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SEC Dissemination in a high-frequency world**

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Run EDGAR run: SEC Dissemination in a high-frequency world

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Abstract

We use a large recent sample of Form 4 insider trading filings to provide evidence on the process through which SEC filings are disseminated via EDGAR. We find that while the delay from a filing's acceptance by EDGAR to its initial public availability on the SEC website is relatively short, with a mean (median) posting time of 40 (36) seconds, in the majority of cases the filing is available to Tier 1 subscribers before its availability on the public SEC site. We further show that prices, volumes, and spreads respond to the filing news beginning around 30 seconds before public posting, consistent with some market participants taking advantage of the posting delay. These results raise questions about whether the SEC dissemination process is really a level playing field for all investors.

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1. Introduction

Under the efficient markets hypothesis (Fama, 1970, 1991), security prices quickly reflect all public information. To test efficiency, researchers need to know when information becomes publicly available to market participants. Because the disclosure of most value relevant news about companies is regulated by the US Securities and Exchange Commission (SEC), it is important to understand the process through which the SEC disseminates mandated disclosures such as insider filings (Form 4s), earnings releases (Form 8-Ks), quarterly and annual financial statements (Form 10-Q and 10-K filings), etc.

It is common for researchers to use the date and/or time news is released to the public through the media to measure public dissemination. Studies using daily returns typically use Wall Street Journal publication dates while studies using intraday returns typically use release times on wire services such as Dow Jones. The implicit (and reasonable) assumption is that these dates and times are a good proxy for when information first became available to market participants.

With the advent of high frequency trading (e.g., Budish, Crampton, and Shim, 2013; Jones, 2013), trading advantages are measured in milliseconds, so understanding the mechanics of the dissemination process becomes critical.¹ In a widely publicized example, Thompson-Reuters (T-R) sold advance access to the University of Michigan's Consumer Sentiment Index, a closely watched indicator of aggregate consumer spending. According to press accounts, certain clients paid T-R to access the data two seconds before its release to the full set of T-R clients, who in turn received it in advance of its public release (the first set of clients received the feed at 9:54:58 a.m. Eastern time, while the regular clients received the feed at 9:55:00 a.m.; the news was posted to the university website at 10:00:00 a.m.).² While this timing advantage seems short (two seconds), it is sufficiently

¹ In some circles the term "low latency" is used rather than "high frequency."

² "Traders pay for early peek at key data," The Wall Street Journal, June 12, 2013. See also "SEC reviews how ISM releases manufacturing data," Wall Street Journal, June 27, 2013, for similar questions regarding how the Institute for

valuable that these clients, apparently large institutional investors, pay for this timing advantage. It is clear from the high frequency trading (HFT) literature that trading advantages measured in milliseconds are economically valuable, so two seconds is actually a long time (see, for example, Budish et al., 2013; Martinez and Rosu, 2013).³

We use Form 4 insider trading filings to provide detailed evidence on the process through which public company filings are publicly-disseminated through the SEC's EDGAR system.⁴ While the casual observer may assume that the EDGAR dissemination process is effectively instantaneous, we show that in fact this process takes some time, typically around 40 seconds. We further show that the news is available to certain intermediaries before it is posted to the public SEC website (when public users first have access): for 57% of insider purchases (sales are very similar), the filings are available to at least one Tier 1 subscriber before they are posted to the SEC EDGAR website (the number for sales is similar).⁵ We also show that prices, volumes, and spreads all move 15-30 seconds in *advance* of when the news is posted to the SEC EDGAR site (and so first becomes "public"). This implies that the process through which company filings are disseminated via

Supply Management releases its closely watched manufacturing data, as well as "Financial information groups face NY probe," *Financial Times*, July 9, 2013, "Peeking early: A continuing kerfuffle over releases of privately sourced data," *The Economist*, September 7, 2013 and "Fed probes for leaks ahead of policy news," *Financial Times*, September 24, 2013. A major Wall Street firm has claimed that a 1-millisecond trading advantage can be worth \$100 million per year to a major brokerage firm; see <http://www.informationweek.com/wall-streets-quest-to-process-data-at-the-speed-of-light/d/d-id/1054287?>

³ See also "FBI joins SEC in computer trading probe," *Financial Times*, March 5, 2013: "Authorities are exploring potential holes in the system, including new algorithms referred to as 'news aggregation' that search the internet, news sites and social media for selected keywords, and fire off orders in milliseconds. The orders are so quick, often before the news is widely disseminated, that authorities are debating whether they violate insider trading rules."

⁴ The SEC describes EDGAR as follows: "EDGAR, the Electronic Data Gathering, Analysis, and Retrieval system, performs automated collection, validation, indexing, acceptance, and forwarding of submissions by companies and others who are required by law to file forms with the U.S. Securities and Exchange Commission (SEC). Its primary purpose is to increase the efficiency and fairness of the securities market for the benefit of investors, corporations, and the economy by accelerating the receipt, acceptance, dissemination, and analysis of time-sensitive corporate information filed with the agency." See <http://www.sec.gov/edgar/aboutedgar.htm>. Compared to other filings such as Form 10-Qs and Form 10-Ks, Form 4s are simple filings with well-defined, homogeneous content that should require minimal processing after they are submitted to EDGAR.

⁵ Our data are from a single Tier 1 subscriber. This subscriber has two feeds. We show that that at least one of these feeds "beats" the SEC post time in 57% of cases for insider purchases, and that both of the feeds beat the SEC post time in 53% of cases.

EDGAR provides certain intermediaries and their clients with a significant timing advantage and that some market participants trade on this advantage.

Our data also allow us to investigate whether outsiders profit from the public release of insider trading news. While the insider trading literature shows that insiders profit from their trades and that insider purchases are more profitable and move prices significantly more than sales (Jaffe, 1974; Seyhun, 1986; Jeng et al., 2003; Lakonishok and Lee, 2001), it is much less clear whether outside investors can also profit from this news. Prior to 2002, it was not possible to know exactly when investors could access insiders' SEC filings, as well as filings more generally.⁶ In June 2003, the SEC required that these filings be made electronically using EDGAR, meaning that the information is quickly available to outside investors and removing the ambiguity about when the data become publicly available.⁷ Because we know exactly when the insider trading news first becomes publicly-available, we can cleanly separate the returns available to insiders before the news becomes public from returns available to outsiders, something that previous research was unable to do because of data limitations. We find that most of the returns associated with insider purchases occur after the information becomes publicly-available (meaning its posting to the SEC website).

Our findings have a number of implications. Perhaps most notably, they show that the SEC's process for the dissemination of insider filings (and likely other types of filings as well) is not a level playing field, in that certain intermediaries and investors have access to insider filings submitted to EDGAR before others, and that prices, volumes, and spreads move in the direction of the news in advance of it being posted (and publicly-available) on EDGAR.

⁶ Lakonishok and Lee (2001) discuss the dissemination of the information in SEC filings by CDA/Investnet's Insider Trading Monitor. They indicate that this service typically takes several days to report the filing information, with the implication that this delayed the price response. More generally, studies of the information content of SEC filings such as Form 10-K filings often have trouble establishing precisely when filings actually become available to the public (Carter and Soo, 1999; Alford, Jones, and Zmijewski, 1994).

⁷ Some firms voluntarily filed Form 4 documents electronically prior to the required June 2003 date. In May 2002, the SEC added the acceptance time-stamp, which we require, to the actual filings.

Our research is related to the recent literature on high frequency trading (HFT). Most of this research examines policy questions such as whether HFT affects the functioning of the market microstructure in such a way as to be harmful to market liquidity or other measures of trader welfare (e.g., Brogaard, Hendershott, and Riordan, 2014; Budish, Crampton, and Sim, 2013; Easley, de Prado, and O’Hara, 2012; Martinez and Rosu, 2013). One important form of HFT is driven by traders who seek to gain an advantage by getting access to fundamental news before other traders, even if this difference is measured in milliseconds (Jones, 2013). By providing evidence of significant time lags in the process through which SEC filings are disseminated, we provide evidence that there are opportunities for certain traders to profit by trading on delays in the public dissemination of information.

2. The EDGAR dissemination process and research questions

Basic information about the EDGAR dissemination process is available from the SEC website; we summarize the process in Figure 1. This site describes the EDGAR Public Dissemination Service (PDS), which aims “to provide the public an accurate, complete and fast method of obtaining all accepted and valid EDGAR filings.”⁸ A private vendor runs the PDS; the vendor during the period for which we have data (March 2012 through December 2013) was NTT Data. Access to the PDS is subscription based, with fees set by the vendor. EDGAR transmits the filing to both the SEC website (where it is available to the public) and to the PDS. The PDS transmits the data to paying subscribers. According to the SEC’s description of the subscriber service, subscribers receive filings that are accepted by EDGAR “at the same time” they are sent to the SEC site with “real-time transmission” of all valid public documents. Thus, at least in theory,

⁸ <http://www.sec.gov/info/edgar/ednews/dissemin.htm>. Last accessed July 28, 2014.

the system operates to ensure simultaneous access for all interested parties, whether or not they subscribe to the system.

Further detail about the dissemination process is provided in the EDGAR Public Dissemination Service – New Subscriber Document. The process begins when EDGAR receives a filing that is submitted by an SEC registrant or other filing party. The document is “parsed” to extract key information, and then run through a “rigorous series of syntactic and semantic validation rules” before being accepted by EDGAR. The document is then “reassembled with informative header tags” before being transmitted to the PDS and the SEC website. The document states that this process “usually takes no longer than two (2) minutes from the receipt of filing submissions to EDGAR.”⁹

Our paper provides evidence on the timeliness of this process, including the extent to which any lags advantage some subset of market participants. Previous papers (Li et al., 2011) provide evidence that the original EDGAR process (circa 1996) had a built-in delay that provided certain intermediaries with a timing advantage of up to 24 hours.¹⁰ This changed in 2002, after which filings were immediately made available to the public, with the then SEC chairman stating that the change ensured there was a “level playing field” so that investors received “timely information.”¹¹

According to the subscriber document, after acceptance EDGAR transmits processed filings to the PDS and to the SEC site simultaneously. The PDS server compresses the documents and

⁹ All quotes from EDGAR Public Dissemination Service – New Subscriber Document (Updated Apr. 1, 2013) at page 3. This document was downloaded from <http://www.sec.gov/info/edgar/pdsnewssubscriber.pdf> on May 14, 2014. The document has since been updated (July 1, 2014) with a new vendor, Attain LLC, but all of the language cited in the text is retained in the new document.

¹⁰ Li et al. (2011, p. 677, note 10) indicate that when EDGAR was first introduced in 1996, Level 1 subscribers had immediate access to filings but filings were not posted to the SEC site (and so did not become publicly available) for 24 hours.

¹¹ See “SEC Announces Free, Real-Time Public Access to EDGAR Database at www.sec.gov” <http://www.sec.gov/news/press/2002-75.htm> (last accessed July 29, 2014). This release contains the following quote from then-Chairman of the SEC, Harvey Pitt: “This latest improvement to the Commission’s web site will help meet our long-standing goal of providing investors with timely access to information they need to make investment decisions,” Pitt said. “Through this initiative we are continuing to level the playing field for all investors.”

forwards them through a firewall to the IP address of the subscribers' servers. Our understanding is that there are around 20 such Tier 1 subscribers, and that the PDS transmits filings to these subscribers sequentially ("someone is first and someone is last"). Based on this description, it seems that dissemination to Tier 1 subscribers occurs at the same time or after documents are available on the public SEC EDGAR site.¹² As we show below, this is not, in fact, the case.

Most previous event study analyses of SEC filings use the date/time that filing information is disseminated by the media or the acceptance date/time stamp in the header of the respective filing on the SEC public site to proxy for the public release of information.¹³ This process worked well when using daily returns, with earnings announcement studies conventionally using days -1 and 0 relative to the WSJ announcement date as the event window. For intraday analyses, studies typically used the DJNS release time, which provided the time (hour and minute) when the news was transmitted by the news wire service. These proxies for the public-availability of the news contained in SEC filings are reasonable given the questions being asked in these studies (do returns respond to earnings news?) and available data (daily returns or minute-by-minute data for intraday studies). However, given the advent of HFT, it has become necessary to partition the event window more finely. We consider four different points in time (measured to the closest second¹⁴), three of which we obtain from a Tier 1 subscriber:

¹² Our discussions with SEC staff confirm that EDGAR initially transmits filings to the PDS and waits for an (automated) acknowledgment of receipt. Once that occurs, EDGAR transmits the filing to the SEC site, where it becomes publicly-available. The PDS then begins the process of transmitting filings to the Tier 1 subscribers.

¹³ Griffin (2003) and Li and Ramesh (2009) use the EDGAR filing date in studies of Form 10-Q and Form 10-K filings. Niessner (2014) uses the earlier of the press release date and the EDGAR filing date in her study of the timing of Form 8-K filings. Patell and Wolfson (1982) use announcement times from the Dow Jones News Service (the "Broad Tape") for their study of intraday earnings announcement timing. Most studies of earnings announcements use the Compustat earnings announcement date. Compustat obtains this from "...various news media (such as the Wall Street Journal or newswire services)..." (Cohen et al., 2007, p. 156). Bagnoli, Clement and Watts (2005) obtain earnings announcement times from Reuters Forecast Pro while Doyle and Magilke (2009) use Wall Street Journal Online. Dellavigna and Pollet (2009) take the earliest of the IBES and Compustat earnings announcement dates, which they verify for accuracy using PR newswire for a small subsample. Hirshleifer et al. (2009) also follow this approach.

¹⁴ More precisely, we truncate to the second, providing assurance that the information release did not come before $t=0$ (assuming the TAQ and Tier 1 Subscriber clocks are perfectly synchronized).

1. EDGAR acceptance time (the time the filing is accepted by the EDGAR system). As discussed above, acceptance occurs after EDGAR performs certain rudimentary checks on the filing so some time (presumably very short) elapses between when the filing is submitted and when it is accepted. The time of acceptance is the “official” EDGAR time stamp and comes from the header text of each Form 4 filing in EDGAR.
2. Filing received by Tier 1 Subscriber PDS Feed #1.
3. Filing received by Tier 1 Subscriber PDS Feed #2.
4. Filing first posted to SEC public site; we refer to this time henceforth as “posting.”¹⁵ We obtain this time from the Tier 1 subscriber.

Our data for 2.-4. are from a Tier 1 Subscriber. Our understanding is that some subscribers for whom the timing is crucial obtain a backup feed as well as a primary PDS feed because technical issues sometimes slow dissemination via a given feed (as indicated above, the PDS transmits filings to subscribers sequentially, so having more than one feed hedges against the possibility that a given subscriber is towards the end of the queue).

Our tests address three main research questions. First, do Tier 1 Subscribers obtain a timing advantage vis-à-vis investors who obtain filing information from the public SEC site? To answer this question, we first provide evidence on the time (in seconds) between when EDGAR accepts a filing and when it is posted to the SEC site. To the extent there are delays in this process, we examine factors that explain variation in the delays, including whether “busy” periods (with large numbers of filings) slow the process. We then compare the time a filing is posted to the SEC site to the earliest of the two PDS feeds, which is our proxy for private availability to Tier 1 Subscribers

¹⁵ As far as we know, this time is not available on any publicly-available database. We initially obtained these times using real time “scrapes” of the SEC EDGAR site. We subsequently used a collection of these times made available by the Tier 1 subscriber. Given that this entity’s business model depends, at least in part, on obtaining and disseminating these filings in the most timely manner possible, they have strong incentives to collect accurate information about when filings become available on the SEC website.

and their clients.¹⁶ We use the term “first dissemination” to denote the earliest of times 2., 3., and 4. above; that is, the first time the information is available to a Tier 1 subscriber and/or the public via the SEC site.

Second, to examine whether Tier 1 Subscribers (and their clients) obtain a timing advantage that provides a trading advantage, we analyze intra-day (second-by-second) price, volume, and spread data to see whether markets respond to the insider trade news before it is posted to the SEC site and so becomes publicly available.

Finally, because we are able to partition event time precisely, we are able to estimate very accurately the extent to which outsiders can profit from insider trading news, a longstanding open question in the insider trading literature.

3. Sample and data

Table 1 summarizes how we construct the sample. We obtain SEC Form 4 filings from T-R. We exclude options trades and trades made by insiders who are not officers, directors, and committee members, as well as trades made outside of the period from March 1, 2012 and December 31, 2013 (to allow us to match to the Tier 1 Subscriber feed data). This results in a sample of 97,372 trades. We then use the insider name and company CIK to match to the SEC filing from EDGAR, which reduces the sample to 86,940 trades. To enable us to unambiguously associate filings with market effects, we remove observations for which there are multiple filings for the same firm within a given five minute window, which reduces the sample to 64,553 trades. We then match these observations to the data from the Tier 1 Subscriber, from whom we obtain their two PDS feed times and the SEC post time (no loss of observations).

¹⁶ To the extent our data provider receives the filing after other Tier 1 subscribers this timing may be biased late.

We restrict attention to trades made between 9:40am and 3:30pm eastern to ensure trades occur during the trading day and avoid beginning and end of day trading effects. This results in the loss of 2/3 of the observations, reducing the sample to 20,425 observations, and occurs because the majority of trades are made outside of trading hours. We then require TAQ data and that the insider transaction price occurs within the daily trading range indicated by CRSP (to remove obvious data errors), resulting in a final sample of 17,960 observations.

Table 2 provides descriptive information on the sample, including a comparison of the final sample to a larger set of observations before we impose the trading day restrictions; specifically, we compare observations on Lines 3 and 6 of Table 1 (we provide variable definitions in Appendix A). Panel A provides data for insider purchases while Panel B provides data for sales.

There are significant differences between insider transactions reported within and outside trading hours. For both purchases and sales, trade size, whether filings “cluster,” and the amount of prior trading by the insider are smaller for filings made within trading hours even though larger firms are more likely to report during trading hours. Median firm size (total assets) is \$678 million for trades reported within trading hours compared to \$540 million for the Line 3 sample that includes all trades, with mean differences in the same direction. Median trade size is \$16,649 for trades reported within trading hours versus \$18,146 for the unrestricted Line 3 sample. The filing cluster variable indicates that a median of 2 filings are made in the minute before filing for filings made within the trading day compared to 3 filings made in the minute before filings in the Line 3 sample. Finally, the median amount of prior purchases by the insider is \$37,845, but declines to \$35,464 for the sample within trading hours.

Directionally, the differences are similar for the sample of insider sale transactions in Panel B, though the sale magnitudes are generally substantially larger, as has been noted in extant studies (e.g., Lakonishok and Lee, 2001; Rogers, 2008; and Brochet, 2010). Insider sales are larger

transactions, tend to be at larger firms, and tend to follow larger prior trades. However, the current trade size and prior trading activity are still smaller for those within market hours and sales activity in market hours occurs at relatively larger firms.

These requirements provide us with a final sample for which we know the times (to the second) of the following events: (1) acceptance of the Form 4 filing by EDGAR, (2) filing first becomes available to the Tier 1 Subscriber, being the earliest time of its two PDS feeds and the public posting on the SEC site, and (3) filing is first posted to the SEC site.

4. Evidence on timing of dissemination

We provide initial evidence on the timeliness of Form 4 filings of these events in Table 3, which reports the number of trading days between the insider trade and when the corresponding Form 4 filing is accepted by the SEC. In 2002, as part of the Sarbanes-Oxley legislation, the SEC substantially shortened the time between an insider trade and when information about that trade has to be filed with the SEC. Prior to this change, insiders had up to 10 days after the end of the calendar month in which the trade occurred to file the requisite information (Form 4) about the trade with the SEC. After the rule change in 2002, insiders were required to make these filings within two business days of the trade. Table 3 shows that it typically takes one day (median) for insiders to file the Form 4 with the SEC for both purchases and sales (this is consistent with Brochet, 2010). The means are larger (4.0 days for purchases; 2.5 days for sales) because there are some large outliers; the 99th percentiles are 37 days and 8 days, respectively.

Table 4 provides information on the timing of the SEC post for the filing (when it first becomes publicly available after processing by EDGAR) relative to when it is first available to the Tier 1 Subscriber (the earliest of the two PDS feeds). This table reports the distribution of times

relative to the time of the SEC post, bucketed in five second windows. Once again, we separate the data into purchases and sales.

The results here are striking. We discuss purchases first; results for sales are very similar. In columns (1) and (2), negative (positive) differences indicate that the earliest PDS feed occurs before (after) the SEC post, meaning that Tier 1 Subscribers had the data before it was posted to the SEC site (and became public).¹⁷ Of the sample of 4,782 purchases, 57% (43%) are available to the Tier 1 Subscriber via one of the PDS feeds before (at or after) SEC posting; the corresponding fractions for sales are 56% (44%). Thus, in the majority of cases the filing is available to Tier 1 Subscribers before it is publicly-available. When one of the PDS feeds beats the SEC posting it is usually the case that both feeds do so: while 57% of the purchase filings are received by at least one of the PDS feeds before the SEC, 53% are received by *both* PDS feeds prior to the SEC posting (untabulated).

While the time differences are measured in seconds, these delays are likely to be significant in the world of HFT. The time difference is less than 5 seconds in 11.5% of cases, from 5 to 10 seconds in 11.0% of cases, from 10-15 seconds in 10.2% of cases, and 15 seconds or more in 25% of cases, with less than 2% of the differences exceeding one minute. If milliseconds now matter in securities markets, these numbers challenge the notion that the public dissemination process is a level playing field.

We next report on the time it takes from acceptance of the initial filing by EDGAR to posting on the SEC site; see Table 5, Panel A. For the 4,782 purchases, the mean (median) time between acceptance and SEC posting is 40 (36) seconds, with a standard deviation of 24 seconds, indicating there are some large outliers; in some cases, there is a (relatively) long delay in getting the filing posted. It is hard to evaluate these numbers in an absolute sense, except to say that the system

¹⁷ This assumes that the time the filing is received by the earlier of the two PDS feeds is representative of the time it is available to other Tier 1 subscribers.

seems to process most filings quickly, in that it typically takes only 30-40 seconds for documents to be posted.¹⁸

If we look instead at the time between acceptance and first dissemination (i.e., the first time the Tier 1 Subscriber receives the filing, either from one of its feeds or from the SEC posting if that occurs first), the numbers confirm that dissemination to the Tier 1 Subscribers often occurs more quickly than posting to the SEC site. The mean (median) time to initial dissemination is 30 (30) seconds with a standard deviation of 10 seconds, as compared to the mean (median) of 40 (36) seconds to initial public posting.

When we directly compute the time difference from when the Tier 1 Subscriber first receives the filing, either from one of the PDS feeds or the SEC site directly, to when the filing is posted to the SEC site, which is the time of private advantage, the mean (median) is 10.5 (3.2) seconds, numbers that are reliably different from zero. The 75th percentile is 14.9 seconds and the standard deviation is 22.5 seconds, indicating that the delay is sometimes quite large.

It is unclear why there are delays in the posting of the Form 4 filings to the SEC site. As discussed in Section 2, transmission of accepted filings to the SEC site should occur as soon as the PDS acknowledges receipt, after which it begins dissemination to the subscribers. To provide some evidence on what delays when filings are posted to the SEC site relative to their availability to the Tier 1 Subscribers, Panel B of Table 5 provides univariate comparisons of various attributes of the insider purchases partitioned by whether the filing is available in the PDS feeds before or after it is posted to the SEC site. Specifically, Panel B compares trade size (the log of 1 + the total dollars), firm size (log of 1 + total assets, in millions), prior trading (log of 1 + total purchase activity, in dollars, that the insider engaged in during the prior 365 days), a CEO dummy, a CFO dummy, and

¹⁸ We do not report the Table 5 numbers for sales, in part because our subsequent tests are limited to insider purchases which, as noted above, are the transactions that have information content (previous research shows that there is little information content in sales).

filing cluster (log of 1 + the number of filings posted to the SEC site in the 60 seconds prior to the Form 4).

With one notable exception, the results provide little evidence of any systematic difference in filings available to the Tier 1 Subscriber before/after they are posted to the SEC site. Interestingly, the filing cluster variable is larger for observations for which the filing is available to the Tier 1 Subscriber at or after the time of posting to the SEC site, implying that busy periods delay transmission more to the Tier 1 Subscribers than to the public site. This impression is reinforced by the results of regressions in Panel C that include these variables as explanatory variables in regressions that explain the various time lags, from the time of initial EDGAR acceptance until: (a) posting to the SEC site (and so available to the public); (b) PDS feed #1; (c) PDS feed #2. A fourth regression explains the time difference from when the Tier 1 Subscriber first receives the information (from either of their feeds or the SEC posting; that is, first dissemination) to the SEC posting, which ranges from positive when the earliest PDS feed occurs before posting to the SEC site to zero when the initial receipt of the filing is the SEC posting itself.

The results of these regressions largely confirm the univariate evidence. The only variable that is significant in these regressions is filing cluster, which captures the extent to which a lot of filings are posted to the SEC site in a short period of time. Clusters in filings delay the transmission of the filing to the SEC site and, to a larger extent, to the Tier 1 Subscribers; when there is clustering, it is less likely that the PDS feeds “beat” the posting to the public SEC site. For the acceptance-to-SEC regressions, the coefficient on this variable is around 5 ($t = 3.85$) and the R-squared is 1.9%; in contrast, for the two acceptance-to-PDS feed regressions, the coefficient is around 15 ($t = 19$) and the R-squared is 24%, so clustering of filings plays a more important role in delaying feeds to the Tier 1 Subscribers, both in absolute terms and relative to the time of SEC

posting. The implication is that the Tier 1 Subscribers obtain larger advantages during less busy times.

5. Evidence on trading advantage

The results to this point indicate that while the EDGAR dissemination process usually processes filings quickly, typically in about 40 seconds, the initial public posting to the SEC site often occurs after the filing becomes available to Tier 1 Subscribers. In more than half of all cases, Tier 1 Subscribers have access to the filing before the initial post to the SEC site, with these differences being around 10 seconds, a potentially significant time in the context of HFT.

To provide evidence on the economic significance of this difference, we next report a series of tests designed to examine the second-by-second market response to the news in the insider filings, to determine whether the timing advantage available to the Tier 1 Subscribers also results in a trading advantage. As a precursor to these tests, we report the returns associated with the insider trades. In Table 6, we report returns over three windows: (1) from the time of the trade until the corresponding Form 4 is accepted by EDGAR (the return available to the insider before filing); (2) from acceptance until initial public dissemination (i.e., the first time the Tier 1 Subscriber receives the information, either from one of its feeds or from the SEC posting); and (3) from initial public dissemination through the following ten trading days. Once again, we report results separately for purchases and sales; the literature consistently shows that insider purchases predict returns but that insider sales do not (e.g., Jaffe, 1974; Finnerty, 1976; Seyhun, 1986; Lakonishok and Lee, 2001; Jeng, Metrick, and Zeckhauser, 2003).

Insider purchases are associated with modest but significant positive returns over the ten days after public release. The mean (median) raw return over this interval is 2.37% (1.18%), which is reliably different from zero. The corresponding numbers for insider sales are 0.49% (0.50%), which,

although smaller, are also statistically significant. For the window from insider trade to initial acceptance by EDGAR, the mean (median) return for purchases is 0.42% (0.06%), which is also statistically significant. Finally, returns from initial acceptance to first dissemination are small, with a mean (median) of 0.15% (0.00%) but are statistically significant. Because the returns to sales are relatively small we drop them from further analysis.

We use three variables to provide evidence on the market response: (1) changes in prices in event time (the percent change in price relative to the price 60 seconds prior to dissemination), (2) abnormal volumes (the percent of abnormal volume relative to the typical volume for the two minutes around the dissemination),¹⁹ and (3) abnormal spreads (the spread relative to the spread 60 seconds prior to dissemination). Formal definitions of these measures are provided in Appendix A. Each of these variables is measured at one second intervals.²⁰ We report results in a series of figures.

Figure 2 shows how these variables change in event time relative to initial posting to the SEC website, measured from 60 seconds before posting to 60 seconds after, windows that, for the large majority of observations, are wide enough to capture the full interval from initial acceptance to dissemination via the last of our three possible dissemination events. To assess the effect of the timing advantage, we partition observations according to whether they are available to the Tier 1 subscribers before posting to the SEC site (“advantaged observations”) or not.

The results shown for the changes in prices (returns) in Figure 2 Panel A are striking. There is a clear difference between the two sets of observations, with price moving upward for the

¹⁹ More precisely, we take cumulative dollar volume from $t = -60$ to through event second t minus the average volume for the exact same window (calculated over the previous 52 weeks), deflated by the average cumulative volume for the entire 120 second window (again calculated over the prior 52 weeks).

²⁰ Our tests assume that the clocks used by our Tier 1 provider and by TAQ are correctly synchronized. This seems reasonable based on the importance to the Tier 1 provider of having extremely accurate measurement of time. The tests also assume that there is no delay in recording the quotes using TAQ and (later) trading volumes and spreads. The quote assumption is inconsistent with early work in the microstructure literature (Lee and Ready, 1991) but is supported by more recent tests (Rogers, 2008).

advantaged observations beginning around 30 seconds before public posting with most of the positive return (of around 0.30% for the full two minute window shown here) occurring before public posting. In contrast, for the non-advantaged observations, most of the upward shift in price occurs exactly at the time of the posting, with a small upward movement in the few seconds before and additional “drift” in the seconds after.²¹ The overall price change over the full window is very similar for the two series, suggesting that the information content of the trades is similar. The differences between the two series from at least 30 seconds prior to public dissemination through one second after are statistically significant (Panel D plots t-statistics for the differences between the two series). These results provide strong evidence that some traders take advantage of knowing about the insider purchases in advance of public dissemination.

The results for the volume tests reported in Figure 2, Panel B are consistent with those from the returns test. Once again, there is evidence of market response, this time measured as abnormal volume that begins around 30 seconds before the public posting for the advantaged observations but noticeably later for the non-advantaged observations, with a sharp spike at the posting time. And once again, the two series merge within 10-15 seconds after the public posting, suggesting that the overall volume response is similar. As for the price differences, the differences in volume are statistically significant from more than 30 seconds before public dissemination until just before dissemination (Panel D).

Panel C presents the spread results. As in the previous two figures, we report the advantaged and non-advantaged time series of relative spreads. Very similar to the previous figures, these results show that spreads reflect the information in the trades noticeably earlier for the advantaged observations relative to the non-advantaged observations. The fact that spreads, which should reflect information asymmetry among market participants, behave in this way—jumping

²¹ It is hard to see how we would obtain this sharp spike at the time of posting if the measured clock times used in our tests were inaccurate.

sharply for the advantaged observations—provides additional assurance that the effects we are capturing are informationally-based.

Overall, these results present clear evidence that the market responds over a period of about 30 seconds before public posting for the advantaged transactions, while most of the response occurs exactly at the time of public posting for the non-advantaged transactions, consistent with information leakage occurring through Tier 1 Subscribers when they receive filings before their initial public release. The conclusion is that the playing field is not fully level, at least for a short time.

A different approach to showing the effect of timing is to report the price, volume, and spread changes using different definitions of event time. Specifically, the next set of tests define time 0 alternatively as: (1) public posting to the SEC site (“SEC time”), and (2) the first time that the Tier 1 Subscriber receives the information from either one of the PDS feeds or the public SEC posting (“PDS time”). The idea is to see graphically from the event plots which of the times is most likely to be the important informational event, as measured by the most pronounced “spike” at time 0.

The results of the price test (Figure 3 Panel A) support the idea that the important informational event is when the filing becomes available to the Tier 1 Subscribers, as opposed to its posting to the SEC site. There is a very sharp, distinct spike in price at time 0 when we define the event as availability to the Tier 1 Subscribers (the earliest dissemination among the Tier 1 feeds and the SEC posting). While there is also a time 0 effect when it is defined as the SEC posting time, it is evident from this plot that a significant fraction of the response occurs before time 0, consistent with leakage via the PDS channel.

The volume results in Figure 3 Panel B as well as the spread results in Panel C, provide similar evidence. Once again, what is clearly the most pronounced time 0 spike occurs when event

time is defined as the time the filing news is first available to the Tier 1 Subscribers. In contrast, a good part of the reaction occurs prior to time 0 when it is defined as the SEC post time, with something of an incremental spike at time 0, suggesting that there are at least some observations for which SEC post time is when the news is first available.

Notice also that in all the price and volume charts, while most of the response occurs in the window before time 0, there is nevertheless significant continued “drift” upwards in prices and volume after the event. Thus, the market adjustment process appears to continue over a period that continues past the end of this two minute window. Indeed, the evidence from Table 6 suggests that while we clearly document a strong price and market response in this short window, this response is relatively small compared to that for the full ten day window that begins with dissemination. Moreover, the mean return of approximately 0.30 percent over the two minute period is roughly comparable to that available to insiders prior to the initial filing of the Form 4, of 0.42% (Table 5, Panel A).

6. Summary and conclusions

We provide evidence on the timeliness of the EDGAR process used by the SEC to publicly disseminate Form 4 insider filings. Over the last several years the emergence of traders who take advantage of very small timing differences, sometimes measured in milliseconds, between when information becomes available to different market participants means that the timeliness of this process has become critical.

Our evidence, which is based on a sample of Form 4 insider trading filings from 2012 to 2013, shows that EDGAR processes these filings quickly, with around a 40 second lag between when filings are accepted by EDGAR and when they are made available to the public on the SEC website. However, we also show that Tier 1 PDS subscribers, who pay for direct access to

EDGAR, usually receive filings before they are available on the SEC website (this occurs in 57% of cases for insider purchases and in 56% of cases for insider sales). The average timing advantage is about 10 seconds, a relatively long time in the world of high frequency trading. Moreover, we report clear evidence—from prices, trading volume, and spreads—that certain market participants appear to trade on the news in advance of its public release. We find that all three measures of market activity begin to move up to 30 seconds before the filing is made available on the SEC site. This is hard to reconcile with the notion that the EDGAR process provides a level playing field to investors.

Our data also allow us to separate the returns available to insiders before the information in Form 4 filings is made available to the public. Of the total return available to insiders from the time an insider purchase is made through ten days after the corresponding Form 4 is made available by EDGAR, insiders earn relatively little in the period before information about the trade is made public—these returns are significant but are less than 0.5%. This contrasts with a mean return for the full period of 2.37%, implying that most of the price movement occurs after the news is disseminated to the public. This is in some ways comforting, because it suggests that those who trade only after the news about insider trades are made public are able to capture a relatively large amount of the associated return. Alternatively put, there is little advantage to be had by insiders (or others with advance access to the news) in the period before the news about insiders' purchases is made available to the public.

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Appendix A: Variable Definitions

Independent Variables (Tables)

Note: all continuous variables winsorized at 1% and 99%.

<i>Trade Size</i>	= The dollar value of the insider purchase, from T-R.
<i>Firm Size</i>	= Total assets, from Compustat, in millions.
<i>Filing Cluster</i>	= The number of filings posted to EDGAR in the 60 seconds prior to the Form 4 posting.
<i>Prior Trading</i>	= The total amount of purchase activity, in dollars, that the insider engaged in during the prior 365 days, from T-R.
<i>CEO</i>	= 1 if the insider is the CEO, 0 otherwise.
<i>CFO</i>	= 1 if the insider is the CFO, 0 otherwise.
<i>DJ Coverage</i>	= 1 if the firm has Form 4 filings covered by Dow Jones (per the RavenPack archive), 0 otherwise.

Market Reaction Variables (Figures)

<i>Returns</i>	= The percent change in price between event time and the price 60 seconds prior to dissemination.
<i>% Abnormal Volume</i>	= Cumulative dollar volume from $t = -60$ to through event second t minus the average of the same for the exact same window (calculated over the prior 52 weeks), deflated by the average cumulative volume for the entire 120 second window (again calculated over the prior 52 weeks).
<i>% Abnormal Spreads</i>	= The percent abnormal spread, measured as (actual spread – normal spread for time t) / (normal spread at 60 seconds prior to dissemination).

Table 1: Sample construction

This table describes the sample construction procedures. The table begins with T-R insider trading data. We then merge in data from three other sources. First, we add in the Form 4 insider trading time-date stamps obtained from the SEC's EDGAR filing system. Second, we incorporate TAQ data. Finally, we merge in details about the Dow Jones media coverage of the filings. The details on sample attrition for the full sample, as well as purchases and sales separately, are provided below.

	Total Trades	Purchases	Sales	% Purchases
Line 1: Starting sample from T-R (stock not options, Form 4, Mar. 1, 2012 - Dec. 31, 2013, including Officers, Directors and Committee members)	97,372	23,113	74,259	23.7%
Line 2: Match company CIK and insider name to SEC filings on EDGAR	86,940	18,852	68,088	21.7%
Line 3: Restrict to "isolated" Form 4 filings (exclude multiple filings within 5 minutes of each other)	64,553	14,951	49,602	23.2%
Line 4: Posted to SEC website 9:40am to 3:30pm EST	20,425	6,610	13,815	32.4%
Line 5: With TAQ data	18,721	5,289	13,432	28.3%
Line 6: Insider's last transaction price within daily trading range on CRSP	17,960	4,782	13,178	26.6%

Table 2: Descriptives

This table provides descriptive statistics for trade and firm characteristics for insider purchase transactions (Panel A) and sale transactions (Panel B). All variables are defined in Appendix A. The p-values are from tests of differences in means (medians) between samples from a two-sided t-test (Wilcoxon rank-sums test). For binary variables, significance is based on p-values from a χ^2 test.

Panel A: Insider purchase transactions									
	Line 3 Sample			Line 6 sample (restrict to within trade hours)			Test of Diff (p-value)		
	N	Mean	Median	N	Mean	Median	Mean	Median	
<i>Trade Size</i>	14,951	186,551	18,146	4,782	104,861	16,649	<0.01	0.02	
<i>Firm Size</i>	14,191	3,414	540	4,473	3,690	678	0.21	<0.01	
<i>Filing Cluster</i>	14,951	4.73	3.00	4,782	3.09	2.00	<0.01	<0.01	
<i>Prior Trading</i>	14,951	492,780	37,845	4,782	257,387	35,464	<0.01	0.01	
<i>CEO</i>	14,951	0.18	0	4,782	0.17	0		0.10	
<i>CFO</i>	14,951	0.06	0	4,782	0.06	0		0.70	
Panel B: Insider sale transactions									
	Line 3 Sample			Line 6 sample (restrict to within trade hours)			Test of Diff (p-value)		
	N	Mean	Median	N	Mean	Median	Mean	Median	
<i>Trade Size</i>	49,602	918,228	245,794	13,178	684,194	209,989	<0.01	<0.01	
<i>Firm Size</i>	49,406	8,044	1,431	13,099	9,037	1,887	<0.01	<0.01	
<i>Filing Cluster</i>	49,602	5.05	3.00	13,178	3.17	2.00	<0.01	<0.01	
<i>Prior Trading</i>	49,602	991,834	250,000	13,178	735,397	214,291	<0.01	<0.01	
<i>CEO</i>	49,602	0.14	0	13,178	0.11	0		<0.01	
<i>CFO</i>	49,602	0.08	0	13,178	0.08	0		0.01	

Table 3: Distribution of trading days between insider trade and acceptance of the filing by the SEC

This table provides the distribution, for the Line 6 sample in Table 1, of the number of trading days between the date of the insider trade and the date EDGAR accepts the Form 4 filing as reported in filing header.

	Purchases	Sales
Observations	4,782	13,178
Mean	4.0	2.5
99%	37	8
95%	4	2
90%	2	2
75% Q3	2	2
50% Median	1	1
25% Q1	1	1
10%	0	1
5%	0	0
1%	0	0

Table 4: Summary of timing differences between SEC posting and the earlier of the two Tier 1 Subscriber PDS feeds

<i>Seconds different</i>	Purchases		Sales	
	<i>Percent</i>	<i>Cum. Percent</i>	<i>Percent</i>	<i>Cum. Percent</i>
less	1.40%	1.40%	1.40%	1.40%
-89 to -85	0.13%	1.53%	0.05%	1.46%
-84 to -80	0.08%	1.61%	0.09%	1.55%
-79 to -75	0.10%	1.71%	0.17%	1.71%
-74 to -70	0.08%	1.80%	0.13%	1.84%
-69 to -65	0.02%	1.82%	0.11%	1.96%
-64 to -60	0.04%	1.86%	0.12%	2.08%
-59 to -55	0.15%	2.01%	0.08%	2.16%
-54 to -50	0.17%	2.17%	0.17%	2.32%
-49 to -45	0.21%	2.38%	0.24%	2.56%
-44 to -40	0.17%	2.55%	0.28%	2.85%
-39 to -35	0.33%	2.89%	0.44%	3.29%
-34 to -30	1.25%	4.14%	1.12%	4.40%
-29 to -25	3.53%	7.67%	3.31%	7.71%
-24 to -20	7.36%	15.04%	6.66%	14.36%
-19 to -15	9.39%	24.42%	9.48%	23.84%
-14 to -10	10.16%	34.59%	10.28%	34.13%
-9 to -5	10.98%	45.57%	10.71%	44.83%
-4 to 0 (PDS 1st)	11.54%	57.11%	11.49%	56.32%
1 to 5 (SEC 1st)	11.04%	68.15%	11.45%	67.77%
6 to 10	9.41%	77.56%	9.27%	77.04%
11 to 15	7.36%	84.92%	7.30%	84.34%
16 to 20	4.45%	89.38%	5.01%	89.35%
21 to 25	3.16%	92.53%	3.39%	92.74%
26 to 30	2.24%	94.77%	2.10%	94.84%
31 to 35	1.38%	96.15%	1.31%	96.15%
36 to 40	0.79%	96.95%	0.80%	96.96%
41 to 45	0.88%	97.83%	0.86%	97.81%
46 to 50	0.48%	98.31%	0.48%	98.29%
51 to 55	0.38%	98.68%	0.34%	98.63%
56 to 60	0.19%	98.87%	0.24%	98.87%
61 to 65	0.38%	99.25%	0.22%	99.09%
66 to 70	0.15%	99.39%	0.18%	99.27%
71 to 75	0.13%	99.52%	0.09%	99.36%
76 to 80	0.06%	99.58%	0.12%	99.48%
81 to 85	0.08%	99.67%	0.07%	99.55%
86 to 90	0.04%	99.71%	0.08%	99.64%
More	0.29%	100.00%	0.36%	100.00%
	100%		100%	
# zeros	3		7	
# obs	4,782		13,178	

Table 5: Potential explanations for when the Tier 1 Subscriber feed is first and by how much

This table provides descriptive statistics and regression analysis of the reporting delays. Panel A presents the distributions of various delays. Panel B provides univariate statistics of trade and firm variables based on whether the Tier 1 Subscriber receives the filing first or not via the PDS feeds. Columns 1, 2, and 3 of Panel C examine the delay between the acceptance of the document by the SEC and the SEC posting, PDS feed #1, and PDS feed #2, respectively. Column 4 examines the time delay between when the Tier 1Subscriber first receives the information (earliest of all 3 feeds) and the SEC posting. All variables are defined in Appendix A. The p-values of tests of differences in the means across samples are for a two-sided t-test. The p-values of tests of differences in the medians across the samples are for a two-sided Wilcoxon rank-sum test. For binary variables, significance is based on p-values of a χ^2 test. Standard errors are clustered at the year-month level.

Panel A: Descriptive statistics for reporting delays

	N	25th	50th	75th	Mean	StDev
Acceptance to SEC post	4782	31.4	36.2	41.6	40.2	23.9
Acceptance to first dissemination	4782	22.2	30.2	36.4	29.7	10.4
Private (PDS feed) advantage	4782	0	3.2	14.9	10.5	22.5

Panel B: Univariate Descriptives

	PDS before SEC			PDS equal to SEC			Test of Diff (p-val)	
	N	Mean	Median	N	Mean	Median	Mean	Median
<i>Trade Size</i>	2,728	63,061	16,480	2,054	70,563	17,250	0.11	0.19
<i>Firm Size</i>	2,556	3,223	668	1,917	3,270	707	0.86	0.92
<i>Filing Cluster</i>	2,728	2.3	2.0	2,054	4.0	4.0	<0.01	<0.01
<i>Prior Trading</i>	2,728	163,332	35,442	2,054	180,221	35,613	0.23	0.63
<i>DJ Coverage</i>	2,728	0.79	1	2,054	0.80	1		0.42
<i>CEO</i>	2,728	0.17	0	2,054	0.17	0		0.48
<i>CFO</i>	2,728	0.06	0	2,054	0.06	0		0.87

Panel C: OLS regressions examining timing differences

Dependent variable:	Acceptance to SEC post		Acceptance to PDS feed #1		Acceptance to PDS feed #2		PDS (earliest of all 3 feeds) to SEC post	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Intercept	31.096 ***	8.14	19.626 ***	13.97	19.589 ***	14.91	11.367***	2.96
Log(1+Trade Size)	0.275	0.85	0.425	1.46	0.392	1.47	-0.065	-0.21
Log(1+Firm Size)	0.281	1.16	0.063	0.48	0.044	0.36	0.257	1.10
Log(1+Filing Cluster)	4.998 ***	3.85	14.474 ***	18.42	14.610 ***	19.03	-3.090**	-2.24
Log(1+Prior Trading)	-0.126	-0.33	-0.428	-1.39	-0.387	-1.37	0.174	0.54
DJ Coverage	-0.23	-0.26	-0.185	-0.27	-0.111	-0.15	0.057	0.07
CEO	0.207	0.27	0.154	0.31	0.125	0.25	-0.194	-0.25
CFO	0.24	0.16	0.362	0.38	0.28	0.32	-0.253	-0.17
R-squared	0.019		0.243		0.245		0.008	
N	4,473		4,473		4,472		4,473	

Table 6: Returns

This table shows the raw returns following insider trades during three periods: 1. trade to upload of the Form 4 filing from by company to EDGAR, 2. upload to the first dissemination (the earliest of the two PDS feeds and the SEC posting), and 3. first dissemination to ten days following the dissemination. Panel A provides details on these returns for insider purchases and Panel B provides the same for insider sales.

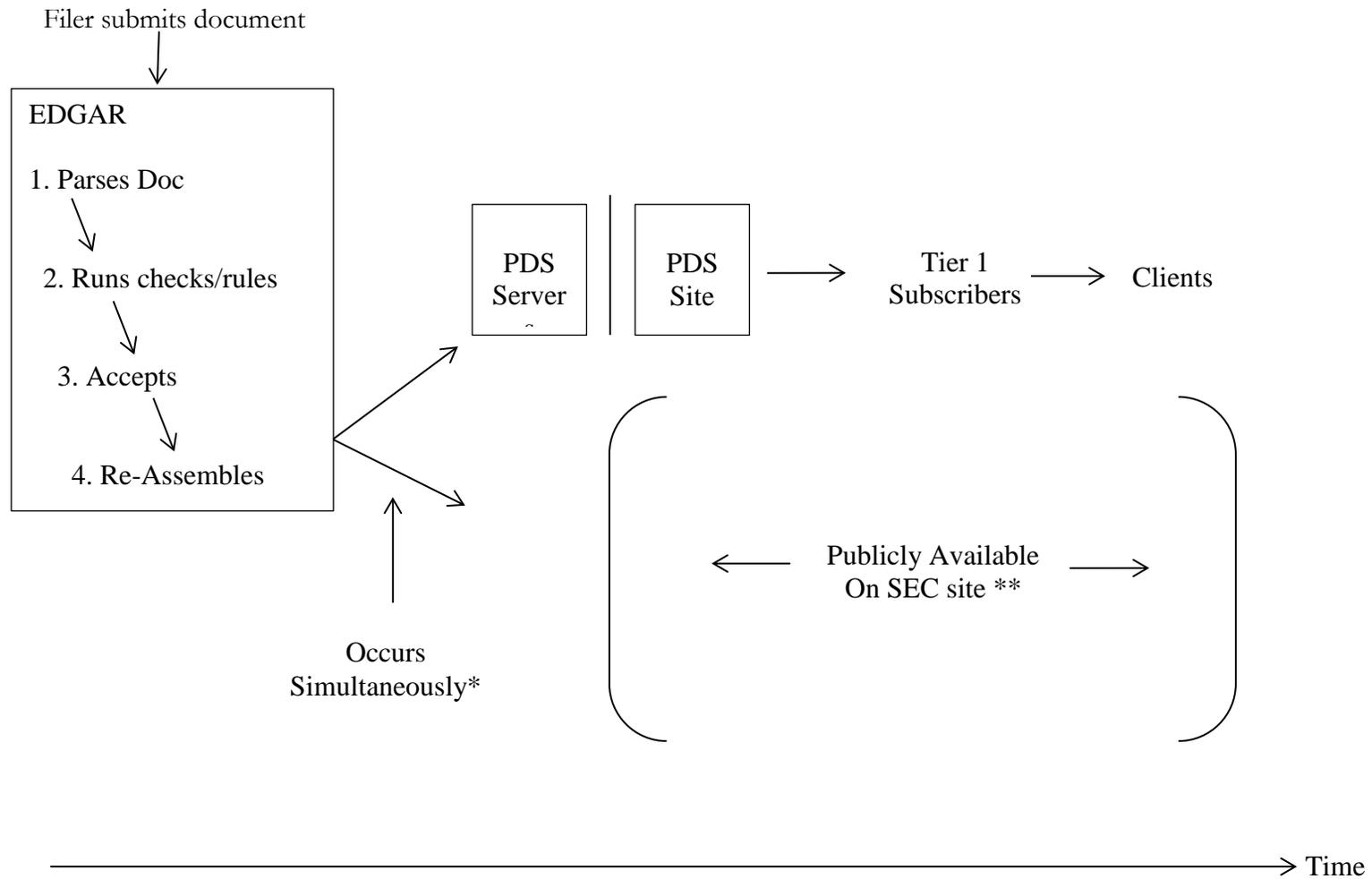
Panel A: Purchases

	N	25th	50th	75th	Mean	Test of means (pvalue)
Insider trade to EDGAR acceptance	4,782	-0.0104	0.0006	0.0129	0.0042	<0.001
EDGAR acceptance to first dissemination	4,782	0	0	0.0006	0.0015	<0.001
First dissemination to 10 days after	4,708	-0.0163	0.0118	0.0469	0.0237	<0.001

Panel B: Sales

	N	25th	50th	75th	Mean	Test of means (pvalue)
Insider trade to EDGAR acceptance	13,178	-0.0082	0.001	0.0103	0.0017	<0.001
EDGAR acceptance to first dissemination	13,178	0	0	0	0	0.97
First dissemination to 10 days after	12,945	-0.0207	0.005	0.0313	0.0049	<0.001

Figure 1: The EDGAR Dissemination Process



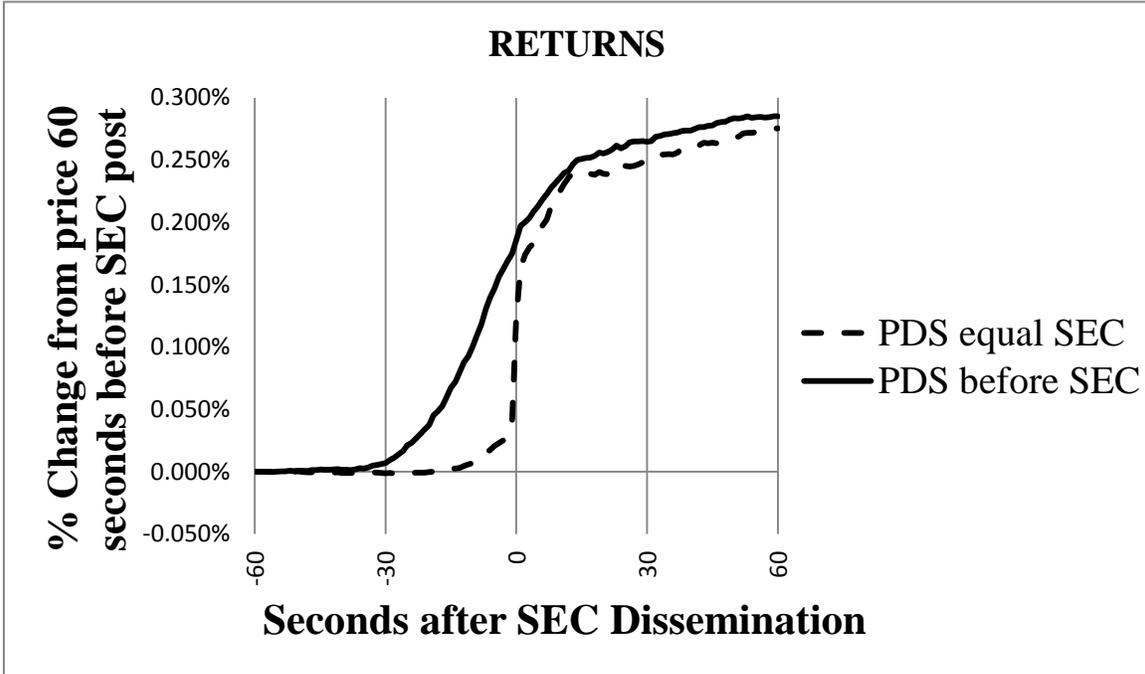
* According to SEC documentation, these will occur simultaneously

** Can be before or after filing available to Tier 1 Subscribers and/or clients

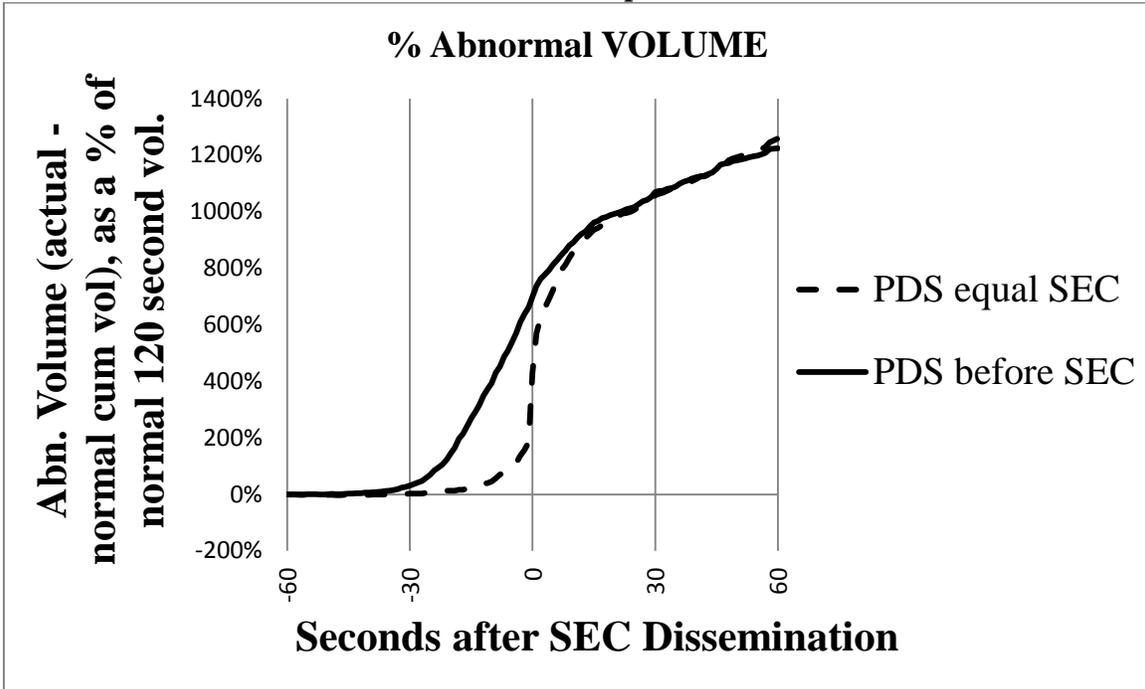
Figure 2: Market reactions in “SEC Time” based on whether the Tier 1 Subscriber receives the information (the earliest of all 3 sources received) before or at the same time as the SEC post

Market reaction variables are defined in Appendix A.

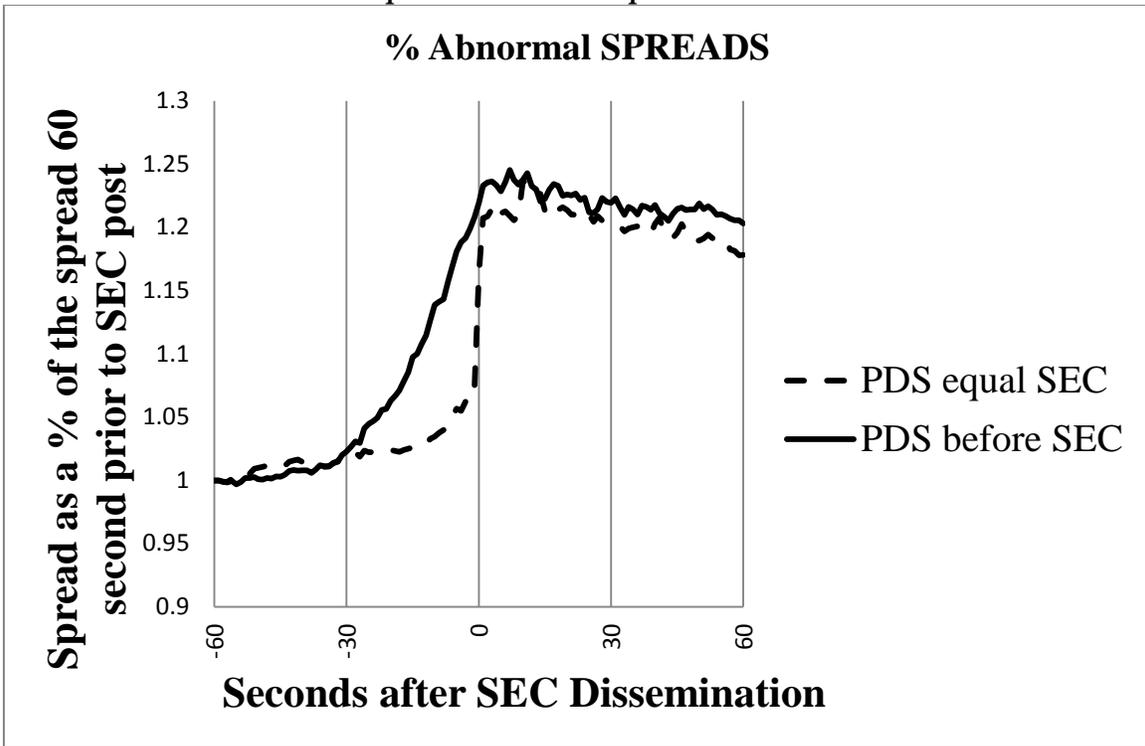
Panel A: Returns for insider purchases



Panel B: Percent abnormal volume for insider purchases



Panel C: Percent abnormal spreads for insider purchases



Panel D: Distribution of t-statistics testing (PDS before SEC) versus (PDS equal to SEC) timing

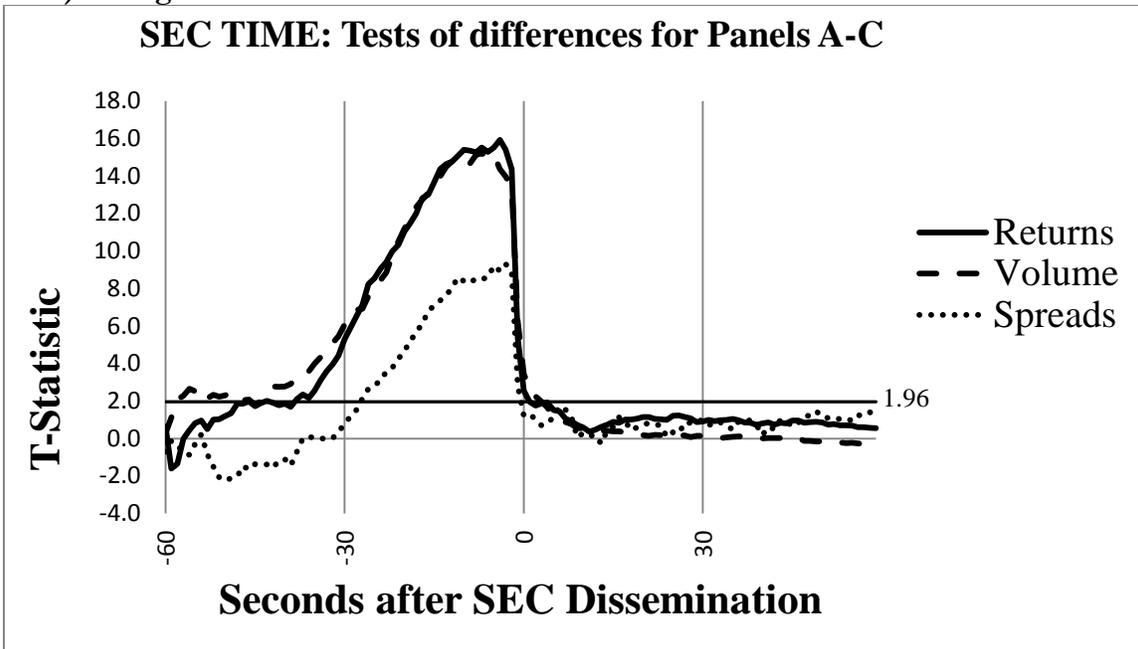
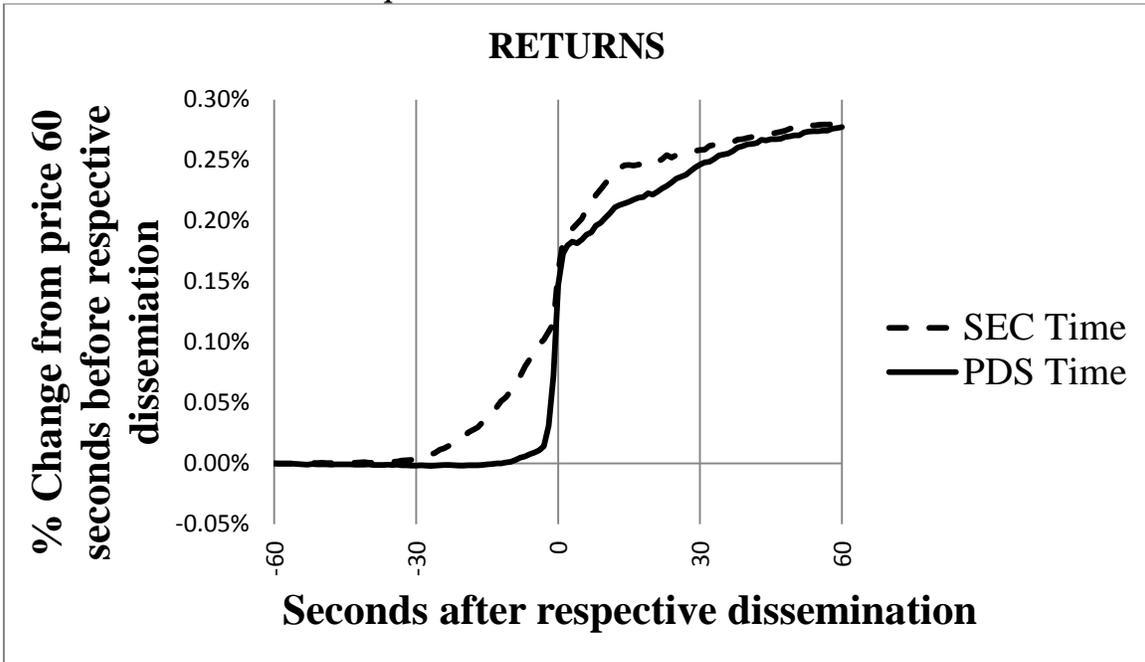


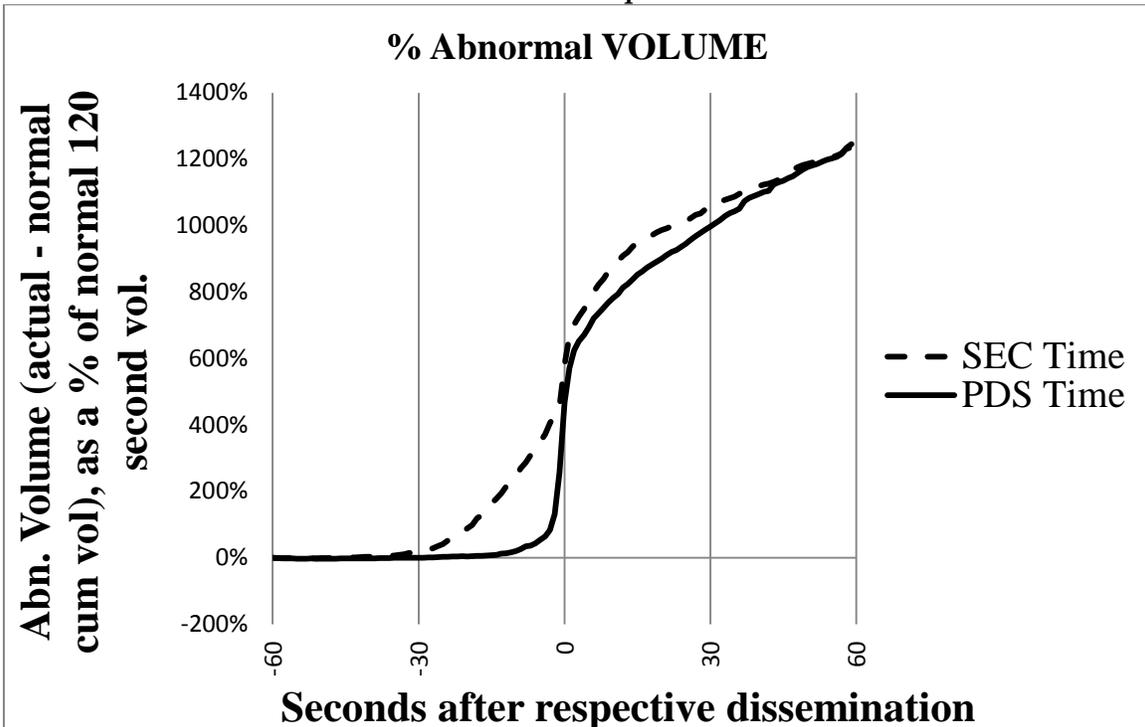
Figure 3: Market reactions of the full sample in “Tier 1 Subscriber Time” (PDS Time) and “SEC Time” (i.e., t=0 is defined based on when information is received by each source)

Market reaction variables are defined in Appendix A.

Panel A: Returns for insider purchases



Panel B: Percent abnormal volume for insider purchases



Panel C: Percent abnormal spreads for insider purchases

