Insider Trading: Frequency Matters

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Abstract

We investigate whether the trading performance of an individual insider changes over time and if this change in performance correlates to the frequency of the insider's trades. We find that performance declines as an insider executes successively more acquisitions; conversely, returns improve over successive selling, especially with larger sales. Our results also suggest that insiders who trade infrequently, whether buying or selling, outperform insiders who trade frequently. Frequent and infrequent traders tend to moreover remain frequent and infrequent traders throughout their tenures as insiders. Our findings add novel behavioral perspective to a well-studied area of research that, until now, is mute on the evolution of insider trading frequency and trade performance.

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1. Introduction

Nearly all prior studies on insider trading activity implicitly assume that the performance of an insider remains constant over time. Whether an insider's trades are informationally motivated or influenced by factors such as liquidity, diversification needs, contrarian strategies, or a desire to avoid litigation, the existing literature largely ignores the sequencing of an insider's trades or how long the insider has been with their firm. Two exceptions are Cohen, Malloy, & Pomorski (2012) who link longer tenure to superior insider trading performance, and Inci (2012), who reports that buyer performance tends to decline over time. In this paper, by separately analyzing the trade sequencing of buyers and sellers, we show how these seemingly conflicting findings can co-exist. Specifically, our goal is to investigate whether an insider's trading performance changes considerably over time, and if it changes differently for buyers as compared to sellers. Additionally, no prior work considers trade timing from the standpoint of comparing insiders who trade frequently against those who do not. In our second research question, we examine the impact of trade frequency on insiders' trade performance.

Due to longstanding investor focus and a public policy interest in fair markets, a considerable body of research focuses on questions related to insiders trading in shares of their own companies. The results of these studies sometimes conflict. Broad themes include the number of insiders transacting (Lakonishok & Lee, 2001), the effects of firm size and corporate governance (Lin & Howe, 1990), informational hierarchies among insiders (Fidrmuc, Goergen & Renneboog, 2006; Wang, Shin & Francis, 2012), the varying types of information and circumstances that might motivate an insider to transact (Aboody & Lev, 2000; Alldredge & Cicero, 2015), and the natural tensions and subtle stratagems arising from an insider's desire to profit, balanced against a need to avoid legal jeopardy, especially when larger share volumes are in play (Barclay & Warner, 1993; Yermack, 2009).

Based on the number of publications, perhaps the most persistent avenue of inquiry is the differing motivation and performance of buyers versus sellers. This avenue appears in much of the nascent work on insider activity which established an early consensus that the magnitude of abnormal performance for stocks that insiders purchase is greater than the magnitude of abnormal performance for stocks that insiders sell (Rogoff, 1964; Baesel & Stein, 1979). Some of the work comparing insider buying performance favorably against selling investigates circumstances where buyers outperform by more proficiently exploiting earnings signals (Allen & Ramanan, 1995) or temporary share price volatility (Gidera & Westheide, 2016), as examples. This finding of buyers outperforming is consistent with the view that whereas buyers strictly seek profit, insiders might sell for reasons relating to liquidity or the need to diversity (see, e.g., Jeng, Metrick & Zeckhauser, 2003). Furthermore, one-off situations such as stock splits arise where insiders' sales underperform (Ma, Sun, & Yur-Austin, 2000). In this broad camp, some authors report that insider selling has no predictive power (e.g., Lakonishok & Lee, 2001).

Another strand of the literature supports the view that insider selling can in fact be predictive and informationally motivated. One approach within this line of inquiry investigates non-US markets and finds that sellers outperform buyers in the United Kingdom (Pope, Morris, & Peel, 1990) and more recently in Hong Kong (Firth, Leung & Rui, 2009). In addition, there is evidence that sales by insiders holding large stakes are generally predictive in the United Kingdom (Madden & Moran, 2004), and in Sweden before poor earnings announcements (Kallunki & Hellstrom, 2009). A second approach in support of informationally motivated predictive insider selling seeks to isolate and highlight situations in US markets where sellers appear to perform well, e.g., before poor earnings announcements or restatements (Ravina & Sapienza, 2009), by exploiting publicly available information about customers (Alldredge & Cicero, 2015), or by

executing a sale that reverses a previous purchase (Pettit & Venkatesh, 1995). Other studies along these lines find that large sales, greater numbers of sellers (Toutkoushian, 1996), and option exercise-and-sale transactions involving large amounts (Kyriacou & Mase, 2005) are predictive.

A third line of inquiry uncovers a variety of subtler informationally motivated insider strategies for unloading stakes that later prove unusually likely to fall in value. One US example involves selling shares through preprogrammed 10b5-1 plans, a process that on its face might suggest an orderly series of sales over time, but in reality, is often designed to facilitate large sales at the first opportunity. There is evidence that 10b5-1 preprogrammed selling occurs disproportionately before negative earnings surprises (Jagolinzer, 2008) and can predict share price decline more than insider sales in general (Milian, 2016). Other studies find that selling insiders sometimes appear to work subtly with analysts around the timing of earnings revisions (Richardson, Teoh, & Wysocki, 2004), or otherwise massage earnings accrual information (Kraft, Lee, & Lopatta, 2014), or the timing of share repurchases (Bonaime & Ryngaert, 2013) and earnings restatements (Agrawal & Cooper, 2015) to support a stock price before a sale. There is also evidence that insiders sell well in advance of a default (Beneish, Press, & Vargas, 2012) or bankruptcy (Iqbal & Shetty, 2002), or alternatively, reduce selling ahead of receiving a takeover bid (Agrawal & Nasser, 2012). Not every subtle exit strategy involves selling; informationally motivated share disposal occurs through prepaid forward contracts (Jagolinzer, Matsunaga, & Young, 2007) and large charitable gifts (Yermack, 2009). A propensity for companies with greater informational asymmetries to lock up insiders longer after an initial public offering (Brav & Gompers 2003) is perhaps an indication of an awareness of such share-unloading initiatives with companies now baking deterrence measures into their policies.

Interestingly, and possibly in line with work suggesting that insiders might be more litigation-averse to sell before bad news than to buy before positive developments (Cheng & Lo, 2006; Aier, 2015), the existing literature does not seem to break out potential informationally-motivated scenarios around buying to the degree it does with sales. Studies that explore why insiders buy find that abnormal insider outperformance correlates with higher R&D expenditures (Aboody & Lev, 2000; Huddert & Ke, 2007) or tends to occur more frequently in smaller and newer R&D-focused technology companies with less analyst coverage (Gu & Li, 2007). One recent paper examining takeovers finds that target companies previously subject to more active insider trading have better outcomes after the merger (Suk & Wang, 2021). Most research into insider buying triggers, however, tends to focus on earnings releases or other corporate disclosures.

While most of the literature suggests that insiders outperform, there are opponents to this view. Separate lines of inquiry contend that much or all abnormal performance attributed to insiders may instead result from an insider's proclivity towards value (Rozeff & Zaman, 1998) or volatility (Gangopadhyay & Yook, 2015). Others weigh informational advantage versus contrarian tendencies as components of insider outperformance and find that contrariness accounts for a greater share of the superior results (Piotroski & Roulstone, 2005). One author finds insiders to be contrarian to the point of rejecting rational measures such as price to book although notes that insider buys still outperform by 3% annually after accounting for these factors (Jenter, 2005). Gidera & Westheide (2016) further blur the lines between the informational and contrarian viewpoints by arguing that insiders should be credited for knowingly increasing buys and decreasing sales during volatile periods, as volatility provides better opportunities for realizing an advantage.

Prior to June 2003, when the SEC began requiring insiders to file transactional disclosures online within two business days, research had started to explore the idea that whereas insiders might outperform, outsiders mimicking insiders might fail to mimic insider success owing to trading costs and reporting lag (Seyhun, 1986) as well as spreads (Lin & Howe, 1990). Some authors found that outsiders could mimic insider profits (Bettis, Vickrey, & Vickrey, 1997), or more recently, that the market reacts to insider trades (Inci, Lu, & Seyhun, 2010).

Our work follows a strand of the literature that considers the *timing* of trades in attempting to ascertain which insider purchases or sales may be informationally motivated. One paper in this line compares 'routine' insider buys occurring approximately annually against 'opportunistic' buys timed more randomly and finds that only the latter show significant outperformance (Cohen Malloy Pomorski, 2012). Another recent paper by Biggerstaff, Wintoki, and Babajide (2020) wades into the contrariness-and-volatility-versus-alpha debate and finds strong abnormal outperformance for both buying and selling. More specifically, the paper shows that insiders with more time to act on an opportunity spread trades over time, whereas insiders having less time to catch fleeting opportunities act more quickly. Interestingly, the authors also find that insiders facing time constraints tend to file trade disclosures after the market close while executing larger transactions showing greater abnormal outperformance. We extend prior work on trade timing in examining the frequency of an insider's trades and whether their performance changes over time.

Using a large sample of insider trades from 2003 through 2019, we provide robust evidence that acquirer performance declines steadily and markedly as an insider executes successively more acquisitions; conversely, insider returns improve over successive sales. This outperformance is both statistically and economically significant. By comparing the frequency of their trading activities, we find that frequent and infrequent traders tend to remain frequent and infrequent

traders throughout their tenures as insiders. We moreover find that insiders who trade infrequently, whether buying or selling, outperform insiders who trade frequently. Together these findings bring a new behavioral perspective to the study of insider trading.

We believe our findings will contribute significantly to ongoing dialogue about the insider buyer/seller dynamic as well as to a more refined awareness of which transactions are less or more likely to be informationally driven. Our work ties into previous studies regarding why an insider might choose to trade, and the extent to which trade timing may stem from informational as opposed to contrarian, volatility, or personal financial factors. Our findings have important implications for researchers, practitioners, and regulators. In particular, our results suggest a potential need to reexamine much of the existing work on insider activity from the new perspective of acknowledging that the trading performance of an insider does not remain constant over time, and that trading frequency is an important factor.

2. Data, Sample Construction and Descriptive Statistics

The data is primarily from three sources, (i) insider trading data from Form 4 insider filings downloaded from the SEC EDGAR website, (ii) stock price data from the Center for Research in Securities Prices (CRSP), and (iii) industry return data from the Kenneth French website. Our starting sample of insider trade data includes 2,146,760 filings from July 1, 2003, through April 24, 2020.[1]

Our analysis considers only officers and directors and excludes insiders filing solely as 10% shareholders. We face an initial methodological challenge in the treatment of an insider's transactions occurring over multiple days, weeks, or longer. Previous studies use different

[1] We use a proprietary Form 4 downloading tool to scan footnotes and correct miscategorized filings which we observe in commercially available scrapers.

approaches to aggregate transactions spanning extended periods. Our approach is to consider any sequence of continuous activity to be part of the original acquisition or sale until the insider ceases transacting for a defined period. Deciding on an appropriate period of inactivity is inherently subjective. We use 30 days based on the rationale that legal permission to transact generally covers short time spans. For robustness, we also use a 182-day period of inactivity, a period that aligns with the short-swing profit rule wherein buyers and sellers must wait six months before reversing direction. In situations where insiders sell after acquiring shares through the exercise of options within a six-month period, a practice permitted under the short-swing profit rule since 1991, we net sales against acquisitions and count as open market sales only shares sold in excess of shares acquired. We count as net option-related acquisitions any instance where an insider retains more shares than sold. As an illustrative example, we ignore an option-related acquisition of 10,000 shares followed by a 10,000-share sale, but if the insider instead sells 7,000 or 12,000 shares, we treat the transaction as a 3,000-share option-related acquisition or a 2,000-share sale respectively. Using this approach, we further net and aggregate any continuing sequence of trades until there is a 30- or 182-day gap in activity. We measure the benchmarked returns of all open market purchases, open market sales, and option-related share acquisitions. The final sample includes 522,604 transactions.[2]

An important aspect of our study involves identifying which transaction represents an insider's first purchase, second purchase, etc. The same applies to the insider's sales, or option-related acquisitions. Each insider in our sample could have been active prior to the start of our sample period. To increase the likelihood that the first trade we observe for an insider in our sample

[2] Our reference to insider buying, selling, trading, or transacting may refer either to individual trades or to trade clusters that we treat as individual trades. The term 'acquisition' may refer to open market buys, share acquisitions through option exercise, or combinations of these transactions.

is in fact that insider's first trade, we exclude all activity for all insiders who trade during the first 18 months of our sample, i.e. from July 1, 2003 through December 31, 2004. In other words, we argue that if an insiders first trade in our sample occurs in January 2005 or later, then that is likely the insider's first trade the stock. We use this approach in studying changes to insider performance over time as well as performance correlations to the frequency with which an insider trades.

We only include companies listed on the New York Stock Exchange, the American Stock Exchange, or NASDAQ, and for benchmarking, we measure returns against Fama French 48 sectors (FF48) and SIC 2-Digit classifications using one-month, three-month, six-month, one-year and two-year horizons. We winsorize all returns at the 1% and 99% level.

Following the above steps, our dataset distills down to 50,584 open market buys, 25,255 option-related acquisitions, and 83,611 sales when applying a 30-day netting-and-aggregating inactivity gap and 32,365 open market buys, 18,186 option-related acquisitions, and 49,935 sales when using an inactivity gap of 182 days. In rare cases, insiders buy and sell (or vice versa) within short periods of time that would appear to violate the short-swing profit rule; we classify these transactions as buys or sales based on the dominant direction in dollar volume. In measuring performance, when an insider buys a stock that increases in price more significantly (or experiences a smaller loss) than its underlying benchmark, we treat the buy as outperforming the market. We treat a seller as outperforming, conversely, when their stock rises less than or falls more than underlying benchmarks during applicable measurement periods.

Table 1 is a summary of data composition. Panel A summarizes the raw data after cleaning. Our CRSP performance data covers trades initiated from January 1, 2005 through December 31, 2019. Panels B and C summarize the netted and aggregated data encompassing 39,595 unique insiders at 3,836 companies. We separate acquisitions into open market buys and option-related

transactions to ascertain differences in alpha or behavior between these two activities. There are almost twice as many open market buys as option-related acquisitions. A small number of clustered 'hybrid' transactions involves open market purchases combined with option-related share acquisitions.

Netting and aggregating changes the ratio of transactions counted as acquisitions from 45% in the raw data to 48% when applying the 30-day gap approach and to 51% when using an inactivity gap of 182 days. We do not believe this introduces bias in measuring performance, however, and note that netting and aggregating has the important benefit of preventing a small number of insiders transacting continually for extended periods from disproportionately impacting our data. Panels A and B of Table 2 summarize a detailed distribution of individual transactions over time with regard to netting and aggregation. Most transactions do not entail a need to net or aggregate trades; a small number of serially-active insiders pulls up the averages.

Panels C and D of Table 2 show distributions of netted and aggregated trades similar in pattern to the prior tables. Most insiders execute single-filing trades with a small number engaging in extended activity. Most of our analysis of netted and aggregated transactions focuses on an insider's initial trades or clusters of trades, as the data becomes sparse for insiders executing large numbers of trades over time.

In addition to the three categories of transactions for which we measure returns - open market buys, option-related acquisitions, and open market sales - the SEC EDGAR website provides disclosures for other activities for which we did not measure performance such as stock awards, options grants and expiries, gifts, retitling for estate plans, etc. For our study, these added 'white noise' disclosures help in establishing an insider's presence at a company, a consideration in examining more fully how frequently an insider has traded. When an insider trades in more than

one company, meanwhile, we treat their transactions in each company as if executed by separate individuals. 'Different insiders' in our paper can thus refer to two or more individuals or can mean one person trading in multiple companies, depending upon context. With the date of the earliest filing (d_0), we can measure the intervals between an insider's trades or clusters of trades ($d_{i,i=1,2,\ldots,t}$) and subsequently determine the average interval between trades for each insider, which we define as the "frequency" (*f*) of an insider's trades, in preparation for further evaluation. Equation 1 and 2 are the formulas we used to measure frequency:

$$f_i = \frac{d_i - d_0}{i} \tag{1}$$

$$f = \frac{\sum_{i=1}^{t} f_i}{t} \tag{2}$$

We classify as 'infrequent' those insiders who trade less often than 50% of insiders for a given transaction type (i.e., open-market buys, sales, or option-related acquisitions) and we analyze each group separately. As the above tables show, the 182-day netted and aggregated data have far fewer individual transactions than the 30-day, so our analysis of frequently- versus infrequently-trading insiders rests mainly on the latter, our focus being on open market purchases and sales wherein we compare performance according to an insider's frequency of trading and by transaction type. Accordingly, there are four groups of insiders in this portion of our analysis: frequent buyers, infrequent buyers, frequent sellers, and infrequent sellers. Under our methodology, a frequent buyer will in some cases be an infrequent seller, and an infrequent buyer may be a frequent seller.

Table 3 summarizes trends in time intervals between transactions by type and the performance of previous trades. The tables provide three insights. First, the time interval between trades gets shorter for both buyers and sellers. Second, sellers wait longer than buyers before

executing next trades. Third, insiders following successful trades tend to wait longer before trading again. The analyses in the further sections rest upon these three points.

Figure 1 adds one noteworthy finding as we proceed through our analysis: insiders are more likely to acquire shares in earlier transactions and to sell shares as time goes on.

3. Methodology

Our analysis divides into two stages. First, we examine changes to an insider's trading performance over time, an assessment which includes whether prior trades influence later transactional behavior. We use exploratory and statistical techniques including an Auto-Regressive (AR) Model and an Ordinary Least Squares (OLS) Regression. The AR Model differs from OLS Regression in that the former focuses on the consecutive returns for each insider as a time series whereas the latter pairs transactions sequentially and calculates the beta. Finally, we examine the relationship between selling performance and average trade size, splitting all open market sales into two groups comprising those involving greater versus lesser dollar amounts.

Our second stage examines the trading performance of insiders who trade frequently versus those who do not. This analysis requires additional tests prior to applying exploratory and statistical techniques. We need initially to ascertain whether insiders initially trading infrequently tend to continue trading infrequently or whether a more fluid situation prevails, as greater fluidity would complicate our analysis. We start by ascertaining whether an insider's first transaction is a buy or a sale and whether they start as 'infrequent,' using 'white noise' filings to establish an insider's tenure before their first trade. Putting all insiders into four categories - infrequent buyers, infrequent sellers, frequent buyers, and frequent sellers - we count trade types and trading-frequency groupings across all transactions to ascertain the extent to which insiders stay within their original categories. Using this approach, we test whether the trading patterns of buyers and

sellers over time hold continuously even if we split them into different trading-frequency groupings.

As a part of our second stage encompassing our frequent-versus-infrequent trader analysis, we conduct Two-Way ANOVA which also includes transaction sequence for comparing the performance of frequent versus infrequent traders against each transaction type. Although our data size already ensures the normality of the distribution, stock returns skew right: a stock can increase over 100% from its original value whereas the opposite does not hold. Before executing our analysis, we therefore exclude records with the highest and lowest 1% returns. This process transforms the return distribution to a normal one, as Figure 2 shows, and records with extreme values which can be outliers or even data entry errors also fall away, enhancing analytical robustness. We include the transaction sequence in the model due to the potential influence of time on performance to improve precision, which can also reduce dependence within the levels of a factor of interest and bias arising from confounding.

With the performance of each frequency grouping, the final question we seek to answer is whether infrequent insiders ultimately earn less in total excess return simply for having executed fewer trades. In other words, even if infrequently-trading insiders perform exceedingly well on the fewer trades they execute, perhaps frequently-trading insiders with lower average gains earn more in aggregate after summing all of their returns. We adopt two approaches to test this question, the first being to take the dollar volume of each trade ($c_{i,i\,=\,1,2,\ldots,t}$) into account, multiply by percentage return ($r_{i,i\,=\,1,2,\ldots,t}$) to get the total dollar return for each insider (R), and divide each insider's total dollar volume by each of their respective investments (C) to get general return percentages ($P_{(A)}$), as Equation 3 to 5 shows:

$$C = \sum_{i=1}^{t} c_i \tag{3}$$

$$R = \sum_{i=1}^{t} c_i \, r_i \tag{4}$$

$$P_{(A)} = \frac{R}{C} \tag{5}$$

This is, in summary, a value-weighting approach toward each of an insider's trades.

Our alternative approach is to consider each trade equally, sum all percentage returns for an insider by transaction type, and sum the averages to obtain a general return percentage ($P_{(B)}$), as Equation 6 shows:

$$P_{(B)} = \frac{\sum_{i=1}^{t} r_i}{t} \tag{6}$$

This second approach is essentially an equal-weighting of each insider's respective returns.

During the analysis, when discussing sequences of trades, we count open market purchases and open market sales separately. As an example, if an insider has seven transactions consisting of four buys and three sales, we record the insider as a four-time purchaser and a three-time seller. When an insider trades in more than one company, as mentioned, we treat the activities separately. As an example, if the above insider sells twice in one company and once in another, we treat the insider as a two-time and one-time seller respectively.

4. Results and Discussion

4.1 Overall data

Before discussing changes to buyer and seller returns over time and the performance of frequent versus infrequent traders, we would like to calibrate first by noting our general findings regarding insider alpha. Three panels in Table 4 show: 1) the ex-post returns of individual stocks after insider transactions, and, 2) the ex-post active returns (ex-post returns less sector returns) on

FF48 and SIC sectors. In total, the active return from an insider transaction is 9.7% one month after the trade, diminishing to approximately 1.2% within 2 years. We annualize all returns.

Abnormal outperformance is greater in purchases than in sales. In fact, the active return for acquisitions is 17.0% for one month, and 25.9% for open market purchases versus 3.4% for sales. This could imply that insiders better foresee increases than decreases in share prices, or alternatively, that they hesitate to sell before decreases. Insiders may also sell for liquidity or to diversity. It could be a combination of any of these factors.

Most of the alpha within the acquisitions comes from open market purchases rather than option-related acquisitions. That the options-related acquisitions show less alpha is perhaps unsurprising, as insiders execute options at strike prices lower than the market price. The actual profit an insider earns is higher.

4.2 Changes to Insider Trading Performance Over Subsequent Transactions

Following our conclusion that insider transactions show significant abnormal returns, a conclusion much covered in previous literature, we reach our first novel questions of whether and to what extent insider performance changes as insiders execute additional transactions over time.

We start by using the AR Model of analysis. Panels A and B of Table 5 show the AR(1) betas for the transaction categories we examine. The AR(1) betas within our data for the buys are consistently smaller than those for the sales within the active returns, implying that buying performance worsens at a faster rate than occurs for the sellers. Betas for the sales should be arguably greater than 1.00 before allowing a conclusion that sellers improve. We believe, however, that having betas slightly below 1.00 is optimal, as betas higher than 1.00 would make our model

unviable owing to destabilized returns. In the AR Model, we use gross returns, i.e., returns plus 1, to avoid having different signs which could affect the signs of coefficients.

In addition to an AR Model analysis, we perform cross-sectional OLS Regression analysis to further validate the hypothesis of buyer performance deteriorating and seller performance improving. In the cross-sectional analysis, we compare returns from pairs of consecutive trades. The return from the second trade within the pair is the dependent variable whereas the return of the first trade is the independent variable. We again use gross returns to avoid issues arising from positive and negative signs.

As Panels A through D of Table 6 show, consistent with the results of the AR Model analysis, a cross-sectional OLS Regression analysis confirms a pattern of acquirer performance deteriorating more rapidly than occurs for sellers.

Whereas the AR Model examines consecutive returns for each insider at a firm and treats them as a time series, a cross-sectional OLS Regression pairs these trades sequentially and calculates the beta without considering how many trades each insider executes at a firm.

The OLS betas on active returns for buys and sales show 1~2% differences depending upon the methods used. Considering that the returns are semiannual, these differences are sufficient to argue that acquirer trading performance gets worse at a more rapid rate than occurs for sellers. The difference between the OLS betas of purchases versus sales is most significant in the second trade and remains significant until the 5th or 7th trade. Overall, Welch's t-test statistic on the difference between the purchase and sale betas shows -10.16.

In the previous paragraphs, we examine the cross-sectional OLS Regression on the entire return data. We now expand our analysis to include a cross-sectional OLS Regression for each order of transactions. Below, we examine trades in reverse order. For example, when looking at

the return from the final transaction of an insider at a firm and the preceding transaction by that insider at the same firm, we label the final transaction as order -1 and the prior transaction as order -2. We then make a data frame of all order -1 and order -2 transactions across each firm and perform cross-sectional OLS Regressions, followed by OLS Regressions for order -2 and order -3 transactions, and so on. The approach enables a closer examination of how returns change from the perspective of the final transaction.

When performing OLS Regressions, we label x-variables representing returns for trades occurring earlier in time as order -2, and we label y-variables representing returns for trades occurring subsequently as order -1, and so on. We label the resulting beta as order -2, and so on in Figure 3. The number of observations decreases as the order goes farther away from -1, meaning that more observations are concentrated near the right end of the x-axis.

The acquirer and seller graphical comparisons on active returns show a clear diverging pattern in the tails. The dashed line – sales – shows improvements whereas the solid line – purchases – shows declines. The two graphs clearly diverge from the -4th to the -2nd trades. This approach shows acquirers worsening and sellers improving in their trading performance. We take similar approaches in examining the open market purchases and option related acquisitions, although the patterns are less clear.

As a final step in testing the hypothesis of buyers worsening and sellers improving, we perform a conditional return analysis examining a trade's return conditional on the positive or negative sign of its prior trade return. That is, we examine how subsequent returns change following a winning or a losing trade. Table 7 shows correlations for two trades in sequence. The betas for returns after a win are all below one, implying diminishing alpha, whereas the betas for returns after a loss are all above one, implying convergence of alpha. The betas for buys are smaller

than the betas for sales after a win, indicating that the alpha for buys diminishes more rapidly for buys than sales. The betas for returns after a loss are greater in purchases than in sales, implying that the speed of recovery after a negative return is also faster in purchases.

4.3 Changes to Seller Performance – Relationship to Dollar Volume

To further explore possible underlying drivers of why insider performance might improve over subsequent selling, using AR Model and OLS Regression analyses, we take an additional step of dividing all sales into two groups based upon larger vs smaller dollar size. Panels C and D of Table 5 show the AR(1) betas for open market sales in the two groupings. The AR(1) betas for the smaller sales are consistently lower than for the larger sales within the active returns, implying that the performance of larger sales improves at a faster rate than occurs for smaller sales. This is consistent with the results that OLS Regression Panel E of Table 6 and Panel C of Figure 3 show. The performance of all sales improves over time, whereas the performance of larger sales improves more rapidly.

4.4 Comparing the Performance of Frequently- Versus Infrequently-Trading Insiders

Our second novel question is to examine correlations between how frequently an insider trades and the returns on their transactions. Preliminarily, as Table 8 shows, fewer than 13% of insiders show both purchases and sales in their transaction histories within a company, the remaining 87% being strictly buyers or sellers over time. Only approximately a quarter of insiders meanwhile change trading-frequency groupings. Interestingly, nearly half of insiders executing both purchases and sales also change trading-frequency groupings, suggesting that a switch in

transaction type tends to come with a change in frequency grouping. The opposite does not hold, however, as only 30.2% of insiders changing frequency groupings (2,522 of 8,351) consist of buyers who later sell, or vice versa. This result establishes that insiders starting in one trading-frequency grouping tend to remain in that grouping going forward.

Getting further into the statistics, Panels D and E of Table 5 show the AR(1) betas for open market purchases and sales in different trading-frequency groupings. As we split insiders, frequently- versus infrequently-trading insiders show diverging trends: whereas the AR(1) betas of buyers are still smaller than those of sellers in most cases, infrequent sellers consistently show larger gaps over infrequent buyers as compared with frequent sellers over frequent buyers, suggesting that as the performance of both frequent and infrequent buyers worsens at a faster rate than occurs for sellers, the rate of change for infrequently-trading insiders is greater.

Again, we develop the Cross-Sectional OLS Regression in two parts. We compare the returns from pairwise consecutive clusters in both normal and reversed sequence, and we calculate a general beta value of all clusters. Panels F and G of Table 6 and Panels D and E of Figure 3 show the results of each part.

The results of OLS Regression are consistent with those of the AR Models. The performance of sellers improves over time, whereas the performance of buyers diverges when comparing the frequent- and infrequent-trader groupings. Frequent-buyer performance even improves on reversed transaction data starting from the final purchase. The difference of beta in normal sequence also indicates that the gap between open market purchases and sales for infrequently-trading insiders is smaller.

Building on Figure 2 showing the distribution of returns over time between the two insider trading-frequency groupings, for better visualization, we display bar plots of average returns in Figure 4 which shows infrequent traders outperforming frequent traders. We use Mann–Whitney tests with Bonferroni correction to verify this pattern statistically. Table 9 lists the p-values of Two-Way ANOVA over trading-frequency groupings between buyers and sellers. Both p-values are small enough to validate that infrequent traders outperform frequent traders. Moreover, the p-value of trade sequence for open market purchases does not show significance, which is consistent with our previous result that after splitting into two frequency groupings, the pattern of changes to buyer performance over time is no longer clear.

After ascertaining that insiders who trade infrequently on average outperform insiders who trade frequently, we consider the related question of whether the cumulative results of a frequently-trading insider's greater number of lesser-performing trades might - in total - earn more in total than an infrequent trader's larger but rarer wins. The question has potential relevance to discussions around insider performance versus outsiders mimicking insiders, although we find that infrequent traders in aggregate earn more notwithstanding trading fewer times. Table 10 is the summary of the general return percentage of each approach. The results of both approaches indicate that although trading less frequently, the infrequent insiders outperform after summing all returns because they perform exceptionally well on their infrequent trades. The performance gap between frequent vs infrequent buyers is much larger than for sellers. This holds because the percentage of frequent buyers trading only once far exceeds that of infrequent buyers: 44.8% (3,743 of 8,360) of infrequent buyers trade only once and 23.4% (1,957 of 8,360) trade twice, while 65.8% (6,267 of 9,518) of frequent buyers make only one purchase. In other words, the percentage of frequent buyers who purchase only once is around the sum percentage of infrequent

buyers who make one or two purchases. When discussing frequency, we note the *expected* frequency based on an insider's transactional history. Accounting for tenure at a company, an infrequent trader can sometimes have more transactions than a frequent trader in our data. For infrequent buyers, a higher average return on each trade, together with a smaller percentage of insiders trading only once, contributes to the significant gap in total return over frequent buyers.

Sellers meanwhile show a more even distribution in trading instances: 39.6% of infrequent sellers trade only once, 19.0% sell twice, and 12.7% trade three times versus 40.3% of frequent sellers trading only once, 16.1% selling twice; and 9.7% selling three times. For insiders selling more than three times, frequent sellers outnumber infrequent traders by 5.2%, but as with frequent vs infrequent buyers, infrequent selling insiders earn more in cumulative returns than frequent sellers who have executed more transactions.

5. Conclusion

We investigate the previously unexplored questions of whether the trading performance of an insider changes over time and whether such changes relate to the frequency of the insider's trades. We find that trade performance steadily declines when insiders are acquiring shares whereas performance improves with over subsequent sales. We also find that insiders who start as frequent or infrequent traders tend to respectively remain frequent or infrequent traders, and that infrequent traders, whether buying or selling, tend to outperform insiders who trade more frequently.

These patterns on trading sequence and frequency together are important because they intersect most aspects of insider activity with the potential to change outcomes across a broad array of prior studies in the field. These behavioral insights also open the door to a better understanding of what motivates an insider to trade, and how an insider's motivations can affect the trading outcome.

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Table 1: Summary of Transaction

This is a summary of data composition covering trades initiated from January 1, 2005 through December 31, 2019. Panel A summarizes the count and percentage of the raw data after cleaning. Panels B and C summarize the count and percentage of the netted and aggregated data encompassing 39,595 unique insiders at 3,836 companies. We separate acquisitions into open market buys and option-related transactions.

Panel A - Cleaned Raw Data

	Open Market	Option-Related	All Transactions
Acquisitions	106,618 (33%)	38,900 (12%)	145,518 (45%)
Sales	180,341 (55%)	0 (0%)	180,341 (55%)
Total	286,959 (88%)	38,900 (12%)	325,859 (100%)

Panel B - Netted and Aggregated Data (30-Day Inactivity Gap)

	Open Market	Option-Related	Hybrid	All Transactions
Acquisitions	50,584 (32%)	25,255 (16%)	362 (0.2%)	76,201 (48%)
Sales	83,661 (52%)	0 (0%)	0 (0%)	83,661 (52%)
Total	134,245 (84%)	25,255 (16%)	362 (0.2%)	159,862 (100%)

Panel C - Netted and Aggregated Data (182-Day Inactivity Gap)

	Open Market	Option-Related	Hybrid	All Transactions
Acquisitions	32,365 (32%)	18,186 (18%)	1,215 (1%)	51,766 (51%)
Sales	49,935 (49%)	0 (0%)	0 (0%)	49,935 (49%)
Total	82,300 (81%)	18,186 (18%)	1,215 (%)	101,701 (100%)

Table 2: Summary Statistics

This table contains several statistics to illustrate the distribution. Panels A and B summarize the distribution of individual transactions over time with regard to netting and aggregation. Panels C and D show distributions of netted and aggregated trades.

	Count	Mean	STD	Min	Q1	Median	Q3	Max
Panel A - Netted and Aggregated Trade (30-Day Inactivity Gap)								
Acquisition	76,201	1.46	2.72	1	1	1	1	159
Sale	83,661	1.59	5.61	1	1	1	1	1,239
Panel B - Netted and Aggregated Trade (182-Day Inactivity Gap)								
Acquisition	51,766	2.10	6.57	1	1	1	2	251
Sale	49,935	2.70	9.50	1	1	1	2	1,239
Panel C - Netted and Aggregated Trades per Insider per Company (30-Day Inactivity Gap)								
Acquisition	76,201	2.63	3.43	1	1	2	3	82
Sale	83,661	3.46	4.00	1	1	2	4	60
Panel D - Netted and Aggregated Trades per Insider per Company (182-Day Inactivity Gap)								
Acquisition	51,766	1.84	1.40	1	1	1	1	16
Sale	49,935	2.11	1.68	1	1	2	4	14

Table 3: Time Interval

This table summarizes trends in time intervals between transactions by type and the performance of previous trades. Panels A and B indicate that the time interval between trades gets shorter for both buyers and sellers, while sellers wait longer than buyers before executing subsequent trades. Panels C and D suggest that insiders following successful trades tend to wait longer before trading again.

Panel A - Days Before Each Netted and Aggregated Trade, Open Market Purchases (30-Day Inactivity Gap)

Trade	Mean	Median	Count
1	231.4	0	17878
2	297.2	192.4	7868
3	276.3	207.7	4441
4	252.3	197.9	2724
5	228.7	182.3	1844
6	209.9	169.3	1306
7	197.6	167.0	987
8	185.3	157.6	769
9	172.1	150.5	613
10	163.4	144.5	486

Panel B - Days Before Each Netted and Aggregated Trade, Open Market Sales (30-Day Inactivity Gap)

Trade	Mean	Median	Count
1	507.3	281.0	19487
2	420.5	308.6	11702
3	369.1	297.2	8133
4	327.3	279.0	5851
5	294.5	260.0	4334
6	269.7	245.7	3327
7	250.2	230.1	2561
8	233.2	216.6	1960
9	218.0	208.0	1546
10	206.7	197.8	1257

Table 3 contd.

Panel C - Outperformance Before Each Netted and Aggregated Trade, Open Market Purchases (30-Day Inactivity Gap)

Trade	Outperformance	Mean	Median	Count
2	No	291.8	188.0	3772
2	Yes	302.3	200.0	4096
3	No	275.0	209.3	2205
3	Yes	277.7	207.2	2236
4	No	254.3	197.3	1341
4	Yes	250.4	199.0	1383
5	No	231.2	182.5	878
5	Yes	226.4	182.0	966
6	No	201.0	164.5	618
6	Yes	217.9	178.8	688
7	No	192.4	164.8	520
7	Yes	203.4	169.0	467
8	No	175.9	149.3	387
8	Yes	194.8	165.3	382
9	No	168.7	145.1	313
9	Yes	175.7	157.2	300
10	No	163.6	147.4	225
10	Yes	163.2	143.4	261
11	No	159.1	138.5	206
11	Yes	153.5	135.9	180
12	No	150.3	133.1	158
12	Yes	146.2	127.8	163
13	No	137.6	116.0	132
13	Yes	143.9	132.3	147
14	No	138.7	118.0	128
14	Yes	132.0	115.3	119
15	No	127.8	103.7	103
15	Yes	130.8	115.8	110

Table 3 contd.

Panel D - Outperformance or Not Before Each Netted and Aggregated Trade, Open Market Sales (30-Day Inactivity Gap)

Trade	Outperformance	Mean	Median	Count
2	No	426.6	312.0	5383
2	Yes	415.4	307.0	6319
3	No	370.6	298.9	3738
3	Yes	367.7	295.7	4395
4	No	322.3	277.5	2768
4	Yes	331.8	280.8	3083
5	No	290.6	255.4	2103
5	Yes	298.2	267.2	2231
6	No	270.3	246.2	1576
6	Yes	269.2	245.2	1751
7	No	249.5	230.9	1249
7	Yes	250.9	229.3	1312
8	No	230.7	218.3	908
8	Yes	235.3	215.6	1052
9	No	218.5	210.6	776
9	Yes	217.4	207.0	770
10	No	204.2	194.1	606
10	Yes	208.9	202.3	651
11	No	195.4	190.3	482
11	Yes	200.3	193.0	530
12	No	185.5	178.9	384
12	Yes	189.3	183.2	431
13	No	173.3	165.0	330
13	Yes	181.5	175.0	342
14	No	165.4	156.2	278
14	Yes	175.4	167.2	273
15	No	166.0	161.6	211
15	Yes	155.1	141.3	238

Table 4 Return Summary

This table contains multiple return metrics of transactions. Panel A shows the ex-post returns of individual stocks after insider transactions, while Panels B and C show the ex-post active returns on FF48 and SIC sectors. We calculate the active return as ex-post returns less sector returns. We record returns for sales as negative if a stock price increases relative to its benchmark following a transaction, an outcome implying that the insider should have sold at another time.

Panel A Raw Return (30-Day Inactivity Gap)

	1 Month	3 Month	6 Month	1 Year	2 Year
All Transactions	8.7%	1.9%	1.2%	0.2%	0.0%
Acquisitions	24.7%	10.5%	9.9%	9.5%	9.2%
Sales	-3.9%	-5.4%	-6.4%	-8.2%	-9.5%
Open Market Buys	34.9%	12.2%	11.8%	10.7%	10.4%
Option-Related Acquisitions	6.0%	7.3%	6.2%	7.1%	6.9%

Panel B Active Return on FF48 Sectors (30-Day Inactivity Gap)

	1 Month	3 Month	6 Month	1 Year	2 Year
All Transactions	9.7%	3.4%	2.8%	1.9%	1.2%
Acquisitions	17.0%	4.0%	3.7%	3.2%	2.5%
Sales	3.6%	2.8%	2.0%	0.7%	-0.1%
Open Market Buys	25.9%	5.7%	5.5%	4.6%	3.6%
Option-Related Acquisitions	0.5%	0.6%	-0.1%	0.4%	0.4%

Panel C Active Return on SIC Sectors (30-Day Inactivity Gap)

	1 Month	3 Month	6 Month	1 Year	2 Year
All Transactions	9.8%	3.4%	2.7%	1.9%	1.2%
Acquisitions	17.3%	4.1%	3.8%	3.5%	2.9%
Sales	3.4%	2.7%	1.8%	0.5%	-0.3%
Open Market Buys	26.4%	5.9%	5.7%	4.9%	4.2%
Option-Related Acquisitions	0.6%	0.6%	-0.1%	0.5%	0.4%

Table 5 AR Model Summary

This table contains the betas of the AR Model. Panels A and B of show the AR(1) betas for the transaction categories we examine, while Panels D and E show all open market trades for frequent and infrequent trader comparisons. Panel C show all sales split into two groups based on the transaction dollar volume. In the AR Model, we use gross returns, i.e., returns plus 1, to avoid having different signs in returns which could affect the signs of coefficients.

Panel A AR(1) Beta (t-value) of 3-Month FF48 Active Return (30-day Inactivity Gap)

	3	4	5	6	7	8	9	10
All Transactions	0.9895	0.9884	0.9884	0.9879	0.9881	0.9876	0.9881	0.9877
	(7.26)	(9.70)	(11.86)	(13.07)	(14.63)	(15.33)	(16.74)	(18.40)
Acquisitions	0.9878	0.9877	0.9873	0.9868	0.9876	0.9858	0.9859	0.9873
	(6.76)	(9.48)	(11.33)	(12.51)	(13.22)	(14.67)	(14.99)	(18.10)
Sales	0.9915	0.9911	0.9899	0.9905	0.9898	0.9893	0.9892	0.9880
	(8.15)	(10.93)	(12.59)	(14.24)	(16.01)	(16.41)	(17.74)	(18.26)
Open Market Buys	0.9857	0.9862	0.9848	0.9846	0.9843	0.9849	0.9855	0.9868
	(6.38)	(9.06)	(10.15)	(12.00)	(12.33)	(14.32)	(14.74)	(17.17)
Option-Related Acquisitions	0.9912	0.9913	0.9893	0.9915	0.9901	0.9908	0.9885	0.9929
	(7.81)	(11.05)	(13.11)	(14.61)	(15.36)	(19.28)	(18.69)	(23.34)

Panel B AR(1) Beta (t-value) of 3-Month FF48 Active Return (182-day Inactivity Gap)

	3	4	5	6	7	8	9	10
All Transactions	0.9906	0.9898	0.9899	0.9900	0.9900	0.9900	0.9894	0.9903
	(7.78)	(10.61)	(13.12)	(14.74)	(15.63)	(17.31)	(19.57)	(19.64)
Acquisitions	0.9899	0.9883	0.9887	0.9870	0.9902	0.9891	0.9897	0.9854
	(7.33)	(9.72)	(12.06)	(12.74)	(15.29)	(17.04)	(21.12)	(16.50)
Sales	0.9930	0.9922	0.9920	0.9925	0.9923	0.9933	0.9923	0.9907
	(8.75)	(12.01)	(14.39)	(17.16)	(17.79)	(21.16)	(22.17)	(21.40)
Open Market Buys	0.9891	0.9867	0.9876	0.9856	0.9857	0.9916	0.9895	0.9858
	(6.83)	(8.97)	(11.23)	(12.32)	(14.86)	(19.68)	(21.12)	(17.00)
Option-Related Acquisitions	0.9810	0.9772	0.9832	0.9802	0.9848	0.9898	0.9918	0.9854
	(21.27)	(17.03)	(20.31)	(19.12)	(21.78)	(27.00)	(35.58)	(18.92)

Panel C AR(1) Beta on 3-Month FF48 Active Return, Sales (30-Day Inactivity Gap)

	3	4	5	6	7	8	9	10
Small Dollar Volume	0.9904	0.9902	0.9891	0.9869	0.9891	0.9867	0.9890	0.9840
	(7.31)	(10.56)	(12.64)	(12.28)	(15.96)	(14.05)	(17.08)	(16.61)
Large Dollar Volume	0.9928	0.9925	0.9909	0.9908	0.9904	0.9900	0.9899	0.9903
	(8.30)	(12.32)	(13.55)	(15.05)	(16.55)	(18.57)	(18.51)	(21.30)

Table 5 contd.

Panel D AR(1) Beta on 3-Month FF48 Active Return, Infrequent Traders (30-Day Inactivity Gap)

	3	4	5	6	7	8	9	10
Sales	0.9921	0.9923	0.9900	0.9915	0.9913	0.9905	0.9903	0.9878
	(8.62)	(11.63)	(12.96)	(14.60)	(17.66)	(17.59)	(19.37)	(18.37)
Open Market Buys	0.9863	0.9864	0.9845	0.9826	0.9855	0.9848	0.9855	0.9859
	(6.35)	(9.07)	(9.60)	(11.28)	(12.64)	(13.81)	(14.74)	(16.99)

Panel E AR(1) Beta on 3-Month FF48 Active Return, Frequent Traders (30-Day Inactivity Gap)

	3	4	5	6	7	8	9	10
Sales	0.9899	0.9888	0.9876	0.9882	0.9877	0.9855	0.9876	0.9855
	(7.26)	(9.73)	(11.46)	(12.96)	(14.03)	(13.94)	(16.59)	(17.28)
Open Market Buys	0.9846	0.9872	0.9863	0.9864	0.9847	0.9852	0.9858	0.9886
	(6.74)	(9.35)	(11.07)	(12.64)	(12.40)	(15.35)	(14.96)	(19.52)

Table 6 Cross-Section OLS Regression Summary

This table contains the betas of OLS regression. We compare returns from pairs of consecutive trades. The return from the second trade within the pair is the dependent variable whereas the return of the first trade is the independent variable. Here, we also use gross returns to avoid different signs in returns.

Panel A OLS Beta (t-value) of 3-Month Raw Return

	30-Day Inactivity Gap	182-Day Inactivity Gap
All Transactions	0.9736	0.9682
	(1277)	(986)
Acquisitions	0.9719	0.9642
	(810)	(595)
Sales	0.9824	0.9803
	(970)	(741)
Open Market Buys	0.9737	0.9624
	(609)	(413)
Option-Related Acquisitions	0.9716	0.9698
	(513)	(378)

Panel B OLS Beta (t-value) of 3-Month FF48 Active Return

	30-Day Inactivity Gap	182-Day Inactivity Gap
All Transactions	0.9808	0.9767
	(1462)	(1127)
Acquisitions	0.9754	0.9673
	(894)	(653)
Sales	0.9895	0.9897
	(1139)	(876)
Open Market Buys	0.9766	0.9650
	(671)	(453)
Option-Related Acquisitions	0.9753	0.9728
	(570)	(420)

Table 6 contd.

Panel C OLS Beta (t-value) of 3-Month FF48 Active Return (30-day Inactivity Gap)

	2	3	4	5	6	7	8	9	10
All Transactions	0.9785	0.9789	0.9811	0.9829	0.9815	0.9826	0.9841	0.9875	0.9849
	(729)	(635)	(561)	(491)	(440)	(395)	(358)	(329)	(289)
Acquisitions	0.9725	0.9721	0.9776	0.9816	0.9737	0.9866	0.9771	0.9860	0.9770
	(505)	(406)	(333)	(283)	(253)	(226)	(190)	(169)	(144)
Sales	0.9937	0.9898	0.9840	0.9858	0.9876	0.9866	0.9973	0.9860	0.9917
	(581)	(497)	(445)	(383)	(338)	(297)	(262)	(243)	(213)
Open Market Buys	0.9735	0.9705	0.9837	0.9856	0.9760	0.9805	0.9852	0.9733	0.9914
	(387)	(304)	(246)	(205)	(183)	(171)	(144)	(129)	(113)
Option-Related Acquisitions	0.9724	0.9775	0.9722	0.9768	0.9772	0.9852	0.9817	0.9938	0.9831
	(340)	(266)	(219)	(176)	(151)	(128)	(113)	(105)	(92)

Panel D OLS Beta Difference (Buy less Sell) of 3-Month FF48 Active Return (30-Day Inactivity Gap)

	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
t-value	-8.24	-5.68	-1.74	-0.98	-2.88	0.00	-3.15	0.01	-1.78
p-value	0.0000	0.0000	0.0411	0.1645	0.0020	0.4991	0.0008	0.4970	0.0373

	Overall
t-value	-10.16
p-value	0.0000

Panel E OLS Beta on 3-Month FF48 Active Return, Sales (30-Day Inactivity Gap)

	Beta (t-value)
Small Dollar Volume	0.98 (721.95)
Large Dollar Volume	0.99 (842.32)

Panel F OLS Beta on 3-Month FF48 Active Return, Infrequent Traders (30-Day Inactivity Gap)

	Beta (t-value)
Sales	0.99 (777.64)
Open Market Purchases	0.97 (474.51)

Table 6 contd.

Panel G OLS Beta on 3-Month FF48 Active Return, Frequent Traders (30-Day Inactivity Gap)

	Beta (t-value)
Sales	0.99 (665.78)
Open Market Purchases	0.98 (422.07)

Table 7 Conditional Cross-Section OLS Regression Summary

This table contains the result of conditional return analysis examining a trade's return conditional on the positive or negative sign of its prior trade return. Each panel shows correlations for two trades in sequence. The betas for returns after a win are all below one, implying diminishing alpha, whereas the betas for returns after a loss are all above one, implying convergence of alpha.

Panel A OLS Beta (t-value) of 3-Month FF48 Active Return with respect to Win/Loss of Previous Trade

	30-Day Inactivity Gap		182-Day Inactivity Gap	
	After Win	After Loss	After Win	After Loss
All Transactions	0.9026	1.1137	0.9016	1.1087
	(1088)	(964)	(960)	(845)
Acquisitions	0.8894	1.1153	0.8863	1.1095
	(687)	(636)	(550)	(506)
Sales	0.9202	1.1088	0.9217	1.1036
	(881)	(738)	(768)	(644)
Open Market Buys	0.8886	1.1246	0.8851	1.1188
	(508)	(467)	(392)	(343)
Option-Related Acquisitions	0.8961	1.0940	0.8913	1.0924
	(460)	(439)	(340)	(342)

Panel B OLS Beta Difference (Buy less Sell) of 3-Month FF48 Active Return with respect to Win/Loss of Previous Trade

	30-Day Inactivity Gap		182-Day Inactivity Gap	
	After Win	After Loss	After Win	After Loss
t-value	-18.50	2.82	-17.65	2.14
p-value	0.0000	0.0024	0.0000	0.0016

Table 8 Insider Composition

This table contains the count and percentage of insiders who switch transaction type or frequency grouping during trades. Only approximately a quarter of insiders change trading-frequency groupings, which establishes that insiders starting in one trading-frequency grouping tend to remain in that group going forward.

(30-Day Inactivity Gap)

	Count	Proportion
Total (A)	33,174	100%
Insiders who switch transaction type (B)	4,191	12.6%
Insiders who switch frequency grouping (C)	8,351	25.2%
Insiders who switch both (B ∩ C)	2,522	7.6%

Table 9 Two-way ANOVA

This table summarizes the statistics of Two-Way ANOVA over trading-frequency groupings between buyers and sellers. Both p-values are small enough for us to validate that infrequently-trading insiders outperform frequent traders. Moreover, the p-value of trade sequence for open market purchases does not show significance, which is consistent with our previous results that after splitting into two frequency groupings, the pattern of buyer performance is no longer clear.

Panel A Open Market Purchases (30-Day Inactivity Gap)

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Trade	80	1.5	0.0185	0.633	0.996
Frequency	1	0.8	0.8367	28.601	8.94e-08 ***
Trade:Frequency	53	0.7	0.0135	0.460	1.000
Residuals	42605	1246.3	0.0293		

Panel B Open Market Sales (30-Day Inactivity Gap)

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Trade	56	1.9	0.03463	1.543	0.005641 **
Frequency	1	0.3	0.29917	13.334	0.000261 ***
Trade:Frequency	27	1.0	0.03746	1.670	0.015958 *
Residuals	66081	1482.6	0.02244		

Table 10 General Return Percentage

This table summarizes the general return percentages of value- and equal-weighting approaches. The former takes the dollar volume of each trade ($c_{i,i\,=\,1,2,\ldots,t}$) into account, multiplies by percentage return ($r_{i,i\,=\,1,2,\ldots,t}$) to get the total dollar return for each insider (R), and divides each insider's total dollar volume by each of their respective investments (C) to get general return percentages ($P_{(A)}$). The latter sums all percentage returns for an insider by transaction type and sums the averages to obtain a general return percentage ($P_{(B)}$). The results of both approaches indicate that notwithstanding a smaller number of trades, the infrequent insiders still outperform after summing all returns as they perform exceptionally well on these trades.

Panel A General 3- Month FF48 Active Return Percentage over Transaction Type and Frequency Grouping, VW approach (30-Day Inactivity Gap)

Transaction Type	Frequent	Mean	Median
Open Market Buys	No	2.20%	1.25%
Open Market Buys	Yes	1.20%	0.41%
Sales	No	2.06%	1.54%
Sales	Yes	2.05%	1.51%

Panel B General 3-Month FF48 Active Return Percentage over Transaction Type and Frequency Grouping, EW approach (30-Day Inactivity Gap)

Transaction Type	Frequent	Mean	Median
Open Market Buys	No	2.25%	1.46%
Open Market Buys	Yes	1.24%	0.53%
Sales	No	1.79%	1.24%
Sales	Yes	1.69%	1.02%

Figure 1 Probability versus Transaction

This figure includes the transaction type likelihood of an insider's Nth trade through their first ten trades. The y-axis denotes an insider's total number of transactions while the x-axis refers to the nth trade. The sum of any two matching cells, e.g., the third trade of a four-time transactor, be equal to 1. As time goes on, insiders are more likely to acquire shares in their earlier transactions and to sell shares later.

Panel A Probability that Nth Trade is an Acquisition (30-Day Inactivity Gap)

# of Trades	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Avg.
1x	62.58%										62.58%
2x	59.91%	52.45%									56.18%
3x	59.09%	51.40%	48.17%								52.89%
4x	55.18%	48.14%	44.55%	42.25%							47.53%
5x	55.14%	49.03%	46.66%	44.60%	41.71%						47.43%
6x	54.31%	47.70%	44.21%	42.09%	38.78%	37.25%					44.06%
7x	53.57%	46.96%	43.24%	40.27%	38.91%	37.61%	36.78%				42.48%
8x	51.80%	45.03%	41.75%	40.06%	39.53%	37.84%	37.53%	35.94%			41.19%
9x	50.51%	46.90%	43.15%	41.13%	39.39%	37.95%	36.65%	34.63%	33.19%		40.39%
10x	50.08%	45.89%	41.71%	38.49%	38.33%	36.55%	35.75%	33.17%	33.33%	30.43%	38.37%
Avg.	59.24%	50.03%	45.50%	42.01%	39.81%	37.46%	36.77%	34.78%	33.26%	30.43%	55.21%

Panel B Probability that Nth Trade is a Sale

# of Trades	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Avg.
1x	37.42%										37.42%
2x	40.09%	47.55%									43.82%
3x	40.91%	48.60%	51.83%								47.11%
4x	44.82%	51.86%	55.45%	57.75%							52.47%
5x	44.86%	50.97%	53.34%	55.40%	58.29%						52.57%
6x	45.69%	52.30%	55.79%	57.91%	61.22%	62.75%					55.94%
7x	46.43%	53.04%	56.76%	59.73%	61.09%	62.39%	63.22%				57.52%
8x	48.20%	54.97%	58.25%	59.94%	60.47%	62.16%	62.47%	64.06%			58.81%
9x	49.49%	53.10%	56.85%	58.87%	60.61%	62.05%	63.35%	65.37%	66.81%		59.61%
10x	49.92%	54.11%	58.29%	61.51%	61.67%	63.45%	64.25%	66.83%	66.67%	69.57%	61.63%
Avg.	40.76%	49.97%	54.50%	57.99%	60.19%	62.54%	63.23%	65.22%	66.74%	69.57%	44.79%

Figure 2 Performance Distribution over Trade

This figure contains the distribution of 3-month FF48 active return of the first 10 trades. Boxplot in black represents infrequent insiders and boxplot in grey represents frequent insiders. As we exclude records with the highest and lowest 1% returns, the distribution looks like normal distribution.

Panel A Open Market Purchases (30-day Inactivity Gap)

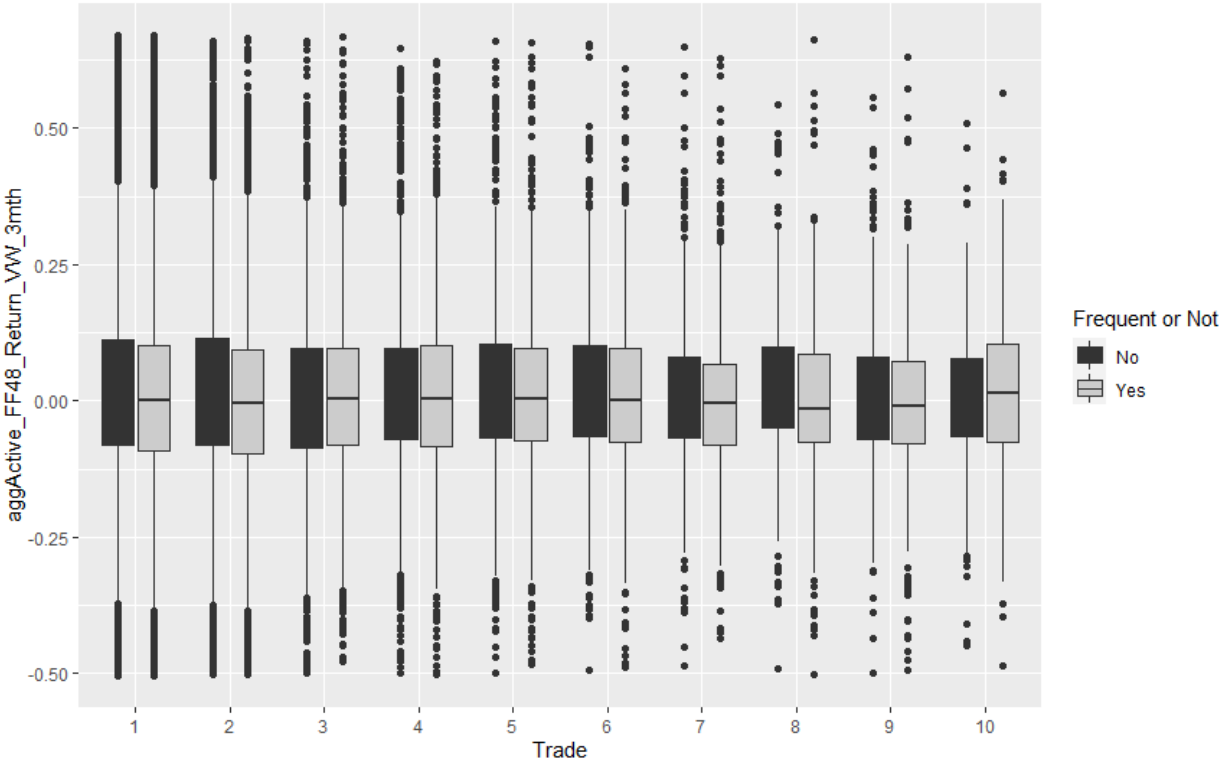


Figure 2 contd.
Panel B Sales (30-day Inactivity Gap)

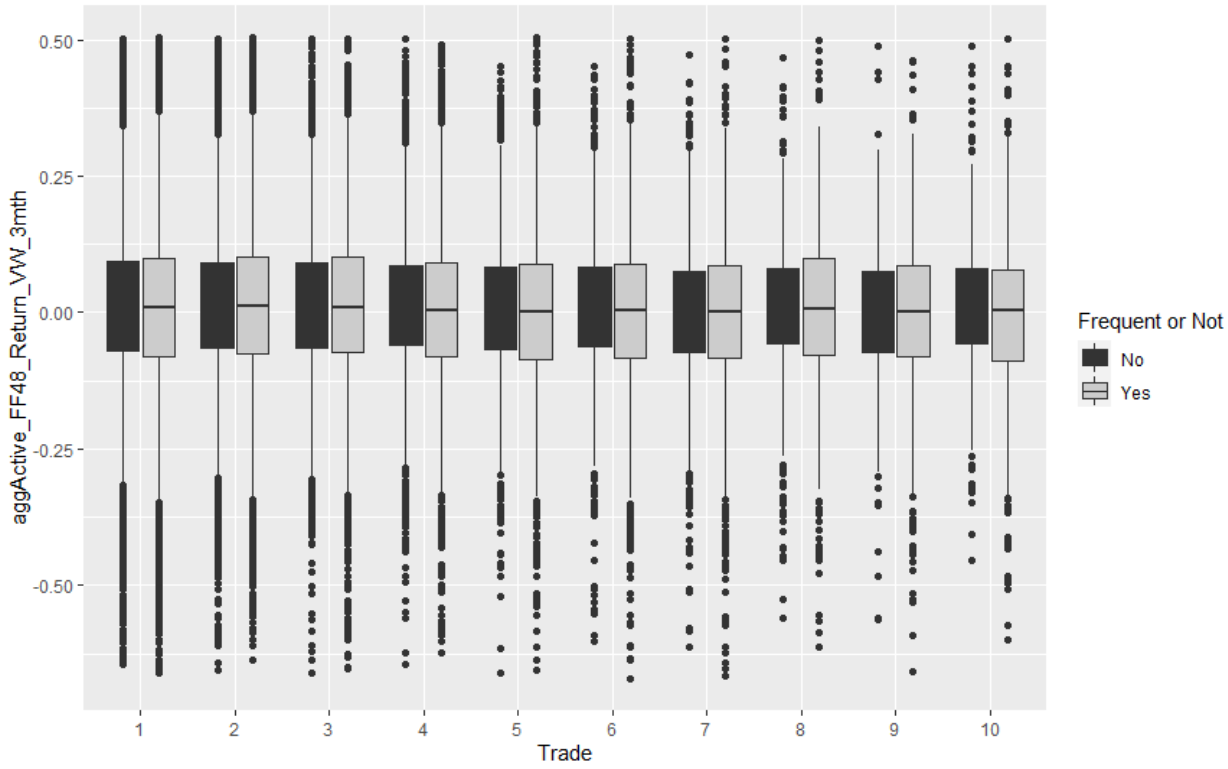
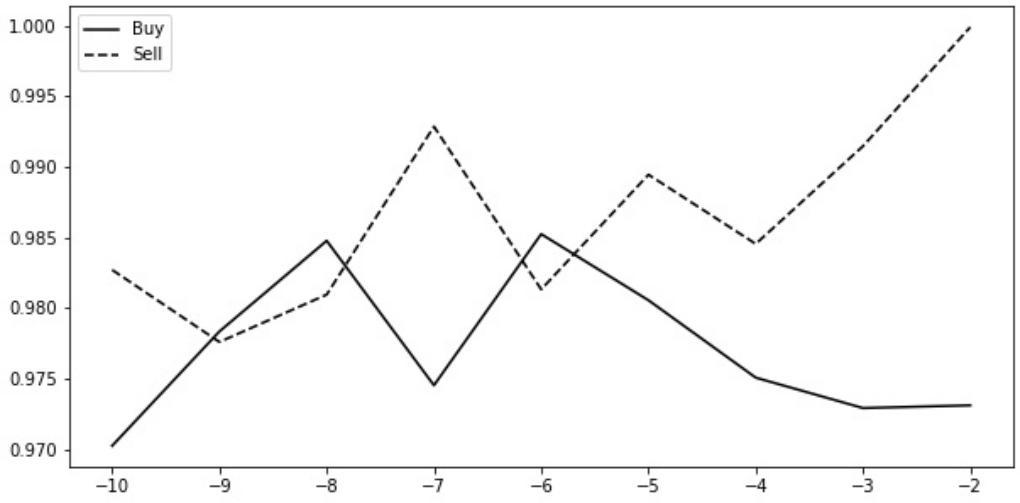


Figure 3 Cross-Section OLS Regression in Reverse Order

This figure examines trades in reverse order. When performing OLS Regressions, we label x-variables representing returns for trades occurring earlier in time as order -2, and we label y-variables representing returns for trades occurring subsequently as order -1, and so on. The number of observations decreases as the order goes farther away from -1, meaning that more observations are concentrated near the right end of the x-axis.

Panel A OLS Beta of Purchase and Sale 3-Month FF48 Active Return (30-Day Inactivity Gap)



Panel B OLS Beta of Open Market Purchase and Option Related Acquisition 3-Month FF48 Active Return (30-Day Inactivity Gap)

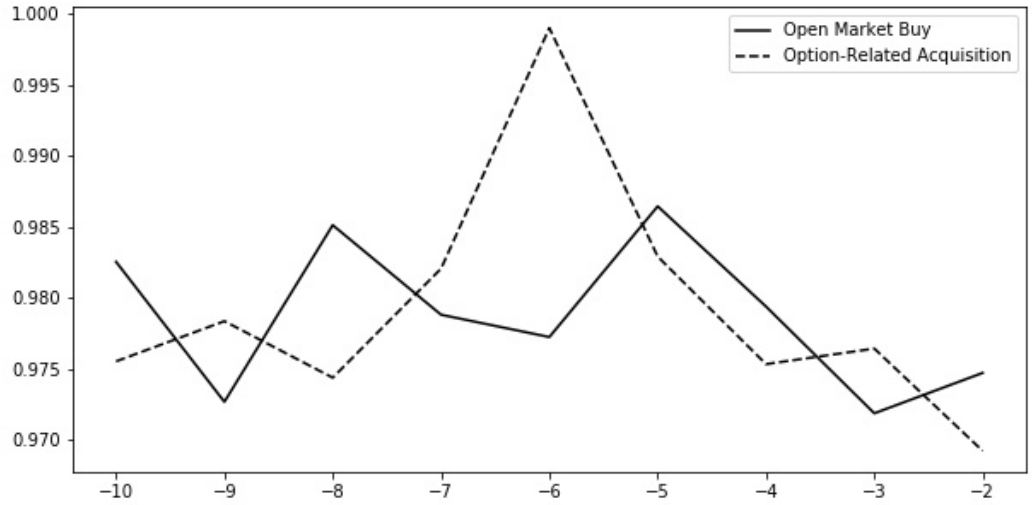
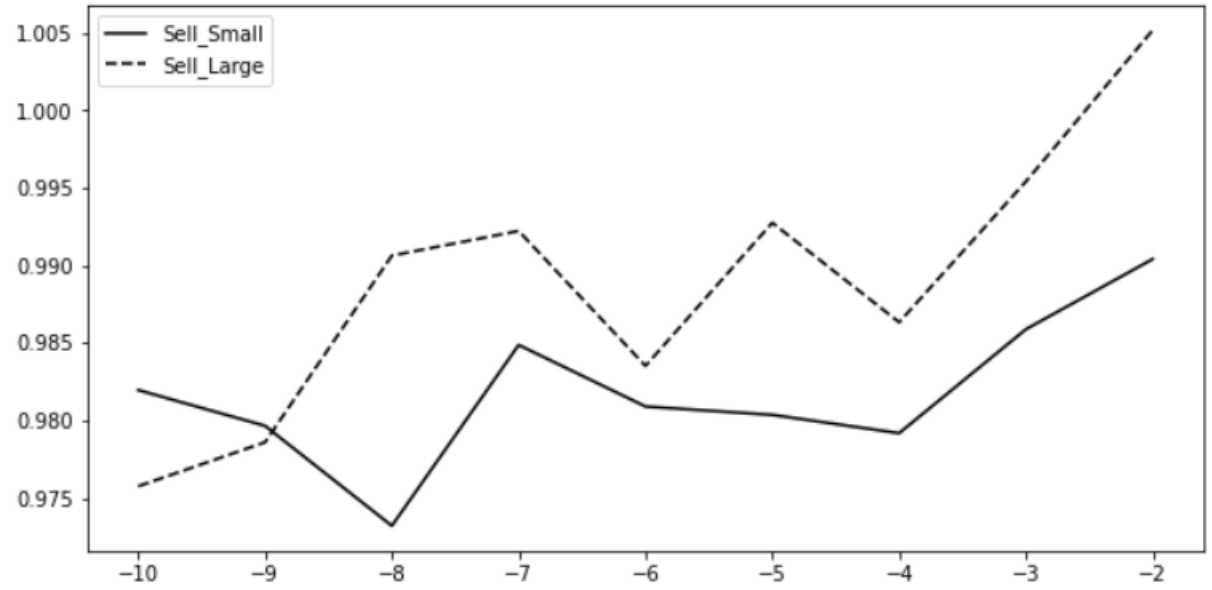
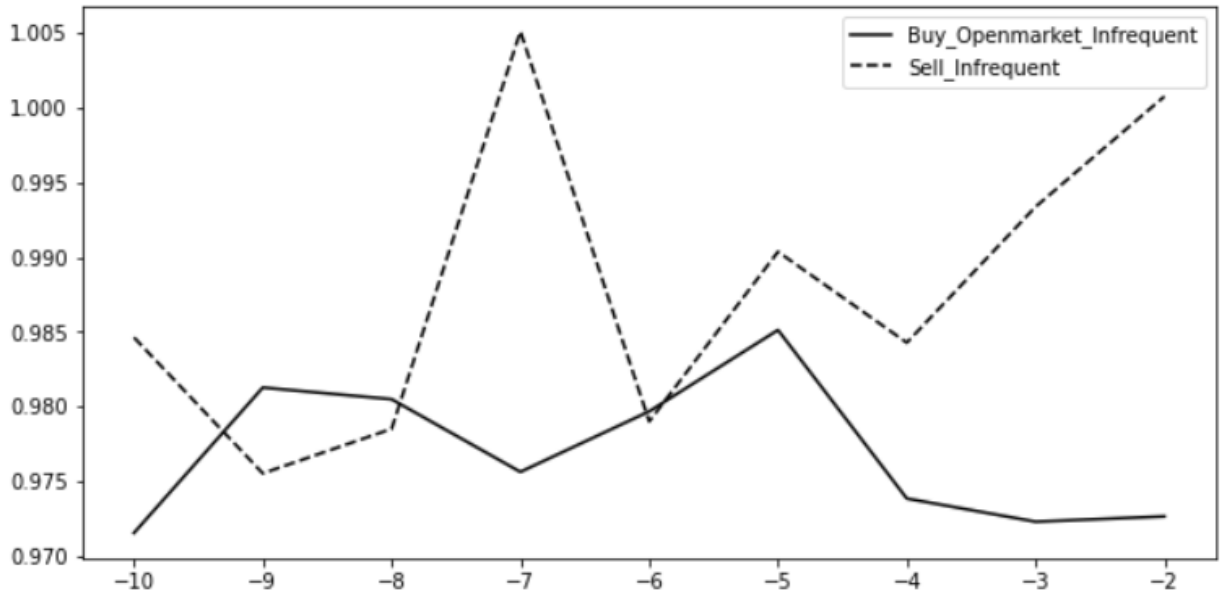


Figure 3 contd.

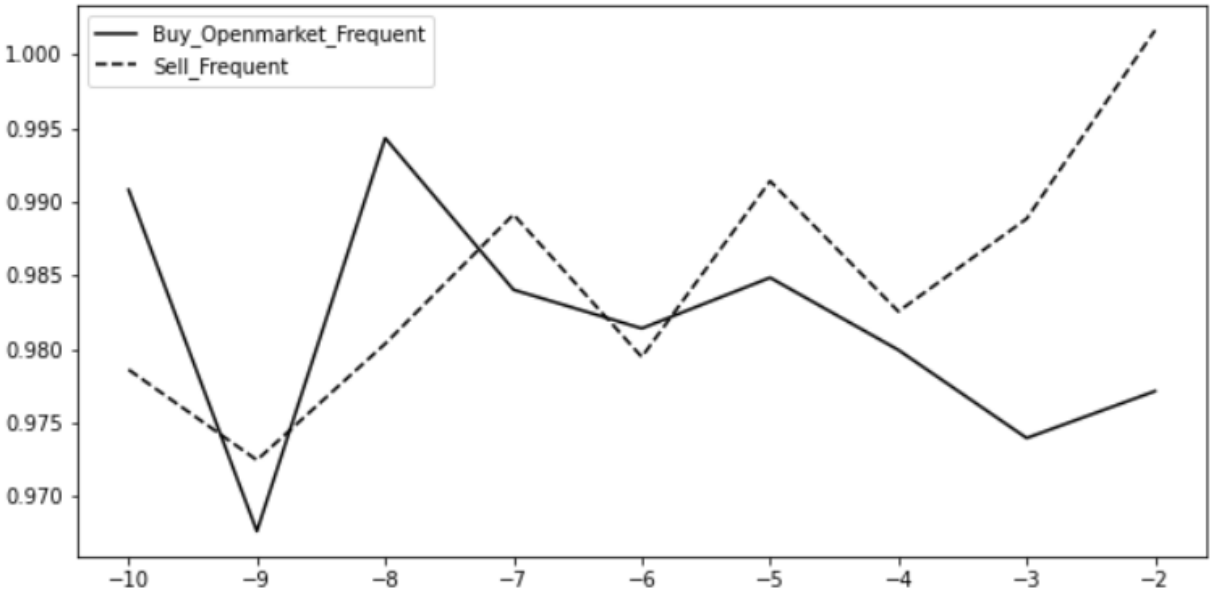
Panel C OLS Beta of Sale 3-Month FF48 Active Return (30-Day Inactivity Gap)



Panel D OLS Beta on 3-Month FF48 Active Return, Infrequent Traders (30-Day Inactivity Gap)



Panel E OLS Beta on 3-Month FF48 Active Return, Frequent Traders (30-Day Inactivity Gap)


Buy_Openmarket_Frequent
Sell_Frequent
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0.995
0.990
0.985
0.980
0.975
0.970
−10
−9
−8
−7
−6
−5
−4
−3
−2

Figure 4 Performance Comparison over Trade

This figure displays bar plots of average 3-month FF48 active returns which shows infrequently-trading insiders outperforming frequent traders. The bar in black refers to infrequent insiders and the bar in grey refers to frequent insiders.

Panel A Average 3-Month Active Return, Open Market Purchases (30-Day Inactivity Gap)

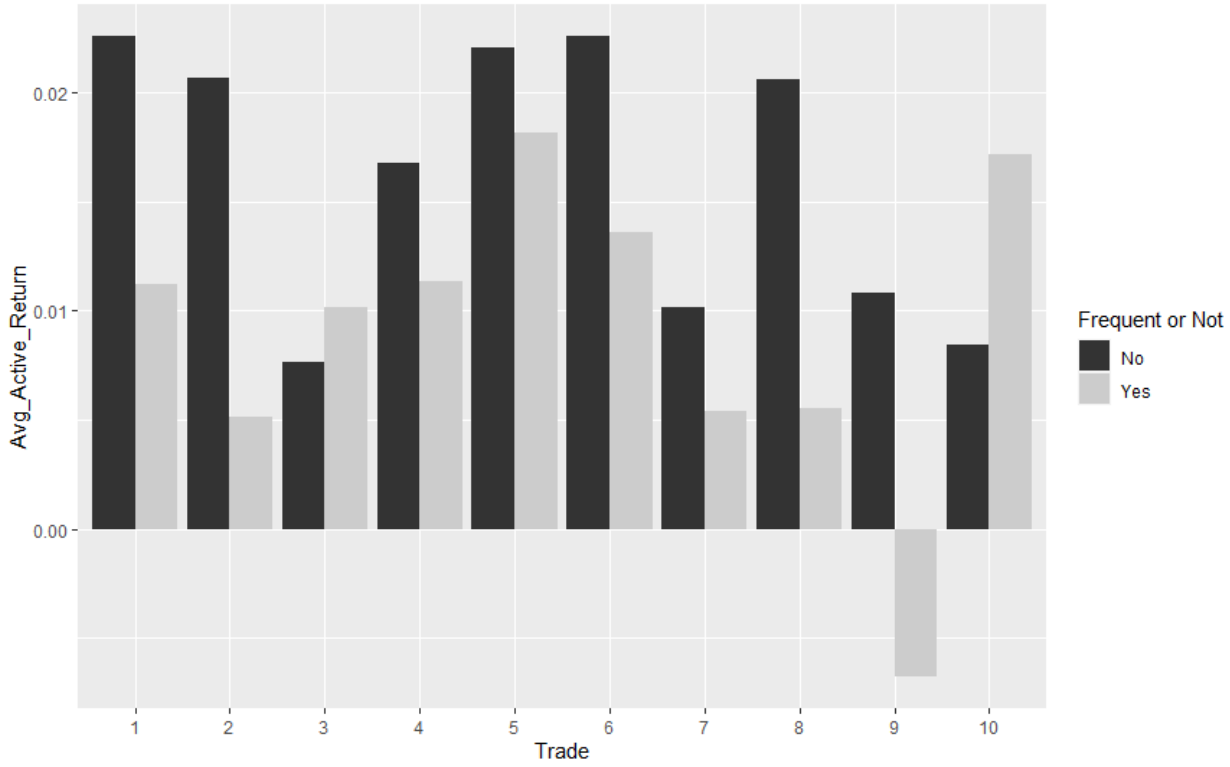

Figure 4 contd.

Panel B Average 3-Month Active Return, Sales (30-Day Inactivity Gap)