis points more negative than the news filed around but before 5:30pm. This is consistent with the presence of an informational blackout at 5:30pm. News filed any time between 5:30pm and 6am will be posted together at 6am,

¹⁵ The calculation of the abnormal returns uses a simple OLS market model on an estimation window that starts 255 days before the filing and ends 46 days before the filing.

all bundled together and without much time before trading starts. This institutional feature creates a good opportunity for obfuscation. However, in order for this obfuscation to take place, other types of news need to be filed in the overnight period for different reasons. For example, some firms may want to disclose news on new events as soon as possible but did not have all relevant details before 5.30pm or some firms' headquarters operate in different time zones.

The dependent variable in Column 3 of Table II is a measure of the ex-ante nature of filings. We construct the variable using a classification from Niessner (2015). The SEC classifies 8k filing into several well-defined sub-categories, called items, depending on the nature of the information filed. Examples of these item categories include: director is elected, change in company status or shutting down a plant among many others. The classification in Niessner (2015) splits the population of 8k filings according to the average market response to each item category. In particular, we use a dummy variable takes value one if the item category of an 8k filing is one that is normally associated with negative abnormal returns and zero otherwise. The results show that the news filed after-hours is in general perceived ex-ante as worse news. The effect is strongest for the *late after-hours* period with a 4% additional probability of filing ex-ante bad news relative to the normal trading hours. Columns 4 and 5 replicate the results in column 3, but restricting the sample to ex-ante good news and ex-ante bad news respectively. The results are similar across both specifications, with slightly more negative returns and more pronounced sorting in the specification with ex-ante bad news. The results in columns 3, 4 and 5 jointly show that firms prefer to file bad news (both ex-ante and ex-post bad news) after-hours and, in particular in the late after trading hours slot and the overnight slot. The dependent variable in Column 6 is the five day abnormal return, net of the predicted abnormal return of the particular type of item category. That is, we run a regression in which the five day abnormal return is regressed against dummy variables of each of the standard 8k item categories. The results confirm the pattern in Columns 4 and 5. Returns seem to stack in a similar way, even after controlling for the information contained in each the particular type of 8k filing.

In general, the results of this section show that, relative to trading hours, firms tend to file bad news after trading hours. This is true for all after trading hours sub-periods, but it is particularly intense in the overnight period after 5:30pm. Given that the release of overnight filings is bundled at 6:00am of the next days, the information overflow may be used by firms to partially obfuscate the content of bad news. This is consistent by the low number of filing downloads in the overnight period that indicates some degree of inattention. The selection of bad news filing into the after-hours period when the market is closed applies both to the realized returns, but also to news that according to their classification, are ex-ante likely to be bad. Interestingly, after conditioning for the ex-ante expectation of each type of news, the sorting of returns does not seem to be altered in a substantial way. This is especially the case for the *late after-hours* period, which attracts a lot of ex-ante bad news.

In Figure IV we report we show non-parametric regressions allowing for jumps of the main variables in this section. Panel A shows the cumulative abnormal returns on a -5/+5 window. Although the average abnormal returns in each sub-period match with the results in the regressions, there are no big jumps at the relevant thresholds. This is consistent with the idea that the obfuscation of bad news must follow some kind of mixed strategy in filing times to avoid that investors can infer the nature of the news directly from the filing time. Panel B shows the filing of news classified as ex-ante bad according to the item classification in Niessner (2014). The results here are quite stark, news that are considered ex-ante bad tend to be filed in the *late after-hours* period where attention is maximal, but there are very limited trading opportunities. However, we know from the results of Panel A that these news do not generate a significantly different market reaction. Taking together Panel A and Panel B one can see that it is a particular sub-set of ex-ante bad news that gets filed in the *late after-hours* period: these are news that ex-ante look bad, but on a closer inspection are not as bad as one would infer from their item classification. The results in Panel C and Panel D confirm this intuition, the abnormal returns conditional on being a filing ex-ante good or bad news are slightly different for good and bad news but by a small economic

magnitude (under 0.5%) in the pre 5:30pm period. These results are consistent with more complex news being reported just before 5:30pm to allow investors to read before trading (see section 4.3)

4.2 Relevance - Big news:

Firms may want to use after trading hour filings to release big news that entail a large price impact or a big volume of transactions. The lack of simultaneous trading and posting allows investors to understand the news better. It also allows for some degree of price formation before the market opens with less contemporaneous feedback and informational cascades that could lead to excessive price fluctuations or costly trading halts. In this section we relate filing times with dependent variables that measure the importance of the news filed.

In Columns 1 and 2 of Table III the dependent variables are the absolute cumulative abnormal returns on a -1/+1 day and a -5/+5 day window. This is a non-directional measure of abnormal returns that measures the absolute price impact of the 8k filing. The results show that after trading hours filings are associated with larger absolute abnormal returns. The result is particularly pronounced for the *early after-hours* period and the coefficients associated with this period are statistically different from the trading hours period and the late after trading hours period at a 1% significance level. Similarly, in Column 3, the dependent variable is the high-low spread of a filing during the trading hours over the next 24h of trading. Again, the *early after-hours* period stands out, with higher spreads (3.1 additional basis points) than the average filing during trading hours. The estimate is also statistically different from the *late after-hours* filings or the overnight filings. Similarly, Column 4 uses as dependent variable the average bid ask spread of a stock on the 24h after a filing, normalized by the stock's mid-price. The results are again consistent with the idea that big news that are difficult to digest from a pure trading perspective tend to be filed in the early after market hours period. This period carries an additional bid-ask spread of 0.03% relative to trading hours, while other after-hours periods are associated with narrower spreads. In Column 5 the dependent variable is the daily variance of returns, where returns are calculated over 5 minute

intervals. Again, the *early after-hours* period stands out as the period with filings with a highest variance of returns. Jointly, the results in columns 1 to 5 show that news filed in the *early after-hours* period are those in which price formation is more volatile, with higher spreads, intra-day volatility, and absolute returns.

In Figure V we show the non-parametric analysis relevant to this section. The four variables used are the absolute value of the -5/+5 cumulative abnormal return variable, the high-low spread, the bid-ask spread and the 24h trading volume. They are all defined as in the regressions in Table III and they are all indicative of big news. The results are consistent across all four panels of the figure. There is a large, discrete jump in big news just after the market closes at 4pm. The volume of big news remains high during the whole After-hours period, but it slowly decreases towards the late After-hours period. Recall that the only institutional discrete jump at 4pm is the closure of the regular trading market and that during the after-hours period, over the counter liquidity dries out quickly. Therefore, big news are released when there is no direct price posting but when market liquidity is still reasonably high.

Overall, the results in this section show that firms strategically choose the timing for those news that are big, from a trading perspective, either because they may lead to large price fluctuations or because they generate a lot of trading volume. The *early after-hours* period is the most popular for such news, and it is attractive as there is no simultaneous price posting and there is some remaining trading volume in the after-hours and over the counter markets. This allows investors to rebalance their portfolios without generating trading halts, informational cascades or excessive price feedback. Note that this news need not be complicated to process or understand although their return implications may be. Complexity is the subject of the next section.

4.3 Complexity - Hard to process news:

Some news may be hard to process not from a pure trading perspective, but from an informational perspective. Filings that contain a lot of different news, that are ambiguous at first

inspection, requiring a careful reading, those that are simply long or that contain a lot of information require some time for investors and analysts to process. Firms may want to file these news after the market closes to avoid trading that is simultaneous with the processing of the information of the filing. In this section we explore the relationship different proxies of the complexity of news with filing times.

In Column 1 of Table IV, the dependent variable is the Fog measure of the complexity of the text used in the filings. In general, 8ks filed after market closure use more complex text than the ones filed during trading hours. Within all after market periods, filings in the *late after market hours* period are particularly complex. The coefficient is statistically different from zero, but also different from the *early after-hours* coefficient and the overnight coefficient.

The dependent variable in Column 2 of Table IV is the length of the filings. The results are very similar to those about complexity. Late filings are in general longer, but those filed in the *late after-hours* period are particularly long. Similarly, in Column 3 we report results regarding the number of items (different issues according to the standard categories) that compose a filing. More items bundled together increase the difficulty of processing the information in a filing, both because the filing is longer and because the filing contains several documents. The results in Column 3 are again aligned with the results in Columns 1 and 2. More complex filings with more items concentrate in the late after market hours period.

Figure VI shows the non-parametric equivalent to the regressions in Table IV. The results are consistent across all three measures of complexity. The news reported right after market closure are relatively simple (although important, according to section 4.2). Note that this is a slightly different result as in the regression analysis, as the news right before market closure are slightly more complex than the average news during trading hours. As the after-hours period progresses, news become more and more complex, reaching a peak of complexity precisely at the point of maximum investor attention, right before 5:30pm. The overnight period is again characterized by relatively simple news.

Summing up, the results in this section show how news that are more complex and harder to process are filed more often in the late after market hours slot. This is consistent with an intention of companies of giving analysts and investors time to read them before trading starts. The evidence in Section 2.1 shows that this is the time slot that accumulates more downloads before the first market trade.

4.4 Ex-ante vs ex-post

The results of the previous section suggest that firms file more bad news after trading hours, but that there is substantial heterogeneity between the different time periods after trading. In particular, firms are more likely to file relevant news in the early after-hours period, complex news in the late after-hours period, and bad news in the overnight period. These patterns suggest that firms sort news according to how much processing time they would like to give investors before the next trading opportunity. In this section we explore in more detail how much unexpected and hence hard-to-process content news contains.

To this end, we show in Table V how much markets react to ex-ante easily observable features of news. To this end, we saturate the specification with fixed effects of the identity of the firm, the year, month, and weekday, and the type of item filed. The rationale of this approach is that these ex-ante variables are easily observable, knowing them does not require reading the filing in depth and hence they are immune to reading time.

In Table A, Column 1 and 2, the dependent variable is a dummy variable for negative abnormal returns in a (-5,5) window around announcement, where we add firm, year, month, weekday, and item fixed effects in column 2. The introduction of these fixed effects captures characteristics of the filing that are immediately observable and do not require reading time. The remaining variation, which identifies the reported coefficients, corresponds to the part of the filing that needs to be read and understood. Fixed effects remarkably reduce the coefficient for early after-hours by 79%, from 0.029 to 0.006. The effect on the coefficients is much smaller: fixed effects reduce the coefficient for

overnight filings by 21% and the one for late after-hours filings by 31%. This reinforces the idea that early-after hours filings, although very relevant, are relatively simple to understand. However, late after hour filings are more complex. Finally, overnight filings contain bad news *in their writing* and not just in the item type, so they are worth obfuscating.

In both specifications, the coefficients for the after-trading periods are positive, indicating that even controlling for ex-ante effects news filed after trading-hours are more likely to be negative (around 1% for all after-hours filings). However, not all periods are equally likely to have negative news. On the bottom of the table we report test of differences between the coefficients. News released overnight is overall significantly less likely to be negative than late after-hours news. This effect, however, becomes *positive* and insignificant when we control for fixed effects. That is, news release overnight has more negative content that is not obvious at first sight than after-hours news. This is consistent with our argument that firms hide negative news in the overnight period where all news are released in a big dump on the next morning, whereas they release news in the late after-hours period if they want investors to read it more carefully.

Columns 3 and 4 show the same tests where the dependent variable is a dummy variable for returns smaller than -18% (lowest 5% quantile): extremely bad news. Here again the fixed effects reduce the coefficient most for early after-hours news, by 20%. The reduction for coefficients of late after-hours and overnight news is 53% and 55%, respectively: less than for merely negative returns but still much less than for early after-hours. Overall, the coefficients are around half the magnitude of the regressions in columns 1 and 2 where the dependent variable indicates merely negative market reactions. The relationship between overnight and late after-hours news flips: returns to overnight news are more likely to be extremely negative. This effect disappears once we control for fixed effects.

We repeat the exercise in columns 5-8 where we define the dependent variable to be a positive market reaction (or returns $>18\%$, respectively). As one would expect, the results on the positive returns dummy is exactly the flip side of the ones for negative returns. For extremely high returns,

the prevalence is highest in news released early after-hours, followed by late after-hours. Overnight news is significantly less likely to have very positive returns. The fixed effects eliminate almost all the effects on the early after-hours, 88% of the coefficient on overnight news, and 85% of the coefficient for late after-hours news. Again, these results suggest that early after-hours are used to release relevant news that are easy to read. With fixed effects, none of the coefficients is significantly different from zero, indicating that firms do not purposefully release unexpectedly extremely positive news in these periods.

In Panel B we show similar tests but control for the absolute value of the returns: hence these tests show the likelihood of a negative or positive market reaction abstracting from the relevance of the news. Once we control for the absolute size of returns fixed effects virtually have no effect any more: the results controlling for fixed effects (columns 2, 4, 6) are almost the same as without (columns 1, 3, 5). The only exception is very positive returns where the results flip once we control for fixed effects, albeit on a very small economic level (<6 basis points). In general, the coefficients for early after-hours news are very small (<6 basis points) once we control for the absolute size of returns. This again indicates that firms release relevant news in early after-hours regardless of their sign.

In Figure VI we show the distribution of returns from 1 day after the filing until 5 days after the filing, for the different regimes. These returns measure the delayed impact of filings and, hence, the degree of positive and negative news that they contain beyond a superficial inspection. The distribution depicted in black is the distribution for trading hours and serves as a benchmark for all firms. In panel A we can see that the long-term impact of filings in the early after hours period has higher dispersion than the benchmark of trading hours. Even if these news are relatively simple, they are quite big and there are subsequent movements of the price beyond the first day of trading that seem to exhibit fatter tails than the distribution for trading hours. However, there is not a lot of directional difference and both distributions are more or less equally centered. In panel B we see the same results for the late after hours period. These are complex news, but the distribution of

returns does not seem to be out of line with trading hours. Finally, in Panel C we can see the filings on the overnight period. Here it is quite marked that the distribution of returns has more weight on negative returns both for extreme returns and moderate negative returns. Firms may decide to file in the overnight period to temporarily obfuscate bad news, however in a 5 day period, markets already take into account the negative nature of these news.

Overall, the results in this section suggest that news released in early after-hours are easy to categorize, relevant news whereas news released later in the evening are more complex news. The results also are broadly consistent with the hypothesis that firms hide news that are more negative than they look in the overnight dump but release news late after-hours to facilitate reading.

4.5 Types of news vs. types of firms

In this section we investigate what part of the sorting of news into different regimes corresponds to firms regularly sorting themselves into regularly filing at certain times according to their characteristics and/or to given firms selecting different times for different types of news. That is, this section explores the cross sectional firm sorting effect and the within-firm-across-news sorting effect.

Table VI decomposes the effects of some of the key variables in Section IV into their cross sectional and within firm component.¹⁶ Panel A of Table VI shows between groups regressions. These are regressions of firm averages of the dependent variable on firm averages of the independent variables. Given that they are pure cross-sectional regressions, they capture how different types of firms are more likely to file in different time slots. Conversely, Panel B of Table VI shows within-groups regressions. That is, regressions that include firm fixed effects. As the firm

¹⁶ The full set of regressions equivalent to Section IV can be found in External Appendix 1.

fixed effects absorb the average filing pattern of each firm, the regressions in Panel B can be interpreted as deviations of the firm relative to its average filing policy.

Columns 1 and 2 focus on good vs. bad news as in Table II. Column 1 shows results on abnormal returns on a +5/-5 day window and Column 2 on a dummy variable that takes value one if news contains an item that is ex-ante bad. Both panels A and B show consistent results. Bad news is present throughout the whole overnight period (which is consistent with firms using some form of mixed strategy) both in the cross section and in the pure time series component. The overnight period attracts particularly bad news and particularly bad firms.

Columns 3, 4 and 5 show results relative to the filing of big news, as in Table III. While the results are again present both in the time series and in the cross section, it seems that a larger fraction of the effect concentrates on the cross section. That is, firms with news that regularly have higher price impact and trading volume impact regularly tend to file their news in the early after hours period, relative to other periods.

Columns 6 and 7 of Table VI focus on the issue of the complexity of news. The pattern here is similar that the one in Columns 3, 4 and 5 but even more pronounced. The effect is present both in the time-series and in the cross section, but it is more intense in the cross section of firms. This indicates that firms with news that are regularly more complex tend to file in the late after hours period as a form of firm policy.

Overall, the results on this section show that the main effects of the paper are consistently present both at a firm level and at news (within firm) level. The results are particularly balanced when it comes to good vs. bad news. However, the patterns associated with big and complex news are more intense across firms than within firm.

V. Conclusions

We use corporate news to study strategic timing of news releases in the presence of heterogeneous attention. In the context of corporate news releases by public U.S. firms, the sender (the firm) has discretion over the timing, but not over the release of news. Differing opening times of the stock market and the news filing system allow us to separate institutionally driven regimes in investor attention that affect news releases.

We document the existence of three periods within the time period after markets closure that differ significantly in terms of attention, opportunities to trade, price formation, and opacity. First, because the SEC's filing system closes overnight at 5.30pm, later filings are made public only in a group release on the next day. This leads to an "information blackout" during the night and a sudden influx of information at the next morning. Second, we distinguish two different regimes in the after-hours period between market closure at 4pm and the closure of the filing system. The beginning of the after-hours period is characterized by high OTC liquidity, which gradually diminishes to almost zero at 5.30pm, making it difficult for investors to trade immediately. These institutional differences result in distinct attention patterns. Contrary to popular beliefs, and to the sustained assumption of most of the pre-existing literature, we document investor attention is high throughout the after-hours period. The low liquidity at the end of the after-hours period renders that time particularly attractive for complex news that requires processing time.

We show that firms strategically time the release of information to optimize the extent and nature of attention. First, firms are more likely to disclose simple but important news at the beginning of the after-hours period where attention and liquidity is still high but market closure allows to smooth price formation. Second, firms are more likely to disclose news that are difficult to process at the end of the after-hours when OTC markets have almost ceased but attention is still high. This enables investors to investigate the content of the information more extensively before the next opportunity to trade. Finally, firms with negative news tend to release their news overnight to be released in a group at the next morning, as opposed to releasing them in the after-

hours. This allows them to benefit from a lack of available attention when many filings are released at the same time.

As information processing has accelerated over the recent years, a better understanding of the timing of information has become more relevant for the interpretation of information and subsequent decision-making. Our results show that even on an intraday granularity, senders of information time the release strategically and systematically. Our results provide guidance on the implications of information timing that are not only useful for investors, but for all recipients of information. Related contexts include the information exchange between policy makers and the public, teachers and pupils, hospitals and patients and diplomacy.

REFERENCES

Ahern, Kenneth R., and Sosyura, Denis (2014), Who Writes the News? Corporate Press Releases during Merger Negotiations. *Journal of Finance* 69, 241-291.

Amihud, Y. (2002), Illiquidity and Stock Returns: Cross-Section and Time-Series Effects. *Journal of Financial Markets* 5, 31-56.

Bar-Isaac, Heski, Guillermo Caruana, and Vicente Cuñat (2012) Search, Design and Market Structure. *American Economic Review* 102, Issue 2, April 2012

Barclay, Michael J., and Terrence Hendershott (2003), Price Discovery and Trading After Hours. *Review of Financial Studies* 16, 4, 1041-1073.

Bessembinder, H. (2001), Price-Time Priority, Order Routing, and Trade Execution Costs in NYSE-Listed Stocks, working paper.

Boulland, Romain, and Olivier Dessaint (2015), Announcing the Announcement. Working paper.

Cliff, Michael, Cooper, Michael J, and Gulen, Huseyin (2008), Return Differences between Trading and Non-trading Hours: Like Night and Day. University of Utah Working paper.

Chordia, T., A. Sarkar, and A. Subrahmanyam (2005), An Empirical Analysis of Stock and Bond Market Liquidity, *Review of Financial Studies* 18, 85-130.

Cohn, Jonathan, Gurun, Umit, and Rabih Moussawi (2015), Micro-Level Value Creation Under CEO Short-termism. University of Texas Working Paper.

DeHaan, Ed, Terry J. Shevlin, and Jacob Thornock (2015), Market (In)Attention and the Strategic Scheduling and Timing of Earnings Announcements. *Journal of Accounting and Economics* 60,1, p. 36-55.

Dellavigna, Stefano, and Joshua Pollet (2009), Investor Inattention and Friday Earnings Announcements. *Journal of Finance* 64, 709-749.

Doyle, Jeffrey T., and Matthew Magilke (2009), The Timing Earnings Announcements: An Examination of the Strategic Disclosure Hypothesis. *The Accounting Review* 84, 157-182.

Edmans, Alex, Luis Goncalves-Pinto, Moqi Groen-Xu and Yanbo Wang (2015), Strategic News Releases in Equity Vesting Months. LSE Working Paper.

Gennotte, Gerard, and Brett Trueman (1996), The Strategic Timing of Corporate Disclosures. *Review of Financial Studies* 9, 2, 665-690.

Griffin, Paul A. (2003), Got information? Investor Response to Form 10-K and Form 10-Q EDGAR Filings. *Review of Accounting Studies* 8, 433-460.

Gunning, Robert (1952), *The Technique of Clear Writing* (McGraw-Hill, New York).

Hasbrouk, Joel (2010), The Best Bid and Offer: A Short Note on Programs and Practices (October 14, 2010). NYU working paper.

Hirschleifer, D., and S. Teoh. "Limited Attention, Information Disclosure, and Financial Reporting." *Journal of Accounting and Economics*, 36 (2003), 337-386.

Hong , Harrison, and Jeremy C. Stein (2007) Disagreement and the Stock Market *Journal of Economic Perspectives* vol. 21, no. 2 (Spring 2007):109-128

Jackson Jr., Robert J., Wei Jiang, Joshua Mitts (2015), How quickly do markets learn? Private information dissemination in a natural experiment. Working paper version 2015

Jain, Prem, and Gun-Ho Joh (1988), The Dependence between Hourly Prices and Trading Volume. *Journal of Financial and Quantitative Analysis* 23, 3, p. 269-283.

Jiang, Christine X., Tanakorn Likitapiwat, and Thomas H. McNish (2012), Information content of earnings announcement: Evidence from After-Hours Trading. *Journal of Financial and Quantitative Analysis* 47, 1303-1330.

Johnson, Justin P. and David P. Myatt (2006) "On the Simple Economics of Advertising, Marketing, and Product Design," *American Economic Review* 96(3):756-784.

Lee, Charles M. C., Paul Ma, and Charles Wang (2015), "Search-Based Peer Firms: Aggregating Investor Perception through Internet Co-Searches". *Journal of Financial Economics* 116, 410-431.

Li, Jiasun (2015), Slow Price Adjustment to Public News in After-Hours Trading. Working paper.

Lou, Dong, Christopher Polk, and Spyros Skouras (2015), A Tug of War: Overnight versus Intraday Expected Returns. Working paper.

Loughran, Tim, and Bill McDonald (2011), When is a liability not a liability? Textual analysis, dictionaries, and 10-Ks, *Journal of Finance* 66, 35-65.

Loughran, Tim, and Bill McDonald (2014), Measuring Readability in Financial Disclosures, *Journal of Finance* 69, 1643-71.

Michaely, Roni, Amir Rubin, and Alexander Vadrashko (2013), Corporate Governance and the Timing of Earnings Announcements. *Review of Finance*

Niessner, Marina (2015), Strategic Disclosure Timing and Insider Trading. Working paper.

Patell, J.M., and M. Wolfson (1982), Good News, Bad News, and the Intraday Timing of Corporate Disclosures. *Accounting Review* 57, 509-527.

Peng, L., and Xiong, W. (2006), Investor Attention, Overconfidence and Category Learning. *Journal of Financial Economics* 80, 563-602.

Shapiro, A. "The Investor Recognition Hypothesis in a Dynamic General Equilibrium: Theory and Evidence." *Review of Financial Studies*, 15 (2002), 97-141.

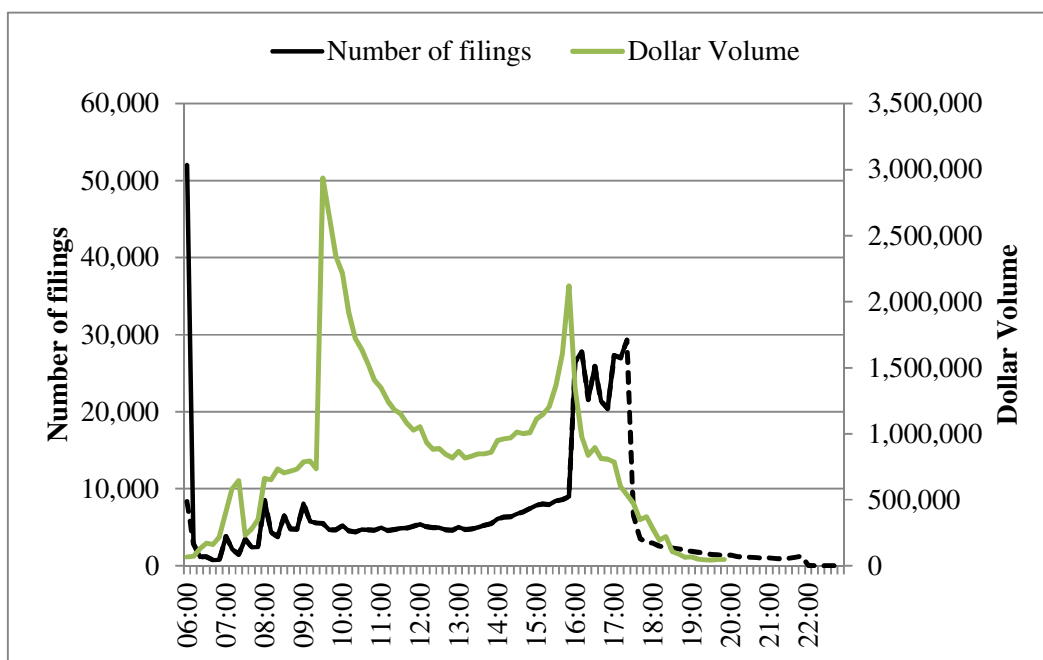


Figure I. Number of filings and dollar volume across the day.

This figure shows the number of 8-K filings filed between 2003 and 2012, ordered by the hour of their public appearance on EDGAR, and the average dollar trading volume for the first 24 hours after 8-K filings. For the number of filings, the solid line indicates the hour when filings become publicly available, and the dashed line indicates the hour of acceptance for after-hour filings that only become public after a delay.

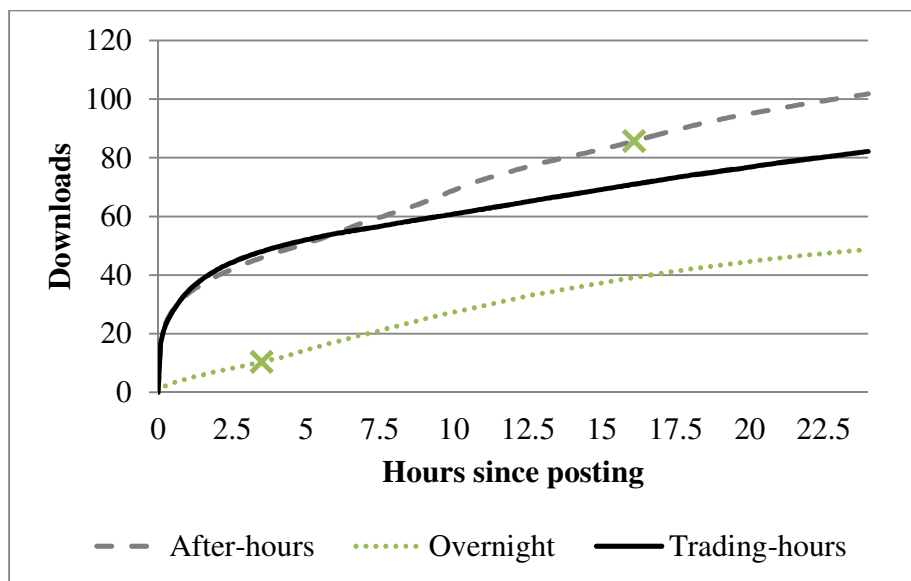


Figure II. Number of Downloads by Filing Time.

This figure shows the number of downloads for the first 24 hours after the acceptance time by the time of filing. For After-hours and Overnight filings, “x” marks the earliest time when markets open.

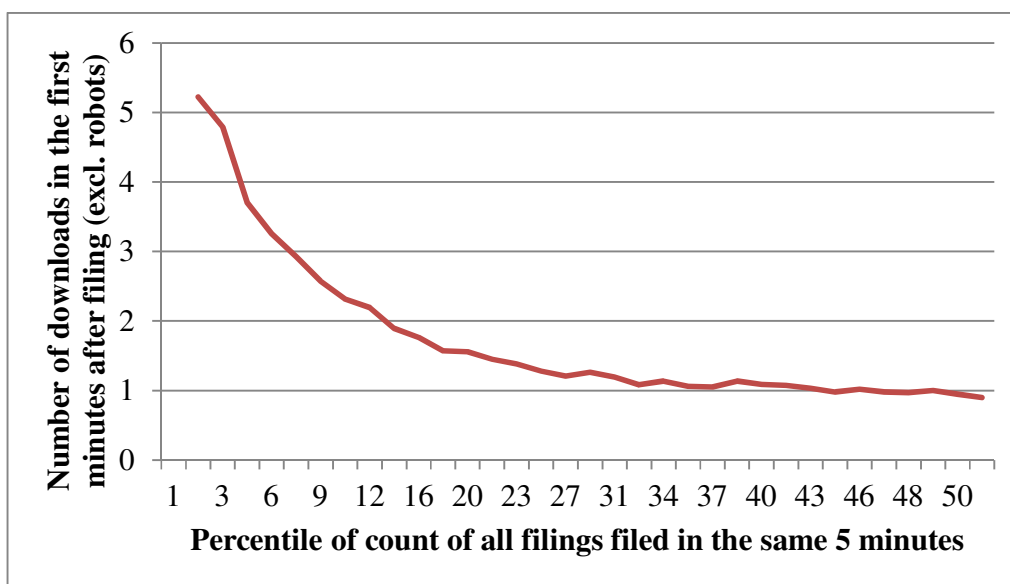
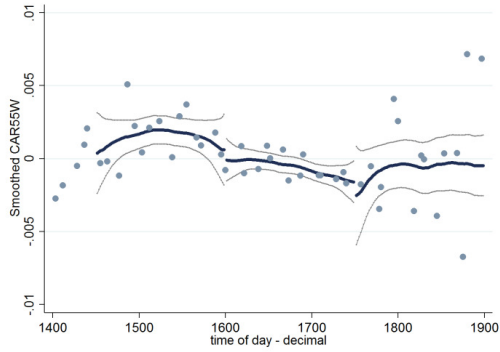


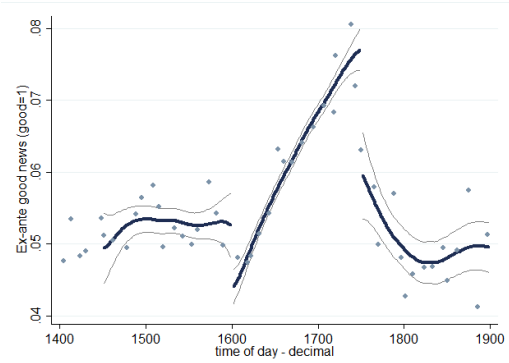
Figure III. Number of Downloads vs. Number of Simultaneous Filings.

This figure shows the number of downloads in the first five minutes on the y-axis and the percentile of simultaneous filings (the total number of filings in the same five-minute-bracket) on the x-axis.

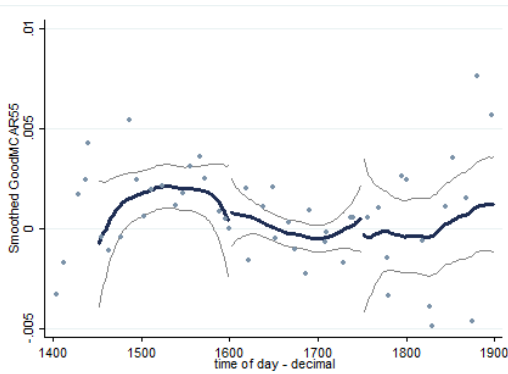
Panel A
Cumulative abnormal returns on a -5/+5 day window.



Panel B
Ex-ante good vs. ex-ante bad news



Panel C
Cumulative abnormal returns on a -5/+5 day window for ex-ante good news.



Panel D
Cumulative abnormal returns on a -5/+5 day window for ex-ante bad news.

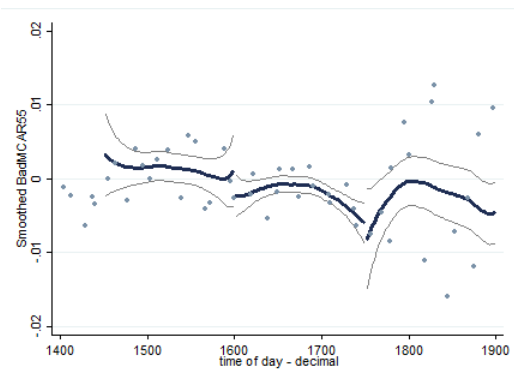
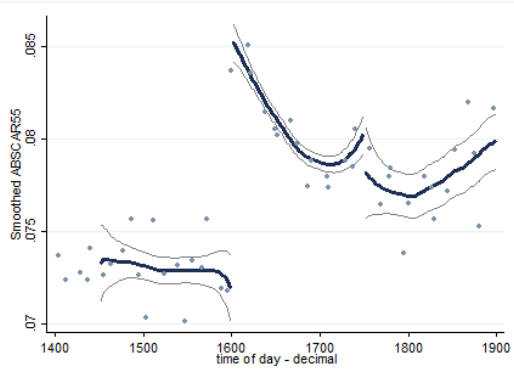
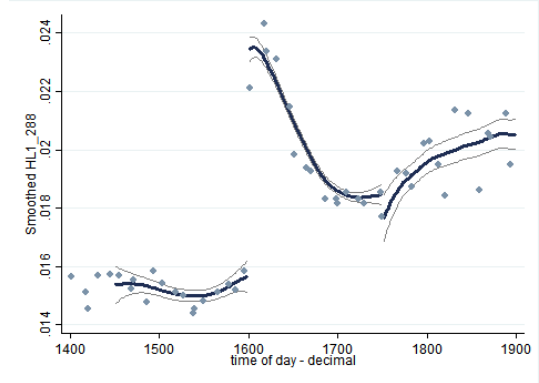


Figure III. Good vs. Bad News

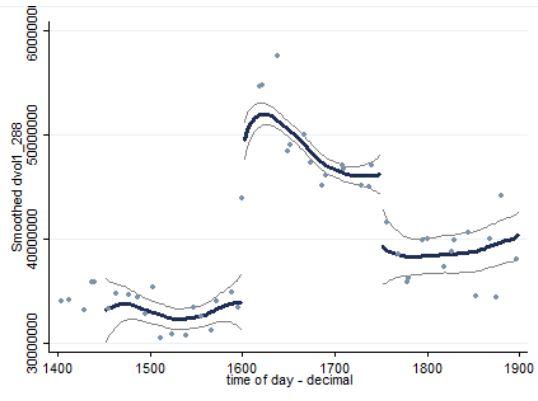
Panel A
 Absolute cumulative abnormal returns on a -5/+5 day window.



Panel B
 24h high vs. low price



Panel C
 24h trading volume



Panel D
 24h bid-ask spread

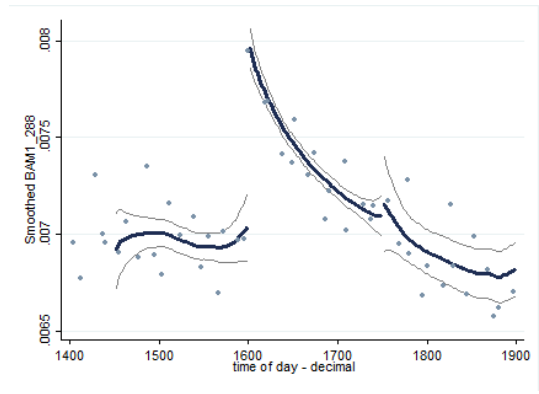
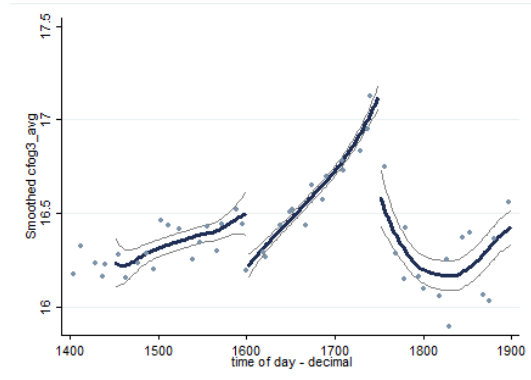
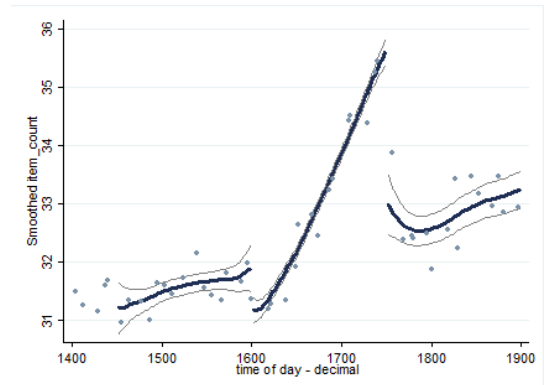


Figure IV. Big vs. Small News.

Panel A
FOG measure of text readability, per filing



Panel B
Number of items per filing.



Panel C
Length of a filing in words

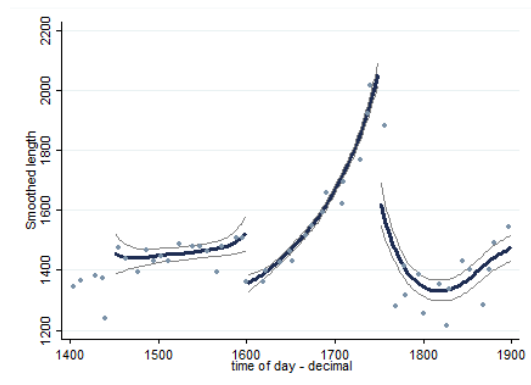


Figure V. Complex News.

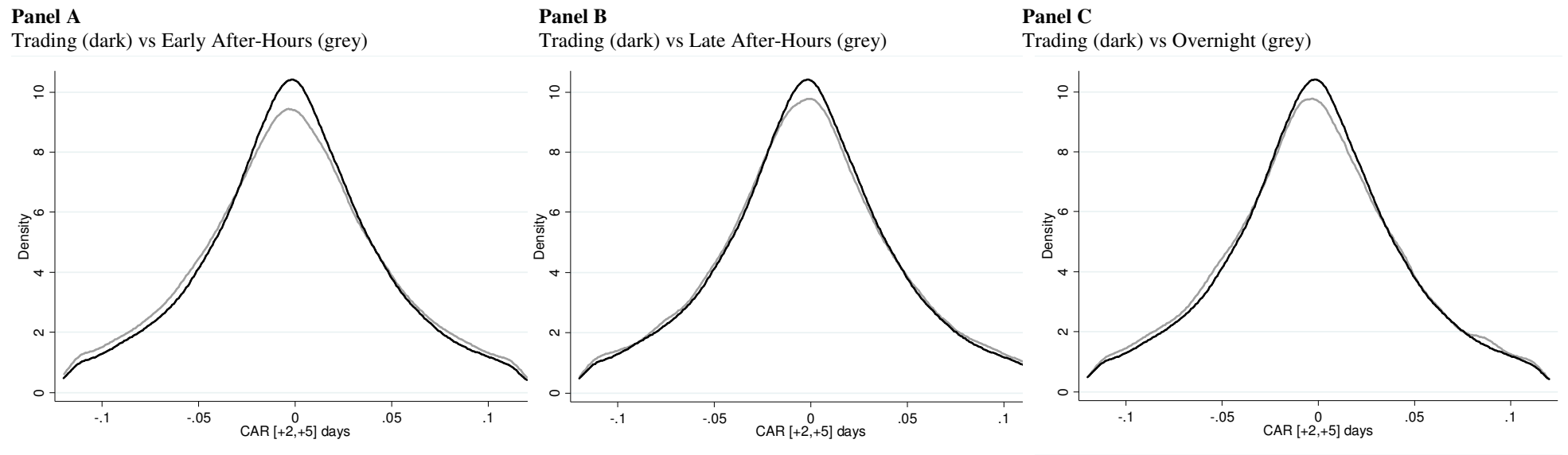


Figure VII. Delayed Returns.

TABLE I.**Descriptive Statistics**

Panel A displays the frequency of 8-K filings and the number of downloads per filing in the first 24 hours (excluding and including automated downloads, respectively) over time. Data is collected from the SEC for all 8-K filings from 2003 until 2012. Panel B describes the sample of 581,954 8-K filings. Filing length is the number of words in a filing. Fog is $0.4 \times (\text{average number of words per sentence} + \text{percent of words with more than two syllables})$. Downloads, dollar volume, and trading halt (length) are the number of downloads (incl. and excl. robots), sum of dollar volume, and number of trading halts (and their average length) in the first 24 hours after the filing. High-low spread and bid-ask spread are the average spread of the difference between the highest and lowest price, and the average of the difference between the best bid and best ask, normalized by the mid, in each five-minute intervals throughout the first 24 hours. Note that the number of observations may change due to missing values in some of the variables.

Panel A. Number of Observations by Year

Year	Filings	Downloads	Downloads incl. robots
2003	31,117	6.77	12.46
2004	54,267	10.11	28.28
2005	74,889	8.31	29.57
2006	77,814	6.48	20.75
2007	74,395	10.68	35.58
2008	69,782	15.37	46.32
2009	63,698	27.39	139.59
2010	61,754	32.96	194.79
2011	59,387	35.64	215.92
2012	14,851	38.69	248.06
Total	581,954	18.27	88.47

Panel B. Summary Statistics

Variable	Mean	Median	Std. dev.	10th Per.	90th Per.
Number of items	1.98	2.00	0.82	1.00	3.00
Filing length	4939.70	1120.00	18759.64	40.00	10077.60
Fog	14.63	16.12	7.41	0.00	22.58
Downloads	18.27	8.00	58.00	0.00	41
Downloads (incl. robots)	88.47	39.00	173.88	7.00	203
Dollar volume	37600000	430118	214000000	0	66800000
High-low spread	0.03	0.00	3.78	0.00	0.04

Bid-ask spread	0.0034	0.0000	0.0057	0.0000	0.0106
Trading halt	0.06	0.00	0.24	0.00	0.00
Trading halt length	12861.69	16522.00	9322.32	0.00	22835

TABLE II.

Good vs. Bad News

This table shows regression results on dependent variables that classify news into good and bad news. "CAR -1/+1" refers to cumulative abnormal returns on a +1/+1 day window. "CAR -5/+5" refers to cumulative abnormal returns on a +5/+5 day window. "Ex-ante bad" classifies news as bad according to the classification in Niessner (2015). "Net CAR -5/+5" measures abnormal returns, net of the average abnormal return of a filing of a given classification throughout the sample. All regressions contain Year, Month and Weekday Fixed-effects. A dummy for morning filings is included in all regressions. The constant captures the omitted category (Trading Hours). See section 2.3 for a detailed definition of the different filing times.

Variable	(1) CAR -1/+1	(2) CAR -5/+5	(3) Ex-ante bad	(4) CAR-5/+5 ex-ante good	(5) CAR-5/+5 for ex-ante bad	(6) Net CAR - 5/+5
Overnight	-0.0020*** (0.000392)	-0.0025*** (0.000632)	0.0199*** (0.00219)	-0.00202*** (0.000729)	-0.0035*** (0.00125)	-0.00221*** (0.000651)
Early After- hours	-0.0014*** (0.000267)	-0.0015*** (0.000430)	0.0165*** (0.00151)	-0.00178*** (0.000495)	-0.000785 (0.000853)	-0.00114*** (0.000443)
Late After-hours	-0.0019*** (0.000323)	-0.0025*** (0.000520)	0.0406*** (0.00181)	-0.00202*** (0.000608)	-0.0031*** (0.000999)	-0.00224*** (0.000538)
Constant (Trading hours)	0.000688 (0.000606)	-0.0026*** (0.000977)	-0.013*** (0.00339)	-0.00341*** (0.00106)	0.0124* (0.00730)	-0.00434*** (0.00102)
Observations	467,144	467,222	581,966	331,806	135,416	429,834
R-squared	0.001	0.001	0.049	0.002	0.000	0.001
Year Month & Weekday FE.	YES	YES	YES	YES	YES	YES
Late After-hours - Overnight p-val	9.17e-05 0.838	5.46e-05 0.0907	0.0207 0	-5.46e-06 0.712	0.000450 0.747	-2.58e-05 0.972
Early After- hours - Late After-hours p-val	9.17e-05 0.145	5.46e-05 0.940	0.0207 0	-5.46e-06 0.995	0.000450 0.0275	-2.58e-05 0.0538

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

TABLE III.

Big vs. Small News.

This table shows regression results on dependent variables that classify news into big and small news. "ABS - CAR -1/+1" refers to absolute cumulative abnormal returns on a +1/+1 day window. "ABS - CAR -5/+5" refers to absolute cumulative abnormal returns on a +5/+5 day window. "High-Low" measures the spread between the highest and lowest traded price over 24h after the filing. "Bid-Ask" measures the bid-ask spread, normalized by midprice over 24h. Return Variance measures the variance of returns over 5min intervals over a 24h window. Trading Volume measures total trading volume (in million \$) over a 24h window after the filing. All regressions contain Year, Month and Weekday Fixed-effects. A dummy for morning filings is included in all regressions. The constant captures the omitted category (Trading Hours). See section 2.3 for a detailed definition of the different filing times.

Variable	(1) ABS- CAR - 1/+1	(2) ABS- CAR - 5/+5	(3) High- Low	(4) Bid-Ask	(5) trading_vo lume
Overnight	0.00497*** (0.000289)	0.00575*** (0.000448)	-0.00222 (0.0191)	-0.00021*** (2.78e-05)	5.141*** (1.076)
Early After-hours	0.00586*** (0.000196)	0.00643*** (0.000304)	0.0317** (0.0131)	0.000323*** (1.90e-05)	14.86*** (0.737)
Late After-hours	0.00176*** (0.000238)	0.00420*** (0.000368)	0.0192 (0.0157)	-0.00010*** (2.29e-05)	8.537*** (0.885)
Constant (Trading hours)	0.0444*** (0.000446)	0.0788*** (0.000691)	-0.0266 (0.0294)	0.00301*** (4.28e-05)	15.17*** (1.657)
Observations	467,144	467,222	561,674	561,674	561,674
R-squared	0.039	0.043	0.000	0.074	0.012
Year Month & Weekday FE.	YES	YES	YES	YES	YES
Late After-hours - Overnight	-0.00321	-0.00155	0.0214	0.000109	3.396
p-val	0	1.06e-08	0.457	0	0.00587
Early After-hours - Late After-hours	-0.00321	-0.00155	0.0214	0.000109	3.396
p-val	0	0.00240	0.327	0.000601	0

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

TABLE IV.

Complex vs. Simple News.

This table shows regression results on dependent variables that classify news into complex and simple news. "Fog" refers to the fog index of text readability. "Lengh" refers the length of the document. "Item Count" measures the number of different items filed within one filing. All regressions contain Year, Month and Weekday Fixed-effects. A dummy for morning filings is included in all regressions. The constant captures the omitted category (Trading Hours). See section 2.3 for a detailed definition of the different filing times.

Variable	(1) Fog	(2) Length	(3) Item Count
Overnight	0.284*** (0.0368)	245.2*** (17.65)	1.630*** (0.109)
Early After-hours	0.135*** (0.0253)	97.49*** (12.16)	0.235*** (0.0745)
Late After-hours	0.419*** (0.0303)	494.9*** (14.53)	3.084*** (0.0891)
Constant (Trading hours)	13.42*** (0.0568)	897.8*** (27.29)	17.58*** (0.245)
Observations	572,753	572,753	537,478
R-squared	0.008	0.008	0.031
Year Month & Weekday FE.	YES	YES	YES
Late After-hours - Overnight	0.136	249.7	1.454
p-val	0.00127	0	0
Early After-hours - Late After-hours	0.136	249.7	1.454
p-val	0	0	0

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

TABLE V.

Ex-Ante vs. Ex-Post.

This table shows regression results on dependent variables that indicate whether cumulative abnormal returns on a -5/+5 windows were negative, positive, or below -18%/above +18%. "ABS - CAR -5/+5" refers to absolute cumulative abnormal returns on a -5/+5 day window. A dummy for morning filings is included in all regressions. The constant captures the omitted category (Trading Hours). See section 2.3 for a detailed definition of the different filing times. Panel B regressions include the absolute value of returns. See section 2.3 for a detailed definition of the different filing times.

<i>Panel A.</i>							
Dependent variable	(1)	(2)	(3)		(4)	(5)	(6)
			Bad news				Good news
	Returns < 0		Returns < -18%		Returns > +18%		
Fixed effects	No	Yes	No	Yes	No	Yes	
Overnight	0.0133*** (0.00242)	0.0106*** (0.00254)	0.00860*** (0.000992)	0.00404*** (0.00107)	0.00406*** (0.00100)	0.000506 (0.00109)	
Early After-hours	0.0293*** (0.00166)	0.00628*** (0.00179)	0.0119*** (0.000680)	0.00242*** (0.000757)	0.00817*** (0.000686)	-4.22e-05 (0.000768)	
Late After-hours	0.0134*** (0.00199)	0.00922*** (0.00210)	0.00738*** (0.000815)	0.00333*** (0.000887)	0.00431*** (0.000822)	0.000729 (0.000900)	
Constant	0.389*** (0.00104)		0.0354*** (0.000426)		0.0383*** (0.000430)		
Overnight = Late After-Hours	-6.30*** (0.000)	1.62 (0.105)	3.15*** (0.002)	1.44 (0.149)	-3.91*** (0.000)	0.48 (0.630)	
Overnight = Early After-Hours	-0.05 (0.963)	0.47 (0.635)	1.08 (0.282)	0.58 (0.559)	-0.22 (0.830)	-0.18 (0.856)	
Observations	581,966	519,332	581,966	519,332	581,966	519,332	
R-squared	0.001	0.137	0.001	0.075	0.000	0.067	
Firm Fixed Effects	No	Yes	No	Yes	No	Yes	
Year Month & Weekday FE	No	Yes	No	Yes	No	Yes	
Item FE	No	Yes	No	Yes	No	Yes	

Panel B. Controlling for absolute returns

Dependent variable	(1)	(2)	Bad news		(5)	(6)
	Returns < 0		Returns < -18%		Returns > +18%	
Fixed effects	No	Yes	No	Yes	No	Yes
Overnight	0.0129*** (0.00279)	0.0141*** (0.00305)	0.00156 (0.00105)	0.00157 (0.00114)	-0.00517*** (0.00102)	-0.00317** (0.00111)
Early After-hours	0.00555*** (0.00189)	0.00577*** (0.00213)	0.000509 (0.000712)	0.000957 (0.000793)	-0.00532*** (0.000691)	-0.00218** (0.000772)
Late After-hours	0.0111*** (0.00229)	0.0104*** (0.00252)	0.00173** (0.000865)	0.00163* (0.000938)	-0.00294*** (0.000839)	-0.00191** (0.000913)
Constant	0.506*** (0.00137)		-0.0617*** (0.000518)		-0.0686*** (0.000503)	
Overnight = Late After-Hours	2.51** (0.012)	2.62*** (0.009)	0.96 (0.338)	0.52 (0.604)	0.14 (0.886)	-0.86 (0.388)
Overnight = Early After-Hours	0.56 (0.576)	1.08 (0.280)	-0.14 (0.887)	-0.05 (0.963)	-1.92* (0.055)	-1.01 (0.312)
Observations	467,222	429,754	467,222	429,754	467,222	429,754
R-squared	0.000	0.025	0.285	0.303	0.338	0.352
Firm Fixed Effects	No	Yes	No	Yes	No	Yes
Year Month & Weekday FE	No	Yes	No	Yes	No	Yes
Item FE	No	Yes	No	Yes	No	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

TABLE VII.

Between Firm vs. Within Firm Variation.

This table shows regression results on dependent variables that classify news into good and bad news. "CAR -1/+1" refers to cumulative abnormal returns on a +1/+1 day window. "CAR -5/+5" refers to cumulative abnormal returns on a +5/+5 day window. "Ex-ante bad" classifies news as bad according to the classification in Niessner (2015). "Net CAR -5/+5" measures abnormal returns, net of the average abnormal return of a filing of a given classification throughout the sample. All regressions contain Year, Month and Weekday Fixed-effects. A dummy for morning filings is included in all regressions. The constant captures the omitted category (Trading Hours). Panel B regressions include firm fixed effects. See section 2.3 for a detailed definition of the different filing times.

Panel A. Between Firms

VARIABLE	Good vs. Bad		Big vs Small			Complex vs. Simple	
	1 CAR - 5/+5	2 Ex-ante bad	3 ABS- CAR -5/+5	4 Bid-Ask	5 Trading Volume	6 Fog	7 Length
Overnight	- 0.0172* **	0.0480**	0.0236***	-0.001***	5.195	0.338	455.8***
Early After-hours	-0.004 -0.0048*	-0.022 0.0667***	-0.005 0.0403***	0.0003 0.003***	-9.474 43.03***	-0.443 0.727**	-125.4 198.1**
Late After-hours	-0.003 -0.005 -0.004	-0.015 0.141*** -0.019	-0.003 0.0166*** -0.004	0.0002 -0.001*** 0.0003	-6.362 22.43*** -8.406	-0.299 1.320*** -0.395	-84.59 703.7*** -111.8
Constant (Trading hours)	- 0.0250* **	-0.036	0.0988***	-7.89e-05	17.39	8.300***	-460.6**
	-0.007	-0.035	-0.008	-0.001	-15.33	-0.709	-201
Observations	467,222	581,966	467,222	561,674	561,674	572,753	572,753
R-squared	0.022	0.111	0.103	0.067	0.034	0.018	0.075
Number of Firms	7,059	9,758	7,059	9,756	9,756	9,668	9,668
Firm Fixed Effects	No	No	No	No	No	No	No
Year Month & Weekday FE	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Panel B. Within Firm

VARIABLE	Good vs. Bad		Big vs Small			Complex vs. Simple	
	1 CAR -5/+5	2 Ex-ante bad	3 ABS- CAR -5/+5	4 Bid-Ask	5 Trading Volume	6 Fog	7 Length
Overnight	-0.0023*** -0.001	0.0067*** -0.002	0.0033*** 0.000	-0.0001*** 0.000	4.657*** -0.818	0.200*** -0.032	151.3*** -18.130
Early After- hours	-0.0012** 0.0005	0.0055*** -0.001	0.0017*** 0.000	0.000 0.000	4.790*** -0.572	-0.032 -0.023	50.05*** -12.730
Late After-hours	-0.002*** -0.001	0.0173*** -0.002	0.0011*** 0.000	0.000 0.000	-0.948 -0.671	0.157*** -0.026	374.6*** -14.880
Constant (Trading hours)	-0.0026** -0.001	-0.004 -0.003	0.0826*** -0.001	0.0033*** 0.000	12.17*** -1.252	13.61*** -0.049	969.0*** -27.890
Observations	467,222	581,966	467,222	561,674	561,674	572,753	572,753
R-squared	0.001	0.053	0.047	0.107	0.013	0.010	0.006
Number of Firms	7,059	9,758	7,059	9,756	9,756	9,668	9,668
Firm Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Year Month & Weekday FE	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1