

Evidence on the Non-linear Relation between Insider Trading Decisions  
and Future Earnings Information

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## Evidence on the Non-linear Relation between Insider Trading Decisions and Future Earnings Information

### **Abstract**

In this paper, we explore an insider's decision to trade or not trade on the basis of future earnings information. Consistent with litigation, political and reputation-related costs shaping insider-trading decisions, we find that the relations between insider trading decisions and next year's earnings change are not strictly linear. First, we find that the likelihood of insider purchases is positively related to next year's earnings innovation, yet this relation is attenuated in the case of extreme positive innovations. Second, we find that the likelihood of an insider selling shares and exercising stock options is negatively related to next year's earnings innovation, yet this relation is attenuated in the case of extreme negative innovations. The non-linear relation between insider sales and future negative earnings news is more pronounced than the nonlinearity between insider purchases and future earnings news, suggesting that the expected costs associated with insider selling are economically larger than the costs associated with insider buying. Together, these estimations suggest that insiders trade on the basis of future earnings news, yet there exist regions where the expected costs of trading subsume the expected gains to trading on private information. Finally, we investigate the role of earnings persistence as an alternate explanation for our results. We find that insiders only trade on persistent earnings innovations, and that, after controlling for persistence, insiders still curtail trading when earnings innovations are extreme.

## Section 1 Introduction

This paper examines whether an insider's decision to trade is influenced by the firm's future earnings performance. Prior research shows that, conditional on observing insider trading, net trading activity is positively related to future earnings innovations. However, insiders can choose to not change their level of investment in the firm -- i.e., not trade on the basis of private information. We investigate the role of future earnings in this trade – no trade decision.

Theoretically, insider trading will only be observed when the expected gains to trade exceed the expected costs. We hypothesize that if legal liability, political and reputation-related trading costs are heightened around extreme earnings changes, then there could exist regions where insiders avoid trading despite the existence of private, price-relevant earnings information. Consistent with the existence of such “no trade” regions, we find that the relation between insider trading decisions and next year's earnings change is not strictly linear. First, the likelihood of insider buying is positively related to next year's earnings change, yet the positive relation between insider purchases and next year's earnings change is attenuated among larger positive innovations. This attenuation in the presence of extreme good news is consistent with increasing trading costs.

Second, we find that the likelihood of insider selling is negatively related to next year's earnings change, yet extreme earnings events, regardless of sign, inhibit insiders from engaging in these sales. Specifically, in advance of bad news, insiders appear to curtail sales to avoid the appearance of impropriety. The attenuation of the relation between insider selling and extreme negative earnings changes is more pronounced than the attenuation of the relation between insider purchases and extreme positive earnings changes, suggesting that the perceived legal, political and reputation-related costs associated with insider selling are economically larger than the costs associated with insider buying. Similar inferences exist with respect to an insider's decision to exercise stock options (and sell shares) versus continuing to hold the options.

We conclude that insiders do trade in anticipation of future earnings news, yet there exist regions beyond which insiders will not trade regardless of the potential gains associated with either future stock price appreciation or avoidance of future losses. This observed non-linearity in the relation between trading decisions and future earnings information is consistent with the existence of potential legal, political and/or reputation costs deterring informed trade. However, an alternate explanation is that extreme positive and negative earnings innovations are less

persistent than non-extreme innovations. If insiders only trade on persistent changes in firm performance, then the non-linear relation between insiders' decisions to trade and earnings innovations may be due to variation in the persistence of the earnings innovation. We find that when our sample is split into persistent (consecutive earnings innovations of the same sign) versus non-persistent (consecutive earnings innovations of differing signs) insiders only trade on persistent earnings innovations. Within persistent earnings innovations, extreme innovations continue to attenuate the relation between earnings changes and trading decisions. Thus, after controlling for earnings persistence, expectations of heightened legal liability continue to inhibit trading ahead of extreme earnings news.

The rest of the paper is organized as follows. Section 2 provides background on insider trading research and outlines the primary hypothesis of this study. Section 3 discusses the methodology and the data, while section 4 presents descriptive evidence on firm-years with and without insider trading. Section 5 presents our main empirical tests, and section 6 addresses our robustness tests. Section 7 concludes.

## **Section 2 Prior research and hypothesis development**

### ***2.1 Prior research on insider trading***

Given the *ex post* profitability of insider transactions, early research concludes that insiders' information advantage allows them to trade in advance of future price movements (Jaffe [1974]; Givoly and Palmon [1985]; Seyhun [1986]; Rozeff and Zaman [1988]). Subsequent research documents that insiders trade in advance of significant corporate events associated with predictable pricing behavior, such as merger and acquisition activity (Meulbrook [1992]; Seyhun [1990]), bankruptcy (Seyhun and Bradley [1997]), dividend initiations (John and Lang [1991]), seasoned equity offerings (Karpoff and Lee [1991] and share repurchase activity (Lee, Mikkelson and Partch [1992]).<sup>1</sup> Finally, recent research suggests that insiders recognize the relative valuation of their firm's securities and trade in advance of predictable price corrections. For example, Seyhun [1992] shows that insiders are more likely to sell (purchase) shares following periods of significant price appreciation (decline), while Rozeff and Zaman

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<sup>1</sup> It is important to note that, in most of these event studies, the benefits to trade can be quite large. For example, one-year returns following seasoned equity offerings have been shown to be approximately negative fifteen percent (e.g., Loughran and Ritter [1995]). Given that we observed heightened trading in advance of these events, it must be the case that these trading benefits subsume the potential costs of trading on this information.

[1998] show that, given the decision to trade, insiders predominantly buy (sell) shares in value (glamour) firms. Together, these papers demonstrate that insiders trade in advance of events leading to significant price changes and provide support for Manne's (1966) observation that insider trading can be a source of information to the market.

A complementary set of research examines the relation between insider trading and one type of price-relevant, firm-specific information: future earnings. Executives and directors are insiders of the firm who, (1) possess value relevant financial information before it is priced and (2) face less uncertainty about the firm's future financial performance outcomes than the average market participant does. Given this informational advantage, insiders should engage in more purchasing (or selling) activity in advance of strong (or weak) firm-specific earnings news, *ceteris paribus*.

Early research examining the relation between insider trading and future earnings information, however, provides mixed evidence. Elliott, Morse and Richardson [1984] find that insiders increase (decrease) purchases (sales) in the twelve months before extreme earnings increases, yet find little evidence that insiders sell in advance of extreme earnings decreases. In contrast, Huddart, Ke and Petroni [2003] find insiders' sales increase in the year before a firm experiences a break in consecutive quarterly earnings increases, while Billings [2007] finds that insiders selling shares in advance of significant price declines delay the release of bad earnings news. Givoly and Palmon [1985] are unable to document a link between insider trading profits and specific disclosure events (including earnings and dividend announcements), while Noe [1999] examines insider trading around management forecasts of earnings and finds the trading patterns to be unrelated to the forecasted earnings news.

Unfortunately, these studies are predicated on examining insider-trading behavior around specific earnings-related events, where the litigation and reputation-related costs of trading are likely to be heightened. To eliminate these confounding effects, Piotroski and Roulstone [2005] search for a general cross-sectional relation between the sign of observed insider trading activity and one-year-ahead earnings changes. Conditional on the existence of insider trading, they find a positive relation between the relative amount of insider purchase activity versus sale activity and next year's earnings change. They also find that the strength of the relation between insider trading and future earnings is inversely related to the firm's information-processing environment. Similarly, Beneish and Vargus [2002], show that insiders evaluate the quality of their firm's

current earnings innovation when making their trading decisions. They find that managers are more likely to buy (sell) their firms' securities when current earnings is driven by permanent (transitory) positive accruals. Together, Piotroski and Roulstone [2005] and Beneish and Vargus [2002] show that insiders' trading decisions are influenced, at least in part, by their private expectations about next year's earning realization.

## ***2.2 Hypothesis development: Non-linear relation between insider trading and future earnings***

The probability of an insider purchasing shares is likely to be positively influenced by the sign and magnitude of expected future earnings news. Specifically, insiders are more likely to buy shares in advance of good future earnings news, with stronger trading incentives for larger innovations, *ceteris paribus*. Similarly, the probability of an insider selling shares is likely to be negatively related to the sign and magnitude of future earnings innovations. Thus, absent trading costs, net gains to trading are monotonically related to the magnitude of next year's unexpected earnings innovation.<sup>2</sup>

However, insiders do not have to trade in a given year. If the costs to trading on future earnings news are sufficiently large and exceed the expected benefits from trading, insiders will not trade. One potential cost of an insider transaction is legal liability risk. If an insider trades in advance of material information that he had a duty to disclose, then the insider could face potential legal costs associated with his trade. Additionally, trading in advance of a material earnings change could draw greater regulatory or investor scrutiny, resulting in adverse political or reputation effects. For example, an insider's transaction has a greater probability of being scrutinized and "red flagged" as having been motivated by private information if the trade is subsequently followed by large earnings surprise and material price change.

If these expected trading costs are increasing with the magnitude of subsequent earnings news, then managers will have an increasing incentive *to not trade* the greater the magnitude of the earnings innovations. In the presence of these trading costs, we predict that the relation between the likelihood of insider trading and next year's earnings innovation is not strictly linear.

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<sup>2</sup> This relation hinges on the assumption that the pricing implications of an earnings change is positively related to the magnitude of the change. We address the issue of differential levels of persistence in section 6.

**Alternate Hypothesis:** The association between insider sales and stock option exercises (purchases) and large negative (positive) earnings innovations is attenuated due to potential legal liability costs associated with trading on extreme transactions.

Our alternate hypothesis predicts that despite possessing information about future earnings, insiders will have an increased incentive to forego trading on extreme earnings news. This prediction assumes that the potential costs of trading on such information are sufficiently large and subsume the trading benefits. As such, we recognize that our tests are really examining a joint hypothesis about both the managerial response to the costs and benefits of insider trading and the existence of sufficiently credible legal liability, political and reputation-related costs to deter trading.

### **Section 3 Research Design**

#### ***3.1 Sample selection***

Our sample is derived from the complete set of firm-year observations available on CRSP and COMPUSTAT between 1996 and 2004 with sufficient stock price and earnings data to compute current and one-year ahead annual earnings and price changes. For each firm-year observation identified through CRSP and COMPUSTAT, we gather annual information about the insiders' open-market trading activity through Thomson Financial First Call Insiders Data (formerly CDA/Investnet). We restrict our measurement of insider trading activity to activity by a firm's executives and directors for comparability with prior research.

#### ***3.2 Measurement of insider trading activity***

Our tests examine the relationship between insider trading decisions and next year's earnings innovation. In our tests, we examine four different dimensions of insider trading activity: TRADE, PURCHASE, SALES, and EXERCISE. The first dimension is whether or not trading occurred in a given year. The indicator variable  $TRADE_{i,t}$  equals one if any insider of firm  $i$  bought or sold securities on the open market during fiscal year  $t$ , zero otherwise. Our first set of tests identifies firm characteristics associated with the presence of insider trading activity irrespective of the direction of trade.

The second set of tests examines the insider’s decision to trade in a given direction (as opposed to not trading in that direction). The first “direction of trade” construct we examine is whether or not insiders are net purchasers of shares during fiscal year  $t$ . We define the indicator variable  $PURCHASE_{i,t}$  to equal one if any insider of firm  $i$  purchased shares in an open-market transaction during year  $t$  *and* total shares purchased by insiders is greater than or equal to total shares sold by insiders; zero otherwise. Analogously, the second “direction of trade” construct we examine is whether insiders are net sellers of shares during fiscal year  $t$ . We define the indicator variable  $SALES_{i,t}$  to equal one if any insider of firm  $i$  sold shares in an open-market transaction during year  $t$  *and* total shares sold by insiders is greater than total shares purchased by insiders, zero otherwise. Our final construct measures stock option exercises by insiders during year  $t$ . We define the indicator variable  $EXERCISE_{i,t}$  equal to one if any insider exercised stock options during the year; zero otherwise. We expect that incentives for insiders to sell shares and to exercise options will be positively related (i.e., negative information about future prospects will induce insiders to both exercise options and sell existing holdings of stock).<sup>3</sup> Our second set of tests identifies firm characteristics associated with the specific direction of insider trading.<sup>4</sup>

### ***3.3 Measurement of future earnings performance and related earnings attributes***

The primary focus of our paper is to examine the impact future earnings has on an insider’s decision to trade or not trade in a given fiscal year. To characterize the insider’s private information about future earnings, we measure two dimensions of profitability: next year’s annual earnings innovation and the presence of special, one-time items.

We define the firm’s future earnings performance as earnings for the fiscal year *following* the measurement of insider trading behavior (i.e., year  $t+1$ ). (See Figure 1 for a timeline on the measurement of our variables). Specifically, we define *future earnings news* as year  $t+1$ ’s annual earnings change, measured as:

$$\Delta E_{t+1} = \frac{E_{t+1} - E_t}{ASSETS_t}$$

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<sup>3</sup> To ensure our measures of sales and option exercises do not overlap, insider sales do not include transactions that are flagged by Thomson Financial as “option related.”

<sup>4</sup> Although our main tests use indicator variables for the presence of trading, our results are robust to measuring trading using the number of shares traded. These results are discussed in Section 6.3

where  $E_{t+1}$  ( $E_t$ ) equals net income before extraordinary items for fiscal year  $t+1$  (year  $t$ ) and  $ASSETS_t$  equals total assets at the end of year  $t$ . We define the *absolute information content* of the future earnings realization as the absolute value of  $\Delta E_{t+1}$ . We focus on next year's annual earnings innovation given the results in Piotroski and Roulstone [2005].<sup>5</sup>

Our legal liability arguments suggest that managers will be averse to trading in advance of large changes in earnings that draws the attention of investors and regulators. One such dimension of an extreme earnings change is to examine the absolute magnitude of the innovation itself (i.e.,  $|\Delta E_{t+1}|$ ). An alternative dimension is to determine whether or not future earnings contain a significant, non-recurring special item (such as the recording of a restructuring or acquisition-related charge). We define the indicator variable  $SPECIAL_{i,t+1}$  to equal one if the firm reported a special item during fiscal year  $t+1$ , zero otherwise. For completeness, we also identify whether or not the firm recorded a special item in the year of insider trading activity (i.e., year  $t$ ).

If insiders use future earnings information when forming their decision to trade, then we would expect to document a positive (negative) relationship between  $PURCHASE_{i,t}$  ( $SALES_{i,t}$  and  $EXERCISE_{i,t}$ ) and  $\Delta E_{t+1}$ . To the extent that managers are concerned about the legal liability implications of trading in advance of extreme earnings news, then the absolute magnitude of next year's earnings change and the presence of a special, one-time charge should decrease the probability of insider trading activity (i.e.  $TRADE_{i,t}$ ). To the extent that legal liability concerns outweigh the expected gains from trading on large earnings changes, we would expect to see an inverse relation between extreme positive (negative) earnings news and  $PURCHASE_{i,t}$  ( $SALES_{i,t}$  and  $EXERCISE_{i,t}$ ). Our multivariate tests examine these predicted relations.

Finally, we include next year's market adjusted return ( $MARET_{i,t+1}$ ) in our multivariate tests to control for the errors-in-variables problem associated with using the realized earnings innovation  $\Delta E_{i,t+1}$  as a measure of the earnings innovation expected by insiders at the time of their trading decision (see Collins, Kothari, Shanken and Sloan [1994] for details).

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<sup>5</sup> We refer to our earnings change variable as the "news" or "innovation" in earnings in the following sense: annual earnings follow a random-walk process (Watts and Leftwich [1977]). In a random walk, the innovation in the process is simply the change in successive observations, which is the numerator of our earnings change variable.

### ***3.4 Measurement of insider trading activity explanatory variables***

Prior research identifies several firm-level constructs that influence whether or not insiders trade in their firm's securities: past returns, relative valuation (i.e., book-to-market ratio), the existence of stock-based compensation activity, firm size and the presence of R&D activities. We also examine the relation between insider trading decisions and earnings variability, the presence of special items and next year's annual earnings innovation. We present our motivation for and measurement of our explanatory variables in the following paragraphs.

#### *Past returns*

Seyhun [1992] and Rozeff and Zaman [1998] show that insiders are more likely to buy (sell) shares after significant stock price appreciation (decline). Based on their findings, we expect that the probability of observing insider trading increases with the absolute magnitude of the firm's recent return, while the decision to buy (sell) securities should be positively (negatively) related to past returns realizations. To be comparable with Rozeff and Zaman [1998] and Piotroski and Roulstone [2005], we control for the effect of recent price movements by measuring the firm's contemporaneous market-adjusted stock return ( $MARET_{i,t}$ ).  $MARET_{i,t}$  is measured as the firm's twelve-month buy-and-hold return less the twelve-month buy-and-hold value-weighted market index return over the fiscal year corresponding to the measurement of insider trading activity.

#### *Valuation attributes (Book-to-market ratio)*

Rozeff and Zaman [1998] document that, conditional on observing insider trading, an insider's decision to buy (versus sell) securities is inversely related to the firm's relative valuation, as proxied by the firm's book-to-market ratio. To control for insiders' incentives to purchase (sell) undervalued (overvalued) securities, we measure the firm's book-to-market ratio ( $BM_{i,t}$ ) as the firm's book value of common equity scaled by market capitalization of equity at the end of fiscal year  $t$ . Based on their findings, we expect insiders of firms with high (low) book-to-market ratios to be more likely to engage in buying (selling) activity.

Prior research, however, does not provide any evidence about the role of book-to-market ratios on the decision to trade or not trade. To the extent that both over and under-valuation creates an incentive to trade,  $BM_{i,t}$  will discriminate the direction of trade, but will not help

identify which insiders are more likely to trade.<sup>6</sup> Alternatively, to the extent that growth firms are systematically more likely to rely on equity-based compensation (either explicitly through stock or option grants or implicitly by encouraging insiders to trade for private gains), one could expect the probability of observing insider trading activity to trade to be inversely related to  $BM_{i,t}$ . Given the alternative scenarios, we do not have a prediction about the relation between  $BM_{i,t}$  and  $TRADE_{i,t}$ .

#### *Stock-based compensation*

An insider's trading behavior will be influenced by changes in their holdings due to the granting and exercising of stock options (see Ofek and Yermack [2000]). To control for the impact of concurrent compensation-related activity on insider trading decisions, we gather data on two variables measuring changes in insider holdings: number of stock options granted and the number of stock options exercised in year  $t$ . We define the indicator variable  $GRANT_{i,t}$  to equal one if an insider was granted stock options during year  $t$ , zero otherwise. We define the indicator variable  $EXERCISE_{i,t}$  to equal one if an insider exercised stock options during fiscal year  $t$ , zero otherwise. *Ceteris paribus*, we expect that both granting and exercising activity will give insiders an incentive to sell previously held shares in order to rebalance their portfolio and diversify their wealth. This data is gathered through Thomson Financial and is only available for fiscal years 1996 through 2004; as such, this data is the primary constraint on our sample's timeframe.

#### *Presence of research and development activities*

Aboody and Lev [2000] document that gains to insider trading are larger when the firm is engaged in research and development activities. The positive association between trading gains and R&D activities is attributed to the greater information asymmetry between managers and investors that is present in R&D intensive firms. To control for this fundamental difference in potential trading benefits across firms, we classify firms based on whether or not R&D activities existed during the year of insider-trading measurement. We define the indicator variable  $RESEARCH_{i,t}$  to equal one if firm  $i$  reports a non-zero research and development expense during fiscal year  $t$ , zero otherwise. Although Aboody and Lev do not document that insider trading

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<sup>6</sup> Bettis, Coles and Lemmon [2000] examine a set of firms with open market insider transactions and find that the number of trades is inversely related to the firm's book-to-market ratio. However, their sample does not include firms without insider trading activity.

activity is more prevalent in R&D intensive firms, we expect insiders of R&D firms to be more likely to engage in trading activity given the greater gains available to trade, *ceteris paribus*.<sup>7</sup>

#### *Firm size*

Large firms are more likely to implement stock-based compensation plans (Smith and Watts [1992]). These compensation plans will lead to greater liquidity trading by managers. Similarly, securities of large firms tend to be more liquid. Recent theoretical work by Hong and Huang [2002] suggests that an insider's ability to covertly trade and profit from their information is positively related to their firm's share liquidity. Together, these arguments would suggest that insider-trading activity is more likely in large firms.<sup>8</sup>

Piotroski and Roulstone [2005] show that the relation between the direction of trade and future earnings news is attenuated (magnified) in large (small) firms. Their result is consistent with firm size proxying for both cross-sectional differences in these firm's information environments and the related benefits to trading on earnings information (e.g., Lang and Lundholm [1993]) as well as cross-sectional differences in political costs of trading on earnings information (e.g., Watts and Zimmerman [1986]).<sup>9</sup> Large firms are also more likely to implement restrictions (or moratoriums) on insider trading activity due to the greater public and regulatory scrutiny large firms garner (Roulstone [2003]). Given the reduced benefits of trade and greater potential costs, the decision to trade (as opposed to not trading) could be inversely related to firm size. Given these competing arguments, we do not predict a relation between insider trading and firm size. We measure firm size ( $MVE_t$ ) as the firm's market capitalization at the end of fiscal year  $t$ .

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<sup>7</sup> One concern is that our R&D indicator variable may be insufficient to capture meaningful differences in information asymmetry about project outcomes. To the extent that Aboody and Lev's result is not really driven by R&D *per se*, but instead reflects differences in information asymmetry between firms with assets-in-place versus firm's with growth options,  $RESEARCH_{i,t}$  could proxy for the firm's asset-type. Our inclusion of book-to-market ratios in our multivariate tests should capture these asset-type differences. As a control for growth option vs. assets-in-place differences, we expect  $BM_i$  to display an inverse association with observed insider trading activities.

<sup>8</sup> Consistent with these arguments, Bettis, Coles and Lemmon [2000] show that, for a sample of 403 firms with open-market insider trading activity, both the number of shares traded and the number of shares sold by insiders is increasing in firm size. However, they are unable to document a relation between firm size and the number of shares purchased as they do not examine firms without insider trading activity. In contrast, Frankel and Li [2002] are only able to document a weak relation between number of insider transactions and firm size using a large cross-section of publicly-traded firms.

<sup>9</sup> For example, Collins, Kothari and Rayburn [1985] and Collins and Kothari [1989] show that earnings is impounded earlier in the year for large firms, allowing insiders fewer opportunities to trade on earnings information.

### *Variation in earnings*

An insider's ability to trade on future earnings information will be a function of their long-term ability to predict future earnings realizations. We assume that firms with greater volatility in their annual earnings innovations possess less predictable earnings. We measure the variable  $STDEARN_{i,t}$  as the standard deviation of firm  $i$ 's annual change in earnings ( $\Delta E_{i,t}$ ) over the period 1996 to 2004.

### ***3.5 Data description and sample characteristics***

This paper utilizes the complete set of firm-year observations available between 1996 and 2004 with sufficient earnings, stock return, insider-trading and stock-based compensation data. We obtain a final sample of 48,072 firm-year observations. Descriptive statistics are presented in Table 1.

Panel A presents evidence on insider trading activity in our sample. We find that 73.1 percent of the firm-years are associated with some form of insider trading activity.<sup>10</sup> In terms of observed trading, 17.2 percent and 22.2 percent of the firm-years in the sample have only insider purchases or sales, respectively, while 33.7 percent of the firm-years are associated with *both* insider buying and selling activity. Finally, 26.9 percent of the sample consists of firm-years without any open market insider trading activity (i.e., no-trade observations).

Panel B presents descriptive statistics about the key variables used in this study. These statistics highlight considerable economic variation and diversity of the firm-years included in our sample. The average current earnings realization for our sample of firms is -0.018, yet only 31% of our sample is associated with negative earnings (median  $ROA_t = 0.020$ ). The mean one-year-ahead earnings change is 0.007, and 59% of our firm-year observations are associated an increase in next year's earnings (median  $\Delta E_{t+1} = 0.003$ ). Consistent with the sample containing a broad cross-section of firms, the inter-quartile range of MVE is \$47.86M to \$983.7M, with a sample average of \$2,878M. Additionally, there exists considerable variation in compensation-related incentives to sell securities, with 64.4 percent of the firms granting stock options and 48.1 percent of the firms having insiders who exercised stock options in the year of insider-trading measurement. Finally, 48.7 percent (52.0 percent) of the firms reported a special item in the year

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<sup>10</sup> By comparison, Lakonishok and Lee [2001] find that approximately 55% of the firm-years in their sample period [1976-1994] were associated with some form of insider trading activity.

of (in the year following) the measurement of insider-trading activity. These special items accounted for, on average, 1.8 percent (1.9 percent) of total assets at the beginning of the respective year.

## **Section 4: Empirical results on the insider's trade versus not to trade decision**

### ***4.1 Characteristics of firm-years and firms with and without insider trading activity***

Table 2 presents descriptive statistics for firm-years with and without insider trading activity. For each variable, mean and median statistics are presented. We test differences in mean and median characteristics using a two-sample t-test of means and a non-parametric signed-rank Wilcoxon test, respectively. Consistent with prior research, insider trading is more prominent among larger firms, growth firms (i.e., low book-to-market firms) and firms with R&D activities. We also find that stock granting and option exercising activity is more prevalent among firms with insider-trading activity. However, given the strong correlation between these compensation activities and both firm size and book-to-market ratios, univariate relationships need to be interpreted with caution.<sup>11</sup>

In terms of performance, firm-years with insider trading have stronger contemporaneous return performance, are marginally more profitable, have less volatile earnings streams, and display a greater frequency of contemporaneous and future special items than firm-years without insider trading. In terms of future performance, firm-years with insider trading activity have weaker contemporaneous return performance and display no material difference in terms of future earnings performance than firm-years without insider trading.

Finally, firm-years with insider trading are associated with significantly smaller absolute earnings changes, suggesting that insiders limit their trading activities in advance of large earnings changes. Additional evidence on this inverse relation is also found in Figure 2, which presents a histogram of the percentage of firm-years with insider trading (both purchases and sales) conditional on the relative, ranked magnitude of next year's earnings innovation. Specifically, the histogram shows that insider trading is less prevalent around extreme earnings changes (i.e., as represented by the far left and far right bins along the horizontal axis) than around smaller earnings changes (i.e., bins located near the center of the distribution). The

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<sup>11</sup> The Pearson correlation between  $\log(\text{MVE})$  and the variables  $\log(1+\text{BM})$ , GRANT and EXERCISE is  $-0.310$ ,  $0.596$  and  $0.536$ , respectively.

following section examines the impact of future earnings news on likelihood of insider trading in a multivariate setting.

#### ***4.2 Multivariate analysis of firms and firm-years with and without insider trading***

Given the strong correlation between many of our explanatory variables, we examine the relation between the presence of insider trading and the magnitude of future earnings changes in a multivariate setting. Specifically, we estimate the following pooled, cross-sectional logistic model:

$$\text{Prob}(\text{TRADE}_{i,t}=1) = \text{logit}(\alpha + \beta_1|\Delta E_{i,t+1}| + \beta_2\text{SPECIAL}_{i,t+1} + \beta_3\log(\text{BM}_{i,t}) + \beta_4\log(\text{MVE}_{i,t}) + \beta_5\text{ROA}_{i,t} + \beta_6\text{SPECIAL}_{i,t} + \beta_7|\text{MARET}_{i,t}| + \beta_8\text{STDEARN}_i + \beta_9\text{GRANT}_{i,t} + \beta_{10}\text{EXERCISE}_{i,t} + \beta_{11}\text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \quad [1]$$

where the depended variable,  $\text{TRADE}_{i,t}$ , is an indictator variable equal to one if any insider of firm  $i$  bought or sold shares on the open market in fiscal year  $t$ , zero otherwise. All other variables are as defined in Appendix 1. In order to examine the decision to trade (i.e., unsigned trading behavior), all of our contemporaneous and future performance variables are measured in terms of absolute realizations. Table 3 presents marginal effects from our estimation of equation (1). Two-tailed  $p$ -values for the significance of the marginal effects are calculated using standard errors robust to heteroscedasticity and clustered at the firm level (in parentheses).

This estimation reveals that the probability of insider trading decreases with firm size, the firm's book-to-market ratio, volatile earnings streams, and the presence of R&D activities, and increases with the presence of stock-based compensation grants and option exercises. After controlling for these firm-specific attributes, the probability of insider trading is decreasing in the magnitude of next year's annual earnings innovation. This negative relation is consistent with a manager wishing to avoid trading on material information that they may have a duty to subsequently disclose prior to the earnings announcement date. Interestingly, the presence of contemporaneous or future special items does not influence the probability of insider trading. The lack of a significant relation between insider trading and special items suggests that managers are neither tempted nor deterred from trading in advance of material, one-time earnings information and/or that these charges are not predictable one-year in advance (e.g., these charges are recorded in the period the economic events occur through timely recognition practices, offering minimal opportunities for managers to exploit their informational advantage).

## **Section 5: The impact of future earnings news on the insider's decision to purchase or sell firm securities**

Our primary research objective is to document the role of future earnings information on the insider's decision to trade or not trade in a given direction. This section explores that issue.

### ***5.1 Characteristics of firm-years with and without insider purchasing and selling transactions***

Table 4 presents descriptive evidence on firm-years with and without insider trading, conditional on the dominant direction of trade. Panel A presents evidence conditional on the presence of majority insider purchases, or lack thereof. Panel B presents evidence conditional on the presence of majority insider selling, or lack thereof.

In terms of firm characteristics, firm-years with net insider purchasing activity are associated with smaller firms, firms with lower valuations and fewer growth options (i.e, high book-to-market ratios), and firms with insiders who are not contemporaneously exercising stock options. By contrast, firm-years with dominant selling activity are associated with larger firms, firms with higher valuations and larger growth options (i.e., low book-to-market firms), and firms where insiders are contemporaneously exercising stock options. In terms of earnings attributes, firm-years with insider purchases have weaker ROA realizations in the year of trade, have larger (average) earnings innovations in year  $t+1$  and are less likely to report a special item in year  $t+1$  than firm-years without majority insider purchases. In contrast, firm-years with majority insider selling have stronger current earnings and weaker future (average) earnings innovations than firm-years without majority selling activity. Finally, unlike insider purchasing behavior, insider selling is actually stronger in the presence of both contemporaneous and future special items.

### ***5.2 The impact of future earnings on insider purchasing, selling and option exercising behavior***

In order to isolate the primary drivers of insider buying and selling activity and to control for correlated omitted variables, we examine the relation between these trading decisions and next year's earnings changes in a multivariate setting. We estimate the following three logistic models using pooled cross-sectional data:

$$\begin{aligned} \text{Prob}(\text{PURCH}_{i,t}=1) = & \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{MARET}_{i,t+1} + \beta_3 \log(\text{BM}_{i,t}) + \beta_4 \log(\text{MVE}_{i,t}) + \beta_5 \text{MARET}_{i,t} \\ & + \beta_6 \text{GRANT}_{i,t} + \beta_7 \text{EXERCISE}_{i,t} + \beta_8 \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [2]$$

$$\begin{aligned} \text{Prob}(\text{SALES}_{i,t}=1) = & \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{MARET}_{i,t+1} + \beta_3 \log(\text{BM}_{i,t}) + \beta_4 \log(\text{MVE}_{i,t}) + \beta_5 \text{MARET}_{i,t} \\ & + \beta_6 \text{GRANT}_{i,t} + \beta_7 \text{EXERCISE}_{i,t} + \beta_8 \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [3]$$

$$\begin{aligned} \text{Prob}(\text{EXERCISE}_{i,t}=1) = & \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{MARET}_{i,t+1} + \beta_3 \log(\text{BM}_{i,t}) + \beta_4 \log(\text{MVE}_{i,t}) + \beta_5 \text{MARET}_{i,t} \\ & + \beta_6 \text{GRANT}_{i,t} + \beta_7 \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [4]$$

All variables are as defined in Appendix 1. While our empirical analyses have, to this point, focused on exclusively insider buying and insider selling activities, for completeness we also examine the determinants of option exercises. Over the time period of our study (1996-2004) option exercises have become an increasingly important component of executive pay and equity holdings, and we expect that private information about future earnings realizations should also impact the timing insiders exercise their stock options. Our estimations are presented in Table 5.

The first column of Table 5 presents coefficients from an estimation of our insider purchases model (eq. [2]), the second columns presents an estimation of our insider sales model (eq. [3]), and the third column presents an estimation of our option exercises model (eq. [4]). We perform these logistic estimations using all available firm-year observations and report marginal effects calculated at the means of the independent variables.<sup>12</sup> Two-tailed p-values for the significance of the marginal effects are calculated using standard errors robust to heteroscedasticity and clustered at the firm level (in parentheses).<sup>13</sup>

First, focusing on insider purchase decisions, we find that likelihood of insiders purchasing shares is inversely related to the firm's past return performance, firm size, and the presence of R&D activities, and positively related to the firm's book-to-market ratio. The probability of insider buying is also lower if executives are concurrently exercising stock options, consistent with the insider's need to diversify their holdings. Interestingly, insiders are more likely to purchase shares in the presence of concurrent stock option granting activity. This positive relation between insider purchases and option granting is contrary to our intuition that insiders receiving stock and option grants, at a minimum, would not want to increase the

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<sup>12</sup> For simplicity, we will refer to the marginal effects reported in the tables as "coefficients."

idiosyncratic component of their wealth. Instead, this positive relation could reflect many firms' joint use of stock option grants and mandatory stock purchase plans (see Core and Larker [2002]).<sup>14</sup> After controlling for these firm-specific attributes, we document the expected positive relation between the probability of an insider purchase and next year's annual earnings innovation.

Second, focusing on insider selling decisions, we find that the probability of insiders selling shares is positively associated with firm size, contemporaneous returns, and the presence of firms granting and insiders exercising stock options, and inversely related to the firm's book-to-market ratio. After controlling for these firm-specific attributes, we document the expected negative relation between the likelihood of insider selling and next year's earnings innovation.

Third, the final column presents our estimation of the determinants of option exercising activity. Similar to the results for insider selling, the likelihood of an insider exercising options is stronger among large firms, low book-to-market firms, among firms with R&D activities, and among firms that are contemporaneously granting additional stock options. After controlling for these firm attributes, we find a significant, negative, relation between option exercises and next year's earnings innovation. Together, these three estimations indicate that insiders systematically choose to adjust their holdings in their firm in a manner consistent with possessing private information about changes in the firm's future earnings performance.

### ***5.3 Non-linearity in the relation between insider trading decisions and future earnings***

Our primary prediction is that the relation between insider trading decisions and next period's earnings innovation is non-linear. To test for this non-linearity, we add the square of next year's earnings change into equations (2), (3), and (4), conditional on the underlying sign of the earnings change. Specifically, we estimate the following models:

$$\begin{aligned} \text{Prob}(\text{PURCH}_{i,t}=1) = & \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_3 \text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_4 \text{MARET}_{i,t+1} + \beta_5 \log(\text{BM}_{i,t}) \\ & + \beta_6 \log(\text{MVE}_{i,t}) + \beta_7 \text{MARET}_{i,t} + \beta_8 \text{GRANT}_{i,t} + \beta_9 \text{EXERCISE}_{i,t} + \beta_{10} \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [5]$$

$$\text{Prob}(\text{SALES}_{i,t}=1) = \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_3 \text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_4 \text{MARET}_{i,t+1} + \beta_5 \log(\text{BM}_{i,t}))$$

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<sup>13</sup> The variability of earnings (STDEARN) is omitted from these models for parsimony. Tests indicate that this variable is insignificant in a multivariate setting and its inclusion does not alter the sign or magnitude of the remaining variables.

<sup>14</sup> This positive relation could be reflective of the self-selection nature of observed compensation schemes, where boards select stock-based compensation in advance of strong price performance.

$$+ \beta_6 \log(\text{MVE}_{i,t}) + \beta_7 \text{MARET}_{i,t} + \beta_8 \text{GRANT}_{i,t} + \beta_9 \text{EXERCISE}_{i,t} + \beta_{10} \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \quad [6]$$

$$\begin{aligned} \text{Prob}(\text{EXERCISE}_{i,t}=1) = & \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_3 \text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_4 \text{MARET}_{i,t+1} \\ & + \beta_5 \log(\text{BM}_{i,t}) + \beta_6 \log(\text{MVE}_{i,t}) + \beta_7 \text{MARET}_{i,t} + \beta_8 \text{GRANT}_{i,t} + \beta_9 \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [7]$$

where  $\text{POS}_{i,t+1}$  ( $\text{NEG}_{i,t+1}$ ) is an indicator variable equal to one (negative one) if  $\Delta E_{i,t+1}$  is greater than (less than or equal to) zero, zero otherwise. If insiders are concerned about the legal liability implications of trading in advance of a large earnings innovation (i.e., buying or selling in advance of a large earnings increase or decrease, respectively), then we expect the coefficient on the term  $\text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2$  to be significantly negative in the purchase estimation, while the coefficient on the term  $\text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2$  should be significantly positive in the sales estimation. In other words, the coefficients on these particular squared terms should capture the attenuation (and subsequent reversal) of the unconditional positive (negative) relation between the likelihood of insider purchasing (selling) and  $\Delta E_{i,t+1}$ . Table 6 presents the results of these estimations.

### 5.3.1 Non-linearity in the relation between purchase decisions and next year's earnings change

Consistent with the estimation of model (3), the insider's decision to purchase securities is positively associated with next period's earnings (i.e., marginal effect of  $\Delta E_{i,t+1}$  is 0.061, p-value = 0.003). After introducing non-linearity into the estimated model, we find that the first-order earnings term has a coefficient marginally larger in magnitude than the coefficient from the linear model. After controlling for this first-order effect (and other relevant determinants), we find that the squared term associated with a positive earnings innovation - i.e., the coefficient on term  $\text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2$  - is significantly negative at the 10% level. This negative coefficient suggests that the incentive to purchase diminishes as the expected litigation-related costs of trading on this information increases. On the other end of the earnings spectrum, we find no incremental impact of an extreme negative innovation on the likelihood of purchasing securities.

An interpretation of our coefficients suggests that the marginal effect is not just one of a diminishing positive slope on the purchase-earnings relation as earnings innovations get larger; instead, there exists a point where marginally larger positive earnings innovations have a negative relation with probability of insider purchasing. Based on our sample's characteristics, we estimate the inflection point around  $\Delta E_{i,t+1} = 1.610$ . Economically, such a realization is in the extreme 1% upper tail of the distribution of earnings innovations in our sample. Thus, while

insider purchases do display a non-linear relation, with purchasing becoming less positively related to future earnings news as the news becomes extreme, only in the far positive tail of the earnings distribution do we see purchasing activity ceasing ahead of good news.

### *5.3.2 Non-linearity in the relation between selling decisions and next year's earnings change*

In terms of insider selling behavior, our estimations find the first-order  $\Delta E_{i,t+1}$  term to have a significant negative coefficient (coefficient on  $\Delta E_{i,t+1} = -0.175$ , p-value = 0.000), consistent with a general negative relation between the probability of insider selling and future earnings news. In addition, we find that insiders are incrementally less likely to sell securities in advance of large earnings increases (coefficient on  $POS*(\Delta E_{i,t+1})^2 = 0.090$ , p-value = 0.001), consistent with insiders deferring consumption in order to capture the expected gains from this information. In contrast, insiders are significantly less likely to sell securities in advance of large negative earnings innovations, as captured by the coefficient on the squared term  $NEG*(\Delta E_{i,t+1})^2$ . This negative coefficient is consistent with our prediction that the incentive to sell decreases as the expected litigation-related costs of trading on this negative earnings news increases, with the estimated point of inflection for insider selling in advance of negative earnings news at  $\Delta E_{i,t+1} = -0.483$ .

Similar inferences can be drawn from the relation between option exercises and future earnings news. As expected, option exercises have a strong, negative relation with future earnings innovations. This negative relation is attenuated in the presence of extreme positive or negative earnings innovations (coefficient on  $POS*(\Delta E_{i,t+1})^2 = 0.070$ , p-value = 0.014; coefficient on  $NEG*(\Delta E_{i,t+1})^2 = 0.547$ , p-value = 0.000). These coefficients suggest that insiders have an incentive to curtail option exercises ahead of extreme negative news: the point at which option exercises cease ahead of negative news is -0.431.

Together, the evidence supports the notion that in advance of bad news, insiders appear to curtail trades to avoid the appearance of impropriety. Moreover, consistent with insider sales and option exercises in advance of material earnings news drawing greater scrutiny and yielding larger expected costs than insider purchases, the non-linear relation between insider sales and option exercises and future earnings innovations “kicks in” more quickly than the non-linear relation between insider purchases and future earnings innovations.

#### 5.4 Non-linear relations between insider trading and future earnings information conditional on firm size

To better understand the preceding results, we examine whether the observed non-linearity between insider trading decisions and future earnings varies across size partitions. We annually assign firms to a size tercile (i.e., large, medium and small firms) based on the rank of their market capitalization in that year. Table 7 presents the results from the estimation of equations [5], [6], and [7] conditional on firm size.

These estimations reveal three findings. First, focusing on insider purchase decisions, the effects of legal liability are similar among large and small firms. Although the magnitude of the coefficient on  $POS * \Delta E_{i,t+1}$  is substantially more negative for large firms than for small firms, the main effect of the future earnings innovation is also larger for large firms than for small firms; as such, the inflection point at which no trading occurs is roughly similar between the two groups of firms ( $\Delta E_{i,t+1} = 1.1$  for large firms, versus  $\Delta E_{i,t+1} = 1.00$  for small firms). Second, focusing on insider selling decisions, the effect of legal liability is similar across large and small firms, although the implied inflection point is marginally lower for large firms relative to small firms. Third, focusing on option exercise decisions, the effect of legal liability is greatest for small firms, with the implied inflection point is lower for small firms than for medium-sized firms; in contrast, there is no significant non-linearity in the relation between future earnings innovations and option exercises among large firms.

#### 5.5 Role of future non-recurring, or special, items on the decision to trade

An alternative dimension of next year's earnings innovation is the presence of special, or one-time, charges. In our sample, the mean special item charge (scaled by beginning assets) in year  $t+1$  is  $-0.019$ ; ceteris paribus, these bad news items should create an incentive to sell shares in advance of these realizations. However, to the extent that these observable, one-time events attract greater regulatory or investor scrutiny, heightened legal liability concerns should inhibit insider selling. To test for the impact of a special item in the next fiscal year on current insider-trading behavior, we estimate the following models:

$$\begin{aligned} \text{Prob}(\text{PURCH}_{i,t}=1) = & \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{SPECIAL}_{i,t+1} + \beta_3 \text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_4 \text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_5 \text{MARET}_{i,t+1} \\ & + \beta_6 \log(\text{BM}_{i,t}) + \beta_7 \log(\text{MVE}_{i,t}) + \beta_8 \text{MARET}_{i,t} + \beta_9 \text{GRANT}_{i,t} + \beta_{10} \text{EXERCISE}_{i,t} + \beta_{11} \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [8]$$

$$\text{Prob}(\text{SALES}_{i,t}=1) = \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{SPECIAL}_{i,t+1} + \beta_3 \text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_4 \text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_5 \text{MARET}_{i,t+1})$$

$$+ \beta_6 \log(\text{BM}_{i,t}) + \beta_7 \log(\text{MVE}_{i,t}) + \beta_8 \text{MARET}_{i,t} + \beta_9 \text{GRANT}_{i,t} + \beta_{10} \text{EXERCISE}_{i,t} + \beta_{11} \text{RESEARCH}_{i,t} + \varepsilon_{i,t} \quad [9]$$

$$\begin{aligned} \text{Prob}(\text{EXERCISE}_{i,t}=1) = & \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{SPECIAL}_{i,t+1} + \beta_3 \text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_4 \text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_5 \text{MARET}_{i,t+1} \\ & + \beta_6 \log(\text{BM}_{i,t}) + \beta_7 \log(\text{MVE}_{i,t}) + \beta_8 \text{MARET}_{i,t} + \beta_9 \text{GRANT}_{i,t} + \beta_{10} \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [10]$$

All variables are defined in Appendix 1. Table 8 presents the results of these estimations. Consistent with the preceding arguments,  $\text{SPECIAL}_{i,t+1}$  displays an inverse relation with both  $\text{SALES}_{i,t}$  and  $\text{EXERCISE}_{i,t}$ , although the relation is substantially stronger for option exercises. These estimations also show that the observed relations between insider trading behavior and next year's earnings change are robust to the inclusion of special items in our models.

## Section 6 Robustness of empirical results

### 6.1 Classification of insider trading behavior

In our current research design, the nature and direction of insider trading behavior is defined on the basis of the presence of net (i.e., majority) purchase or sale transactions. As currently defined, the indicator variable  $\text{PURCH}_{i,t}$  ( $\text{SALES}_{i,t}$ ) equals zero if insiders either (1) did not engage in any open-market transactions designed to increase (decrease) their holdings or (2) engaged in purchasing behavior to a lesser (greater) extent than selling behavior. A potential limitation to this approach is that it treats minority purchase behavior (minority selling behavior) as equivalent to not purchasing (not selling) at all. Because it is common to have liquidity selling at the same time as information-based purchasing within a given firm, we may be throwing out some information related to informed purchasing behavior.

To control for this potential imprecision in our measurement, we conduct robustness tests where insider trading is defined on the basis of whether any buying or selling occurs. Thus, firm-year observations where any selling occurs would be treated as a sales observation; similarly, firm-years with any purchasing activity would be treated as a purchase observation. Estimations [not presented] using these trading definitions yield results and inferences generally consistent with those reported and tabulated using the complete sample.<sup>15</sup>

<sup>15</sup> The major difference is that the estimations of the determinants of insider purchases fail to document a non-linear relation between positive earnings innovations and the presence of insider purchasing: while the coefficient on  $\text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2$  is negative, it is not significantly different from zero. For insider sale estimations, the non-linear relation documented in Table 6 is still found; however, the magnitude of the coefficients on the earnings measures is smaller than those reported in Table 6. This suggests that when insider selling is less than concurrent insider purchasing it is more likely to be liquidity based.

## 6.2 Insider trading and earnings persistence

Prior research shows that more persistent earnings innovations lead to greater changes in equity prices (Kormendi and Lipe [1987]). Because extreme earnings innovations tend to be less persistent than smaller earnings innovations, the value implications of an extreme, yet transitory, earnings innovation will not be as large as a smaller, yet persistent, earnings change. To the extent that insiders are aware of the persistence of next year's earnings innovation when making their trading decision, the non-linear relation we document in this paper could be driven by differences in earnings persistence across future earnings realizations.

An insider's decision to trade on the basis of future earnings information will ultimately be determined by the expected return to trading on this private information. Earnings persistence is relevant to insiders because more persistent earnings changes will lead to a greater change in firm value than a transitory shock. As such, an insider contemplating purchasing (selling) ahead of an increase (decrease) in earnings should give greater weight to earnings changes that reflect persistent, long-term changes in firm performance than short-term, transitory earnings changes.

To test this idea, we re-estimate the logistic models in Table 6 after separating the sample into firm-years with persistent and non-persistent earnings innovations. Our definition of a persistent earnings innovation is as follows: if the sign of the one-year ahead earnings innovations ( $\Delta E_{i,t+1}$ ) equals the sign of the two-year ahead earnings innovation ( $\Delta E_{i,t+2}$ ) then the one-year ahead earnings innovation is "persistent." In other words, if an increase in earnings is followed by another increase in earnings (or a decrease in earnings is followed by another decrease in earnings) then next year's earnings are classified as "persistent." Otherwise, the one-year ahead earnings innovation is deemed to be transitory and classified as "not persistent."

These tests require data on two-years-ahead earnings changes, resulting in the loss of all observations from fiscal year 2004 as well as those other firm-years lacking two-year-ahead data. Our sample for these tests consists of 34,527 firm-years, split between 24,821 "persistent" and 9,706 "not persistent" observations. Table 9 presents coefficients from our logistic estimations using these two samples.

Panel A presents select coefficients from estimations of our insider purchase, insider sale, and option exercise models when next year's earnings innovations are classified as persistent. As expected, the relations between one-year ahead earnings innovations and the insider trading decisions are stronger for this sub-sample than for the overall sample. In other words, insiders

place a greater weight on next year's earnings innovation when this information is likely to have a larger impact on equity prices. However, even when this earnings change is persistent, there continues to exist a non-linearity in the purchasing-earnings relation, where extreme positive earnings innovations are weighted negatively. Similarly, insider sales and option exercises display a negative relation with next year's earnings, yet this negative relation weakens among extreme innovations.

In contrast, Panel B documents these relations when next year's earnings innovations are classified as "not persistent." In this setting, there are neither linear nor non-linear relations between insider trading decisions and next year's earnings innovations. Together, these panels suggest that not only are insiders able to forecast future changes in firm performance, but they accurately assess the persistence of these earnings changes and trade only on those earnings innovations that will have the largest impact on firm value. Finally, after controlling for the differential persistence of each earnings innovation, insiders continue to avoid trading on the most extreme innovations, consistent with the presence of expected legal liability, political and reputation costs shaping their trading decisions.

### *6.3 Additional robustness analyses*

We verify the robustness of our results using a variety of additional specifications. First, we replicate our results using an earnings change variable that is closer to the change in return-on-assets variable. The new variable is equal to the difference between next year's earnings, scaled by next year's ending assets, and the current year's earnings, scaled by the current year's ending assets. All of our results are robust to using this new earnings change variable. Second, we use conditional logit to estimate our main regressions while including firm fixed effects. Results with this estimation are generally similar to those reported although the significance of future earnings changes weakens for regressions where EXERCISE is the dependent variable. Third, we use Ordinary Least Squares (OLS) regressions to estimate our models, i.e., we estimate a linear probability model rather than a logit model. The relations between insider trading and future earnings news and the non-linearity in these relations are all found when estimating the linear probability model. Fourth, we replace our indicator variables for the presence of insider trading with the log of shares traded, scaled by shares outstanding. We then use OLS to estimate the relation between these measures and future earnings changes. Again,

the relations between insider trading and future earnings news and the non-linearity in these relations are all found when using trading volume as the dependent variable. Fifth, we re-run the OLS models (with either the indicator variable measures of insider trading or the shares traded measures of insider trading, as the dependent variables) including firm fixed effects. Results again are similar to those reported.

Finally, our measure of next year's earnings innovation could be capturing a shift in corporate activities, not earnings changes *per se*. Specifically, firms may engage in investment or divestiture-related activities that substantially change the composition of their operating assets between the end of year  $t$  and the end of year  $t+1$ , resulting in a change to both the level and likely persistence of the firm's earnings stream. For robustness, we have undertaken all of our empirical work after restricting the sample to firms whose assets change from year  $t$  to year  $t+1$  by no more than 30% in either direction; this restriction that reduces our sample size by 10,287 observations (21.4%). Results with this sample are similar to those reported, with the economic magnitudes of the non-linearities we document in the earnings-trading relation stronger for this sample than for the overall sample [results untabulated]

## **Section 7 Conclusion**

Existing research on insider trading currently presents a fragmented set of (potentially) conflicting results. By documenting that there exist regions of trading and no-trading with respect to future earnings innovations, this paper provides a framework for understanding the diverse set of results in the literature.

In this paper, we provide evidence that the relations between insider trading decisions and next year's earnings are not strictly linear. In terms of insider purchases, we find that insider buying is positively related to next year's earnings innovation. In the case of extreme good news, we find that the relation between buying and earnings is attenuated the larger the positive innovation, consistent with increasing costs to trading. We conclude that insiders do purchase on future earnings news; however, there exists a region beyond which insiders will not buy regardless of the potential stock appreciation gains.

In terms of insider selling, our results support the idea that majority insider sales are associated with future earnings news. However, in advance of bad news, insiders appear to

curtail liquidity trading to avoid the appearance of impropriety. Insider option exercises also exhibit relations with future earnings news similar to those observed for insider selling.

We conclude that the observed variation in these purchase, sale, and option exercise decisions are consistent with the expected existence of heightened legal liability, political and/or reputation-related costs around extreme earnings changes. Our coefficient estimations suggest that the aversion to trading as a result of legal liability concerns appears to be stronger for insider selling than buying. In addition, we find that not only are insiders able to forecast earnings innovations, they are able to assess the persistence of these innovations, trading only on the innovations that are persistent, and will thus lead to the greatest changes in firm value. The persistence of earnings however, does not drive the non-linear relation between trading decisions and earnings innovations; after controlling for differential levels of earnings persistence, trading decisions exhibit concave relations with future earnings news.

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## Appendix 1

### Variable Definitions

Variable	Definition <sup>a</sup>
PURCHASE <sub>i,t</sub>	= An indicator variable equal to one if any insider of firm i bought shares during fiscal year t and total insider purchases exceed total insider sales, zero otherwise. Insider trade data is gathered through Thomson Financial First Call Insiders Data.
SALES <sub>i,t</sub>	= An indicator variable equal to one if any insider of firm i sold shares during fiscal year t and total insider sales exceed total insider purchases, zero otherwise.
TRADE <sub>i,t</sub>	= An indicator variable equal to one if any insider of firm i bought or sold shares during fiscal year t, zero otherwise.
EXERCISE <sub>i,t</sub>	= An indicator variable equal to one if any insider of firm i exercised options during year t
MVE <sub>t</sub>	= Market value of equity measured at the end of fiscal year t
BM <sub>t</sub>	= Book-to-market ratio, measured as the firms book value of shareholders' equity (Compustat item #60) at the end of year t, scaled by MVE.
ΔE <sub>t+1</sub>	= Future first-difference in net income before extraordinary items, i.e., net income before extraordinary items for year t+1 (Compustat item #18) less net income before extraordinary items for year t, scaled by average total assets (Compustat item #6).
MARET <sub>t+1</sub>	= Future twelve-month market-adjusted return, measured as the firm's twelve-month cumulative return during fiscal year t+1 less the corresponding twelve-month return on the value-weighted market index.
MARET <sub>t</sub>	= Contemporaneous twelve-month market-adjusted return, measured as the firm's twelve-month cumulative return during fiscal year t less the corresponding twelve-month return on the value-weighted market index.
ROA <sub>t</sub>	= Net income before extraordinary items for fiscal year t, scaled by the average of beginning and ending total assets of year t.
STDROA <sub>t</sub>	= Standard deviation of the firm's annual change in earnings, ΔE <sub>i,t</sub> , between fiscal year's 1996 and 2004.
SPECITEM <sub>t</sub>	= Value of special items reported by the firm in fiscal year t, scaled by total assets at the beginning of the year.
SPECIAL <sub>t</sub>	= An indicator variable equal to one if SPECITEM <sub>t</sub> is not equal to zero, zero otherwise.
GRANTS <sub>t</sub>	= An indicator variable equal to one if the firm granted shares of restricted stock or stock options to the firm's executives and directors during fiscal year t, zero otherwise.
RESEARCH	= An indicator variable equal to one if the firm reported a non-zero research and development expense during fiscal year t, zero otherwise.

<sup>a</sup> All return and price data are gathered through CRSP. All financial statement-based information is gathered through Compustat. All data on insider trades, option grants and option exercise activity is gathered through Thomson Financial.

**Table 1**  
Descriptive Statistics

**Panel A: Insider trading behavior (fiscal years 1996-2004; n=48,072)**

Classification:	No Trading	Only Purchases	Purchases $\geq$ Sales	Purchases < Sales	Only Sales
# of observations	12,922	8,280	4,479	11,712	10,679
% of sample	26.88%	17.22%	9.32%	24.36%	22.21%

**Panel B: Firm-level characteristics**

	Mean	Std. Dev.	5 <sup>th</sup> Pctl.	25 <sup>th</sup> Pctl.	Median	75 <sup>th</sup> Pctl.	95 <sup>th</sup> Pctl.
PURCHASE <sub>i,t</sub>	0.265	0.442	0.000	0.000	0.000	1.000	1.000
SALES <sub>i,t</sub>	0.466	0.499	0.000	0.000	0.000	1.000	1.000
TRADE <sub>i,t</sub>	0.731	0.443	0.000	0.000	1.000	1.000	1.000
EXERCISE <sub>i,t</sub>	0.481	0.500	0.000	0.000	0.000	1.000	1.000
MVE <sub>i,t</sub>	2,877.68	12,488.68	8.685	47.855	207.423	983.67	10,677.12
log(MVE <sub>i,t</sub> )	5.464	2.159	2.094	3.906	5.349	6.914	9.222
BM <sub>i,t</sub>	0.712	0.887	0.109	0.318	0.545	0.857	1.792
log(1+BM <sub>i,t</sub> )	0.476	0.302	0.100	0.267	0.426	0.615	1.029
ROA <sub>i,t</sub>	-0.018	0.274	-0.408	-0.012	0.020	0.061	0.154
$\Delta E_{i,t+1}$	0.007	0.168	-0.200	-0.018	0.003	0.030	0.206
MARET <sub>i,t</sub>	0.101	0.929	-0.734	-0.320	-0.029	0.280	1.248
MARET <sub>i,t+1</sub>	0.079	0.879	-0.734	-0.317	-0.033	0.264	1.147
SPECITEM <sub>i,t</sub>	0.029	0.226	0.000	0.000	0.000	0.014	0.127
SPECITEM <sub>i,t+1</sub>	0.029	0.224	0.000	0.000	0.0003	0.015	0.133
SPECIAL <sub>i,t</sub>	0.487	0.500	0.000	0.000	0.000	1.000	1.000
SPECIAL <sub>i,t+1</sub>	0.520	0.500	0.000	0.000	1.000	1.000	1.000
GRANT <sub>i,t</sub>	0.644	0.479	0.000	0.000	1.000	1.000	1.000
RESEARCH <sub>t</sub>	0.417	0.493	0.000	0.000	0.000	1.000	1.000

**Table 2**  
Comparison of Firm-Years With and Without Insider Trading Activity

The table presents descriptive statistics for firm-years with and without insider trading activity. A firm-year is classified as having insider trading if any insider (i.e., executive or director) in firm  $i$  bought or sold shares on the open market in fiscal year  $t$ .

	Insider Trading (TRADE <sub><math>i,t</math></sub> =1)		No Insider Trading (TRADE <sub><math>i,t</math></sub> =0)		Difference (Trading - No Trading)	
	Mean	Median	Mean	Median	Mean	Median
MVE <sub><math>i,t</math></sub>	2,666.64	239.72	3,451.77	123.65	785.13 <sup>a</sup>	116.07 <sup>a</sup>
BM <sub><math>i,t</math></sub>	0.653	0.504	0.833	0.619	-0.179 <sup>a</sup>	-0.115 <sup>a</sup>
ROA <sub><math>i,t</math></sub>	-0.019	0.023	-0.025	0.014	-0.006	0.009 <sup>a</sup>
MARET <sub><math>i,t</math></sub>	0.119	-0.027	0.094	-0.059	0.025 <sup>c</sup>	0.032 <sup>a</sup>
MARET <sub><math>i,t</math></sub>	0.505	0.332	0.512	0.338	0.006	-0.006
$\Delta E_{i,t+1}$	0.008	0.003	0.008	0.002	0.000	0.001 <sup>a</sup>
\Delta E <sub><math>i,t+1</math></sub>	0.080	0.027	0.098	0.035	-0.018 <sup>a</sup>	-0.008 <sup>a</sup>
MARET <sub><math>i,t+1</math></sub>	0.093	-0.039	0.129	-0.038	-0.036 <sup>a</sup>	-0.001
MARET <sub><math>i,t+1</math></sub>	0.484	0.324	0.528	0.343	-0.043 <sup>a</sup>	-0.019 <sup>a</sup>
SPECIAL <sub><math>i,t</math></sub>	0.490	0.000	0.478	0.000	0.012 <sup>b</sup>	0.000 <sup>c</sup>
SPECITEM <sub><math>i,t</math></sub>	0.029	0.000	0.030	0.000	-0.002	0.000 <sup>c</sup>
SPECIAL <sub><math>i,t+1</math></sub>	0.525	1.000	0.507	1.000	0.018 <sup>a</sup>	0.000
SPECITEM <sub><math>i,t+1</math></sub>	0.028	0.0003	0.031	0.000	-0.003	0.0033 <sup>a</sup>
STDEARN	0.263	0.057	1.104	0.079	-0.841 <sup>a</sup>	-0.022 <sup>a</sup>
GRANT <sub><math>i,t</math></sub>	0.782	1.000	0.266	0.000	0.517 <sup>a</sup>	1.00 <sup>a</sup>
EXERCISE <sub><math>i,t</math></sub>	0.623	1.000	0.097	0.000	0.526 <sup>a</sup>	1.00 <sup>a</sup>
RESEARCH <sub><math>i,t</math></sub>	0.419	0.000	0.412	0.000	0.007	0.000
# of observations	35,150		12,922			

<sup>a,b,c</sup> Difference in mean (median) characteristic between trade and no-trade firm-years is significant at the one, five and ten percent level, respectively, using a two-sample, two-tailed t-test of means (signed ranked wilcoxon test).

**Table 3**  
**Characteristics of Firm-Years With and Without Insider Trading: Multivariate Evidence**

This table presents coefficients from a pooled cross-sectional estimation of the following model:

$$\text{Prob}(\text{TRADE}_{i,t}=1) = \text{logit}(\alpha + \beta_1|\Delta E_{i,t+1}| + \beta_2\text{SPECIAL}_{i,t+1} + \beta_3\log(\text{BM}_{i,t}) + \beta_4\log(\text{MVE}_{i,t}) + \beta_5\text{ROA}_{i,t} + \beta_6\text{SPECIAL}_{i,t} + \beta_7|\text{MARET}_{i,t}| + \beta_8\text{STDEARN}_i + \beta_9\text{GRANT}_{i,t} + \beta_{10}\text{EXERCISE}_{i,t} + \beta_{11}\text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \quad [1]$$

where  $\text{TRADE}_{i,t}$  is an indicator variable equal to one if any insider of firm  $i$  bought or sold shares during fiscal year  $t$ , zero otherwise. All independent variables are as defined in Appendix 1. Logit marginal effects with standard errors robust to heteroscedasticity and correlation across same-firm observations. Two-tailed  $p$ -values are presented in parentheses.  $n=48,072$

Dependent Variable:	Prob ( $\text{TRADE}_{i,t}=1$ )
Intercept	-0.305 (0.012)
$\log(\text{BM}_i)$	-0.009 (0.003)
$\log(\text{MVE}_i)$	-0.012 (0.000)
$\text{ROA}_t$	-0.006 (0.437)
$ \text{MARET}_i $	-0.001 (0.447)
$\text{SPECIAL}_t$	-0.002 (0.573)
$ \Delta E_{i,t+1} $	-0.099 (0.000)
$\text{SPECIAL}_{t+1}$	-0.006 (0.161)
$\text{STDEARN}_t$	-0.001 (0.097)
$\text{GRANT}_t$	0.307 (0.000)
$\text{EXERCISE}_t$	0.331 (0.000)
$\text{RESEARCH}_t$	-0.047 (0.000)
Year Fixed Effects	Yes
Percent Correct	82.71%
Pseudo-R-squared	31.29%
Wald $\chi^2$	5,097.04

**Table 4**  
Descriptive Statistics of Firm-Years with and without Majority Insider Purchase and Sale Transactions

The table presents descriptive statistics for firm-years with and without insider trading activity. Panel A present statistics conditional on the presence of net insider purchasing activity; panel B presents statistics conditional on the presence of net insider selling activity. A firm-year is classified as having majority purchasing activity if any insider (i.e., executive or director) in firm *i* bought shares on the open market in fiscal year *t* and total shares purchased by insiders is greater than or equal to total shares sold by insiders. A firm-year is classified as having majority selling activity if any insider (i.e., executive or director) in firm *i* sold shares on the open market in fiscal year *t* and total shares sold by insiders is greater than total shares purchased by insiders.

Panel A: Firm-year characteristics conditional on the presence of majority insider purchases

	Majority Purchase Transactions (PURCHASE <sub><i>i,t</i></sub> =1)		Minority or No Purchase Transactions (PURCHASE <sub><i>i,t</i></sub> =0)		Difference (Purchase – No Purchase)	
	Mean	Median	Mean	Median	Mean	Median
	MVE <sub><i>i,t</i></sub>	709.99	82.26	3,661.01	306.32	2,951.02 <sup>a</sup>
BM <sub><i>i,t</i></sub>	0.875	0.668	0.639	0.485	0.236 <sup>b</sup>	0.183 <sup>a</sup>
ROA <sub><i>i,t</i></sub>	-0.059	0.011	-0.007	0.028	-0.053 <sup>a</sup>	-0.017 <sup>a</sup>
MARET <sub><i>i,t</i></sub>	0.007	-0.131	0.150	-0.005	-0.144 <sup>a</sup>	-0.126 <sup>a</sup>
SPECITEM <sub><i>i,t</i></sub>	0.029	0.000	0.029	0.000	0.000	0.000 <sup>a</sup>
SPECIAL <sub><i>i,t</i></sub>	0.474	0.000	0.491	0.000	0.017 <sup>a</sup>	0.000 <sup>a</sup>
ΔE <sub><i>i,t+1</i></sub>	0.016	0.002	0.005	0.003	0.011 <sup>a</sup>	-0.001 <sup>a</sup>
SPECITEM <sub><i>i,t+1</i></sub>	0.026	0.000	0.029	0.0005	-0.003 <sup>c</sup>	-0.0005 <sup>a</sup>
SPECIAL <sub><i>i,t+1</i></sub>	0.485	0.000	0.533	1.000	-0.048 <sup>a</sup>	-1.000 <sup>a</sup>
GRANT <sub><i>i,t</i></sub>	0.722	1.000	0.615	1.000	0.107 <sup>a</sup>	0.000
EXERCISE <sub><i>i,t</i></sub>	0.356	0.000	0.527	1.000	-0.171 <sup>a</sup>	-1.000 <sup>a</sup>
RESEARCH <sub><i>i,t</i></sub>	0.364	0.000	0.436	0.000	-0.072 <sup>a</sup>	0.000 <sup>a</sup>
# of observations	12,759		35,313			

<sup>a,b,c</sup> Difference in mean (median) characteristic between trade and no-trade firm-years is significant at the one, five and ten percent level, respectively, using a two-sample, two-tailed t-test of means (signed ranked wilcoxon test).

**Table 4 (continued)**  
Descriptive Statistics of Firm-Years with and without Majority Insider Purchase and Sale Transactions

Panel B: Firm-year characteristics conditional on the presence of majority insider selling

	Majority Sales Transactions (SALES <sub>i,t</sub> =1)		Minority or No Sales Transactions (SALES <sub>i,t</sub> =0)		Difference (Sales – No Sales)	
	Mean	Median	Mean	Median	Mean	Median
MVE <sub>i,t</sub>	3,781.77	436.23	2,089.47	96.84	1,692.29 <sup>a</sup>	339.39 <sup>a</sup>
BM <sub>i,t</sub>	0.527	0.435	0.854	0.645	-0.327 <sup>a</sup>	-0.21 <sup>a</sup>
ROA <sub>i,t</sub>	0.004	0.036	-0.042	0.012	0.046 <sup>a</sup>	0.024 <sup>a</sup>
MARET <sub>i,t</sub>	0.183	0.025	0.050	-0.092	0.133 <sup>a</sup>	0.117 <sup>a</sup>
SPECITEM <sub>i,t</sub>	0.028	0.000	0.029	0.000	0.001	0.000 <sup>a</sup>
SPECIAL <sub>i,t</sub>	0.499	0.000	0.476	0.000	0.023 <sup>a</sup>	0.000 <sup>a</sup>
ΔE <sub>i,t+1</sub>	0.004	0.003	0.012	0.002	-0.008 <sup>a</sup>	0.001 <sup>a</sup>
SPECITEM <sub>i,t+1</sub>	0.029	0.001	0.029	0.000	0.000	0.001 <sup>a</sup>
SPECIAL <sub>i,t+1</sub>	0.548	1.000	0.496	0.000	0.052 <sup>a</sup>	1.000 <sup>a</sup>
GRANT <sub>i,t</sub>	0.817	1.000	0.492	0.000	0.324 <sup>a</sup>	1.000 <sup>a</sup>
EXERCISE <sub>i,t</sub>	0.774	1.000	0.225	0.000	0.549 <sup>a</sup>	1.000 <sup>a</sup>
RESEARCH <sub>i,t</sub>	0.450	0.000	0.388	0.000	0.062 <sup>a</sup>	0.000 <sup>a</sup>
# of observations	22,391		25,681			

<sup>a,b,c</sup> Difference in mean (median) characteristic between trade and no-trade firm-years is significant at the one, five and ten percent level, respectively, using a two-sample, two-tailed t-test of means (signed ranked wilcoxon test).

**Table 5**

The Impact of Future Earnings on Insiders' Decision to Engage in Open Market Purchase and Sell Transactions

This table presents coefficients from pooled cross-sectional estimations of the following models:

$$\text{Prob}(\text{PURCHASE}_{i,t}=1) = \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{MARET}_{i,t+1} + \beta_3 \log(\text{BM}_{i,t}) + \beta_4 \log(\text{MVE}_{i,t}) + \beta_5 \text{MARET}_{i,t} + \beta_6 \text{GRANT}_{i,t} + \beta_7 \text{EXERCISE}_{i,t} + \beta_8 \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \quad [2]$$

$$\text{Prob}(\text{SALES}_{i,t}=1) = \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{MARET}_{i,t+1} + \beta_3 \log(\text{BM}_{i,t}) + \beta_4 \log(\text{MVE}_{i,t}) + \beta_5 \text{MARET}_{i,t} + \beta_6 \text{GRANT}_{i,t} + \beta_7 \text{EXERCISE}_{i,t} + \beta_8 \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \quad [3]$$

$$\text{Prob}(\text{EXERCISE}_{i,t}=1) = \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{MARET}_{i,t+1} + \beta_3 \log(\text{BM}_{i,t}) + \beta_4 \log(\text{MVE}_{i,t}) + \beta_5 \text{MARET}_{i,t} + \beta_6 \text{GRANT}_{i,t} + \beta_7 \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \quad [4]$$

All variables are as defined in Appendix 1. Logit marginal effects with standard errors robust to heteroscedasticity and correlation across within-firm observations. Two-tailed p-values are presented in parentheses. n=48,072

Dependent Variable:	Prob(PURCHASE <sub>i,t</sub> =1)	Prob(SALES <sub>i,t</sub> =1)	Prob(EXERCISE <sub>i,t</sub> =1)
Intercept	-0.421 (0.000)	-2.384 (0.000)	-2.714 (0.000)
$\Delta E_{t+1}$	0.042 (0.000)	-0.042 (0.008)	-0.074 (0.000)
MARET <sub>t+1</sub>	0.007 (0.001)	-0.025 (0.000)	-0.006 (0.019)
$\log(\text{BM}_t)$	0.028 (0.000)	-0.053 (0.000)	-0.060 (0.000)
$\log(\text{MVE}_t)$	-0.042 (0.000)	0.035 (0.000)	0.070 (0.000)
MARET <sub>t</sub>	-0.010 (0.000)	0.011 (0.020)	0.001 (0.796)
GRANT <sub>t</sub>	0.172 (0.000)	0.199 (0.000)	0.435 (0.000)
EXERCISE <sub>t</sub>	-0.116 (0.000)	0.464 (0.000)	- -
RESEARCH <sub>t</sub>	-0.053 (0.000)	-0.009 (0.281)	0.033 (0.000)
Year Fixed Effects	Yes	Yes	Yes
Percent Correct	74.72%	77.64%	73.50%
Pseudo-R-squared	10.57%	27.24%	20.66%
Wald $\chi^2$	3,318.24	7,706.78	4,355.99

**Table 6****Non-linear Estimation of Relation between Future Earnings and Insider Trading Decisions**

This table presents coefficients from pooled cross-sectional estimations of the following models:

$$\text{Prob}(\text{PURCHASE}_{i,t}=1) = \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_3 \text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_4 \text{MARET}_{i,t+1} + \beta_5 \log(\text{BM}_{i,t}) + \beta_6 \log(\text{MVE}_{i,t}) + \beta_7 \text{MARET}_{i,t} + \beta_8 \text{GRANT}_{i,t} + \beta_9 \text{EXERCISE}_{i,t} + \beta_{10} \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \quad [5]$$

$$\text{Prob}(\text{SALES}_{i,t}=1) = \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_3 \text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_4 \text{MARET}_{i,t+1} + \beta_5 \log(\text{BM}_{i,t}) + \beta_6 \log(\text{MVE}_{i,t}) + \beta_7 \text{MARET}_{i,t} + \beta_8 \text{GRANT}_{i,t} + \beta_9 \text{EXERCISE}_{i,t} + \beta_{10} \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \quad [6]$$

$$\text{Prob}(\text{EXERCISES}_{i,t}=1) = \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_3 \text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_4 \text{MARET}_{i,t+1} + \beta_5 \log(\text{BM}_{i,t}) + \beta_6 \log(\text{MVE}_{i,t}) + \beta_7 \text{MARET}_{i,t} + \beta_8 \text{GRANT}_{i,t} + \beta_9 \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \quad [7]$$

All variables are as defined in Appendix 1. Logit marginal effects with standard errors robust to heteroscedasticity and correlation across within-firm observations. Two-tailed p-values are presented in parentheses. n=48,072

	Prob(PURCHASE <sub>i,t</sub> =1)	Prob(SALES <sub>i,t</sub> =1)	Prob(EXERCISE <sub>i,t</sub> =1)
Intercept	-0.415 (0.000)	-2.360 (0.000)	-2.673 (0.000)
$\Delta E_{t+1}$	0.061 (0.003)	-0.175 (0.000)	-0.236 (0.000)
POS*( $\Delta E_{t+1}$ ) <sup>2</sup>	-0.038 (0.058)	0.090 (0.001)	0.070 (0.014)
NEG*( $\Delta E_{t+1}$ ) <sup>2</sup>	0.023 (0.779)	0.362 (0.000)	0.547 (0.000)
MARET <sub>t+1</sub>	0.006 (0.001)	-0.022 (0.000)	-0.004 (0.150)
log(BM <sub>t</sub> )	0.028 (0.000)	-0.057 (0.000)	-0.067 (0.000)
log(MVE <sub>t</sub> )	-0.042 (0.000)	0.034 (0.000)	0.067 (0.000)
MARET <sub>t</sub>	-0.010 (0.000)	0.012 (0.009)	0.002 (0.400)
GRANT <sub>t</sub>	0.172 (0.000)	0.200 (0.000)	0.436 (0.000)
EXERCISE <sub>t</sub>	-0.117 (0.000)	0.463 (0.000)	- -
RESEARCH <sub>t</sub>	-0.052 (0.000)	-0.007 (0.418)	0.037 (0.000)
Year Fixed Effects	Yes	Yes	Yes
Percent Correct	74.74%	77.62%	73.68%
Pseudo-R-Squared	10.58%	27.30%	20.82%
Wald $\chi^2$	3,324.48	7,706.46	4,456.00

**Table 7**  
**Non-linear Estimation of Relation between Future Earnings and Insider Trading Decisions**  
**Conditional on Firm's Market Capitalization**

This table presents coefficients from pooled cross-sectional estimations of the following models, partitioned on the basis of the firm's market capitalization ( $MVE_{i,t}$ ):

$$\begin{aligned} \text{Prob}(\text{PURCHASE}_{i,t}=1) = & \text{logit}(\alpha + \beta_1\Delta E_{i,t+1} + \beta_2\text{POS}_{i,t+1}*(\Delta E_{i,t+1})^2 + \beta_3\text{NEG}_{i,t+1}*(\Delta E_{i,t+1})^2 + \beta_4\text{MARET}_{i,t+1} + \beta_5\log(\text{BM}_{i,t}) \\ & + \beta_6\log(\text{MVE}_{i,t}) + \beta_7\text{MARET}_{i,t} + \beta_8\text{GRANT}_{i,t} + \beta_9\text{EXERCISE}_{i,t} + \beta_{10}\text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [5]$$

$$\begin{aligned} \text{Prob}(\text{SALES}_{i,t}=1) = & \text{logit}(\alpha + \beta_1\Delta E_{i,t+1} + \beta_2\text{POS}_{i,t+1}*(\Delta E_{i,t+1})^2 + \beta_3\text{NEG}_{i,t+1}*(\Delta E_{i,t+1})^2 + \beta_4\text{MARET}_{i,t+1} + \beta_5\log(\text{BM}_{i,t}) \\ & + \beta_6\log(\text{MVE}_{i,t}) + \beta_7\text{MARET}_{i,t} + \beta_8\text{GRANT}_{i,t} + \beta_9\text{EXERCISE}_{i,t} + \beta_{10}\text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [6]$$

$$\begin{aligned} \text{Prob}(\text{EXERCISE}_{i,t}=1) = & \text{logit}(\alpha + \beta_1\Delta E_{i,t+1} + \beta_2\text{POS}_{i,t+1}*(\Delta E_{i,t+1})^2 + \beta_3\text{NEG}_{i,t+1}*(\Delta E_{i,t+1})^2 + \beta_4\text{MARET}_{i,t+1} + \beta_5\log(\text{BM}_{i,t}) \\ & + \beta_6\log(\text{MVE}_{i,t}) + \beta_7\text{MARET}_{i,t} + \beta_8\text{GRANT}_{i,t} + \beta_9\text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [7]$$

All variables are as defined in Appendix 1. Logit marginal effects with standard errors robust to heteroscedasticity and correlation across within-firm observations. Two-tailed p-values are presented in parentheses.  $n=48,072$

	Prob(PURCHASE <sub>i,t</sub> =1)			Prob(SALES <sub>i,t</sub> =1)			Prob(EXERCISE <sub>i,t</sub> =1)			n
	$\Delta E_{t+1}$	POS* ( $\Delta E_{t+1}$ ) <sup>2</sup>	NEG* ( $\Delta E_{t+1}$ ) <sup>2</sup>	$\Delta E_{t+1}$	POS* ( $\Delta E_{t+1}$ ) <sup>2</sup>	NEG* ( $\Delta E_{t+1}$ ) <sup>2</sup>	$\Delta E_{t+1}$	POS* ( $\Delta E_{t+1}$ ) <sup>2</sup>	NEG* ( $\Delta E_{t+1}$ ) <sup>2</sup>	
Predicted:	+	-	+	-	-	+	-	-	+	
Small Firms	0.065 (0.062)	-0.066 (0.051)	0.135 (0.083)	-0.088 (0.006)	0.082 (0.006)	0.145 (0.043)	-0.107 (0.001)	0.050 (0.108)	0.327 (0.000)	17765
Medium Firms	0.070 (0.073)	0.006 (0.869)	-0.036 (0.594)	-0.173 (0.002)	0.036 (0.435)	0.411 (0.001)	-0.230 (0.000)	0.044 (0.359)	0.521 (0.000)	17774
Large Firms	0.094 (0.018)	-0.087 (0.030)	-0.175 (0.024)	-0.145 (0.078)	0.138 (0.030)	0.262 (0.094)	-0.199 (0.010)	0.087 (0.178)	0.204 (0.293)	17774

**Table 8**  
Impact of Future Special Items on Insiders Trading Decisions

This table presents coefficients from pooled estimations of the following models:

$$\begin{aligned} \text{Prob}(\text{PURCHASE}_{i,t}=1) = & \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{SPECIAL}_{i,t+1} + \beta_3 \text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_4 \text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_5 \text{MARET}_{i,t+1} \\ & + \beta_6 \log(\text{BM}_{i,t}) + \beta_7 \log(\text{MVE}_{i,t}) + \beta_8 \text{MARET}_{i,t} + \beta_9 \text{GRANT}_{i,t} + \beta_{10} \text{EXERCISE}_{i,t} + \beta_{11} \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [6]$$

$$\begin{aligned} \text{Prob}(\text{SALES}_{i,t}=1) = & \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{SPECIAL}_{i,t+1} + \beta_3 \text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_4 \text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_5 \text{MARET}_{i,t+1} \\ & + \beta_6 \log(\text{BM}_{i,t}) + \beta_7 \log(\text{MVE}_{i,t}) + \beta_8 \text{MARET}_{i,t} + \beta_9 \text{GRANT}_{i,t} + \beta_{10} \text{EXERCISE}_{i,t} + \beta_{11} \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [7]$$

$$\begin{aligned} \text{Prob}(\text{EXERCISE}_{i,t}=1) = & \text{logit}(\alpha + \beta_1 \Delta E_{i,t+1} + \beta_2 \text{SPECIAL}_{i,t+1} + \beta_3 \text{POS}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_4 \text{NEG}_{i,t+1} * (\Delta E_{i,t+1})^2 + \beta_5 \text{MARET}_{i,t+1} \\ & + \beta_6 \log(\text{BM}_{i,t}) + \beta_7 \log(\text{MVE}_{i,t}) + \beta_8 \text{MARET}_{i,t} + \beta_9 \text{GRANT}_{i,t} + \beta_{10} \text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [8]$$

All variables are as defined in Appendix 1. Logit marginal effects with standard errors robust to heteroscedasticity and correlation across within-firm observations. Two-tailed p-values are presented in parentheses. n=48,072

Dependent Variable:	Prob(PURCHASE <sub>i,t</sub> =1)	Prob(SALES <sub>i,t</sub> =1)	Prob(EXERCISE <sub>i,t</sub> =1)
Intercept	-0.409 (0.000)	-2.351 (0.000)	-2.636 (0.000)
$\Delta E_{t+1}$	0.060 (0.005)	-0.177 (0.000)	-0.250 (0.000)
SPECIAL <sub>i,t+1</sub>	-0.004 (0.395)	-0.010 (0.117)	-0.044 (0.000)
POS*( $\Delta E_{t+1}$ ) <sup>2</sup>	-0.036 (0.068)	0.094 (0.001)	0.085 (0.003)
NEG*( $\Delta E_{t+1}$ ) <sup>2</sup>	0.022 (0.630)	0.359 (0.001)	0.535 (0.000)
MARET <sub>t+1</sub>	0.006 (0.001)	-0.023 (0.000)	-0.005 (0.077)
log(BM <sub>t</sub> )	0.029 (0.000)	-0.057 (0.000)	-0.064 (0.000)
log(MVE <sub>t</sub> )	-0.042 (0.000)	0.034 (0.000)	0.070 (0.000)
MARET <sub>t</sub>	-0.010 (0.000)	0.012 (0.010)	0.001 (0.558)
GRANT <sub>t</sub>	0.172 (0.000)	0.200 (0.000)	0.438 (0.000)
EXERCISE <sub>t</sub>	-0.117 (0.000)	0.463 (0.000)	- -
RESEARCH <sub>t</sub>	-0.052 (0.000)	-0.005 (0.543)	0.044 (0.000)
Year Fixed Effects	Yes	Yes	Yes
Percent Correct	74.72%	77.63%	73.65%
Pseudo-R-Squared	10.58%	27.31%	20.92%
Wald $\chi^2$	3,332.10	7,706.34	4,543.26

**Table 9**

Non-linear estimation of relation between future earnings and insider trading decisions by  
Earnings Persistence

This table presents coefficients from pooled estimations of the following models:

$$\begin{aligned} \text{Prob}(\text{PURCHASE}_{i,t}=1) = & \text{logit}(\alpha + \beta_1\Delta E_{i,t+1} + \beta_2\text{POS}_{i,t+1}*(\Delta E_{i,t+1})^2 + \beta_3\text{NEG}_{i,t+1}*(\Delta E_{i,t+1})^2 + \beta_4\text{MARET}_{i,t+1} + \beta_5\log(\text{BM}_{i,t}) \\ & + \beta_6\log(\text{MVE}_{i,t}) + \beta_7\text{MARET}_{i,t} + \beta_8\text{GRANT}_{i,t} + \beta_9\text{EXERCISE}_{i,t} + \beta_{10}\text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [6]$$

$$\begin{aligned} \text{Prob}(\text{SALES}_{i,t}=1) = & \text{logit}(\alpha + \beta_1\Delta E_{i,t+1} + \beta_2\text{POS}_{i,t+1}*(\Delta E_{i,t+1})^2 + \beta_3\text{NEG}_{i,t+1}*(\Delta E_{i,t+1})^2 + \beta_4\text{MARET}_{i,t+1} + \beta_5\log(\text{BM}_{i,t}) \\ & + \beta_6\log(\text{MVE}_{i,t}) + \beta_7\text{MARET}_{i,t} + \beta_8\text{GRANT}_{i,t} + \beta_9\text{EXERCISE}_{i,t} + \beta_{10}\text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [7]$$

$$\begin{aligned} \text{Prob}(\text{EXERCISES}_{i,t}=1) = & \text{logit}(\alpha + \beta_1\Delta E_{i,t+1} + \beta_2\text{POS}_{i,t+1}*(\Delta E_{i,t+1})^2 + \beta_3\text{NEG}_{i,t+1}*(\Delta E_{i,t+1})^2 + \beta_4\text{MARET}_{i,t+1} + \beta_5\log(\text{BM}_{i,t}) \\ & + \beta_6\log(\text{MVE}_{i,t}) + \beta_7\text{MARET}_{i,t} + \beta_8\text{GRANT}_{i,t} + \beta_9\text{RESEARCH}_{i,t} + \varepsilon_{i,t}) \end{aligned} \quad [8]$$

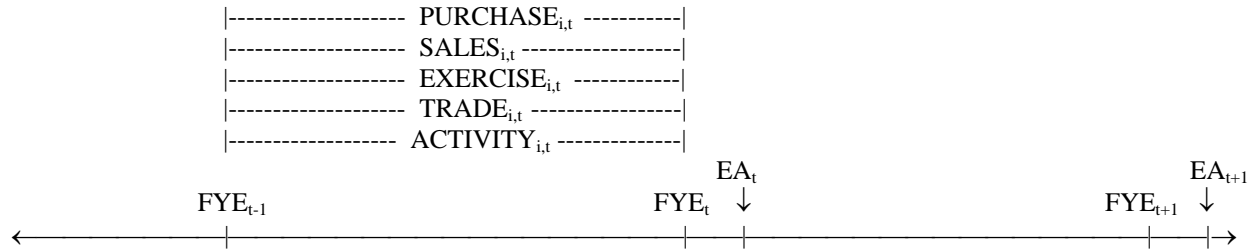
All variables are as defined in Appendix 1. Logit marginal effects with standard errors robust to heteroscedasticity and correlation across within-firm observations. Two-tailed p-values are presented in parentheses. “Persistent Earnings” observations are observations where the sign of  $\Delta E_{t+1}$  equals the sign of  $\Delta E_{t+2}$ ; non-persistent earnings observations are observations where the signs of the two earnings innovations differ

	Prob(PURCHASE <sub>i,t</sub> =1)	Prob(SALES <sub>i,t</sub> =1)	Prob(EXERCISE <sub>i,t</sub> =1)
Persistent Earnings (n=24,821)			
Intercept	-0.117 (0.157)	-2.449 (0.000)	-2.931 (0.000)
$\Delta E_{t+1}$	0.137 (0.000)	-0.286 (0.000)	-0.307 (0.000)
POS*( $\Delta E_{t+1}$ ) <sup>2</sup>	-0.069 (0.007)	0.138 (0.001)	0.114 (0.001)
NEG*( $\Delta E_{t+1}$ ) <sup>2</sup>	-0.057 (0.440)	0.528 (0.000)	0.540 (0.000)
Non-Persistent Earnings (n=9,706)			
Intercept	-0.206 (0.091)	-2.574 (0.000)	-3.151 (0.000)
$\Delta E_{t+1}$	-0.096 (0.196)	0.207 (0.088)	0.041 (0.716)
POS*( $\Delta E_{t+1}$ ) <sup>2</sup>	0.107 (0.447)	-0.654 (0.005)	-0.441 (0.029)
NEG*( $\Delta E_{t+1}$ ) <sup>2</sup>	0.139 (0.396)	-0.013 (0.965)	0.420 (0.168)

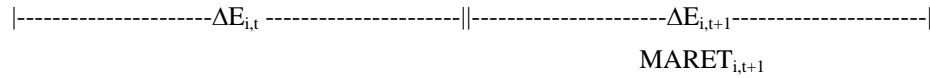
**Figure 1**  
Empirical Timeline

This figure presents a timeline pertaining to the measurement of insider trading and future firm performance variables. For each firm-year observation, insider purchases ( $PURCHASE_{i,t}$ ), sales ( $SALES_{i,t}$ ), and option exercises ( $EXERCISE_{i,t}$ ) are measured for firm  $i$  over fiscal year  $t$ . Contemporaneous and future firm performance is measured over fiscal year  $t$  and  $t+1$  respectively.  $FYE_t$  denotes the fiscal year end for year  $t$ .  $EA_t$  denotes the announcement of year  $t$ 's annual earnings innovation ( $\Delta E_{i,t}$ ). All variables are as defined in Appendix 1.

Insider Trading:



Future earnings performance:



Contemporaneous returns:



**Figure 2**

Proportion of firm-years with insider trading activity by next year's annual earnings innovation

