Insider Trading Patterns[☆]

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Abstract

We revisit the information content of stock trading by corporate insiders with an expectation that opportunistic insiders will spread their trades over longer periods of time when they have a longer-lived informational advantage, and trade in a short window of time when their advantage is fleeting. Controlling for the duration of insiders' trading strategies, we find robust new evidence that both insiders' sales and purchases predict abnormal stock returns. In addition, we provide evidence that insiders attempt to preserve their informational advantages and increase their trading profits by disclosing their trades after the market has closed. When insiders report their trades after business hours, they are more likely to engage in longer series of trades, they trade more shares overall, and their trades are associated with larger abnormal returns. Finally, we show how accounting for these trading patterns sharpens screens for corporate insiders who trade on information.

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1. Introduction

Many researchers have studied the information content of insiders' trades, but the results have been mixed. Although researchers have consistently found that corporate insiders' purchases signal positive future abnormal returns, insights regarding the information content of insiders' stock sales have been elusive. Early work suggested that insiders' sales predicted negative abnormal returns on average, but this conclusion was called into question by subsequent work that more adequately controls for the multiple factors associated with expected stock returns. Accordingly, researchers often suggest that insiders appear to sell their stock mostly for diversification and liquidity needs.[1] More recently, researchers have attempted to isolate informed trades by filtering out transactions that are unlikely to be informed. However, these efforts often do not uncover reliable evidence that a large subset of insiders' sales predict negative abnormal returns. For example, while Cohen, Malloy, and Pomorski (2012) demonstrate that randomly-timed stock sales predict future returns that are lower than those that appear to be routine, the difference appears to be driven largely by the puzzling positive abnormal returns following sales classified as routine.[2] Other researchers provide evidence that insiders' sales are informed in certain narrow contexts. Examples include sales that were pre-planned under Rule 10b5-1 in the early 2000s (Jagolinzer et al., 2011), selling during periods of accounting fraud (Agrawal and Cooper, 2015), and selling motivated by public information (Alldredge and Cicero, 2015).

In this paper, we revisit the informational content of corporate insiders' trades. However, in contrast to previous literature, we employ a methodological innovation that helps account for an important aspect of insiders' trading strategies. The intuition motivating our methodology is this:

[1] Examples of early work suggesting both purchases and sales were informed include Jaffe (1974), Finnerty (1976), Seyhun (1986, 1992, 1998), and Chowdhury, Howe, and Lin (1993). Subsequent work by Lakonishok and Lee (2001) and Jeng, Metrick, and Zeckhauser (2003) show that the abnormal return results for stock sales are not robust to controls for firm size, book-to-market equity value, and momentum. See Jagolinzer, Larcker, and Taylor (2011) for a recent example of work that finds insignificant abnormal returns following insiders' sales when controlling for all of these risk factors.

[2] This fact is most evident in Cohen et al.'s portfolio abnormal return tests.

we expect opportunistic insiders to trade so long as they have an informational advantage. The underpinnings of this expectation are developed more fully in Section II, but it is consistent both with the theoretical models of informed trading developed by Kyle (1985) and others, and with recent evidence on the trading patterns of individuals who have actually been charged with illegal trading by the S.E.C. (Kacperczyk and Pagnotta, 2018).[3]

To illustrate why the trading patterns of informed insiders may differ, consider two hypothetical firms where executives intend to trade on information. At one firm, an executive knows that the firm is likely to miss its earnings in the near-term. At the other firm, an executive has been involved in negotiations with a key supplier that are not going well. This information has no near-term earnings implication, is not routine in nature, and will not be revealed to the market for a number of months. The trading patterns of opportunistic insiders in these situations may differ. To benefit from her information, the executive at the former firm could sell shares immediately and will probably only be able to trade in a short window of time before the negative information is incorporated into prices, either because the trading draws outside investors' attention to signals of earnings weakness or because the earnings are soon disclosed. In contrast, the executive at the latter firm may be able to trade over a longer period of time without the market inferring the unexpected announcement in the distant future (all other signs may point toward good performance in the near term).[4]

Based on this intuition, we classify insiders' trades as either isolated trades, which are concentrated in a short window of time, or trade sequences, that extend over longer windows of time. For

[3]We believe that the insider trading and return patterns identified in this paper may capture both legal and illegal insider trading. It is illegal for insiders or any other party to trade securities based on material private information (Securities and Exchange Act of 1934, Sections 16(b) and 10(b), and the related Security and Exchange Commission rules and case law), and the results we present here could help identify this type of illegal trading. However, as demonstrated by Alldredge and Cicero (2015), corporate insiders may also trade profitably in their own stock by being more attentive than other investors to public information that will affect their stocks' valuations in the near future, and the results of this paper are also consistent with this type of behavior. For a detailed discussion of the statutory and case law that governs illegal insider trading in the United States, see Wang and Steinberg (2006).

[4]Although one may question the wisdom of a CEO trading on information that will soon be revealed in an earnings release, Ali and Hirshleifer (2017) provide evidence that this type of informed trading may be quite common. They find that firms headed by CEOs who brazenly trade before earnings releases are more likely to also engage in other forms of financial misconduct.

our analysis, we define a trade sequence as trading by an individual in the same direction across multiple calendar months. When allowing for gaps in trading not exceeding one month in length, we find that 58% of trading months are isolated and 42% are sequenced. The sequences average 3.6 months in length.

If insiders are trading on information, the isolated trades should be associated with a short-lived informational advantage and abnormal returns should be apparent shortly afterwards. If longer trade sequences are also motivated by an informational advantage that is persistent – either because the market is inattentive to the trading, or because the type of information motivating the trades will not soon be disclosed – then abnormal returns should be apparent following the completion of the trading sequences. For extended trade sequences, we also measure abnormal returns over a window that begins when the insider starts trading and ends shortly after the trade sequence is completed, which should suggest whether trade sequences are motivated by an *ex ante* informational advantage.[5]

Our analysis of insider trades over the period 1986–2017 suggests that, on average, insiders trade on information both when they engage in isolated trades and trade sequences. Isolated insider sales are followed by significant abnormal returns of negative 59 to 66 bps in the following month, and insider sales sequences are followed by abnormal returns of negative 126 to 136 bps in the month following the end of the sequence.[6] Importantly, we also find evidence that sequences are timed relative to information *ex ante*. The average buy-and-hold abnormal return beginning

[5]In our judgement, allowing for month-long gaps in sequences is the most appropriate classification scheme. This allows for trading gaps due to blackout periods where individuals are not allowed to trade (Bettis, Coles, and Lemmon, 2000). When considering an alternative stricter definition of sequences that do not allow for gaps and results remain statistically significant and qualitatively similar.

[6]The striking contrast from results that do not account for trading patterns can be explained by the abnormal returns measured during sales sequences, which are *positive* 63 to 68 bps per month. An empirical strategy that treats each interim sequence months as an independent observation is therefore positively biased, and masks the negative abnormal returns associated with the trading strategy. Why would one find positive abnormal returns during a sequence of insider stock sales? One possibility consistent with our main hypothesis is that an insider opportunistically executes an extended sequence of sales with knowledge that negative information will not be disclosed until a future date. The absence of bad news during the trading period causes the distribution of interim abnormal returns to be *positively* biased.

after the first sequenced trade month and ending three months after sequences are completed are a negative 147 bps. This suggests that insiders had an informational advantage when they began their extended trading strategies.[7]

Accounting for insiders' trading patterns also sharpens our understanding of the abnormal returns associated with insiders' stock purchases. Isolated stock purchases are followed by positive abnormal returns of between 119 and 143 bps, and sequences are followed by positive abnormal returns of 159 to 187 bps. In addition, the buy-and-hold abnormal return measured from the first month after sequences begin until three months after they are completed are 423 bps, which suggests that purchase sequences are also motivated by an *ex ante* informational advantage on average. The overall contrast in returns following insider purchases and sales is captured by four-factor calendar-time return tests for self-financing portfolios that buy stocks the month after isolated purchases and purchase sequence ends, and short stocks after isolated sales and sequence sales ends. This portfolio yields an alpha of approximately 240 bps per month (33% annualized).

Our main results are robust to a number of sorts. For example, they are apparent following insiders' trades at both large and small firms, before and after passage of the Sarbanes-Oxley Act, and when evaluating only the trades of C-Suite executives or the CEO and Chairman of the Board. In addition, given that these results hold over a 16 year time-period that precedes the Sarbanes-Oxley Act, it is also evident that they are not driven by pre-planned trading under Rule 10b5-1, which was enacted in October 2000.

Having found that the overall sample of insiders' trades are informed on average, we also consider whether abnormal returns are evident among the large subset of transactions considered to be "routine" trades by recent literature (Cohen et al., 2012). Once we account for trading patterns, we find compelling evidence that these "routine" traders are also engaging in opportunistic trading. As

[7]To compare our results with prior literature we also calculate abnormal returns using each trade month as an independent observation (in other words, not accounting for trade sequences). Consistent with prior research, results that do not account for trading patterns tests fail to find evidence of significant abnormal returns.

in the overall sample, the apparently "routine" isolated purchases and sales, as well as purchase and sale sequences, predict sizable abnormal returns. The fact that previous researchers did not find evidence of informed stock sales in the routine trader subsample may be because of the relative proportions of sequenced and isolated trades across their samples. We find a higher percentage of sequenced trade months among traders classified as routine under the Cohen et al. (2012) methodology than is apparent in the sample of non-routine traders. When each trade month is treated as an independent observation, the abnormal returns following the "routine" trading months are biased towards zero by the greater fraction of intra-sequence trading months.

An additional robustness test contrasts the returns following insiders' sales to those apparent when insiders do not trade. Other recent work suggests that insiders are in fact *less* likely to sell stock when they possess negative private information about their firms (Marin and Olivier, 2008; Gao, Ma, and Ng, 2015). In contrast to those results, we find that the magnitude of abnormal returns following insiders' stock sales patterns are actually significantly larger than those following insiders' silence once we account for insiders' trading patterns. This may reflect insiders' willingness to trade when in possession of information that predicts more modest price swings, whereas insiders are silent ahead of rare but large price movements.

Further analysis shows that accounting for trading patterns may help sharpen screens for insiders who trade on private information.[8] For example, suppose we set a threshold to identify whether 60% of an executive's stock sales (alternatively, 80% of sales) are followed by negative abnormal returns. When accounting for sales sequences, one would identify 44% (13%) of CEOs as potentially informed inside traders when accounting for insider trading patterns, versus only 38% (9%) if we do not account for trading patterns. Of the CEOs flagged as potentially informed traders under our rule, almost a third would be missed if we do not account for trading patterns.

Having established the relevance of insiders' trading patterns, we consider the factors that pre-

[8]We remind the reader that these results do not necessarily identify illegal insider trading. But we do assert that such a classification scheme may be a useful screen for identifying illegal trading to the extent that it exists.

dict whether insiders engage in isolated or sequenced trades. If investors are opportunistic and trade on information, we expect their trading sequences to be associated with more asymmetric information and the ability to maintain an informational advantage. Consistent with these expectations, we find in multivariate regressions that trade sequences are more likely in firms that are smaller and are followed by fewer analysts. We also find that isolated informed trades are more likely to be followed by an immediate earnings surprise, indicating that routine information with valuation consequences is revealed sooner after isolated trades. In contrast, extended trade sequences are more likely to be followed by the eventual release of information that could have been known further in advance, including future breaks in earnings per share, and announcements that a firm will be acquired.

The last question we address is whether insiders try to preserve their advantage in order to engage in more profitable trading. Our focus is on the time of day at which insiders report their trades to the S.E.C., and, thus, the public. Since August 2002, corporate insiders have been required to report trades in their own securities within two business days on Form 4, and these documents become publicly available through the S.E.C.'s website (EDGAR) within seconds of their filing.[9] Previous research provides evidence that unexpected disclosures attract less attention when they are reported after the market has closed (Niessner, 2015; Doyle and Magilke, 2015). We hypothesize that insiders trading on an informational advantage will be more likely to file their trade reports after hours in an effort to diminish the signal that their trading sends to the market so that they can maximize their own profits.

We find considerable evidence consistent with this hypothesis. First, we find that an insider is more likely to engage in an extended trade sequence when they report their trades after the market has closed. We also find that trades reported after business hours are associated with larger abnor-

[9]Insiders are required to file Form 3 to report initial beneficial ownership of shares, Form 4 to report changes in beneficial holdings, Form 5 to report annual changes in beneficial ownership, and Form 144 to declare their intention to sell restricted shares. Before August 2002, they had until the 15^{th} day of the calendar month following the month in which they traded to report their trading activity.

mal returns. For example, in the three months after a sequence ends, sequenced sales are followed by negative abnormal returns that are 129 basis points larger if the first sale of the sequence was reported after 5 pm. Similarly, sequenced purchases are followed by positive abnormal returns that are 163 bp larger in the three months after the sequence ends if the first sale of the sequence was reported after 5 pm. Finally, we find that after-hours reporting is associated with both a greater number of trade days in a sequence and trading of more shares. All of these results are robust to alternative measures of the frequency of after-hours reporting of trades throughout a sequence. Taken together, these results provide evidence that after-hours trade reporting is associated with more profitable trading. Further tests indicate that executives may also delay reporting trades to the SEC for as long as possible, even violating regulatory requirements that set the number of days allowed before trades must be reported. This analysis suggests that insiders purposefully time their disclosures in order to minimize market impact and maximize their opportunities to profit.

Overall, the results are consistent with our hypothesis that insiders trade opportunistically on private information and that their trading strategies are designed to maximize the advantages of their private information. Nevertheless, a potential alternative explanation, especially with regards to insider sales, is that executives merely begin selling stock for liquidity or diversification and then stop trading when they receive negative information. This alternative explanation would be consistent with negative abnormal returns following the end of a sales sequence. However, for a couple of reasons, we do not believe that this alternative explanation drives our results. First, as we have noted earlier, abnormal returns beginning after the first month of the sequence and ending three months following are significant, suggesting sequences are timed relative to information *ex ante*. Another reason we do not believe that this alternative drives our results is based on our finding that the abnormal returns associated with extended trading sequences is predicted by whether the *first* trade of the sequence is reported after hours. This finding suggests a systematic attempt to preserve an informational advantage that would not be expected if insiders begin trading merely for liquidity and stop when then come into possession of important information. We acknowledge

that our inference is subject to the caveat that there may be unobserved factors that are correlated with sequenced trading, after-hours reporting, and subsequent returns.

The results of this paper should be useful for regulators and investors who wish to understand the trading behavior of informed investors, either to identify those who violate the law, or to update their own beliefs about the value of firms' publicly traded securities. It should also inform researchers on the design of future work that attempts to uncover evidence of informed trading in yet-to-be identified contexts, or that uses indicators of informed trading as an input on a related research topic. We show that the patterns of informed trading and the time at which profits are realized depend upon the nature of the insiders' informational advantage. By implementing a simple classification scheme as we have done here, future researchers may have a more powerful tool for identifying informed trades and traders.

2. Hypotheses

The focus of this paper is on insiders' stock trading patterns as a function of their informational advantage. The first principle motivating this research is the fact that information, by its nature, is time sensitive; it will eventually be incorporated into prices. Insiders wishing to exploit an informational advantage therefore have a finite window of opportunity. The information will eventually be revealed either through earnings announcements, press releases, leakage from other insiders, or through the market impact of aggregate trading activity. We therefore expect that trades concentrated in a short period of time are more likely to be motivated by a short-lived informational advantage and we expect insiders to concentrate their trading over short horizons when they possess the type of information that is likely to be quickly incorporated into prices.

There are times, however, when an insiders' informational advantage may be longer-lived. We expect this to be the case when the information is non-routine in nature. For example, an executive may know her firm is likely to lose a key business relationship in the coming months, have internal data indicating that a particular R&D project looks particularly promising, or be

involved in merger discussions with another firm. Indeed, Heitzman and Klasa (2012) provide evidence that insiders trade opportunistically during private merger negotiations. It is reasonable to expect that insiders with such an advantage will spread their trades out over time. Prior research has shown that larger trades tend to move prices, and trade prices convey information about firm values to the market (Meulbroek, 1992; Gloston and Milgrom, 1985). Optimal trading strategies based on private information therefore involve sequences of trades to avoid sending strong signals (Kyle, 1985). Recent work examining the trading patterns of individuals who were prosecuted for illegal insider trading finds evidence that informed traders behave as predicted by the Kyle model. In particular, they find that these illicit traders spread their orders out over time in order to minimize the price impact of the signal their trading sends to the market. In addition, according to a 2000 internal S.E.C. memorandum discussing the investigation of insider trading, one of the most relevant factors is the size of a trade, so those trading on private information have an incentive to avoid conspicuously large trades (Foster, 2000). Based on this discussion we hypothesize that sequences of trades spread over longer horizons may also be opportunisitic, but they are likely to be motivated by private information that takes longer to be incorporated into prices.

The alternative null hypothesis is that insiders spread their trades over longer periods of time when they are trading for liquidity or diversification purposes. There may be less immediacy to these trades if insiders are not trying to exploit a temporary informational advantage. Insiders may spread these trades out over time because they still face the reality that the market has limited depth and larger trades tend to move prices, which could cause them to realize less favorable average trading prices. Consistent with this expectation, Lebedeva, Maug, and Schneider (2012) demonstrate that insiders spread their trades out over time when they face liquidity constraints.

2.1. Trading Patterns and Abnormal Returns

We begin our analysis by considering the abnormal returns associated with insider trading. As discussed above, we expect that trades concentrated in a short period are more likely to be motivated by a short-lived informational advantage. If this is the case, we expect abnormal returns

to follow soon after isolated trades. We have also hypothesized that longer sequences of trades may be motivated by a longer-lived informational advantage. If this is correct, then we should also find that extended trade sequences are associated with abnormal returns that generally follow completion of the trading sequences. To conclude that trade sequences are motivated by an ex-ante informational advantage, we should also find that the eventual stock prices reflect new information relative to the pre-sequence price. This finding would suggest that insiders are motivated by an informational advantage when they initiate trading. It should rule out the possibility that trade sequences are executed by liquidity traders that anchor their stock valuations and just choose to stop trading when large price movements occur. To summarize, we explicitly make the following predictions:

(i) Insiders' isolated sales will be followed by negative stock returns in the month after the sale while insiders' isolated stock purchases will be followed by positive stock returns.

(ii) Insiders' sales sequences will be followed by negative abnormal returns in the months following the end of the sequences while insiders' purchase sequences will be followed by positive abnormal returns.

(iii) Abnormal returns beginning after initiation of a sales sequence and ending after the conclusion of the sequence will be negative, while abnormal returns associated with purchase sequences over similar windows will be positive.

2.2. **Predicting Insiders' Trading Patterns**

The second part of our analysis focuses on the circumstances associated with insiders' trading patterns. We begin by examining whether proxies for different aspects of the information environment are related to whether insiders execute isolated trades or longer trade sequences. We expect that opportunistic insiders are less likely to initiate a trading sequence when their informational advantage will be short-lived. Our proxy for the immediacy of information is whether the next

quarterly earnings announcement following insiders' trades delivers an earnings surprise in the direction consistent with profitable pre-announcement trading.

We also expect that the higher the general level of information asymmetry between insiders and outsiders, the more likely insiders can maintain an informational advantage and execute longer trade sequences. Firm-specific characteristics may proxy for the speed with which the market incorporates information into stock prices. Prior studies have shown that the prices of smaller firms are less efficient (Seyhun, 1986; Lakonishok and Lee, 2001), and have argued that insiders also have greater informational advantages in growth firms (Smith and Watts, 1992; Barclay and Smith, 1995). In addition, Frankel and Li (2004) show that insiders' individual trades are less profitable when they have a larger analyst following. We expect that insiders' information advantage will dissipate faster when more analysts cover their firms, leading to fewer opportunistic trade sequences. In contrast, the null hypothesis that sequences are executed primarily for liquidity or diversification purposes predicts that these variables are not associated with trade sequences.

Insiders may also attempt to manipulate the information environment to their advantage. If they can hide trading activity, this may enable insiders to maximize profitable trading opportunities. However, corporate insiders are unique in that they must report all of their trades in their companies' securities to the SEC, and these reports are made available to the public immediately. Thus, an opportunistic insider might attempt to extend an informational advantage by manipulating her trade disclosure strategy in a way that minimizes the amount of outside attention drawn to their trading activity.

A number of researchers provide evidence that corporations strategically disclose negative news after business hours are over (Damodaran, 1989; Patell and Wolfson, 1982; Niessner, 2015). When the timing of disclosures are pre-planned and expected, like quarterly earnings releases, there is evidence that firms do this to allow market participants time to interpret the information (Doyle and Magilke, 2009; Michaely, Rubin, and Vedrashko, 2014). In contrast, investors appear to pay less attention to unanticipated announcements, such as earnings guidance and material

corporate events disclosed through Forms 8-K, when they are disclosed outside of market hours (Niessner, 2015; Doyle and Magilke, 2015). Similarly, we might expect investors to pay less attention to trade reporting by insiders because these reports are also typically unanticipated, and this may help insiders preserve their informational advantages. In addition, if insiders have discretion over the timing of these disclosures, it is possible that they intentionally report trades after business hours to maximize their trading opportunities.

This conjecture depends critically upon whether insiders have control over the time when their forms are filed with the S.E.C. In many cases, this activity is likely delegated to a corporate secretary or outside legal counsel. However, as previous studies of executive stock option backdating reveal, executives can likely exert influence or control over the reporting process, as evidenced by the fact that backdated option grants and exercises are associated with longer reporting lags (Heron and Lie, 2007; Cicero, 2009; Dhaliwal, Erickson, and Heitzman, 2009).[10] It is reasonable to expect that insiders may have similar control over the time of day that their trades are disclosed to the S.E.C.

3. Data

The main data source used in this analysis is the Thompson Reuters Financial Network Insider Filing Data, which provides detailed information on insiders' transactions in the stock and derivatives of their own companies. An "insider" is broadly defined under S.E.C. regulations to be those who have "access to non-public, material, insider information," and includes officers, directors and 10 percent beneficial owners of a company's stock. We focus our analysis on insiders' stock trades. For each insider, we aggregate trades on a calendar month basis and we exclude any calendar months where an insider engaged in both sales and purchases during the month. For abnormal

[10]Another assumption is that market participants are actually less attentive to insider trades reported after hours. In Supplementary Material Table IA11, we test, and find support for this inattention to after-hours reporting in our broad sample. We find that cumulative returns on day of, and day after, the insider filing with SEC are *less positive* for insider purchases, and *less negative* for insider sales, than those filed while markets are open.

return tests, we use the full time series of transactions available in the data, which run from January 1986 to December 2017.

Our analysis requires identification of trading sequences. We classify trade months as sequenced if the insider trades in the same direction in multiple months, allowing for one-month long gaps (Appendix Table A1 provides a detailed description of the sample selection and trade classification process). For example, say an executive sells stock in April, May, July, and October of a given year. We will consider her to have executed one trade sequence beginning in April and ending in July, and to have executed another isolated trade in October. Sequences are also allowed to span months across calendar years. As an alternative, in untabulated analysis, we also calculate sequences based on consecutive trading months only, and find results that are qualitatively and quantitatively similar.

As can be seen in Table 1, a large fraction of insiders' trades are sequenced. There are 393,217 isolated sale months in our sample, and 316,673 sequenced sale months. The sequence sale months add up to 99,034 sequences with an average length of 3.68 months. For purchases, there are 233,407 isolated purchase months and 130,871 sequenced purchase months, for a total of 41,037 sequences that are an average of 3.64 months in length. Overall, 42 percent percent of trade months are sequenced. Figure 1 presents a summary of trade sequence durations.

Another notable finding is that insiders trade more shares during a sequence than in isolated transactions months. For sales, the mean (median) number of shares traded is 301,967 (39,834) during a full sequence versus 160,538 (10,000) in isolated sales months. In purchase sequences, insiders trade a mean (median) of 373,320 (10,000) shares versus only 85,573 (2,000) in isolated purchase months. This shows that insiders make larger adjustment to their portfolios when they trade over a number of months. If sequenced trades are motivated by private information, then this suggests that the conditions allowing for insiders to trade over longer periods of time also lead to greater profits.

As discussed above, we also consider whether the timing of insiders' trade disclosures is related

to the length of insiders' trading programs. By regulation, insiders are required to report all of their transactions to the S.E.C.[11] Since 2002, insiders are supposed to report trades within two business days of executing a trade, and the forms, which are filed electronically, are made available to the public through EDGAR almost immediately. Figure 2 presents a histogram of the frequency of insider transaction reporting throughout the day. The timestamps on the filings begin at 6 a.m. and steadily increases during the day until 5 p.m, which is one hour after the market closes. By the time the market closes, 39 percent of sales have been disclosed, and an additional 22 percent are disclosed between 4 p.m. and 5 p.m. The remaining 39 percent are reported between 5 p.m. and 10 p.m., with a steady decline in reporting activity over this time. For purchases, 56 percent are reported before 4 p.m., 18 percent are reported during the 4 p.m. hour, and 26 percent are reported after business hours. If after-hours reporting draws less attention, the greater prevalence of after-hours reporting of sales suggests that insiders have greater incentives to keep bad news from being impounded into their stock price than good news.[12]

We hypothesize that investors are less attentive to news about insider trading disclosed after the market closes. However, given the observed distribution, is is not clear whether we should expect investors' attention to decline when the market closes at 4 p.m., when they can no longer make quick market trades on the information, or if they to maintain attention during the period of high reporting volume from 4 to 5 p.m. and redirect their focus only later in the evening. Given the uncertainty on this point, we control for both possibilities in our empirical analyses.

4. Empirical Analysis

In this section, we present empirical analyses testing the hypotheses discussed in Section 2. We start, though, with an illustration of the patterns we analyze in this paper, taken from two actual

[11] Insiders file Forms 3 to report initial beneficial ownership of shares, Forms 4 to report changes in beneficial holdings, Forms 5 to report annual changes in beneficial ownership, and Forms 144 to declare their intention to sell restricted shares.

[12] This could reflect both the greater litigation risk associated with selling stock when the price is declining, as well as the additional benefit to purchasing during price increases that stock already held is appreciating at the same time.

examples from our dataset. Consider the trades of two CEOs who sold their companies' stock from February to May 2005. The companies are identified only as Company A and Company B, and their trades and stock returns during that period are shown in Fig. 3. After not reporting any insider sales in the previous month, the CEOs of both companies report a sale on February 1 of 2005. Over the next six months, Company A's CEO reports no further trades. In contrast, following his trade in February, Company B's CEO reports sales in March, April and May.

Fig. 3 shows that in the month following the CEO of Company A's isolated sale, its stock price fell by 41 percent, suggesting his trade was informed and the private information was quickly incorporated into the stock price. A review of *World Street Journal* articles reveals that Company A reported a 15 percent decline in quarterly revenue at the end of April and the firm's earnings swung from a profit to a loss. In contrast, the price of Company B actually rose by about 13 percent over the time that its CEO was executing his sequence of trades. In the three months following the completion of the sequence, however, the stock price fell by 44 percent and ended 31 percent lower than when he started trading. This suggests that while the CEO of Company B's trading was informed, it ultimately took longer for the information to be revealed to the market. In this case, the decline in value is concentrated around the time that Company B announced not only that they had missed earnings expectations, but that they had canceled a major distribution contract in Canada – precisely the type of information that the CEO could have anticipated for some time, but that the market would have had difficulty identifying.

4.1. **Analysis of Returns**

We hypothesize that due to the time-sensitivity of information, informed insiders with a short-lived informational advantage will trade quickly and their isolated trades will be followed by abnormal stock returns. In contrast, informed insiders with a long-lived informational advantage will spread their trades over several months, and their trade sequences will not be associated with favorable abnormal return until the sequences end. In this section, we present a number of empirical tests of these hypotheses by comparing the returns following isolated trading months to those that

follow trading months that occur in a sequence.

We use two different methods for calculating abnormal returns. The first is a calendar-time portfolio approach where we regress the returns to an equally-weighted portfolio of stocks where insiders have traded onto factors thought to explain expected stock returns including the market return, firm size, the book-to-market equity ratio, and recent return momentum. The intercept from these regressions, or alpha, represents the abnormal returns.[13] We report separately the results of models controlling for just the equally-weighted market return, the three factors of Fama and French (1993), and the four factors of Carhart (1997).

An issue with implementation of the portfolio regressions is how to treat instances where multiple insiders at a firm trade in the same period, or have overlapping sequences. We treat isolated trades by multiple insiders at a firm in the same month as one observation. We treat a firm-month as a sequenced trade month so long as at least one insider is engaging in a sequence of trades. A month with an isolated trade by one insider and a sequenced trade by another is therefore not included in tests of isolated trading. In addition, when there are overlapping sequences at the same firm the stock does not go into the portfolio for tests evaluating returns following sequenced trading until the end of the latest overlapping sequence. For tests evaluating returns following the beginning of a sequence, the firm goes into the portfolio following the first trade month of the most recent overlapping sequence and stays in the portfolio until after the most recent overlapping sequence ends.

The portfolio tests may not always be best suited for testing whether or not individual trades are motivated by an informational advantage. To better evaluate this question, we also conduct tests at the individual trade level using a matching approach similar to that of Daniel, Grinblatt, Titman, and Wermers (1997) and Wermers (2004). For each observation, a firm's return is compared to the

[13] We focus our analysis on equal-weighted portfolios because we are interested in whether, in general, insiders' trades predict abnormal returns. The results are qualitatively similar if one value-weights the test portfolio, although this method would over-emphasize trading at larger firms.

return on a matched portfolio of firms formed based on size and market-to-book, and recent return momentum. Specifically, each firm-month is matched to one of 125 portfolios of firms formed using the Daniel et al. (1997) annual breakpoints for size and book-to-market quintiles, and rolling monthly 12 month past return quintiles.[14] For tests of returns associated with individual trading months that make up trading sequences, a matching portfolio is selected based on momentum over the 12 months immediately preceding the month of interest. For tests of the aggregate abnormal return associated with a full trade sequence, returns are compared to that of the matching portfolio selected as of the first month of the sequence. Standard errors associated with these tests are clustered by both firm and calendar month because a firm may be in the sample multiple times in the same month.

4.1.1. ***Abnormal Returns Associated with Isolated and Sequenced Trades***

In this subsection, we evaluate the abnormal returns following insiders' isolated and sequenced stock trades. We begin with the calendar-time portfolio regressions in Table 2 Panel A. However, Column (1) first reports regression alphas from tests treating each trade month as an independent observation. These regressions confirm the typical pattern seen in previous literature of generally insignificant returns following stock sale months, and significant positive alphas following purchase months. However, once we control for insiders' trading patterns, results consistent with our hypotheses are evident. Column (2) reports alphas following isolated trading months. The alphas following sales are now significant and negative, ranging from about -59 to -66 bps per month, and the returns following isolated purchases are larger than the results that do not account for trading patterns by an additional 23 bps per month. These results support our first hypothesis that isolated trades are informative about future stock returns.

Trade sequences are evaluated in Columns (3) – (7) of Table 2. We begin, in Column (3), by examining returns during sequences, treating each sequenced trade month as a independent

[14]The DGTW benchmarks are available via http://www.smith.umd.edu/faculty/rwermers/ftpsite/Dgtw/coverpage.htm.

observation. Interestingly, the alphas for sales months is *positive* and significant, ranging from between 63 and 68 bps per month. It is easy to infer that it is the inclusion of these months in tests that do not account for trading patterns that drove the alpha towards zero. But the reality is masked. In Column (4), we only include stocks in the portfolio in the last month of the sequence. Here we begin to observe a small negative abnormal return ranging from −31 to −40 bps. However, it is not until we require the sequences to end before putting stocks into the portfolio that we also uncover a large and significant evidence of negative abnormal returns associated with sequenced stock sales. Column (5) shows that there is a significant alpha of approximately between −126 and −136 bps in the month following sequences, and Column (6) shows that this monthly alpha remains approximately the same if we keep stocks in the portfolio for three months following sequence ends. These tests provide clear evidence that abnormal returns in the expected direction follow completed stock sale sequences.

Given the positive abnormal returns evident during the sequences it is, however, not yet clear that the *initiation* of sales sequences predicts negative abnormal returns. In Column (7) we include stocks in the portfolio from the month following sequence initiations until three months following the end of the sequences, and find statistically significant alphas of −22 to −27 bps per month. This indicates that the initiation of a sequence of trades predicts eventual lower stock returns. Given an average sequence length of 3.68 months, this translates to an average negative cumulative abnormal return of between 146 and 180 bps relative to when insiders begin trading. The interim positive abnormal returns during sales sequences are also consistent with a delay in the revelation of bad information, which could truncate the return distribution from below. Together, these results suggest that on average sales sequences are motivated by information that predicts negative abnormal returns that is not quickly incorporated into prices.[15]

[15] An issue that arises is whether or not one would still find these results if executives merely begin selling stock for liquidity or diversification, and then stop trading when they received negative information. This type of behavior would be consistent with the finding that negative abnormal returns follow sequence ends, and, depending on the magnitude of those sequence-end returns, could also lead to the finding of abnormal returns relative to sequence

Similar return patterns hold when evaluating purchase sequences. Purchase sequences therefore predict larger abnormal returns following their completion, and are also associated with positive alphas while being executed. It is possible that the differing return patterns across sales and purchases reflects different legal risks. Because there is less risk of liability, insiders' may continue to purchase their stock as information is being incorporated into its price. In contrast, they may be careful to stop selling their stock before negative information is impounded into the price due to the greater legal risk associated with informed stock sales.[16]

In Panel B of Table 2, we report the alphas for portfolios that are long firms where insiders have completed either isolated or sequenced stock purchases, and short firms where insiders have completed isolated or sequenced stock sales. The portfolio is rebalanced monthly. The monthly alphas are highly significant and are approximately 240 basis points per month. This translates into an annual abnormal return of approximately 33 percent, and indicates the economic significance of our findings.

As discussed above, the calendar-time portfolio tests may not be best suited for evaluating whether individual trade patterns predict abnormal returns when insiders' trades overlap. We therefore present matching-firm abnormal returns in Table 3. The results are similar.[17] In Panel A Column (1) we show that isolated insider sales are followed by a significant -61 bp abnormal return, and isolated purchases are followed by significant abnormal returns of 164 bps. In Columns (2) through (4) we report returns for both sale and purchase sequences that are similar to those found with the portfolio tests. Individual sequenced sales months, for example, are followed by positive

initiation. However, the fact that we find negative returns from the beginning of sequences suggests they are motivated by ex ante information. This view is also supported by additional analyses in subsequent sections suggesting insiders try to preserve their information advantage. To further evaluate the alternative explanation, we simulate samples of sales sequences with random start dates and ending just before large negative returns, and show that it is unlikely that this behavior could drive our results. The details of this simulation are discussed in Appendix B.

[16]See Skinner (1994), Brochet (2010), and Chen, Martin, and Wang (2013) for arguments regarding the relatively greater legal risk associated with selling stock before price declines.

[17]The tests presented in Table 3 measure observations at the insider level, and thus allow for multiple observations per firm, per month. We have also conducted these tests after aggregating at the firm thus allowing only one observation per firm, per month, and find similar results which we present in Supplementary Material Table IA12.

returns on average (Column (2)), driven by the large positive returns during the sequence (Column (3)); but they are followed by sizeable negative abnormal returns (Column (4)). In Panel B, we report the buy-and-hold abnormal returns (BHARs) that are evident from the month after sequences begin until three months after they end. In these tests sequences have different lengths, so we also report the average monthly abnormal return that is implied by the aggregate BHARs. The initiation of sales sequences are followed by significant BHARs of about −150 bp, which translates into an average monthly abnormal return of −43 bps. Purchase initiations are followed by about 400 bp BHARs that indicate positive abnormal returns of 90 bps per month. In sum, tests focused on individual trading patterns confirm the conclusions of the portfolio analysis.

4.1.2. ***Subsample Analyses***

We conduct abnormal return tests on a variety of subsamples of insider trades. The four-factor alphas for portfolios of stocks formed following either isolated or trade sequences in these subsamples are reported in Table 4. For comparison purposes, Column (1) restates the alphas using the full sample. In Columns (2) and (3), we demonstrate that all of the results hold when only considering trading by insiders at large and small firms, separately. The results in Column (4) are based on trading from 1986 to 2002, and Column (5) reports results for trading from 2003 to 2017. All of the main results continue to hold, although the alphas following insiders' purchases are more pronounced in the earlier period. The next three columns focus on just the trades of top executives. Interestingly, the abnormal returns are more pronounced following trades by members of the executive team (Column (6)), as well as following trades of just the CEO or Chairman of the Board (Column (7)). This is an important result considering that these executives are under the most scrutiny, and demonstrates the importance and power of controlling for insiders' trading patterns. In Column (8), we show that the abnormal returns following the trades of just the CEO are still evident (we limit this subsample to the period after 1995 since the rolecode "CEO" is rarely used before 1995). This evidence of ongoing opportunistic trading by top executives may be of particular concern to researchers and regulators.

In another set of subsample analyses, we evaluate, separately, the returns associated with trades that may have been classified as "routine" versus "opportunistic" by prior research. It is reasonable to expect that some insiders trade only for liquidity or diversification reasons (i.e., for routine reasons), but it is difficult to know the prevalence of this behavior. Cohen et al. (2012) proposed classifying insiders as routine traders if they trade in the same calendar month in three consecutive years, and those that appear to trade randomly in time as likely opportunistic traders. We follow their classification scheme and evaluate the returns following trades in each group separately, controlling for insiders' trading patterns.[18] In unreported preliminary tests that do not control for trading patterns, we find, as do Cohen et al. (2012), that both opportunistic sales and purchases are followed by abnormal returns suggesting they are motivated by private information, and fail to find evidence that routine sales and purchases are motivated by private information. However, once we control for insiders' trading patterns, we find considerable evidence of informed trading in all subsamples. As can be seen in Columns (9) and (10), the alphas following both isolated sales and sales sequences in the subsample thought to capture routine trading are significant and similar in magnitude to those following trades classified as opportunistic. The alphas following purchases expected to be routine are also large, although they are not quite as pronounced as those following expected opportunistic purchases.

The lack of evidence of informed stock sales in the routine trader subsample identified by Cohen et al. (2012) overall may be found in the ratio of sequenced and isolated trades. We find a higher percentage of sequenced trade months among traders classified as routine under the Cohen et al. (2012) methodology than in the sample of non-routine traders. Among the trade months that we are able to classify as routine sales, 60 percent are sequenced while 40 percent are isolated. In contrast, among those that we classify as opportunistic sales, 45 percent are sequenced while 55 percent are isolated. We find a similar split for purchases. If, then, each trade month is treated

[18]See Appendix A for a detailed description of the process we use to classify trade months as either routine or opportunistic.

as an independent observation, the abnormal returns following the "routine" trading months are biased towards zero by the greater prevalence of intra-sequence trades.[19] Our tests demonstrate that once insiders' trading patterns are taken into account, there is more evidence of informed trading among both non-routine traders and those previously thought to trade only for routine purposes, and suggests that informed trading is more widespread than previously thought. It also points to the potential benefit of a more accurate mechanism for identifying those traders that do not appear to trade because of an informational advantage.

The last test we present in this subsection contrasts the returns following insiders' sales to those apparent when insiders do not trade. Marin and Olivier (2008) show that the absence of insider stock selling is positively correlated with the probability of a stock crash and argues that this result reflects trading constraints on insiders. Gao et al. (2015) find similar results and argue that the likely explanation is the increased litigation risk associated with selling stock ahead of very large price moves. In Table 5, we report the four-factor alphas that are apparent following windows of trade inactivity ranging from 3 to 12 months, and also show the alphas to portfolios that are long these firm-months and short stocks in the month following isolated sales or sales sequences. The magnitude of the abnormal returns immediately following trading is larger than those that are apparent when insiders have been silent, and the alpha on the long/short portfolio is significant. It is possible, then, that our results demonstrate insiders' willingness to trade when in possession of information that predicts more modest price swings, whereas insiders are silent ahead of rare but large price movements. Indeed, in an SEC memorandum on how to conduct an insider trading investigation available on the SEC's website, a Senior Attorney in the Division of Enforcement notes that establishing the "materiality" of information traded upon generally requires

[19]Remember that the abnormal returns following an intra-sequence sales month appear to be opposite of the hypothesized direction. It is reasonable that a rule classifying traders as routine based in part on trade frequency would be more likely to pick up sequence traders so long as they also trade more often. We verify that this is the case. Among those traders that can be classified under the Cohen et al. (2012) system, those with an above median number sequenced trades (3 or more of their trades being sequenced) trade in 4.5 times more months than isolated traders.

a price movement of 10 percent or more (Foster, 2000). This seems to indicate that litigation risk may be highest when there is a large price swing, which could cause insiders to avoid trading.

4.1.3. ***Identifying insiders who trade on information***

In this subsection, we demonstrate how accounting for insiders' trading patterns can potentially help identify corporate insiders who are trading on information. We focus on CEOs, since this is the highest profile group of corporate insiders. We begin by calculating the average monthly abnormal returns following individual CEOs' stock sale months. We do this both when counting each trade month as an independent observation and again when only considering isolated sales and the ends of sales sequences. We find that the average abnormal returns are significantly larger in the tail of the distribution of CEOs once we account for trading patterns. For example, the cutoff for the top 10 percent of average abnormal returns following CEOs' sales is −9.01 percent or greater, compared to only −6.00 percent for the 10 percent tail when treating each sale month as an independent observation.

Figure 4a presents a distribution of the fraction of individual CEOs' sales months that are followed by negative abnormal returns. The figure presents distributions for two samples: 1) treating each trade month as an independent observation, and 2) based only on returns following isolated trade months or sequence ends. We find that the distribution is shifted to the right when accounting for trade sequences, indicating that, on average, CEOs trading patterns are followed by abnormal returns more often than we would have otherwise known. We also see an increase in the number of CEOs whose sales are frequently followed by negative abnormal returns. For instance, if using a threshold of 60 percent of trades (80 percent of trades) being followed by negative abnormal returns, one would identify 44 percent (13 percent) of CEOs as potentially informed inside traders when accounting for insider trading patterns, versus only 38 percent (9 percent) when we do not account for trading patterns.

To further demonstrate the usefulness of accounting for trading patterns for identifying opportunistic CEOs, Figure 4b evaluates just those CEOs who look like informed traders once we control

for their trading patterns (the subsample with above 60 percent of sales followed by negative abnormal returns) and shows the distribution of the fractions of their sales months that are followed by negative abnormal returns when not accounting for trading patterns. Of these CEOs, 37 percent cease to look like potential informed traders under the classification scheme that does not account for trading patterns. In other words, more than a third of CEOs who should be screened as potential opportunistic traders would be missed. This illustrates the importance of accounting for trading patterns when screening for informed traders, and it is surely the case that more sophisticated models along these lines could enhance predictability beyond what is demonstrated here.

4.2. Predicting Trading Patterns

In this section, we consider the determinants of the duration of insiders' trading patterns. As discussed in Section 2, we expect that insiders attempting to profit from an informational advantage trade over a longer period of time when their advantage is longer-lived. The circumstances we expect to lead to a longer-lived informational advantage include the immediacy of the information, i.e., how quickly it will be disclosed or can be interpreted, and the intensity of investors' attention to the firm.

4.2.1. ***Isolated versus Sequenced Trades***

Table 6 presents logistic regressions predicting whether new trading by an insider is an isolated event or the beginning of a longer sequence of trades. The sample includes each month where an insider begins trading after having not traded for at least two months, and the dependent variable is an indicator that takes a value of 1 if the observation begins a trade sequence. A value of 0 for the dependent variable indicates an isolated trade month. The independent variables of interest are motivated in Section 2 and include an indicator for whether or not the firm announces an earnings surprise consistent with the direction of the insiders' trading at the next announcement (*Near term earnings surprise*), the number of analysts following the firm (*Ln(No. of Analysts)*), the firms' stock market value (*Ln(Market Cap)*), and it's market-to-book equity value (*Ln(market*

equity/book equity)).

We begin with insiders' sales in Panel A. The relationship between analyst coverage and sales sequences is negative in regressions that do not include the firm characteristics (Columns (1) and (3)). However, when including firm size and book-to-market, the marginal effect of additional analyst coverage is positive. Sales sequences are less likely to be associated with a near-term negative earnings surprise (Columns (2) and (3)). This result continues to hold when controlling for additional firm characteristics in Column (4). From the regression in Column (4), we also see that sales sequences are less likely in larger firms and are more likely in higher market-to-book firms.

The regressions predicting purchase sequences are reported in Panel B. Purchase sequences are negatively related to both analyst coverage and a favorable near-term earnings surprise across all specifications. They are also less likely in larger firms. We find a significant negative relationship between purchase sequences and market-to-book. Overall, sequences are associated with a number of our proxies for information asymmetry. The most persistent results are that sequences are more likely at smaller and higher market-to-book firms and less likely when there is a near-term earnings surprise that can eliminate information asymmetry.

*4.2.2. **After Hours Reporting and Trading Patterns***

We next conduct logistic regressions that test the hypothesis that after hours reporting is associated with trading sequences. Since 2002, insiders have been required to report their trades to the SEC within two business days, and their disclosure forms are available almost immediately on the SEC's website. As discussed above, a substantial fraction of trades are reported after the market closes. Table 7 presents regressions analyzing the relation between disclosure timing and abnormal returns following insiders sales (Panel A) and purchases (Panel B). The specifications reported in Table 7 are similar to those in Table 6, but also include dummy variables indicating whether the first trade of a new trading month was reported to the SEC either in the hour after the market closed (*Reported during 4 pm hour*), or later in the evening (*Reported after 5 pm*).

We find that after-hours reporting is associated with the initiation of trade sequences. The coefficients on the after-hours reporting dummies are consistently positive and significant. In terms of marginal significance, the regression in Column (3) of Panel A indicates a 10 percent increase in the odds of at least one follow-on trade month when an insider reports her initial sale during the 4 p.m. hour, and an 11 percent increase when the trade is disclosed after 5 p.m. For purchases, the regression in Column (3) of Panel B indicates an increase in the odds of additional sequenced trading of 9 percent and 12 percent, respectively, when the trades are reported during the 4 p.m. hour or after 5 p.m.

These results raise the possibility that insiders purposefully disclose trades after business hours to maximize their trading profits. Columns (4) and (5) of Table 7 report regressions showing that the relation between after-hours reporting and trade sequences persists when including either firm- or person-level fixed effects (although this relation is not significant for purchases when we include person-level fixed effects). This would not be expected if insiders were merely executing pre-planned trading programs without concern for the market impact of their trades.

If corporate insiders are opportunistic when they report their trades, we may also expect after-hours trade reporting to be associated with greater trading profits. Table 8 reports regressions of abnormal returns following sequences onto dummy variable indicating whether the first trade of the sequence was reported between 4 pm and 5 pm, or after 5 pm. We focus on the first trade of a new trading program because the insiders' behavior at this point should be the best indicator of their intentions when they begin to trade, and minimizes concerns about endogenous choices with respect to whether or not to report subsequent trades after business hours. In column (1), we find that the overall abnormal return following sales sequences is over twice as large when the first trade is reported after 5 pm. This result continues to be evident when controlling for firm fixed effects in Column (2). The results for purchase sequences in Columns (3) and (4) show that the returns associated with purchase sequences are marginally larger when the first trade is reported after business hours although this result is not at conventional levels when we include firm fixed

effects. For robustness, we present in the Supplementary Material (Panel A of Supplementary Material Table IA1) similar tests that control instead for whether the insider reported either above 33 percent (roughly the median) or more than 50 percent of trades in a sequence after 5 pm. The results are qualitatively the same using these alternative measures.[20]

We then conduct, and report in Table 9, an analysis of the association between after-hours reporting and either the volume of shares traded (Panel A), dollar value of shares traded (Panel B), or trade days in a sequence (Panel C). We find strong evidence of a positive association between after-hours reporting (especially reporting after 5 pm) and all three measures. This is true for both sales and purchase sequences, and is robust to the inclusion of firm fixed effects. The marginal effects are also economically significant. For example, the coefficients on *Reported after 5 pm* in Panel A translate into marginal increases in shares sold during a sales sequence, if the first trade was reported after 5 pm, of 40 percent and 13 percent, respectively, when firm fixed effects are excluded or included. The analysis in Panel B shows a concurrent increase in the dollar value of shares sold in sales or purchase sequences when the first trade is reported after 5 pm. Finally, the analysis in Panel C indicates an increase, if the first trade is reported after 5 pm, in trade days in sales sequences of 11 percent and 3 percent respectively, when firm fixed effects are excluded and included, and an increase in purchase days of 22 percent and 9 percent, respectively, when firm fixed effects are excluded and included.

Other robustness tests (reported in the Supplementary Material) support this analysis. In Panel B of Supplementary Material Table IA1, we demonstrate that these results are similar when we replace the variable of interest with a dummy indicating that greater than either 33 percent or 50 percent of the trades during a sequence were reported after 5 pm. Finally, in Panel C of Supplementary Material Table IA1, we evaluate whether or not after-hours reporting is related to the number of shares reported on that specific disclosure form. We find strong evidence that this is the

[20]We do not attempt to account for person fixed effects in our analyses of sequences and after-hours reporting due to the fact that the number of individual traders is high relative to the total number of trading sequences.

case, and this result also holds when firm fixed effects are included in the regression. Finally, to ensure that this result does not merely reflect the fact that trades may be naturally reported later in the same day when an executive trades more heavily, we also show that the result holds when only considering trades disclosed on subsequent days (i.e., dates when the reporting date differs from the transaction date).

Overall, these analyses suggest insiders may report their trades after the market closes to maximize their trading profits. Subject to the caveat that there may be other unobservable factors that are correlated with both sequenced trading and after-hours reporting, our results indicate that after-hours reporting is associated with sequences of trades, more trading during these sequences, and larger returns.

5. Robustness and additional analyses

5.1. Insider trading returns and restrictions on informed trading

As we note in the introduction, while one may question the wisdom of a CEO trading on private information given the regulatory and firm level prohibitions against the practice, Ali and Hirshleifer (2017) provide recent evidence that this type of informed trading is not uncommon. They show that not only is insider trading fairly common in the period right before earnings announcements but that insiders who makes informed trades during what essentially constitutes a restricted or "black-out" period at most firms continue to make informed trades in the future. This raises two questions related our findings. First, to what extent can our findings of significant returns after accounting for trading patterns be attributable to just the subset of insiders who make profitable trades right before earnings announcements? Second, are the returns following insider trades larger among insiders who have previously made profitable trades right before earnings announcements?

To address these questions, we regress abnormal returns on a binary variable that equals 1 (0, otherwise) if an insider has made a profitable trade in the 21 days immediately prior to past quarterly earnings announcements in the preceding 36 months (*Observable prior profitable QEA*

Trading). We present the results of this analysis in Supplementary Material Table IA2. The results show that even after accounting for past profitable trading in the period immediately prior to quarterly earnings announcements, mean returns following both isolated and sequenced trades are still significant; the intercept in the insider sales regressions are significantly negative, and those in the insider purchases regression are significantly positive. However we do find evidence consistent with Ali and Hirshleifer (2017) suggesting that the magnitudes of the abnormal returns associated with insider trading are larger if the individual has engaged in prior profitable trading right before quarterly earnings announcements.

5.2. Insider trading returns and trading intensity

In our analysis thus far, we have generally not accounted for trading intensity – either the magnitude or value of shares traded during isolated or sequenced trades. Trading intensity could affect our inference in at least two ways, and we examine each in turn.

First, we note that insiders may trade more intensively if they are attempting to profit from an informational advantage. If their information is short-lived, they may trade more shares in a short period of time, and if they are trading on a long-lived informational advantage they may trade more shares over an extended sequence. To explore this possibility, we regress abnormal returns following isolated trades, or sequence ends, on the number or dollar value of shares traded during the month (for isolated sales) or sequence of trade months (for sequenced trades). We present the results of this analysis in Supplementary Material Table IA3. The results show that even after accounting for the magnitude of shares traded, mean returns following isolated and sequenced trades are still significant; the intercept in the insider sales regressions are significantly negative, and those in the insider purchases regressions are significantly positive. However, we find some evidence that abnormal returns following both isolated and sequences of trades are related to trading intensity. For sales, the returns following sequence ends are more negative when more shares are sold during the sequence (although trade intensity does not appear to affect returns following isolated sales). For purchases, returns are generally more positive when more shares are

bought in the month of the isolated purchase, or over the course of the purchase sequence, with the exception of when we use the dollar value of trade following sequence end buys.

A second concern is that the returns following insider trades may simply reflect market reactions to the intensity of trading, rather than the revelation of information. The market may consider more intense insider trading as a stronger signal, and react accordingly. In our data, the mean number of shares traded in isolated sales months is a relatively intense 160,538. Although the number of shares sold in a full sale sequence in total is higher (301,967), the mean number of shares traded per month in a sequence of 82,056 is less intense. Thus, isolated sales months may cause the larger immediate returns on average. If we further assume that the market also reacts to cumulative signals, we would expect returns to eventually follow repeated, but smaller, trades over an extended sequence. Hence, the documented results could be driven more by market reactions to trading intensity than to the importance of the information that was driving the trading.

The first piece of evidence calling this alternative explanation into question comes from observing insider purchases. Unlike with sales, the mean number of shares purchased per month during a sequence (102,560) is larger than the mean number of shares purchased during isolated purchase month (85,573), which is inconsistent with a signaling explanation. Further doubt is cast on this explanation by evaluating returns following the first months of sequences and isolated trade months with similar trade intensity. We create a sample in which we match the first month of every sequence to an isolated trade month in the same direction with a similar value of shares traded. If the results are driven by market reactions to signal intensity, similar returns should follow both groups of trade months. However, as we show in Supplementary Material Table IA4, this is not the case. Columns (1) and (2) evaluate insides' trading volume and confirm that there are no significant difference in trade intensity between isolated and first-month-of-sequence trades in our matched sample. When evaluating returns while controlling for trade intensity in columns (3) and (4), we find that the returns following isolated trade months remain significantly larger than matched first-month-of-sequences for both sales and purchases. This suggests that our returns are

not explained merely by market reaction to trade size.

5.3. **Trading by multiple insiders**

In our analysis thus far, we have not controlled for the number of insiders trading in the same direction contemporaneously. To examine whether this type of trading intensity drives returns, we regress abnormal returns following insider trading on binary variables that equal 1 (0, otherwise) when there multiple isolated/sequenced buyers or sellers in the same month.

We present the results of this analysis in Supplementary Material Table IA5. The results show that, even after accounting for the presence of multiple traders at the same firm, returns following isolated trades and sequence end trades are still significant; the intercept in the insider sales regressions are significantly negative, and those in the insider purchases regression are significantly positive. However, we also find that returns are larger if there are multiple traders. Isolated sell months and sequence-end sell months are followed by returns that are 53 and 95 bps more negative if there are multiple isolated sellers or multiple sequenced sellers in the firm, respectively. Isolated buy months are followed by returns that are 72 bps more positive if there are multiple isolated buyers at the firm, although returns do not appear to be affected by multiple sequenced buyers.

5.4. **Insider trading returns, uncertainty, and sequence length**

We have argued that insiders' trading patterns reflect the durability of their informational advantages. However, it is possible that trading patterns are also related to the level of certainty insiders have about coming events. Insiders may have a high degree of certainty about events that will occur, or information to be disclosed, in the very near future, but they may have less certainty about events that may or may not happen further down the road.

We consider a couple of ways that the degree of certainty about corporate developments could impact insider trading patterns. If short-term information is more certain, insiders may trade more aggressively, and there will be a strong relation between isolated trading and stock price movements. If distant events are less certain, insiders may trade less aggressively at first, and they may

actually stop trading early if it becomes apparent the expected development will not in fact materialize. This suggests one potential testable possibility: that many sequences are cut short because it became apparent that the corporate development would not, in fact, materialize, and that longer sequences indicate that expectations about the future have been confirmed over time. If this is the case, we expect to find stronger abnormal returns following longer sequences due to the higher percentage of predicted outcomes materializing, and weaker abnormal returns following shorter sequences due to the greater percentage of inaccurate predictions. To examine this possibility, we regress abnormal returns following sequence-end months on sequence length and present the results in Supplementary Material Table IA6. The results are mixed. There is evidence that, for insider sales, returns following sequence-end month increases with sequence length, but we find no such association for insider purchases.

Another way uncertainty could be reflected in trading sequences is in its relation to trading intensity over the course of a sequence. On the one hand, uncertainty may be reduced over time as the event becomes more certain, which may cause the insider to trade more aggressively over time. In this case, we will find that trade intensity increases systematically over the course of sequences. On the other hand, uncertainty about the timing of when the information is revealed may cause the insider to trade more aggressively early and perhaps less often – the longer the insider waits, the more risk that the information is revealed. Under these circumstances, we should find that trade intensity decreases systematically over the course of the sequence.

We examine these possibilities in Supplementary Material Table IA7. We regress the number of shares traded (and dollar value of shares traded) on binary variables for sequence beginning month and sequence ending month. Except for sequences that are two months in length (where the second month is the baseline observation), the middle months are the baseline observations to which we compare the first and last month of the sequence. We find no consistent evidence of trends in trading intensity over the course of sequences. For example, in both sales and purchase sequences of more than three months, both the first and last month of the sequence are systematically larger

than the middle months. In sequences of three to six months, the last month is larger than other months for insider but smaller than other months for purchases.

While the results in this subsection do not rule out a role for uncertainty about future events as a factor affecting insiders' trading patterns, they suggest that uncertainty neither explains the results of this paper nor call our interpretation into question. Understanding more fully the role of uncertainty in insiders' trading decisions is, in our view, an area worthy of further research.

5.5. **Insider trading in the post-SOX period**

The passage of SOX in 2002 included increased regulatory scrutiny of insider trading especially with the added requirement for insiders to report their trades to the Securities and Exchange Commission (SEC) within two business days. Prior to 2002, the requirement had only been to report within ten days after the close of the calendar month in which the transaction had occurred. In Table 4 (column 5), we show that returns following isolated trades and sequence-ends remained significant even after 2002. However, a natural extension of our study is to examine the extent to which increased regulatory scrutiny since 2002 has affected insider trading returns following either isolated or sequenced trading.

To examine this possibility, we regress abnormal returns following isolated and sequenced trades on a binary variable (*Post SOX*) that equals 1 (0, otherwise) for trades made after 2002. We do this separately for trades by the CEO/Chair of the Board, and for those by other executives. We present the results in Supplementary Material Table IA8. The results show that even after accounting for whether, or not, the trade was in the post-SOX era, mean returns following isolated trades and sequence end trades are still significant; the intercept in the sales regressions are significantly negative, and those in the purchases regressions are significantly positive. However, the magnitude of returns following the passage of SOX is smaller. The coefficient on the *Post SOX* variable is positive and significant in sales regressions, and negative and significant in purchases regressions. Thus, the increased scrutiny of insider trades in the post-SOX era appears to have reduced the returns to insider trading.

5.6. **Predicting insider trading patterns with other proxies of long-lived information**

In Section 4.2, we provided evidence that one proxy for the life of information, the *Near-term earnings surprise dummy*, predicted that insiders were less likely to start an extended trading sequence. In this section, we propose and examine the effect of two additional proxies for the presence of long-lived information on the propensity to start an extended trade sequence.

The first proxy we examine is long-term foreknowledge of an earnings per share (EPS) break, which is a break in a string of consecutive increases in quarterly earnings. Ke, Huddart, and Petroni (2003) find that insiders start to sell shares in their firms up to two years ahead of an EPS break. We therefore propose that an EPS break that is several months in the future constitutes a potential long-lived informational advantage, and is more likely to predict the start of a sequence in insider sales. For each firm in our insider sales sample, we create a binary variable that equals 1 (0, otherwise) for firms that announce an EPS break 13 to 15 months in the future (*EPS Break Announced Months t + 13 to t + 15*). We create a similar binary variable for firms that announce an EPS break 10 to 12 months in the future (*EPS Break Announced Months t + 10 to t + 12*). We then run a logit model regressing a dependent variable that equals 1 (0, otherwise) if a trade month starts an extended sequence onto proxies for information asymmetry (from Table 6), the near term earning surprise dummy, and the EPS break variables. The result, reported in the first column of Supplementary Material Table IA9, show that an EPS break 13 to 15 months into the future predicts that an insider initiates a trade sequence today. This further supports our expectation that trade sequences are associated with long-lived private information.

The second proxy for long-lived information that we consider is future mergers and acquisitions. Acquisitions are generally good news for insiders and shareholders of target firms. Because they often involve an extended period of private negotiation between target and acquirer executives, acquisitions may allow opportunistic target insiders to initiate extended purchase sequences. We examine this possibility in the second column of Supplementary Material Table IA9, in a sample of firms that were acquired within 15 months following an insider purchase. We find a positive as-

sociation between the number of days prior to the acquisition and the likelihood that the insider is initiating a sequence of trades. This analysis further supports our expectation that trade sequences are associated with a long-lived informational advantage.

5.7. Other ways insiders may extend their informational advantage

We have provided evidence that insiders who wish to trade on long-lived information, and are more likely to initiate a sequence of insider trades, are also more likely to try to preserve this information advantage by reporting their trades after hours. It is possible that insiders may try to extend their information advantage in other ways, and we examine that possibility in this subsection.

Cheng and Lo (2006) find insiders strategically time voluntary disclosures to maximize their trading profits. This raises the possibility that opportunistic insiders may time earnings guidance in such a way as to extend their information advantage. They may time the disclosure of good news to coincide with execution of sales sequences, and, conversely, time the release of bad news to coincide with purchase sequences. Opportunistic insiders may also seek to extend their informational advantage by delaying the reporting of trades as long as possible. As we note in section 5.5, over our sample period, there has always been a regulatory requirement that insiders report their trades to the SEC within a statutory specified period. Prior to 2002, the requirement had been to report within ten days after the close of the calendar month in which the transaction had occurred; since then the requirement was changed to require reporting within two business days. In order to extend their information, insiders may deliberately delay trade reporting. Delayed filing is distinct from the act of filing after hours that we discuss in Section 4.2.2.

To examine if insiders employ these additional means of preserving their informational advantage, we create four additional variables. The first, *Good News Guidance*, is an indicator variable set to 1 (0, otherwise) for observations where we observe a management forecast accompanied by a positive stock price response. The second, *Bad New Guidance*, is an indicator variable set to 1 (0, otherwise) for observations where we observe a management forecast accompanied by a negative

stock price response. The third, *Ln(Max Filing Lag in Month)*, is the natural log of the largest number of days between a particular trade and the date on which the insider reported the trade, in a particular month. The fourth, *Filed with SEC Late*, is a binary variable that equals 1 (0, otherwise) if the insider reported a trade after the regulatory stipulated period. We run a logit model regressing a binary variable that equals 1 (0 otherwise) if the trade month starts a sequence, on the proxies for information asymmetry (from Table 6), the near term earning surprise dummy, and these four additional variables. We predict that sales sequences will be positively (negatively) associated with good (bad) news guidance, purchase sequences will be negatively (positively) associated with bad (good) news guidance, and that both sales and purchase sequences will be positively associated with the reporting lag and late reporting.

We present the results in Supplementary Material Table IA10. Columns (1) and (2) show, as we predict, that the start of a sales sequence is positively associated with good news guidance in the month in which the sequence starts and in the subsequent three months. The start of a sales sequence is negatively associated with bad news guidance in the subsequent three months. For purchase sequences, in columns (5) and (6), the results are more mixed. As we predict, the start of a purchase sequence is negatively associated with good news guidance in the subsequent three months, although it appears that there is a general reduction in guidance in general around purchase sequences.

As predicted, both sales and purchase sequences are positively associated with the length of reporting lags, as shown by the positive coefficient estimate on *Ln(Max Filing Lag in Month)*. Both sales and purchase sequences are also positively associated with late reporting, as shown by the positive coefficient estimate on *Filed with SEC Late*. These results suggest that at times insiders deploy means other than after-hours disclosure to preserve their informational advantage, including strategically altering their voluntary disclosure policies and delaying the disclosure of trades with the SEC by as many days as possible.

6. Conclusion

This paper develops new insights about informed trading by corporate insiders by focusing on their trading patterns. The simple intuition motivating this work is an expectation that opportunistic insiders will trade so long as they can maintain an informational advantage. We identify how insiders trade during a short window of time when their trades are motivated by a short-lived informational advantage, and trade over longer horizons when their informational advantage will persist across longer horizons when their informational advantage will persist. Controlling for these patterns, we find that both insiders' sales and purchases predict abnormal returns. The results for insiders sales, in particular, is in contrast to prior research that fails to control for these patterns.

One circumstance that appears to delay investors' recognition of the information conveyed by insiders' trading is when they report their trades to the S.E.C. after the market has closed, which is a time when investors may be less attentive. We find that after-hours reporting of trades is associated with heavier overall trading by insiders and larger subsequent abnormal returns. Since the timing of these disclosures is discretionary, this raises the possibility that insiders purposefully attempt to manipulate the timing of their disclosures to maximize the duration of their informational advantage and their trading profits.

The analysis of this paper helps us understand how insiders exploit their informational advantages. It also shows that informed insider trading may be more frequent than previously supposed. Future researchers may sharpen their research designs and results by accounting for the patterns uncovered here when investigating new hypotheses about informed trading. In addition, regulators and outside investors could benefit from these insights as they pursue the objective of identifying informed trading.

Appendix A: Sample Selection and Classification Scheme

Table A1 summarizes the sorting procedure that generates the samples of insider trades for our analysis. Corporate insiders' stock grant and trading data is contained in the Thomson Reuters Insider Filing Data Feed Table 1. Starting with the full dataset, we first eliminate observations that are not open market transactions by limiting the sample to those with *trancode* of "S" (sale) or "P" (purchase), and an *acqdisp* code of "D" (disposition) or "A" (acquisition). We also delete observations missing transactions prices, the number of shares traded, or a six-digit CUSIP identifier. These screens result in a preliminary sample size of 5,045,974 individual observations. We then link the insider trading data to CRSP and Compustat using the CRSP Stocknames file and the CRSP/Compustat Linking Table. This results in a primary sample that consists of 3,999,840 observations, which represent 1,787,308 individual trading days and 1,069,813 individual trading months.

We categorize these months as *Sell Only*, *Buy Only*, or *Mixed* based on the activity of the insider over the calendar month. We then categorize the *Sell Only* and *Buy Only* months as either *Isolated* or *Sequenced* trading months. An *Isolated Sell* (*Isolated Purchase*) is where an insider sells (purchases) stock on the open market and has not made a similar transaction in the prior 2 calendar months and does not make a similar transaction in the subsequent 2 calendar months. A *Sequenced Sell* (*Sequenced Purchase*) is where an insider sells or purchases stock on the open market and has made a similar transaction in one of the prior 2 calendar months and/or makes a similar transaction in one of the subsequent 2 calendar months.

We also conduct abnormal return tests on samples of trades classified as *Routine* or *Opportunistic* according to Cohen et al. (2012). To generate these subsamples, we only consider observations of insider transactions that occur after the insider has traded in 3 consecutive calendar years. An insider is classified as a *Routine Trader* after they have a transaction in the same calendar month over three consecutive calendar years; all other insiders are classified as *Opportunistic Traders*. All of the transactions that occur during or after the classification year are "classified" trades. If the

insider is never classified as *Routine* then all of these transactions are classified as *Opportunistic*. Any trades that occur during or after the classification year but prior to the *Routine* classification year are considered *Opportunistic*, and any trades that occur during or after the *Routine* classification year are considered *Routine*. The *Routine* subsample consists of all the transactions by insiders while they are classified as *Routine Traders* and the *Opportunistic subsample* consists of all the transactions by insiders while they are classified as *Opportunistic Traders*.

Appendix B: Returns Associated with Simulated Samples of Insider Sales Sequences

In this appendix, we examine, using a simulation, the alternative explanation that negative returns following sales sequences are entirely due to the possibility that executives merely begin selling stock for liquidity or diversification and then stop trading when they receive negative information. We first restrict our sample of sequences to those that only last up to six months, and confirm that we find similar abnormal return patterns with this sub-sample. We take each observed sequence start date and use this as a sequence start date at a random firm from the group of firms that compose the DGTW portfolio for the actual sequence firm. This procedure approximates a sample of insider trading events where the initiation of the trading sequences is not based on private information. Each "randomized" sequence concludes the month prior to an observed negative return or 6 months (whichever is earlier). We used 5 different cutoffs for the sequence ending abnormal return (<0%, <-1%, <-2%, <-17.5% (which represents a 1 standard deviation negative return), and <-35% (which represents a 2 standard deviation negative return). For each cutoff, we completed 100 runs of the simulation. We calculate the cumulative abnormal return from the start of each "randomized" sequence to 3 months after the conclusion of the sequence. This simulation produces sequences with average cumulative abnormal returns between +51 and +79 basis points depending on the threshold return used to "stop" the simulated sequence of sales. It is therefore very unlikely that the returns associated with the actual sample can be explained by the alternative explanation.

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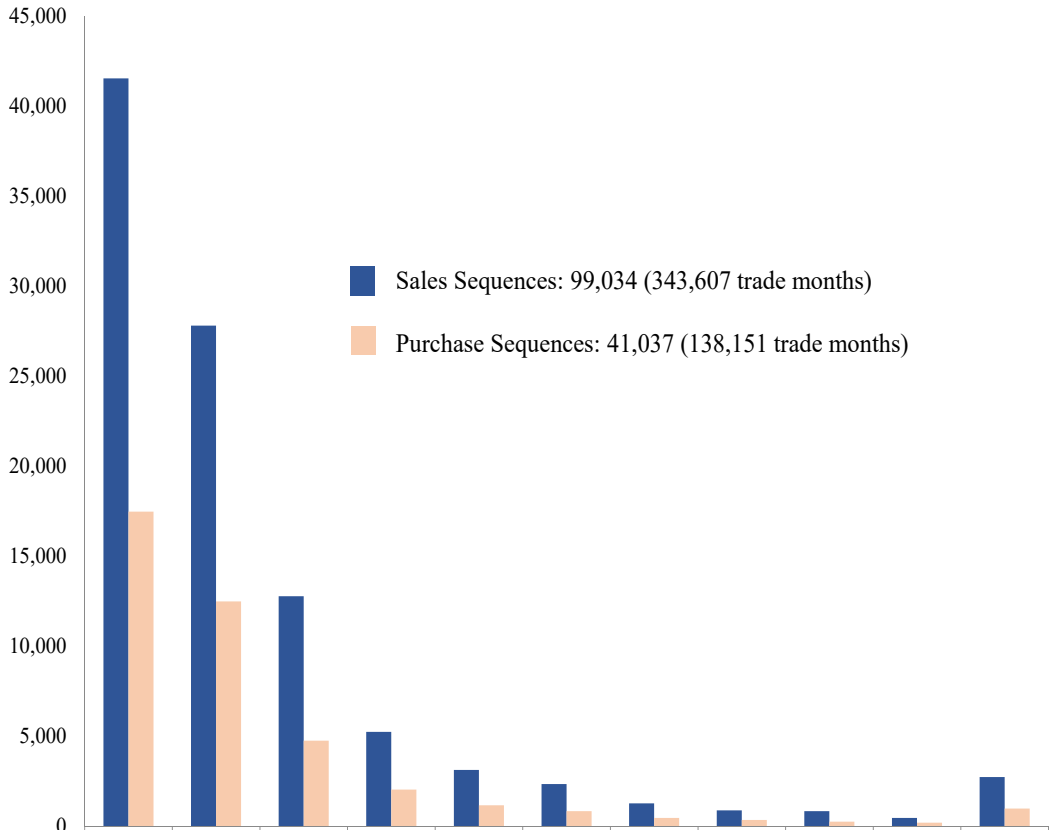
Fig. 1: The figure shows the distribution of trade sequence lengths in our sample. We identify an *isolated* trading month as one where insiders did not trade in the two months before or after. We identify a *sequenced* trade month as one where the insiders also had net transactions of the same type (sales or purchases) within a window of plus or minus two months. The chart shows the number of sequences sorted by the total number months in the sequence.



	2	3	4	5	6	7	8	9	10	11	12
Sale Sequences	41,524	27,800	12,776	5,245	3,129	2,350	1,277	886	840	468	2,739
Purchase Sequences	17,471	12,484	4,757	2,042	1,171	841	465	355	258	205	988

Sequence Length (Months)

Fig. 2: This figure presents a histogram of the percent of insider trading disclosures that are reported to the S.E.C. during different one hour intervals from 6:00 a.m. to 10:00 p.m.

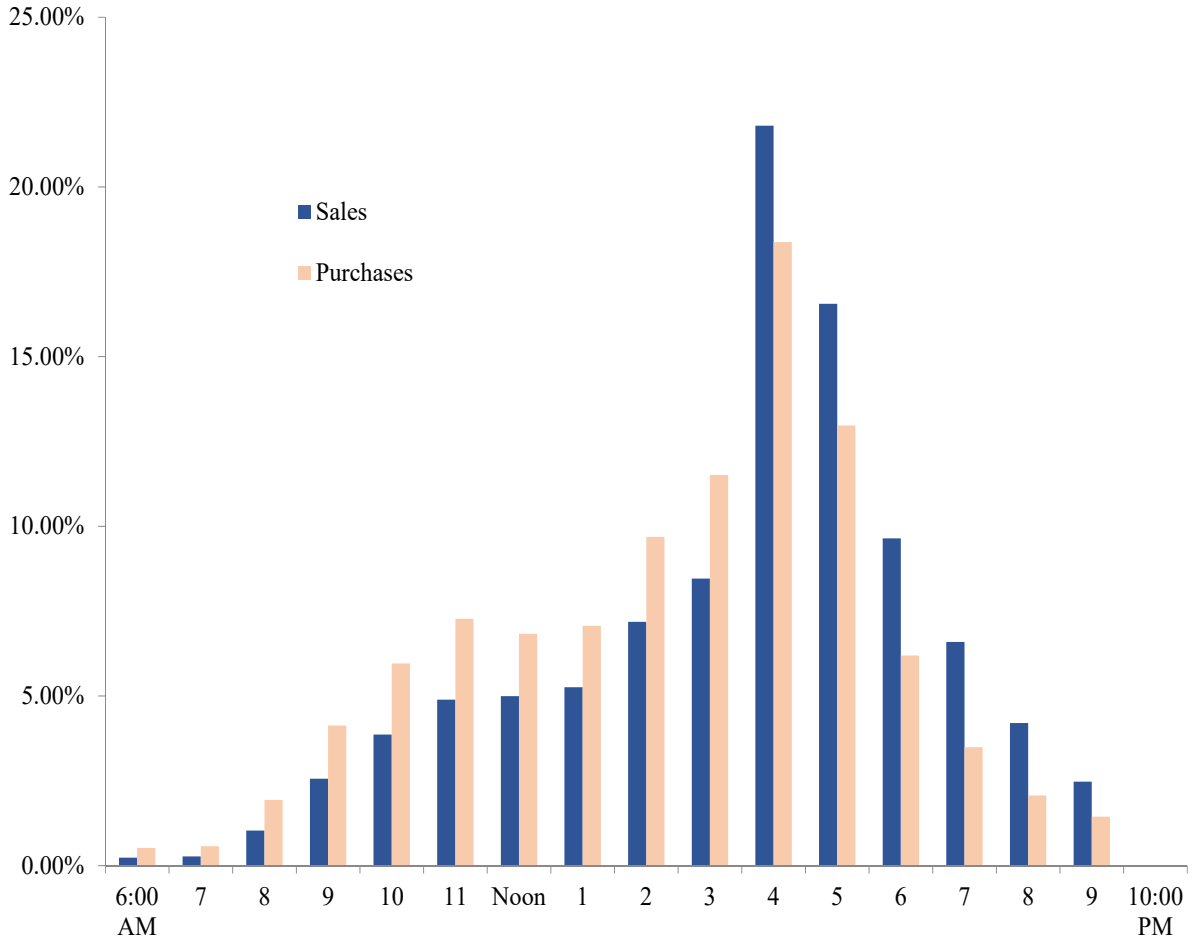


Fig. 3: The figure shows stock sales and prices for executives at Company A and Company B between December 2004 and July 2005. (Price = 1 on 02/01/2005)

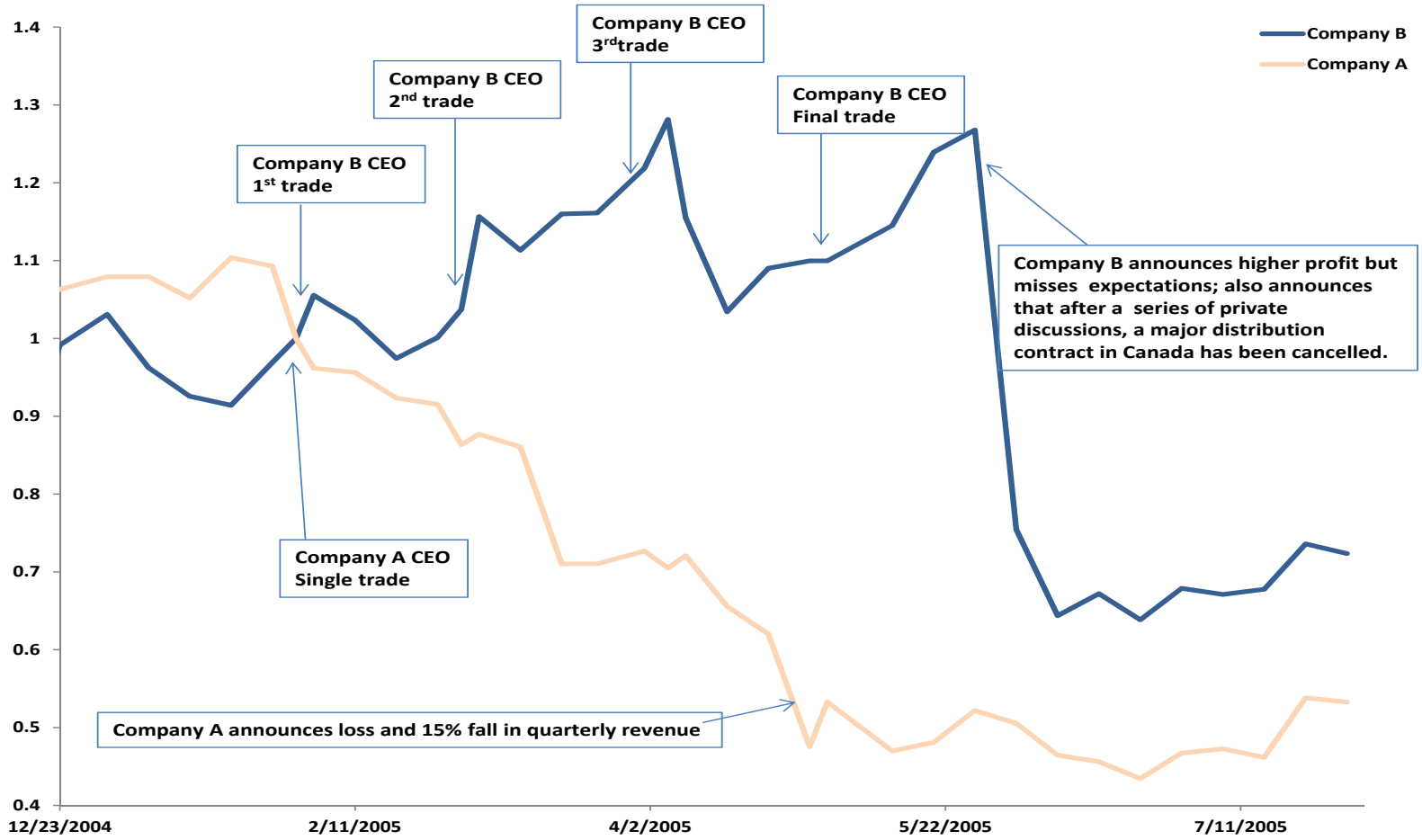


Figure 4a. Fraction of CEOs' sales months followed by negative returns

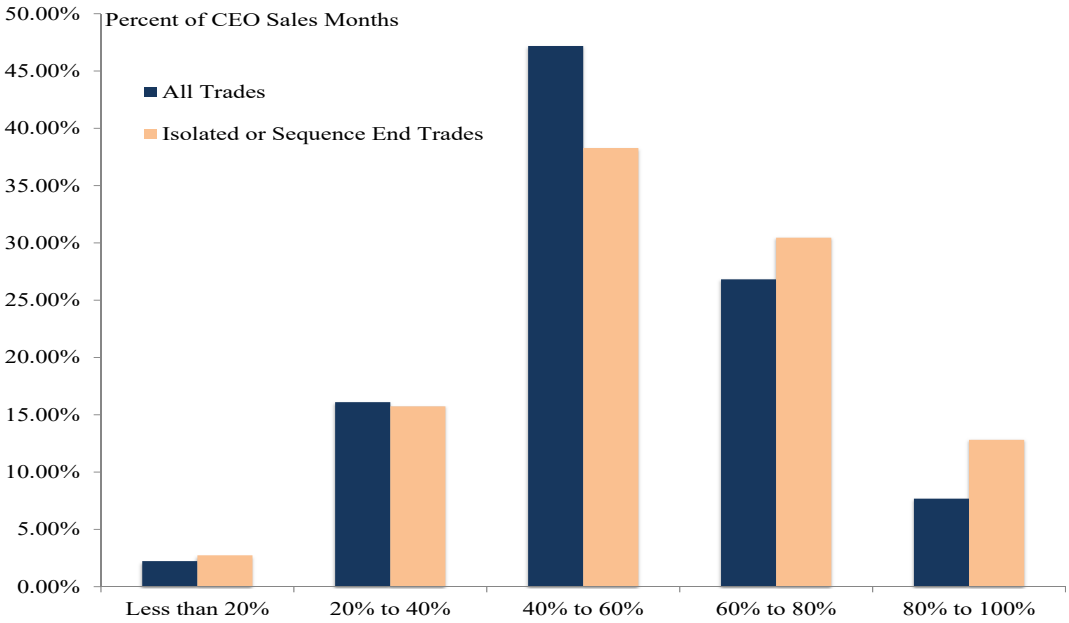


Figure 4b. This figure limits the sample to CEOs with greater than 60% of their sales classified as profitable after accounting for sequences, and shows the fraction of their sales followed by negative abnormal returns if one used a classification scheme that does not account for trading patterns.

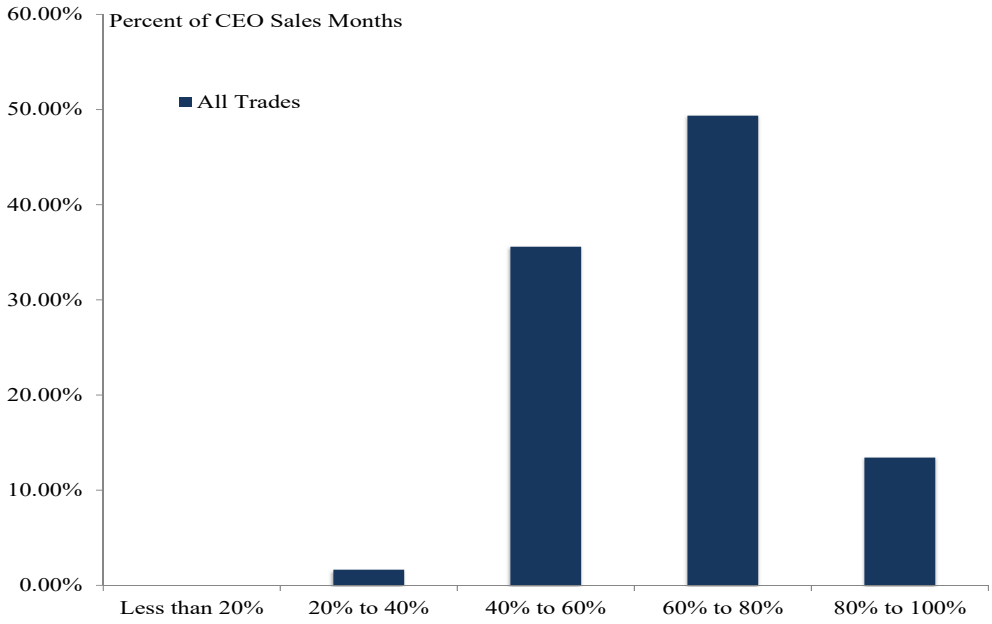


Table 1

Summary Statistics

The table presents a summary of the main sample we use in this paper, and shows the distribution of isolated and sequenced trades. We identify an isolated sale (purchase) month as one where insiders did not sell (buy) in the two months before or after. We identify a sequenced sale (purchase) as one where the insiders also had net sales (purchases) in either of the two months before or after the trade month. Details regarding the sample selection process are provided in Appendix A. *a* represents significance at the 1% level.

Panel A: Sale Transactions by Insiders

	Isolated Trades		Sequenced Trades			
	Mean	Median	Mean	Median	Diff. in Means	*t*-statistic
Firms	11,721		9,192			
Insiders	120,903		50,976			
CEO/COB	10,804		5,910			
Top Executives	28,146		13,646			
All Others	105,850		41,009			
Number of Shares Traded – Entire Event	160,538	10,000	301,967	39,834	(141428.5)[a]	(13.85)
– First Month in Sequence			122,875	12,000		
– Middle Months in Sequence			70,116	10,866		
– Last Month in Sequence			98,202	11,600		
Value of Shares Traded – Entire Event	$8,534,597	$ 276,800	$8,852,812	$954,853	($318,214.60)	(0.04)
– First Month in Sequence			$3,305,149	$281,208		
– Middle Months in Sequence			$2,330,150	$285,666		
– Last Month in Sequence			$2,859,499	$300,000		
Number of Trade Days	1.41	1.00	6.65	4.00		
Months in Sequence			3.68	3.00		
Market Value of Equity ($Mils)	7,293	990	59,447	7,745.37	1348.58[a]	(14.4)
Book Equity/Market Equity	0.43	0.35	0.40	0.32	0.0347[a]	(7.06)
Prior 6 Month Return	20.8%	12.8%	22.2%	12.5%	1.47%[a]	(7.54)
Num. of Person-Firm-Months with Trading	393,217		316,673			
Cohen et al – Routine	39,964		61,046			
Cohen et al – Opportunistic	81,801		66,935			
Number of Trade Events	393,217		99,034			

Panel B: Purchase Transactions by Insiders

	Isolated Trades		Sequenced Trades			
	Mean	Median	Mean	Median	Diff. in Means	*t*-statistic
Firms			8,274			
Insiders	92,015		23,228			
CEO/COB	10,939		3,502			
Top Executives	23,867		6,321			
All Others	76,133		17,912			
Number of Shares Traded	85,573	2000	373,320	10,000	(287746.6)[a]	(8.53)
– First Month in Sequence			204,800	3000		
– Middle Months in Sequence			56,437	1,307		
– Last Month in Sequence			107,401	3,000		
Value of Shares Traded – Entire Event	$978,115	$24,400	$4,066,282	$81,530	($3,088,167)[a]	(5.37)
– First Month in Sequence			$1,815,181	$27,076		
– Middle Months in Sequence			$775,127	$11,609		
– Last Month in Sequence			$ 1,411,659	$24,000		
Number of Trade Days	1.25	1.00	6.58	3.00		
Months in Sequence			3.64	3.00		
Market Value of Equity ($Mils)	2,220	172	1,395	1,112.38	8249.67[a]	(11.54)
Book Equity/Market Equity	0.77	0.60	0.82	0.63	−0.048[a]	(6.76)
Prior 6 Month Return	−1.1%	−2.9%	−0.1%	−2.7%	−0.98%	(4.09)
Num. of Person-Firm-Months with Trading	233,407		130,871			
Cohen et al – Routine	19,502		24,424			
Cohen et al – Opportunistic	35,007		20,296			
Number of Trade Events	233,407		41,037			

Table 2

Portfolio returns associated with isolated and sequenced trades.

The table shows monthly abnormal return associated with insiders' trades. Firms with isolated trades are added to the portfolio in the month after the trade and kept in the portfolio for a month. Firms with sequenced trades are kept in the portfolio for the different time-periods shown in the tables. We report the alphas (αs) from a regression of portfolio returns on the market factor, the return difference between a portfolio of "small" and "big" stocks, the return difference between a portfolio of "high" and "low" book-to-market stocks from Fama and French (1993), and the momentum factor from Carhart (1997). Panel A provides alphas from these regressions for different subsamples of insider trading months. Panel B provides alphas from regressions analyzing the returns to a portfolio long stocks in the month following isolated insider purchases or following the completion of sequenced insider purchases, and short stocks following isolated sales or the end of sales sequences. *t*-statistics are reported in parentheses. *a*, *b* and *c* represent significance at the 1%, 5% and 10% levels respectively.

Panel A: Portfolio returns following isolated and sequenced trades

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All	Isolated	Sequences				
			During sequence	Last month of sequence	One month following sequence	Three months following sequence	From beginning to three months following sequence
Sales							
CAPM	−0.0010	−0.0061^a	0.0063^a	−0.0039^b	−0.0134^a	−0.0135^a	−0.0027^c
	(−0.784)	(−5.035)	(3.902)	(−2.386)	(−8.109)	(−9.879)	(−1.908)
Fama-French 3 Factors	−0.0011^c	−0.0066^a	0.0064^a	−0.0040^a	−0.0136^a	−0.0133^a	−0.0024^a
	(−1.929)	(−9.530)	(7.348)	(−3.766)	(−11.872)	(−20.336)	(−4.345)
Carhart 4 Factors	−0.0007	−0.0059^a	0.0068^a	−0.0031^a	−0.0126^a	−0.0128^a	−0.0022^a
	(−1.127)	(−6.990)	(7.668)	(−2.798)	(−10.448)	(−17.643)	(−3.570)
Purchases							
CAPM	0.0104^a	0.0127^a	0.0061^a	0.0111^a	0.0168^a	0.0121^a	0.0079^a
	(6.458)	(7.908)	(3.504)	(5.161)	(7.870)	(6.887)	(9.879)
Fama-French 3 Factors	0.0094^a	0.0119^a	0.0051^a	0.0101^a	0.0159^a	0.0112^a	0.0070^a
	(7.364)	(9.216)	(3.670)	(5.289)	(8.627)	(7.895)	(5.231)
Carhart 4 Factors	0.0116^a	0.0143^a	0.0073^a	0.0127^a	0.0187^a	0.0137^a	0.0093^a
	(8.533)	(10.469)	(4.968)	(6.377)	(9.685)	(9.275)	(6.706)

Panel B: Long – Short Portfolios

(Long = Isolated and Sequence End Purchases; Short = Isolated and Sequence End Sales)

(1)	(2)	(3)
CAPM	Fama-French	Carhart 4 Factors
0.0228^a	0.0222^a	0.0240^a
(20.67)	(20.23)	(22.66)

Table 3

Characteristic-matched abnormal returns associated with isolated and sequenced trades.

The table shows the characteristic-matched abnormal returns associated with corporate insiders' stock trades. The abnormal returns are measured relative to a portfolio of stocks in the same size, book-to-market and previous 12-month momentum quintile. The benchmarks for the size and book-to-market quintiles are as described in Daniel et al. (1997) and Wermers (2004) while the benchmark for momentum is based on stock returns in the 12 months prior to the trading month. Panel A begins by showing abnormal returns following isolated trading months. It then presents abnormal returns following individual sequenced trading months (All), following only those sequenced trade months that precede the end of trade sequences (During), and following the end of trade sequences (Following). Panel B shows the buy-and-hold abnormal returns (BHAR) beginning the calendar month after a sequence of trades begins and ending three months following sequence ends. Standard errors are clustered at both the firm and month level and *t*-statistics are reported in parentheses. *a* represents significance at the 1% level.

Panel A: Abnormal returns relative to matching firms

	(1)	(2)	(3)	(4)
	Isolated Sells	Sequenced Sells		
		All	During	Following
1 Month Abnormal Return	−0.0061[a]	0.0046[a]	0.0127[a]	−0.0123[a]
	(−19.14)	(11.94)	(27.94)	(−20.86)
Number of Observations	342,979	268,994	182,565	86,429
	Isolated Buys	Sequenced Buys		
		All	During	Following
1 Month Abnormal Return	0.0164[a]	0.0078[a]	0.0033[a]	0.0175[a]
	(26.75)	(11.92)	(4.35)	(15.48)
Number of Observations	182,453	104,713	71,333	33,380

Panel B: Buy and hold abnormal returns following the beginning of sequences

	(1)	(2)
	Sales Sequences	Purchase Sequences
BHAR Total	−0.0147[a]	0.0423[a]
	(−9.88)	(14.22)
BHAR / Months in Sequence	−0.0043[a]	0.0090[a]
	(−15.26)	(14.84)
Number of Observations	48,172	22,341

Table 4

Portfolio returns following isolated and sequenced trades – subsample analysis.

The table shows four-factor alphas following subsamples of insiders' trades. Firms with isolated trades are added to the isolated trades portfolio in the month after trading and kept in the portfolio for a month. Firms with sequenced trades are added in the month following the sequence end and kept in the portfolio for three months. The portfolios are rebalanced monthly. The Cohen et al routine and opportunistic trades are as defined in Cohen et al. (2012). *t*-statistics are reported in parentheses. *a* and *b* represent significance at the 1% and 5% respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Full sample	Large firms	Small firms	1986–2002	2003–2017	Executive Team	CEO or Chairman	CEO (Post 1995)	Cohen et al (2012) Routine	Cohen et al (2012) Opportunistic
Isolated Sales:										
alpha (α)	−0.0059^a	−0.0046^a	−0.0064^a	−0.0064^a	−0.0055^a	−0.0085^a	−0.0095^a	−0.0077^a	−0.0080^a	−0.0070^a
t-stat	(−6.990)	(−6.343)	(−3.932)	(−3.983)	(−8.058)	(−10.243)	(−9.155)	(−4.913)	(−4.763)	(−7.724)
Sequenced Sales:										
alpha (α)	−0.0126^a	−0.0052^a	−0.0123^a	−0.0115^a	−0.0134^a	−0.0183^a	−0.0215^a	−0.0236^a	−0.0134^a	−0.0134^a
t-stat	(−10.448)	(−2.973)	(−5.988)	(−5.710)	(−8.974)	(−12.371)	(−12.076)	(−9.844)	(−7.431)	(−9.943)
Isolated Buys:										
alpha (α)	0.0143^a	0.0044^a	0.0189^a	0.0204^a	0.0076^a	0.0205^a	0.0201^a	0.0187^a	0.0148^a	0.0161^a
t-stat	(10.469)	(3.907)	(10.015)	(8.454)	(6.273)	(10.539)	(8.396)	(6.297)	(7.964)	(9.464)
Sequenced Buys:										
alpha (α)	0.0187^a	0.0116^b	0.0211^a	0.0238^a	0.0131^a	0.0201^a	0.0187^a	0.0189^a	0.0172^a	0.0248^a
t-stat	(9.685)	(2.252)	(8.020)	(7.331)	(5.907)	(7.351)	(5.673)	(4.787)	(5.864)	(8.156)

Table 5

A comparison to the returns following insider "silence".

The table contrasts the abnormal returns following a period of insider "silence" (i.e., months with no insider trades) to those following insider sales months. Column (1) shows the abnormal returns following periods of different lengths of silence, and column (2) shows the return to a portfolio that is long the firms where insiders have been silent and short firms following isolated sales or the ends of sales sequences. We report the alphas (αs) from a regression of portfolio returns on the market factor, the return difference between a portfolio of "small" and "big" stocks, the return difference between a portfolio of "high" and "low" book-to-market stocks from Fama and French (1993), and the momentum factor from Carhart (1997). *a* and *b* represent significance at the 1%, and 5% levels, respectively.

	(1)	(2)
	Cahart 4-factor alpha (α) Silence	Long silence/ Short isolated or sequence end
Silence for 1 month	−0.0004	0.0055[a]
	(−0.650)	(9.361)
Silence for 3 months	−0.0019[a]	0.0040[a]
	(−2.755)	(5.582)
Silence for 6 months	−0.0028[a]	0.0031[a]
	(−3.762)	(4.112)
Silence for 12 months	−0.0038[a]	0.0021[b]
	(−4.647)	(2.539)

Table 6

Predicting insider trading patterns.

This table reports logit regressions predicting whether new trading initiates an extended trade sequence. Panel A reports regressions for sales and Panel B reports regressions for purchases. The dependent variable equals 1 if the trade month begins a sequence and is 0 if it represents an isolated trade. *Ln(# of Analysts)* is the natural log of one plus the average number of analysts that provided fiscal quarter-end forecasts for the firm. *Near-term earnings surprise dummy* equals 1 if the observation was a sale (purchase) month and the firm misses (beats) earnings expectation for the fiscal quarter of the trade, and 0 otherwise. *Ln(market cap)* is the natural log of the firms' market value of equity, and *Ln(market equity/book equity)* is the natural log of firms' market-to-book equity ratio. *t*-statistics are reported in parentheses and are based on robust standard errors that are clustered at the monthly level. *a* represents significance at the 1% levels.

Panel A: Sales Months

VARIABLES	(1)	(2)	(3)	(4)
Ln(# of Analysts)	−0.0329^a		−0.0455^a	0.1017^a
	(−4.101)		(−5.713)	(9.753)
Near-term earnings surprise dummy		−0.1653^a	−0.1786^a	−0.1735^a
		(−12.374)	(−13.526)	(−13.268)
Ln(market cap)				−0.1165^a
				(−17.744)
Ln(market equity/book equity)				0.1345^a
				(14.261)
Constant	−1.3551^a	−1.3698^a	−1.2811^a	−0.9888^a
	(−71.596)	(−83.348)	(−65.536)	(−10.303)
Observations	384,729	384,729	384,729	384,729
Pseudo R2	0.000144	0.000873	0.00114	0.00523

Panel B: Purchases Months

VARIABLES	(1)	(2)	(3)	(4)
Ln(# of Analysts)	−0.2127^a		−0.2085^a	−0.1456^a
	(−18.505)		(−17.954)	(−8.818)
Near-term earnings surprise dummy		−0.1222^a	−0.0832^a	−0.0815^a
		(−6.079)	(−4.079)	(−4.011)
Ln(market cap)				−0.0513^a
				(−5.322)
Ln(market equity/book equity)				0.0391^a
				(2.619)
Constant	−1.5755^a	−1.7626^a	−1.5322^a	−1.2452^a
	(−73.182)	(−77.888)	(−65.536)	(−8.970)
Observations	155,549	155,549	155,549	155,549
Pseudo R2	0.00588	0.000539	0.00612	0.00666

Table 7

Insider trading patterns and after-hours trade reporting time-stamps.

The table reports logit regressions predicting whether or not a trade is an isolated trade or part of a sequence. Panel A reports regressions for sales and Panel B reports regressions for purchases. The dependent variable is 1 if the trade is part of a sequence and 0 if the trade is an isolated trade. *Ln(# of Analysts)* is the natural log of one plus the average number of analysts that provided fiscal quarter-end forecasts for the firm. *Near-term earnings surprise dummy* equals 1 if the observation was a sale (purchase) month and the firm misses (beats) earnings expectation for the fiscal quarter of the trade, and 0 otherwise. *Ln(market cap)* is the natural log of the firms' market value of equity, and *Ln(market equity/book equity)* is the natural log of firms' market-to-book equity ratio. *Reported during 4 pm hour* is a dummy variable indicating that the first trade of the month was reported to the S.E.C. between 4 pm and 5 pm. *Reported after 5 pm* is a dummy variable indicating that the first trade of the month was reported to the S.E.C. after 5 pm. *t*-statistics are reported in parentheses and are based on robust standard errors that are clustered at the monthly level. *a*, *b*, and *c* represent significance at the 1%, 5% and 10% levels, respectively.

Panel A: Sales Months

VARIABLES	(1)	(2)	(3)	(4)	(5)
Reported during 4 pm hour	0.1104^a	0.1106^a	0.1011^a	0.0690^a	0.0569^a
	(5.827)	(5.844)	(5.326)	(4.365)	(3.019)
Reported after 5 pm	0.1358^a	0.1192^a	0.1132^a	0.0593^a	0.0315^c
	(7.521)	(6.656)	(6.304)	(3.755)	(1.673)
Ln(# of Analysts)			0.1194^a		
			(9.116)		
Near-term earnings surprise dummy			−0.1670^a		
			(−9.333)		
Ln(market cap)		−0.0833^a	−0.1320^a	−0.1889^a	−0.0195
		(−14.154)	(−16.980)	(−16.486)	(−1.634)
Ln(market equity/book equity)		0.1346^a	0.1258^a	0.0471^a	0.0296^b
		(12.974)	(12.119)	(3.649)	(1.979)
Constant	−1.4929^a	−1.3534^a	−0.7662^a		
	(−60.900)	(−12.813)	(−6.305)		
Observations	212,682	212,682	212,682	222,151	132,697
Pseudo R2	0.00187	0.00576	0.00750	0.00176	0.000290
Fixed Effects				Firm	Person

Panel B: Purchases Months

VARIABLES	(1)	(2)	(3)	(4)	(5)
Reported during 4 pm hour	0.0595	0.0778^b	0.0900^b	0.0554^c	0.0161
	(1.573)	(2.064)	(2.425)	(1.868)	(0.444)
Reported after 5 pm	0.1210^a	0.1107^a	0.1186^a	0.1050^a	0.0516
	(3.436)	(3.118)	(3.345)	(3.142)	(1.244)
Ln(# of Analysts)		−0.1386^a	−0.0820^a	−0.1043^a	−0.0926^a
		(−12.358)	(−5.340)	(−4.376)	(−4.549)
Near-term earnings surprise dummy		0.0272	0.0232	0.0688^a	0.0317
		(1.058)	(0.925)	(2.777)	(1.266)
Ln(market cap)			−0.1321^a		
			(−5.015)		
Ln(market equity/book equity)			−0.1447^a		
			(−4.405)		
Constant	−1.9629^a	−0.3815^b	−0.8316^a		
	(−55.020)	(−1.987)	(−3.798)		
Observations	64,919	64,919	64,919	70,092	33,623
Pseudo R2	0.000878	0.00893	0.0108	0.00102	0.00102
Fixed Effects				Firm	Person

Table 8

Abnormal returns when trades are reported after business hours

The table evaluates the relation between characteristic-matched abnormal returns and after business hour reporting for rade sequences. The abnormal returns are calculated as in Table 3. *Reported during 4 pm hour* is an indicator variable set to 1 when the first trade of the sequence is reported to the SEC between 4 pm and 5 pm. *Reported after 5 pm* is an indicator variable set to 1 when the first trade of the sequence is reported to the SEC after 5 pm. The table shows the results for buy-and-hold abnormal returns (BHAR) beginning in the calendar month following the first trade and ending three months after the trading sequence ends. Columns 2 and 4 control for firm-level fixed effects. *t*-statistics are reported in parentheses. *a*, *b* and *c* represent significance at the 1%, 5% and 10% levels respectively.

	Buy and hold abnormal returns from beginning of sequence			
	Sales Sequences		Purchase Sequences	
	(1)	(2)	(3)	(4)
Reported during 4 pm hour	−0.0013	−0.0006	0.0079	−0.0028
	(−0.281)	(−0.121)	(0.757)	(−0.220)
Reported after 5 pm	−0.0129^{a}	−0.0082^{c}	0.0163^{c}	0.0105
	(−3.445)	(−1.805)	(1.734)	(0.848)
Constant	−0.0119^{a}		0.0112^{b}	
	(−4.986)		(2.148)	
Observations	26,374	26,374	8,866	8,866
R-squared	0.001	0.001	0.001	0.001
Fixed Effect		firm		firm

Table 9

Reporting after business hours and sequenced trading activity.

This table evaluates the relation between after-hours trade reporting and trading activity in trade sequences. *Reported during 4 pm hour* is a dummy variable indicating that the first trade of the month was reported to the S.E.C. between 4 pm and 5 pm. *Reported after 5 pm* is a dummy variable indicating that the first trade of the month was reported to the S.E.C. after 5 pm. The dependent variable in the Panel A regressions is the natural log of the total number of shares traded by an insider over a sequence. In Panel B, the dependent variable is the natural log of the number of trading days over each sequence. Columns 2 and 4 in each panel control for firm-level fixed effects. *t*-statistics are reported in parentheses. *a*, *b* and *c* represent significance at the 1%, 5% and 10% levels respectively.

Panel A: Shares Traded During Sequences

	Ln(Shares traded over sequence)			
	Sales Sequences		Purchase Sequences	
	(1)	(2)	(3)	(4)
Reported during 4 PM hour	0.2170^a	0.0039	0.4247^a	0.0104
	(7.997)	(0.137)	(6.252)	(0.173)
Reported after 5 PM	0.4028^a	0.1346^a	1.0527^a	0.2472^a
	(16.720)	(5.126)	(17.439)	(4.317)
Constant	10.4433^a	10.5946^a	9.2573^a	9.5670^a
	(639.089)	(632.909)	(290.629)	(334.174)
Observations	26,374	26,374	8,857	8,857
R-Squared	0.011	0.001	0.036	0.003
Fixed Effect		firm		firm

Panel B: Dollar Value of Shares Traded During Sequence

	Ln(Dollar value of shares traded over sequence)			
	Sales Sequences		Purchase Sequences	
	(1)	(2)	(3)	(4)
Reported during 4PM hour	0.2272^a	0.0576^b	0.4609^a	0.0238
	(7.821)	(2.000)	(7.202)	(0.400)
Reported after 5 PM	0.3434^a	0.1747^a	0.9766^a	0.2692^a
	(13.319)	(6.529)	(16.714)	(4.706)
Constant	13.7411^a	13.8443^a	11.4812^a	11.7673^a
	(782.598)	(811.949)	(390.276)	(411.402)
Observations	26,374	26,374	8,858	8,858
R-Squared	0.007	0.002	0.034	0.004
Fixed Effect		firm		firm

Panel C: Number of Trades During Sequences

	Ln(Number of trading days over the sequence)			
	Sales Sequences		Purchase Sequences	
	(1)	(2)	(3)	(4)
Reported during 4 PM hour	0.0248^b	−0.0131	0.0632^a	−0.0093
	(1.968)	(−0.954)	(2.669)	(−0.356)
Reported after 5 PM	0.1137^a	0.0306^b	0.2217^a	0.0937^a
	(10.260)	(2.408)	(10.214)	(3.738)
Constant	1.3887^a	1.4293^a	1.3796^a	1.4300^a
	(184.301)	(176.174)	(117.019)	(114.118)
Observations	26,374	26,374	8,857	8,857
R-Squared	0.004	0.001	0.013	0.003
Fixed Effect		firm		firm

Insider Trading Patterns – Supplementary Material

This document contains the Internet Appendix to the paper "*Insider Trading Patterns*"

Table A1. Sample selection

The table outlines the selection process that for the sample that is summarized in Table 1.

	Observations	
TFN - Table 1	14,433,898	
Observations eliminated by primary filters	9,387,924	
Sample size (post primary filters)	5,045,974	
Observations not linked to CRSP Permno	815,168	
Observations not linked to Compustat	230,966	
Sample Size	3,999,840	
Number of trade-days (individual/firm level)	1,787,308	
Number of trade-months (individual/firm level)	1,069,813	
Number of trade-months (firm level)	520,757	
Break down of trade-months (individual/firm level)		
Sell only	705,535	
Buy only	359,923	
Both buy and sell	4,355	
Total	1,069,813	
Break down of trade-months (individual/firm level)		
Sell only months		
Isolated	393,217	56%
Sequence - Beginning and Middle	213,284	30%
Sequence - End	99,034	14%
Buy only months		
Isolated	233,407	65%
Sequence - Beginning and Middle	85,479	24%
Sequence - End	41,037	11%
Break down of trade-months (individual/firm level)		
Cohen Routine	143,462	
Cohen Opportunistic	202,611	
Total Cohen Classified	346,073	
Primary Filters		
Observations missing CUSIP	78,752	
Observations missing number of shares	3,438,895	
Observations missing transaction price	1,777,313	
Observations where acqdisp is missing or 9	112,708	
Observations that are not marked as open market transactions	3,980,256	
Total	9,387,924	

Table IA1. Evaluation of abnormal returns and trading volume using alternative measures of after-hours reporting.

In this table we provide robustness checks of the relations between after-hours trade reporting and the abnormal returns associated with insider trading or trading volume. Panel A provides alternative analyses of the BHARs associated with trade sequences. The indicator *After 5 PM Ratio At or Above Median* is set to 1 when the fraction of trades in a sequence reported to the SEC after 5 pm is at our above 25%, which is the sample median. The indicator *After 5 PM Ratio Above 50%* is set to 1 when the fraction of trades in a sequence reported to the SEC after 5 pm is above 50%. Panel B provides alternative regressions evaluating the total number of shares traded during sequences and the number of trading days during sequences. Panel C presents an analysis of the number of shares traded on individual trade days as a function of the time the transactions are reported to the SEC. *Reported after 5 pm* is an indicator variable set to 1 when any transaction from the trade day is reported to the SEC after 5 pm. In columns 5 – 8 of Panel C, we limit the sample to trade days where reporting to the SEC does not occur on the same day as the reported transactions. *t*-statistics are reported in parentheses. *a*, *b* and *c* represent significance at the 1%, 5% and 10% levels respectively.

Panel A: Sequence Abnormal Returns

	Buy and hold abnormal returns from beginning of sequence (adjusted based on DGTW portfolio)			
	Sales Sequences		Purchase Sequences	
	(1)	(2)	(3)	(4)
After 5 PM Ratio Above 33%	−0.0056^{c}		0.0004	
	(−1.662)		(0.046)	
After 5 PM Ratio Above 50%		−0.0082^{b}		0.0043
		(−2.424)		(0.514)
Constant	−0.0143^{a}	−0.0134^{a}	0.0173^{a}	0.0159^{a}
	(−6.335)	(−6.136)	(3.473)	(3.308)
Observations	26,374	26,374	8,866	8,866
R-Squared	0.000	0.000	0.000	0.000

Panel B: Sequence Trading Volume

	Ln(Number of Shares Traded Over Sequence)				Ln(Dollar Value of Shares Traded Over the Sequence)			
	Sales Sequences		Purchase Sequences		Sales Sequences		Purchase Sequences	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
After 5 PM Ratio Above 33%	0.3827^{a}		1.0934^{a}		0.3159^{a}		0.9698^{a}	
	(18.068)		(20.166)		(13.991)		(18.779)	
After 5 PM Ratio Above 50%		0.2786^{a}		0.9895^{a}		0.2096^{a}		0.8840^{a}
		(13.013)		(17.479)		(9.201)		(16.324)
Constant	10.3466^{a}	10.4186^{a}	8.9401^{a}	9.0301^{a}	13.6587^{a}	13.7276^{a}	11.1988^{a}	11.2765^{a}
	(689.234)	(736.755)	(284.631)	(294.601)	(851.198)	(905.084)	(391.975)	(402.410)
Observations	26,383	26,383	8,858	8,858	26,383	26,383	8,859	8,859
R-Squared	0.012	0.006	0.046	0.036	0.007	0.003	0.041	0.033

Panel C: Number of Shares Traded - Daily

	Ln(Shares Traded During Tradeday)		Ln(Dollar Volume Traded During Tradeday)		Ln(Shares Traded During Tradeday)		Ln(Dollar Volume Traded During Tradeday)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Reported after 5 pm	0.4899^{a}	0.1560^{a}	0.5067^{a}	0.1913^{a}	0.4772^{a}	0.1468^{a}	0.4953^{a}	0.1850^{a}
	(110.512)	(35.370)	(100.988)	(41.675)	(96.709)	(29.785)	(88.836)	(36.043)
Constant	8.4468^{a}		11.3946^{a}		8.4955^{a}		11.4469^{a}	
	(3,037.141)		(3,613.666)		(2,874.703)		(3,415.091)	
Sample	All Transactions				No transactions where trandate = SECdate			
Observations	870,325	870,325	870,325	870,325	741,689	741,689	741,689	741,689
R-squared	0.014	0.350	0.011	0.447	0.012	0.350	0.010	0.447
Fixed effect		firm		firm		firm		firm

Table IA2. The effect of prior profitable trading during blackout periods on returns following insiders trades

The dependent variable is characteristic-matched abnormal returns associated with corporate insiders' stock trades. The abnormal returns are measured relative to a portfolio of stocks in the same size, book-to-market and previous 12-month momentum quintile. The benchmarks for the size and book-to-market quintiles are as described in Daniel et al. (1997) and Wermers (2004) while the benchmark for momentum is based on stock returns in the 12 months prior to the trading month. *Observe prior profitable QEA Trading* is a binary variable that equals 1 (0, otherwise) if the insider has made a profitable trade in the 21 trading days immediately prior to quarterly earnings announcements, and zero otherwise. *a*, *b* and *c* represent significance at the 1%, 5% and 10% levels respectively.

	Abnormal returns relative to DGTW portfolio			
	(1)	(2)	(3)	(4)
Trade Category	Isolated Sales	Sequence End Sales	Isolated Purchases	Sequence End Purchases
Variables				
Observe prior profitable QEA Trading	-0.0012^{c}	-0.0035^{a}	0.0062^{a}	0.0044^{c}
	(−1.690)	(−2.874)	(4.580)	(1.866)
Constant	-0.0057^{a}	-0.0108^{a}	0.0144^{a}	0.0159^{a}
	(−15.079)	(−14.577)	(19.946)	(11.277)
Observations	342,979	86,429	182,453	33,380
R-squared	0.000	0.000	0.001	0.002

Table IA3. The effect of number and value of shares traded on returns following insiders trades

The dependent variable is characteristic-matched abnormal returns associated with corporate insiders' stock trades. The abnormal returns are measured relative to a portfolio of stocks in the same size, book-to-market and previous 12-month momentum quintile. The benchmarks for the size and book-to-market quintiles are as described in Daniel et al. (1997) and Wermers (2004) while the benchmark for momentum is based on stock returns in the 12 months prior to the trading month. *a*, *b* and *c* represent significance at the 1%, 5% and 10% levels respectively.

Panel A: Isolated Trades

	Abnormal returns relative to DGTW portfolio			
	(1)	(2)	(3)	(4)
Trade Category	Isolated Sell	Isolated Sell	Isolated Buy	Isolated Buy
Ln(Shares Traded During Month)	−0.0001		0.0037^a	
	(−0.283)		(11.334)	
Ln(Dollar Valued Traded During Month)		0.0000		0.0026^a
		(0.116)		(8.785)
Ln(MVE)	0.0005^a	0.0005^b	−0.0038^a	−0.0050^a
	(2.734)	(2.495)	(−12.105)	(−13.933)
Constant	−0.0075^a	−0.0105^a	−0.0145^a	0.0075^b
	(−5.396)	(−5.444)	(−5.715)	(2.490)
Observations	342,975	342,975	182,429	182,429
R-squared	0.000	0.000	0.006	0.004

Panel B: Sequenced Trades

	Abnormal returns relative to DGTW portfolio			
	(1)	(2)	(3)	(4)
Trade Category	Sequence End Sell	Sequence End Sell	Sequence End Buy	Sequence End Buy
Ln(Shares Traded During Sequence)	−0.0009^a		0.0012^a	
	(−2.750)		(2.739)	
Ln(Dollar Valued Traded During Sequence)		−0.0009^b		−0.0003
		(−2.549)		(−0.642)
Ln(MVE)	0.0010^a	0.0013^a	−0.0033^a	−0.0034^a
	(3.191)	(3.834)	(−5.040)	(−5.343)
Constant	−0.0062^c	−0.0119^a	0.0062	0.0358^a
	(−1.848)	(−2.812)	(1.508)	(5.656)
Observations	86,427	86,427	33,373	33,373
R-squared	0.000	0.000	0.002	0.002

Table IA4. Comparing isolated trade month to sequence beginning months.
In this table we match sequence beginning trade months to isolated trade months that are closest in size. The dependent variables are Signed Dollar Value of Shares Traded (columns 1 and 2), and Abnormal Return in the month following the trade month (columns 3 and 4). *Isolated* is a binary variable that indicates whether or not the trade month is an isolated trade month. *t*-statistics are reported in parentheses and are based on robust standard errors that are clustered at the monthly level. *a* represents significance at the 1% level.

	(1)	(2)	(3)	(4)
	Signed Dollar Value of Shares Traded		Abnormal Return Month t+1	
Isolated	67,802	1,453	−0.0189[a]	0.0142[a]
	(0.903)	(0.059)	(−18.921)	(7.491)
Constant	−9,704,580[a]	174,937[a]	0.0114[a]	0.0052[a]
	(−17.338)	(11.342)	(15.852)	(3.964)
Type	Sales Transactions	Purchase Transactions	Sales Transactions	Purchase Transactions
Observations	91,120	40,707	91,120	40,707
R-squared	0.000	0.000	0.006	0.002

Table IA5. Returns following isolated and sequenced trades when other insiders trade in same direction.

In this table, we measure the association between returns following isolated or sequenced trades, and the presence of other insiders making the same trade. The dependent variable is abnormal returns relative to DGTW portfolio. *t*-statistics are reported in parentheses and are based on robust standard errors that are clustered at the monthly level. *a* represents significance at the 1% level.

Panel A: Isolated Trades

	Abnormal returns relative to DGTW portfolio	
	(1)	(2)
	Isolated Sales	Isolated Purchases
Other Isolated Sellers at Firm	−0.0053[a]	
	(−9.111)	
Other Isolated Buyers at Firm		0.0072[a]
		(5.936)
Constant	−0.0028[a]	0.0128[a]
	(−8.416)	(24.662)
Observations	342,971	181,288
R-squared	0.000	0.001

Panel B: Sequenced Trades

	Abnormal returns relative to DGTW portfolio	
	(1)	(2)
	Sequence End Sales	Sequence End Purchases
Other Sequence End Sellers at Firm	−0.0095[a]	
	(−6.827)	
Other Sequence End Buyers at Firm		−0.0009
		(−0.292)
Constant	−0.0087[a]	0.0178[a]
	(−16.423)	(16.277)
Observations	86,426	33,335
R-squared	0.001	0.000

Table IA6. Sequence length and returns following sequenced trades

In this table, we measure the association between returns following sequenced trades, and sequence legnth . The dependent variable is abnormal returns relative to DGTW portfolio. *t*-statistics are reported in parentheses and are based on robust standard errors that are clustered at the monthly level. *a* represents significance at the 1% level.

	(1) Sales	(2) Purchases
Sequence Length (Months)	−0.0020[a]	−0.0011
	(−6.261)	(−1.618)
Constant	−0.0059[a]	0.0216[a]
	(−5.532)	(9.207)
Observations	82,689	32,048
R-squared	0.001	0.000

Table IA7. Number and value of shares traded over the course of a sequence.

In this table, we regress the number of shares traded on binary variables that represent the first or the last month in the trade sequence as specified. *t*-statistics are reported in parentheses and are based on robust standard errors that are clustered at the monthly level. *a* represents significance at the 1% level.

Panel A: Sales transactions

	(1)	(2)	(3)	(4)	(5)	(6)
	Ln(Shares Traded in Month)	Ln($ Traded in Month)	Ln(Shares Traded in Month)	Ln($ Traded in Month)	Ln(Shares Traded in Month)	Ln($ Traded in Month)
Sequence Criteria	Sequences with 2 trading months		Sequences with 3 or more trading months		Sequences with 3 to 6 trading months	
Baseline observation	Month ending sequence		Middle sequence months		Middle sequence months	
Month Begins Sequence	0.0026	−0.0346[a]	0.1401[a]	0.0612[a]	0.0196	−0.0113
	(0.246)	(−3.078)	(13.316)	(5.245)	(1.532)	(−0.805)
Month Ends Sequence			0.1260[a]	0.1323[a]	0.0395[a]	0.0862[a]
			(11.879)	(11.242)	(3.072)	(6.098)
Constant	9.4031[a]	12.5779[a]	9.3579[a]	12.5213[a]	9.4849[a]	12.6014[a]
	(1,295.262)	(1,598.632)	(1,859.622)	(2,197.449)	(1,216.795)	(1,472.299)
Observations	124,898	124,894	191,137	191,714	112,050	112,046
R-squared	0.000	0.000	0.001	0.001	0.000	0.000

Panel B: Purchase transactions

	(1)	(2)	(3)	(4)	(5)	(6)
	Ln(Shares Traded in Month)	Ln($ Traded in Month)	Ln(Shares Traded in Month)	Ln($ Traded in Month)	Ln(Shares Traded in Month)	Ln($ Traded in Month)
Sequence Criteria	Sequences with 2 trading months		Sequences with 3 or more trading months		Sequences with 3 to 6 trading months	
Baseline observation	Month ending sequence		Middle sequence months		Middle sequence months	
Month Begins Sequence	0.0700[a]	0.1018[a]	0.7732[a]	0.6402[a]	−0.0137	0.0273
	(3.751)	(5.526)	(29.679)	(26.462)	(−0.467)	(0.984)
Month Ends Sequence			0.6311[a]	0.4414[a]	−0.1308[a]	−0.1528[a]
			(24.578)	(18.290)	(−4.535)	(−5.523)
Constant	8.0646[a]	10.2442[a]	7.3687[a]	9.7130[a]	8.2772[a]	10.4306[a]
	(613.503)	(795.865)	(542.399)	(781.194)	(456.872)	(604.374)
Observations	53,788	53,863	76,100	76,708	43,306	43,333
R-squared	0.000	0.001	0.014	0.010	0.001	0.001

Table IA8. Returns following isolated and sequenced trades in the post-SOX period.

In this table, we measure how returns following isolated and sequenced end trades differ in the post-SOX period. The dependent variable is abnormal returns relative to DGTW portfolio. *t*-statistics are reported in parentheses and are based on robust standard errors that are clustered at the monthly level. *a* represents significance at the 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post Sox	0.0052^a	0.0043^a	0.0117^a	0.0046^a	-0.0250^a	-0.0143^a	-0.0207^a	-0.0156^a
	(3.264)	(6.451)	(4.142)	(3.605)	(−9.214)	(−11.396)	(−3.961)	(−6.821)
Constant	-0.0118^a	-0.0082^a	-0.0244^a	-0.0141^a	0.0329^a	0.0216^a	0.0289^a	0.0230^a
	(−8.295)	(−14.109)	(−9.739)	(−12.735)	(15.176)	(27.593)	(7.201)	(14.348)
Executive	CEO/COB	Non CEO/COB	CEO/COB	Non CEO/COB	CEO/COB	Non CEO/COB	CEO/COB	Non CEO/COB
Event Type	Sale	Sale	Sale	Sale	Purchase	Purchase	Purchase	Purchase
Categorizaiton	Isolated	Isolated	Sequence End	Sequence End	Isolated	Isolated	Sequence End	Sequence End
Observations	27,528	315,451	10,713	75,716	19,212	163,241	4,990	28,390
R-squared	0.000	0.000	0.002	0.000	0.005	0.002	0.003	0.002

Table IA9. Predicting insider trading patterns: EPS breaks and acquisitions.
This table reports logit regressions predicting whether new trading initiates an extended trade sequence. Panel A reports regressions for sales and Panel B reports regressions for purchases. The dependent variable equals 1 if the trade month begins a sequence and is 0 if it represents an isolated trade. *Ln(# of Analysts)* is the natural log of one plus the average number of analysts that provided fiscal quarter-end forecasts for the firm. *Near-term earnings surprise dummy* equals 1 if the observation was a sale (purchase) month and the firm misses (beats) earnings expectation for the fiscal quarter of the trade, and 0 otherwise. *Ln(market cap)* is the natural log of the firms' market value of equity, and *Ln(market equity/book equity)* is the natural log of firms' market-to-book equity ratio. *EPS Break Announced* is an earnings announcement the breaks a string of consecutive quarterly announcements. *Days to Acquisition* is the number of days between the date of the insider purchase and the subsequent acquisition of the firm. *t*-statistics are reported in parentheses and are based on robust standard errors that are clustered at the monthly level. *a*, *b* and *c* represent significance at the 1%, 5% and 10% levels respectively.

	Months with sales transactions	Months with purchase transactions where the firm is acquired within 15 months
	(1)	(2)
Ln(# of Analysts)	0.1100^a	−0.2029^a
	(10.416)	(−2.805)
Near-term earnings surprise dummy	−0.1681^a	−0.0728
	(−12.702)	(−0.732)
Ln(MVE)	−0.0973^a	0.0028
	(−14.691)	(0.067)
Ln(MVE/Book Equity)	0.1160^a	0.0870
	(11.611)	(1.634)
Number of Trades in Month	0.2255^a	0.3292^a
	(37.995)	(8.733)
EPS Break Announced in Months t + 10 to t + 12	−0.0017	
	(−0.109)	
EPS Break Announced in Months t + 13 to t + 15	0.0385^b	
	(2.326)	
Ln(Days to Acquisition)		0.2948^a
		(2.610)
Observations	384,729	6,567

Table IA10. Predicting insider trading patterns: Earnings guidance and filing lags.

This table reports logit regressions predicting whether new trading initiates an extended trade sequence. Panel A reports regressions for sales and Panel B reports regressions for purchases. The dependent variable equals 1 if the trade month begins a sequence and is 0 if it represents an isolated trade. The sample period for this analysis begins in 2002 due to data limitations. *Ln(# of Analysts)* is the natural log of one plus the average number of analysts that provided fiscal quarter-end forecasts for the firm. *Near-term earnings surprise dummy* equals 1 if the observation was a sale (purchase) month and the firm misses (beats) earnings expectation for the fiscal quarter of the trade, and 0 otherwise. *Ln(market cap)* is the natural log of the firms' market value of equity, and *Ln(market equity/book equity)* is the natural log of firms' market-to-book equity ratio. *Good News Guidance* is an indicator variable set to 1 (0, otherwise) when we observe a voluntary management forecast accompanied by a positive stock price response. *Bad New Guidance* is an indicator variable set to 1 (0, otherwise) when we observe voluntary management forecast accompanied by a negative stock price response. *Ln(Max Filing Lag in Month)* is the natural log of largest number of days between a particular trade and the date on which the insider reported the trade, in a particular month. *Filed with SEC Late* is a binary variable that equals 1 (0, otherwise) if the insider reported the trade after the regulatory stipulated period. *t*-statistics are reported in parentheses and are based on robust standard errors that are clustered at the monthly level. *a*, *b* and *c* represent significance at the 1%, 5% and 10% levels respectively.

	Months with sales transactions				Months with purchase transactions			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(# of Analysts)	0.1402^a	0.1464^a	0.1497^a	0.1499^a	−0.1313^a	−0.1090^a	−0.1239^a	−0.1227^a
	(10.946)	(11.385)	(11.317)	(11.323)	(−5.031)	(−4.047)	(−4.593)	(−4.547)
Near-term earnings surprise dummy	−0.1549^a	−0.1281^a	−0.1661^a	−0.1662^a	−0.1066^a	−0.0906^a	−0.1176^a	−0.1180^a
	(−8.763)	(−7.401)	(−9.269)	(−9.281)	(−3.589)	(−3.007)	(−3.760)	(−3.766)
Ln(MVE)	−0.1169^a	−0.1161^a	−0.1140^a	−0.1146^a	−0.0388^b	−0.0319^b	−0.0529^a	−0.0512^a
	(−14.779)	(−14.579)	(−14.393)	(−14.412)	(−2.454)	(−2.097)	(−3.363)	(−3.280)
Ln(MVE/Book Equity)	0.1182^a	0.1189^a	0.1212^a	0.1213^a	0.0310	0.0341	0.0225	0.0236
	(11.225)	(11.342)	(11.666)	(11.672)	(1.380)	(1.518)	(0.925)	(0.968)
Number of Trades in Month	0.2321^a	0.2321^a	0.2377^a	0.2428^a	0.3642^a	0.3677^a	0.3549^a	0.3593^a
	(25.306)	(25.230)	(41.114)	(42.083)	(15.114)	(15.855)	(13.585)	(13.703)
Good News Guidance - Month *t*	0.1492^a				−0.0558			
	(6.806)				(−1.019)			
Bad News Guidance - Month *t*	0.0082				−0.1247^b			
	(0.329)				(−2.224)			
Good News Guidance - Month *t* + 1 to *t* + 3		0.1325^a				−0.2310^a		
		(6.962)				(−4.763)		
Bad News Guidance - Month *t* + 1 to *t* + 3		−0.0964^a				−0.1504^a		
		(−5.093)				(−3.086)		
Ln(Max Filing Lag in Month)			0.0611^a				0.1009^a	
			(7.762)				(9.466)	
Filed with SEC late				0.0894^a				0.3277^a
				(3.288)				(8.385)
Constant	−1.2593^a	−1.2795^a	−1.3778^a	−1.3125^a	−1.9090^a	−2.0040^a	−1.8266^a	−1.7821^a
	(−10.107)	(−10.265)	(−11.253)	(−10.649)	(−8.044)	(−8.688)	(−7.652)	(−7.427)
Observations	221,602	221,602	217,915	217,915	71,643	71,643	67,023	67,023

Table IA11. Market reaction to insider trading filings

This table predicts the magnitude of cumulative abnoral returns (CAR) around the dates of when insiders file disclosure reports of their trades on Form 4 as required by the SEC. The dependent variable is the cumulative return on days t, and $t + 1$, where day t is the day of the filing and $t + 1$ is the next day. *Reported after 5 pm* is a binary variable indicating that the first trade of the month was reported to the SEC after 5 pm. *Executive Team* is a binary variable indicating whether or not the insider is Chair of the Board, Chief Executive Officer, President, Chief Operating Officer, or General Counsel. t-statistics are reported in parentheses and are based on robust standard errors that are clustered at the monthly level. a, b and c represent significance at the 1%, 5% and 10% levels respectively.

	CAR t to $t + 1$	
	Sales	Purchases
	(1)	(2)
Ln(Dollar value of trades on Form 4)	−0.0000	0.0018^a
	(−0.818)	(16.890)
Reported after 5 pm	0.0003^c	−0.0008^c
	(1.747)	(−1.855)
Executive Team	−0.0001	0.0033^a
	(−0.435)	(7.932)
Firm fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Month fixed effects	Yes	Yes
Observations	222,907	74,272
R-squared	0.041	0.111

Table IA12. Characteristic-matched abnormal returns with trades aggregated at firm level.
The table shows the characteristic-matched abnormal returns associated with corporate insiders' stock trades *with trades aggregated at the firm level*. The abnormal returns are measured relative to a portfolio of stocks in the same size, book-to-market and previous 12-month momentum quintile. The benchmarks for the size and book-to-market quintiles are as described in Daniel et al. (1997) and Wermers (2004) while the benchmark for momentum is based on stock returns in the 12 months prior to the trading month. Panel A begins by showing abnormal returns following isolated trading months. It then presents abnormal returns following individual sequenced trading months (All), following only those sequenced trade months that precede the end of trade sequences (During), and following the end of trade sequences (Following). Panel B shows the buy-and-hold abnormal returns (BHAR) beginning the calendar month after a sequence of trades begins and ending three months following sequence ends. Standard errors are clustered at both the firm and month level and *t*-statistics are reported in parentheses. *a* represents significance at the 1% level.

Abnormal returns relative to matching firms

	(1)	(2)	(3)	(4)
	Isolated Sells	Sequenced Sells		
		All	During	Following
1 Month Abnormal Return	-0.0044^a	0.0036^a	0.0107^a	-0.0104^a
	(−16.475)	(11.863)	(28.761)	(−21.569)
Number of Observations	200,592	165,885	118,875	66,674
	Isolated Buys	Sequenced Buys		
		All	During	Following
1 Month Abnormal Return	0.0143^a	0.0081^a	0.0030^a	0.0179^a
	(30.886)	(14.210)	(4.602)	(17.107)
Number of Observations	120,282	74,176	50,574	27,736