

# Are executive stock option exercises driven by private information?

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**Abstract** In this study, we investigate the extent to which exercise of executive stock options is based upon private information. Contrary to popular belief, we find that shares are held more than 30 days following over a quarter of options exercised. Partitioning the data, we find weak evidence that decisions to exercise and sell immediately are prompted by bad news and stronger evidence that decisions to exercise and hold for at least 30 days are prompted by good news. Enhancing the power of our tests by considering several factors important to exercise decisions, we find that the higher the opportunity costs of early exercise as measured by the time-value of options, the greater the trading profits to executives. We also find that the greater the disguise provided by incentives to diversify and consume as measured by the depth of options in the money, the greater the trading profits to executives who exercise and sell. Turning to non-exercise decisions, we find that a strategy of holding options rather than shares to exploit good news yields positive abnormal returns consistent with theoretical predictions in the absence of dividends.

**Keywords** Private information · Compensation · Stock options · Insider trading

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## 1 Introduction

This study examines whether corporate executives exploit private information when they make decisions on exercising stock options and selling the acquired stocks. It is well established that corporate insiders profit from open market trades in their own company's shares implying that their ability to profit stems from private information (for example Seyhun 1998). Surprisingly few studies have investigated the extent to which insiders may time the exercise of options received as compensation based on private information, notwithstanding that the dollar volume of options granted to insiders is materially larger than that of open market transactions. Furthermore, the studies investigating the timing of option exercises provide mixed evidence on whether the exercise decision is driven by private information. Prominent prior studies include Carpenter and Remmers (2001) and Huddart and Lang (2003). While the former found no evidence that the timing of exercises is conditioned on private information, the latter found that employees not limited to executives are able to exploit their private information in stock option exercises. Our objective is to shed new light on this issue.

A critical issue in empirical studies of insider trading is the *ex ante* determination of whether insiders are likely to have positive or negative private information. In the insider trading literature where open market transactions are considered, this is accomplished with relative ease by assuming that share purchases are driven by good news and share sales are driven by bad news. In option exercise studies, it has been assumed that executives immediately sell all shares after stock option exercises, implying that option exercises indicate bad news. We found this assumption untenable; spanning all transactions reported to the U.S. Security and Exchange Commission (SEC) from 1996 through 2003 and collected by Thompson Financial, 28.6% of the exercises are associated with no sale of shares within one calendar month. Partitioning options exercises, we find that exercises followed by immediate sale of all shares are associated with negative (future) abnormal returns consistent with private bad news, and option exercises that are followed by no immediate sales are associated with positive abnormal returns consistent with private good news. These effects tend to offset when we examine abnormal returns for all exercises without conditioning on whether shares are immediately sold similar to the null findings of Carpenter and Remmers (2001).

Rather than focus only on option exercises, we also examine non-exercise of options, conjecturing that delaying option exercises may also be a strategy for exploiting private good news. Given that insiders are underdiversified and can improve the mean-variance efficiency of their portfolios by exercising and selling shares, then non-exercise for protracted periods may be more likely when they have private good news. Consistent with this conjecture, we find that non-exercise for the prior year is associated with positive abnormal returns.

We further contribute to the literature by taking advantage of the detailed option characteristics for which there is no comparable data available for insider trading

studies of open market purchases and sales. While there is considerable evidence of insider open market purchases being associated with positive private news, there has been little evidence of insider open market sales being associated with private bad news (for example, Seyhun 1998; Lakonishok and Lee 2001; Aboody et al. 2005). The lack of evidence for open market sales has been attributed to noise introduced by insiders' desire to diversify and consume. However, we conjecture that incentives to diversify and consume also provide a measure of disguise for private information-based exercise and sell decisions and that disguise may serve as a defense against allegations of having violated insider-trading regulations. If this is the case, then in principle we should (and do) find stronger evidence of insiders exercising early and selling on private bad news when depth as a proxy for diversification and consumption incentives is high.

Option data also allows us to condition on the opportunity cost associated with the option exercises as measured by the remaining time-value of the options lost when options are exercised. We conjecture that the forgone time-value is positively associated with the strength of the private signal, be it bad news or good news. Consistent with our conjecture we find the magnitude of negative (positive) abnormal returns to be associated with time-value of options exercised and sold immediately (held for at least a month after exercise).

While the observation that not all option exercises are followed by immediate share sales is important in the understanding of executives' option exercise behavior, the question remains why executives exercise options but hold the shares. There are three possibilities. First, insiders may hold the shares to capture dividends. Consistent with this conjecture, we find that firms for which insiders exercise and hold at least a month have a higher average dividend yield than firms for which insiders exercise and sell immediately. However, we do not find significant differences in abnormal returns when we further partition the exercise and hold firms based on dividend yield.

Second, executives may believe that they can reduce their taxes if they exercise the options and hold the shares by paying a capital gains tax (lower than ordinary income) for the share holding period. This explanation has been challenged by MacDonald (2003), who shows that, in the absence of dividend capture effect, the dominant trading strategy under positive private information is not to exercise the options and hold the shares but to hold the options themselves. Nevertheless, this tax strategy has often been promoted by textbooks and practitioners, suggesting that insiders may still perceive an advantage even if it is not the case.<sup>1</sup>

Third, as offered by Heath et al. (1999) in explaining their findings, the suboptimality of option exercise decisions may be an artifact of psychological factors. This interpretation is very much in keeping with a growing literature in economics and finance demonstrating suboptimal individual investment behaviors (for example, Benartzi 2001; Thaler and Benartzi 2004; Barber and Odean 2000, 2001).

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<sup>1</sup> Scholes et al. (2005) summarize this thinking well in their popular textbook (Chapter 8): "if the employee expects—and this is the key assumption that we cannot overemphasize—the price of the stock to continue to rise through the option maturity date or to some point prior to maturity, early exercise of an NQO (non-qualified stock options) and holding the stock until sale date can be tax favored. Early exercise can be tax-favored because more of the total gain is taxed at lower capital gains rates than ordinary rates."

The remainder of this paper is organized as follows: Sect. 2 describes our sample and provides descriptive statistics; Sect. 3 presents our empirical findings; and Sect. 4 concludes.

## 2 Sample and descriptive statistics

### 2.1 Sample

We obtain executive stock option exercise data from Thomson Financial database. The database contains all stock option exercises made by corporate insiders and reported to the SEC from January 1985 through December 2003. We only use data from 1996 through 2003 because we need the information on the option expiration dates, which are necessary for our tests and only available after 1996. We identify 90,864 stock option exercises related to 5,949 firms and 15,311 senior officers of the firms (CEO, CFO, COO, president, and chairman of the board).<sup>2</sup> We focus our tests on the firms' senior officers because a priori we presume that they have the greatest ability to obtain private inside information. We deleted 3,277 officer exercise transactions that could not be located on the CRSP database and 10,542 transactions that lacked an expiration date, thus prohibiting us from calculating the option's time-value at the date of exercise. Our final sample consists of 77,045 transactions related to 5,225 firms and 13,670 individuals.

### 2.2 Descriptive statistics

Panels A of Table 1 presents the yearly distribution of executive stock option grants from 1996 through 2003. In the earlier half of the sample period, from 1996 to 1999, companies steadily increased stock option grants to executives in the number of shares given per grant. The total number of shares peaked in 1999, when there were 8,557 grants and 159,623 shares per grant, yielding a total of 1.4 billion shares. In the second half of our sample period, from 2000 through 2003, companies gradually decreased the size of stock option grants, and in 2003, the total number of options granted was 884 million shares, roughly 60% of the 1999 level. The pattern of stock option grants closely mimics the pattern of market returns. It is consistent with the notion that in market booms, when investors are reaping substantial gains on their investments, they are more willing to reward management with options as a means of sharing increased wealth. But, when the market turns down and investors start to lose money, they reduce option compensation to managers.<sup>3</sup>

Panel B presents the yearly distribution of option exercises. Although the number of option exercises is close to the number option grants, the number of shares in each exercise event is substantially fewer than the number of shares provided in

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<sup>2</sup> There are actually 105,000 exercise observations. However, options that have the same exercise price and expiration date but are classified as independent exercises because they have different vesting date, are considered as one observation.

<sup>3</sup> As well, executives may prefer non-option compensation in such periods.

**Table 1** Sample descriptive statistics

*Panel A: Distribution of option grants*

Year	# Grants	Avg. shares granted	Avg. term	Avg. option value
1996	5,428	96,144	8.56	11.84
1997	7,965	76,543	8.70	13.24
1998	9,335	102,171	8.33	13.39
1999	8,557	159,623	9.60	15.65
2000	8,466	122,551	9.58	17.47
2001	8,537	144,094	9.15	13.25
2002	7,819	127,684	9.93	9.52
2003	7,313	120,924	9.14	9.16

*Panel B: Distribution of option exercises*

Year	# Exercises	Avg. shares exercised	Avg. maturity	Avg. profit made	Avg. option value	Avg. time value
1996	4,178	41,054	4.62	22.35	24.93	2.56
1997	7,061	26,939	4.19	23.75	26.52	2.72
1998	7,340	30,251	3.94	25.17	28.11	2.92
1999	7,331	34,255	2.80	31.78	35.46	3.67
2000	8,646	42,003	6.07	38.17	42.70	4.52
2001	7,747	41,305	4.85	21.97	25.13	3.15
2002	7,326	34,108	4.46	18.11	19.89	1.75
2003	10,159	34,945	4.24	18.39	19.78	1.37

Table 1 continued

## Panel C: Sample characteristics

	Mean	Std. Dev.	1st percentile	25th percentile	Median	75th percentile	99th percentile
Mkt. Cap.	7.28	23.81	0.02	0.38	1.11	3.92	104.98
Dividend	0.01	0.02	0.00	0.00	0.00	0.01	0.08
Volatility	0.52	0.30	0.15	0.31	0.44	0.66	1.44
Depth	0.63	0.24	0.04	0.46	0.66	0.82	1.00
Voption	21.23	34.53	1.32	8.94	15.60	25.45	92.29
Profit	19.22	33.22	0.42	7.34	13.69	23.39	86.94

In Panel A, a grant is counted once per strike price/individual/firm/year. *Term* is the time to expiration (in years) for an option grant. *Option Value (Voption)* is the value of a dividend-paying American call option on the exercise date calculated following Barone-Adesi and Whaley (1987). Both the number of shares granted and the option values are calculated on the grant date. In Panel B, *Profit* is the difference between spot price and strike price on the exercise date. *Time-Value* is the difference between *Option Value* (calculated at the exercise date) and *Profit*. All per-share numbers are calculated on the exercise date. In Panel C, each firm is counted once in a year in calculating market value, dividend yield, and volatility. *Mkt. Cap.* is the market capitalization on the exercise date, in billions of dollars; *Dividend* is the dividend yield, calculated as cash dividends in the previous 12 months over the stock price on exercise dates; *Volatility* is the yearly stock return standard deviation; *Depth* is the extent to which the options are in the money on exercise dates, i.e.,  $(\text{stock price} - \text{strike price}) / \text{stock price}$

each grant. Assuming the 8 years we examine are representative, large numbers of options appear to end up worthless and un-exercised. The number of stock option exercises peaked in 2000 and 2003, coinciding with stock market peaks. Ofek and Richardson (2003) hypothesize that the bursting of the stock market bubble in 2000 may have been prompted by increased selling due the expiration of lock-up agreements in newly created public internet companies. More prevalent stock option exercises may be another factor that contributed to selling pressure.

Employee stock options are American-style call options, and closed form option pricing formulas are not available for these options when the underlying stock pays dividends. Following prior research (for example, Huddart and Lang 2003), we use the approximation technique of Barone-Adesi and Whaley (1987) to calculate option values.<sup>4</sup> The valuation results are reported in Panel C. To calculate the option values, we measured dividend yield as the sum of dividends paid in the previous 12 months divided by the stock price on the grant date and stock volatility as the standard deviation of stock returns in the same 12-month period. Average per share option values are reported in the last column. Over the 8 years we examine, the average value ranges from \$9.16 per share in 2003 to \$17.47 per share in 2000. Multiplying the total number of shares granted by the average option value per share, we arrive at the total annual cost of executive stock option compensation. For example, in the peak year of 1999, this cost totaled \$24 billion.

Executives tend to exercise their options early, with most options exercised after a holding period of between 4 and 6 years, far less than their full term of 10 years. A question that arises in this setting is whether executives exercise too early in the sense that they might be forgoing substantial time-value in favor of the portion that is in the money. To investigate this possibility, we separately calculate the full option value and the depth at the time of exercise and report those amounts in columns 5 and 6 of Panel B. The average time value remaining at the time of exercise—the difference between full option value and depth—is reported in column 7.

We find that on a per-share basis, executives realize profits between \$20 and \$40 when they exercise options. In addition, the exercise timing is slightly early in that between \$1 and \$4 of time-value per share is lost due to the early exercise. On average between 1996 and 2000 executives surrendered 10.4% of option value by early exercise. In contrast, in 2001, a year of poor market-wide performance, executives surrendered 12.5% of option value. Interestingly, in 2002 and 2003, executives surrendered only 8.8% and 6.9%, respectively, of option value, indicating that as the average option value and profit associated with each option drops, executives are less willing to forgo the time value of options.

We also observe an interesting pattern for the average year prior to expiration of options exercised. Specifically, in 2000 executives' exercised options with a remaining life of 6.07 years to expiration, significantly higher than in any other year. This pattern suggests that executives had some knowledge about the upcoming

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<sup>4</sup> We thank Steve Huddart for providing the algorithm used in their study.

market decline. Given that executives face a liquidity discount because they cannot sell company granted options (Kahl et al. 2003) and that this discount is not captured in the Barone-Adesi and Whaley (1987) algorithm, our results indicate that on average executives' exercise timing may be close to optimal.

From descriptive statistics of the sample firms in Panel C, we note that firms in our sample are relatively large, with a median (mean) market capitalization of \$1.1 (\$7.28) billion. Less than 75% of the sample firms pay any dividends, and the average dividend yield is 1%.

### 3 Empirical findings

#### 3.1 Abnormal returns for exercise and non-exercise firms

##### 3.1.1 Abnormal returns for exercise firms

In this section, we examine the extent to which executive option exercises *per se* are motivated by private information. To begin, we replicate the analysis conducted by Carpenter and Remmers (2001) and examine whether executive option exercises are associated with significant subsequent returns. Carpenter and Remmers hypothesize that executive option exercises should be associated with sales of shares acquired, implying negative subsequent returns if the exercises are motivated by private information. However, they found that this is not the case in their full-scale data analysis. Their data span 12 years from 1984 through 1995. Our data complement theirs by spanning from 1996 through 2003. We will describe our procedure for dealing with non-exercise firms in sub-section 3.1.2.

To remove repetition of observations, when a firm has multiple option exercises in a month, we treat each firm-month as one observation. We measure abnormal returns in two periods. The first period starts on the day after stock options are exercised and continues to the end of the following month. When a firm has multiple option exercises in a month, we use the first exercise for abnormal return measurement. The second period consists of 12 consecutive monthly returns starting in the second month following the stock option exercises. Since corporate insiders were required to report stock option exercises by the 10th day of the following month during the time span of our data, our first period is designed to capture returns available only to corporate insiders.<sup>5</sup> The second period is designed to capture the market's lagged reactions to executive option exercises since by the beginning of the second period the stock option exercises are public information. The primary reason for this separation is that prior research on insider trading found substantial lagged market reactions, implying that the stock market can only gradually assimilate information contained in insider transactions (for example, Lakonishok and Lee 2001).

<sup>5</sup> Before the 2002 Sarbanes-Oxley act, corporate insiders were required to report their transactions by the 10th day of the following month. The act reduced the reporting delay to two business days.



**Table 2** Abnormal returns for exercise and non-exercise firms

Month	Returns after option exercises ( $N = 31,045$ )		Returns after non-exercise years ( $N = 42,934$ )	
	Monthly returns	Acc. returns	Monthly returns	Acc. returns
1st period	0.014 (12.92)			
2nd period				
1	0.000 (0.38)	0.000 (0.38)	0.004 (4.19)	0.004 (4.19)
2	0.001 (1.04)	0.000 (0.32)	0.007 (8.11)	0.009 (7.37)
3	0.001 (1.43)	0.001 (0.74)	0.006 (6.56)	0.014 (8.83)
4	0.002 (2.09)	0.002 (1.06)	0.008 (8.69)	0.022 (11.44)
5	0.002 (2.38)	0.004 (1.88)	-0.002 (-2.24)	0.022 (10.07)
6	0.001 (0.65)	0.005 (2.16)	0.002 (2.71)	0.026 (10.88)
7	0.002 (1.79)	0.006 (2.16)	-0.001 (-0.84)	0.028 (10.50)
8	0.003 (3.07)	0.010 (3.34)	-0.004 (-4.38)	0.029 (10.00)
9	0.001 (1.31)	0.013 (3.90)	0.003 (3.24)	0.033 (10.20)
10	0.002 (2.11)	0.014 (3.95)	0.008 (6.82)	0.040 (10.71)
11	0.001 (1.08)	0.017 (4.34)	-0.011 (-10.79)	0.042 (9.63)
12	0.000 (0.31)	0.018 (4.42)	0.005 (4.65)	0.033 (6.99)

Monthly returns are size-adjusted (abnormal) monthly returns, and Acc. returns are accumulated size-adjusted (abnormal) monthly returns. For the option exercise sample, abnormal returns for the first period are from the date of exercises to the end of the next month; the second period includes 12 monthly abnormal returns starting from the second month following exercises. A firm-year is identified as a non-exercise firm-year if, at the end of each calendar year, no options were exercised by its top executives during the previous year. For the non-exercise sample, abnormal return for month  $i$  is the size-adjusted (abnormal) monthly return during the  $i$ th month in the following calendar year

When calculating abnormal returns, we adjust for risk using CRSP size-adjusted abnormal returns as in prior literature.<sup>6</sup> Our results are reported in Table 2. The second and the third columns of Table 2 contain the results for the replication of Carpenter and Remmers (2001). The second column presents the monthly abnormal returns and the third column presents cumulative abnormal returns starting in the second month after option exercises. Our evidence is consistent with that of Carpenter and Remmers (2001). Not only do we fail to find any significant negative abnormal returns following stock option exercises, all returns in the first period and the second period are positive. In the first period, the abnormal return is 1.4% with a  $t$ -statistic of 12.92. In the second period, 4 out of the 12 monthly abnormal returns are significantly positive, with  $t$ -statistics above two; the rest of the monthly returns are positive but not statistically significant at conventional levels. Thus, at this stage, similar to Carpenter and Remmers (2001), we find no evidence of executives exercising options to exploit bad news.

<sup>6</sup> As will be discussed later, to verify whether our results are robust under alternative risk adjustments, we also conduct risk adjustment using the four-factor Fama-French model.

### 3.1.2 Abnormal returns for non-exercise firms

We now turn our attention to the prospect that executives may delay exercising options to exploit good news. To construct the non-exercise sample, for each firm-year, we first identify firms in our sample universe that have executive options outstanding and then identify those that had no option exercises in the current calendar year.<sup>7</sup> We measure monthly size-adjusted abnormal returns in the year following the non-exercise year and report the results in columns four and five of Table 2. We omit the first period because there is no comparable first period for the non-exercise sub-sample and otherwise repeat the analysis for the exercise-and-keep-all sub-sample.

Our evidence is consistent with the notion that some insiders hold their options when they have positive private information. In 8 out of the 12 months, abnormal returns are significantly positive, and most of the positive abnormal returns are concentrated in the first half the year. There are 3 months where the abnormal returns are significantly negative. However, the cumulative abnormal return for the full year is 3.3%, with a *t*-statistics of 6.99. We note that executives' possessing positive private information for the non-exercise sample is necessary but not sufficient to drive our observed results. The other condition that is that stock market only gradually understands the implication of the non-exercise decisions.

## 3.2 Partitions for exercise firms

### 3.2.1 Partition on timing of subsequent sales

An underlying assumption of prior research is that shares acquired by exercising options are sold immediately, therefore predicting a negative abnormal return subsequent to exercise if the exercise is based on private information. However, as mentioned earlier, not all option exercises can be construed as sales of the shares acquired. In particular, dividend and tax incentives might prompt an exercise-and-hold strategy as a means, similar to a stock purchase, of exploiting private good news, leading to a prediction of positive abnormal returns subsequent to exercise. With this prospect in mind, we partition our sample based on the timing of subsequent disposition of the shares acquired as a proxy for whether an option exercise more closely resembles a stock sale or a stock purchase. Specifically, we identify two sub-samples based on whether all shares or no shares are sold within 30 days of exercise, which we label as sell-all and keep-all respectively.<sup>8</sup> Thirty days is appropriate for several reasons. It is sufficient time to sell given a consumption or diversification motive. By selling within a month an executive need only file one report of trades with the SEC. A month is the unit of time that we use

<sup>7</sup> To make sure that a company has options, we use option grant data and option holding data reported in SEC form 3, 4 and 5. For option grants, we first collect all option grant data and select the time for the earliest option grant for each firm. We assume that the company has executive options outstanding after this date.

<sup>8</sup> In analysis not reported here, we also look at a sub-sample with partial sale of shares. The abnormal returns observed are between the sell-all or keep-all sample. This result is available upon request.

to define our observations. And we measure returns on a monthly basis.<sup>9</sup> While it is clear-cut to identify the sell-all sub-sample by examining the executives' trading records immediately following stock option exercises, to ensure that we do not misclassify any transaction to the keep-all sub-sample, we take a conservative approach and require that the executives engage in no stock market transactions following the option exercise.

We find that out of 30,054 firm-month exercise observations in our sample, only in 14,876 cases are the shares acquired sold within 30 days of option. In 8,864 cases no shares are sold within 30 days, and in 6,314 cases some but not all shares are sold. This finding starkly contradicts the maintained assumption in prior literature that all shares are sold immediately after exercise. Accordingly, we believe that more accurate predictions on the information content of the option exercises can be obtained by conditioning on the executives' decision to sell after exercises.

For the sell-all sub-sample, we hypothesize that executives possess negative private information. For the keep-all sub-sample, we hypothesize that executives may possess positive private information and find it optimal to exploit that information by exercising the stock options and receiving cash dividends and (perceived) tax advantaged position.<sup>10</sup> Our results for the sell-all and keep-all sub-samples are reported in Table 3. Panel A presents size adjusted abnormal returns. Panel B presents abnormal returns based on the Fama-French's four-factor model (described below) as a robustness check.

The second and third columns in Panel A contain the results for the sub-sample where all shares are sold within 30 days. Although compared with the general results obtained from the whole sample, abnormal returns are more negative for this sub-sample, in terms of absolute magnitude, we find only weak evidence that this sell-all sample is associated with negative private information. Of all the monthly abnormal returns that we examine, only the first (post-reporting) month of the second period features significant negative abnormal returns.

The results for the keep-all sub-sample (the last two columns) are consistent with our conjecture that executives are exploiting good news. In the first return period, the size adjusted abnormal return is 3.4% with a  $t$ -statistic of 14.32. In the second return period, three out of the 12 monthly abnormal returns are significantly positive (with  $t$ -statistics above 2). The cumulative abnormal return in the second period is 4.1%. Combining the two periods, the exercise-hold sub-sample is associated with a total of 7.5% cumulative abnormal returns over a 13-month period. This highly significant result reaffirms the importance of further conditioning executive stock option exercises on the decision to sell.

To verify whether the results we obtain in Panel A are robust under alternative risk adjustments, we sort stocks into calendar portfolios and run time series regressions based on the Fama-French four-factor model:

$$R_{j,t} - R_{f,t} = \alpha_j + \beta_j(R_{m,t} - R_{f,t}) + \delta_j SMB_t + \sigma_j HML_t + \phi_j UMD_t + \varepsilon_{j,t}$$

<sup>9</sup> Reducing the time frame from 30 days to five business days yields qualitatively similar results.

<sup>10</sup> During our sample period gains to employee stock options were taxed as ordinary income and stock capital appreciation where stock is held for more than 1 year was taxed at a lower capital gains rate.

**Table 3** Abnormal returns following option exercises: partition on the sale of shares

Month	Returns after sell-all type exercises ( <i>N</i> = 14,876)		Returns after keep-all type exercises ( <i>N</i> = 8,864)	
	Monthly returns	Acc. Returns	Monthly returns	Acc. returns
<i>Panel A: Monthly returns are size-adjusted</i>				
1st period	0.000 (0.33)		0.034 (14.32)	
2nd period				
1	-0.003 (-2.55)	-0.003 (-2.55)	0.006 (3.06)	0.006 (3.06)
2	-0.002 (-1.45)	-0.006 (-3.28)	0.005 (2.68)	0.009 (3.52)
3	0.000 (-0.19)	-0.006 (-2.90)	0.003 (1.71)	0.011 (3.35)
4	0.001 (0.85)	-0.007 (-2.57)	0.002 (1.27)	0.012 (3.27)
5	0.003 (2.21)	-0.004 (-1.40)	0.001 (0.55)	0.014 (3.20)
6	-0.001 (-0.90)	-0.005 (-1.24)	0.002 (0.87)	0.017 (3.40)
7	0.002 (1.36)	-0.005 (-1.37)	0.002 (1.00)	0.016 (3.01)
8	0.000 (0.23)	-0.004 (-1.09)	0.005 (2.76)	0.025 (3.95)
9	-0.001 (-0.58)	-0.002 (-0.48)	0.003 (1.70)	0.032 (4.24)
10	0.003 (2.05)	-0.001 (-0.27)	0.003 (1.75)	0.034 (4.47)
11	0.000 (0.27)	0.001 (0.22)	0.002 (1.31)	0.039 (4.65)
12	-0.002 (-1.85)	0.001 (0.25)	0.002 (1.10)	0.041 (4.66)
<i>Panel B: Monthly returns are the estimates of alphas obtained from the four factor returns</i>				
1st period	0.007 (0.36)		0.025 (4.45)	
2nd period				
1	-0.006 (-1.20)	-0.006	0.004 (1.21)	0.004
2	-0.011 (-1.98)	-0.017	0.009 (2.85)	0.013
3	0.005 (0.80)	-0.012	0.007 (2.05)	0.020
4	0.000 (-0.04)	-0.012	0.007 (1.85)	0.027
5	-0.002 (-0.51)	-0.014	0.001 (0.20)	0.027
6	-0.006 (-1.38)	-0.021	0.010 (2.66)	0.038
7	-0.003 (-0.59)	-0.024	0.009 (2.51)	0.047
8	0.001 (0.12)	-0.023	0.004 (1.24)	0.052
9	0.002 (0.34)	-0.021	0.011 (2.60)	0.063
10	0.002 (0.41)	-0.019	0.009 (2.18)	0.072
11	0.001 (0.32)	-0.017	0.007 (2.09)	0.080
12	0.008 (1.16)	-0.010	0.003 (0.80)	0.083

In Panel A, Monthly returns are size-adjusted (abnormal) monthly returns, and Acc. returns are accumulated size-adjusted (abnormal) monthly returns. The sample is partitioned into 2 portfolios based on the number of shares sold immediately by executives after the exercises. Sell-all (keep-all) type exercise means that executives sold all (none of) the shares from exercises within 30 days after the exercises. Abnormal returns for the first period are from the date of exercises to the end of the next month. The second period includes 12 monthly abnormal returns starting from the second month following exercises. In Panel B, Monthly returns are the estimates of alphas obtained from the four factor returns by regressing calendar-time equally weighted portfolio returns on the four factor returns, i.e., SMB, HML, UMD and Market. For the first period, the factor returns are compounded two-period returns

where,  $R_{j,t}$  is firm  $j$ 's stock return;  $R_{f,t}$  is the risk-free rate, measured as 1-month treasury bill rate;  $R_{m,t}$  is the market portfolio return, measured using the CRSP value-weighted index;  $SMB_t$ ,  $HML_t$  and  $UMD_t$  are the size, market-to-book, and momentum factor returns, respectively.<sup>11</sup> The momentum factor is included because past returns are positively correlated with both current period returns and the option exercise decisions. The intercept (Jensen's alpha) is the abnormal return unexplained by the risk factors. Portfolios are formed in calendar time according to whether a firm is classified as an exercise and sell-all or keep-all. Firm and factor returns are then measured for the following one to 13 months. Separate time series regressions are run for each portfolio-month configuration, and the intercepts are reported in Panel B.

The results in Panel B are qualitatively similar to those in Panel A. In particular, we found strong results for the keep-all sub-sample and weak results for the sell-all sub-sample. In general, the regression alphas (Panel B) are very similar to the size adjusted returns in magnitude (Panel A). The strong consistency between the two panels suggests that risk adjustment is not a deciding issue in our study. We therefore adopt the simpler and more data-preserving method of using size-adjusted returns in analyses that follow.

Reflecting on the weak evidence of informed trading for the sell-all sub-sample, the power of our test is plausibly reduced by executives' consumption and diversification motivations to sell shares acquired. A finding of insignificant abnormal returns for sell transactions is a robust phenomenon in the insider trading literature (Seyhun 1998; Lakonishok and Lee 2001). One unique contribution of this study is that we can design more powerful tests to distinguish the information incentive from simply consumption and diversification incentives by conditioning on characteristics of the stock options that are being exercised, something not possible with open market transactions data. To pursue this advantage, we now turn to the next section.

### 3.2.2 Partition on the opportunity costs of exercises

As discussed earlier, executives incur opportunity costs when they choose to exercise options before they expire. The opportunity costs arise because corporate insiders cannot sell their company granted stock options in open markets; hence, they lose the time-value remaining in the options when they exercise early to exploit private information. To the extent that they trade off potential gains to informed trades against opportunity costs, then in equilibrium the intensity of executive's transactions private information should be positively correlated with the proportion of option value lost. This tradeoff should apply to both positive and negative private information.

We measure opportunity cost of early option exercises as the ratio between time-value (the difference between option value and intrinsic value) forgone and total option value on the exercise day. Because our analysis is conditional on option characteristics and in each month multiple options could be exercised for some firms, we can only conduct analysis at the transactions level. This is in contrast with

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<sup>11</sup> The factor returns are obtained from Ken French's website.

Table 3, where the analysis is at the firm level, and multiple transactions in a month are regarded as one observation. In Panel A, we sort option exercises into five equally weighted quintile portfolios based on the time-value to option value ratio and measure size-adjusted abnormal returns following option exercises. Abnormal returns are further divided into two periods in the same way as in Table 3.

The results in Table 4 strongly support our hypothesis that the magnitude of abnormal returns following option exercises is positively correlated with the opportunity cost of options. For the sell-all sub-sample, the average time-value to option value ratio varies from 0.2% to 37.5% from portfolio 1 to portfolio 5. The abnormal returns in the first period are significantly negative for all portfolios except portfolio 2. As we move from portfolio 1 to portfolio 5, the general trend is for abnormal returns to become increasingly negative. Moreover, for the 12-month abnormal returns starting from the second month following the exercises, such abnormal returns for all the portfolios except portfolio 1 are negative. To verify this relationship, in Panel B we report the results of regressing abnormal returns on the ranks of time-value.<sup>12</sup> The coefficients are significantly negative for both the first period returns ( $-0.002$ ,  $t$ -statistic  $-2.98$ ) and the second period returns ( $-0.010$ ,  $t$ -statistic  $-4.30$ ), implying that gains (or avoidance of losses) from executives' sell decisions are positively correlated with their opportunity costs.

Similar results are found for the keep-all sub-sample. In Panel A, as we move from portfolio 1 to portfolio 5, abnormal returns increase monotonically: for the first period, they increase from 2.1% in portfolio 1 to 6.4% in portfolio 5; for the second period, they increase from 1.9% to 12.7%. Regression results reported in Panel B are consistent, with estimated coefficients of 0.011 ( $t$ -statistic 6.67) for the first period and 0.027 ( $t$ -statistic 4.67) for the second period, implying that gains to executives' keep-all decisions are positively correlated with the opportunity costs associated with exercising the options.

### 3.2.3 Partition on the depth of options

In addition to the time-value partition discussed in the preceding section, we also consider partitioning the sample based on option depth. When executives exercise options and sell the shares, if the trade reflects good timing in the sense that the stock price declines after the transaction, there is a possibility that they will be accused of illegal insider trading. However, in defending their actions, executives could point to the fact that by holding company securities as well as fully investing their human capital in the firm, they are underdiversified and, by receiving compensation in the form of options, they must exercise in order to consume. Thus, as an option goes deeper in the money, these motives, especially the diversification incentive, can be used as a disguise for trades based in part on negative private information. Therefore, for the sell-all sub-sample, we hypothesize that the depth of the stock option is negatively correlated with post-exercise abnormal returns. We further hypothesize that this effect would be more pronounced when the options are exercised early because late exercises are explainable by the pending expiration of

<sup>12</sup> The independent variable is ranked from 0 to 4 in pooled population.

**Table 4** Abnormal returns following option exercises: partition on time-value

*Panel A: Portfolio analysis*

Type	T.V. rank	N	Avg. T.V. %	1st period returns	T	2nd period returns	T
Sell-All	1	7,718	0.002	-0.004	(-2.28)	0.037	(4.70)
	2	7,719	0.017	-0.003	(-1.57)	-0.022	(-2.92)
	3	7,719	0.058	-0.012	(-5.62)	-0.068	(-10.23)
	4	7,719	0.140	-0.010	(-4.58)	-0.006	(-0.74)
	5	7,718	0.370	-0.011	(-4.90)	-0.022	(-2.87)
Keep-All	1	2,273	0.001	0.021	(5.91)	0.019	(1.59)
	2	2,273	0.014	0.029	(6.34)	0.001	(0.03)
	3	2,274	0.063	0.041	(7.53)	0.030	(1.69)
	4	2,272	0.177	0.048	(8.88)	0.052	(2.71)
	5	2,273	0.534	0.064	(11.02)	0.127	(5.43)

*Panel B: Regression analysis*

Dependent variable	Intercept	Time-value rank
Sell-All	1st period returns	-0.004 (-2.51)
	2nd period returns	0.004 (0.77)
Keep-All	1st period returns	0.019 (5.00)
	2nd period returns	-0.008 (-0.55)

Time-value is calculated as  $1 - (\text{stock price} - \text{strike price}) / \text{option value}$ , where option value is calculated following the approximation in Barone-Adesi and Whaley (1987). Sell-all and keep-all option exercises are partitioned into quintiles based on option time-value and future size-adjusted (abnormal) returns are calculated for each quintile. Abnormal returns for the first period are from the date of exercises to the end of the next month. The second period includes 12 monthly abnormal returns starting from the second month following exercises

the option contract. Of course, if disguising exploitation of bad news is not at work, or if other motives dominate, then we should find no association or possibly a reverse association between depth and subsequent abnormal returns. For the keep-all sub-sample, however, the diversification and consumption incentives do not apply. This is unlike the opportunity cost consideration that applies in situations with either positive or negative private information. We further note that the depth and the time-value of options are negatively correlated. Therefore, even if depth by itself has no effect on abnormal returns, it is likely to pick up a correlation due to its negative correlation with time-value. However, contrary to our hypothesis, this induced correlation is positive because high (low) depth suggests low (high) time value, which further suggests more (less) negative abnormal returns based on the results in sub-section 3.2.1. Our results are presented in Table 5.

Similar to Table 4, in Panel A of Table 5 we first sort option exercises into three age groups: “early” if options are expiring in more than 6 years, “late” if less than 4 years, and “medium” if in between. Within each age group, we further sort exercises into equally weighted quintile portfolios based on the depth of options scaled by the stock price and measure post-exercise abnormal returns. In Panel B, we report the results of regressing abnormal returns on the depth ranks of options within each age portfolio.

The results are consistent with our predictions. For the sell-all sub-sample in Panel A, we observe that first and second period negative abnormal returns are associated with both the timing of exercise and the depth of the options. In particular, we note that for portfolio 5 (highest depth) within the early group, the abnormal returns are  $-2.0\%$  ( $t$ -statistic  $-3.23$ ) for the first period and  $-16.4\%$  ( $t$ -statistic  $-7.99$ ) for the second period. These results are in sharp contrast with findings in the insider trading literature that provides no evidence of negative abnormal returns for sell transactions. For the sell-all sub-sample, from the regression results in Panel B, we see that the coefficients on the depth of options are negative for both the first period and the second period and significantly so for the latter period with an estimate of  $-0.036$  ( $t$ -statistic  $-7.05$ ).

Moving to the keep-all sub-sample, we find that the results are mixed, which is reasonable since the diversification-disguise explanation more strongly applies to situations where executives exploit negative private information. Although regression coefficients are positive though not significant for all three age groups in the first period, they are significantly negative for all three age groups in the second period. These negative coefficients, however, are an artifact of the negative correlation between the depth and time-value. In further analysis, we find that the coefficients on depth become insignificant when we include time-value as a control variable. However, the significance of the coefficient for the sell-all sub-sample is not reduced when time-value is included.

#### 4 Concluding remarks

In this paper, we find evidence that executive option exercise and sell or hold decisions are partly motivated by private information. We find strong evidence that



**Table 5** Abnormal returns following option exercises: partition on depth

Panel A: *Portfolio analysis*

Type	Option age	Depth rank	N	Avg. depth	1st period returns	T	2nd period returns	T
Sell-All	Early	1	2,199	0.317	-0.014	(-4.60)	-0.001	(-0.13)
		2	2,200	0.528	-0.008	(-2.09)	-0.022	(-1.86)
		3	2,200	0.678	-0.003	(-0.73)	-0.010	(-0.56)
		4	2,200	0.805	-0.013	(-2.62)	-0.054	(-3.17)
		5	2,199	0.931	-0.020	(-3.23)	-0.164	(-7.99)
Medium	Medium	1	3,506	0.367	-0.003	(-1.47)	0.049	(6.39)
		2	3,506	0.589	-0.008	(-3.40)	0.003	(0.28)
		3	3,507	0.723	-0.012	(-4.33)	-0.043	(-4.52)
		4	3,506	0.834	-0.006	(-1.73)	-0.030	(-2.92)
		5	3,506	0.949	-0.011	(-2.42)	-0.064	(-4.38)
Late	Late	1	2,012	0.275	-0.003	(-1.16)	0.016	(1.68)
		2	2,013	0.540	-0.011	(-3.77)	0.013	(1.06)
		3	2,013	0.696	0.001	(0.40)	-0.024	(-2.14)
		4	2,013	0.816	-0.004	(-1.11)	0.003	(0.27)
		5	2,013	0.942	-0.007	(-1.47)	0.106	(5.32)
Keep-All	Early	1	644	0.150	0.034	(4.73)	0.120	(4.18)
		2	643	0.395	0.020	(2.63)	0.107	(2.74)
		3	645	0.571	0.056	(5.37)	0.067	(2.58)
		4	644	0.754	0.043	(3.45)	0.034	(0.72)
		5	643	0.925	0.028	(1.93)	-0.087	(-1.62)
Medium	Medium	1	894	0.261	0.049	(7.44)	0.038	(2.06)
		2	895	0.515	0.036	(4.64)	0.081	(2.35)
		3	894	0.669	0.034	(5.84)	0.051	(2.33)

**Table 5** continued

Type	Option age	Depth rank	N	Avg. depth	1st period returns	T	2nd period returns	T
		4	895	0.804	0.056	(5.82)	0.019	(0.82)
		5	894	0.939	0.057	(5.77)	-0.001	(-0.04)
	Late	1	734	0.244	0.036	(4.07)	0.133	(3.39)
		2	735	0.499	0.037	(6.00)	0.020	(0.66)
		3	735	0.664	0.043	(5.81)	0.079	(3.91)
		4	735	0.793	0.028	(4.60)	0.013	(0.62)
		5	735	0.925	0.042	(5.33)	0.021	(0.84)

*Panel B: Regression analysis*

Dependent variable	1st period returns		2nd period returns		
	Intercept	Depth rank	Intercept	Depth rank	
Sell-All	Early	-0.009 (-2.36)	-0.002 (-1.07)	0.021 (1.70)	-0.036 (-7.05)
	Medium	-0.005 (-2.19)	-0.001 (-1.36)	0.035 (4.23)	-0.026 (-7.70)
	Late	-0.005 (-1.70)	0.000 (-0.08)	-0.011 (-1.02)	0.017 (3.93)
Keep-All	Early	0.034 (4.01)	0.001 (0.37)	0.146 (4.65)	-0.049 (-3.81)
	Medium	0.039 (6.27)	0.004 (1.39)	0.066 (3.16)	-0.014 (-1.65)
	Late	0.036 (6.40)	0.000 (0.16)	0.099 (4.55)	-0.023 (-2.58)

An option exercise is an early (late) age exercise if the option expires in more than 6 years (less than 4 years). Depth is calculated as stock price minus strike price, deflated by stock price. Sell-all and keep-all type exercises in each age group are partitioned further into quintiles based on their depth. Size-adjusted (abnormal) returns for the first period are from the date of exercises to the end of the next month. The second period includes accumulated monthly abnormal returns for 12 months starting from the second month following exercises

executives possess positive private information when they refrain from option exercises for a prolonged period. We also confirm the Carpenter and Remmers (2001) result that executive option exercises as a whole do not indicate any negative private information. We show, however, that the null result is due to the fact that a maintained assumption in prior literature does not hold in data: not all executives sell their acquired shares after option exercises; about 30% of option exercises are followed by no share sales within 30 days. Partitioning the option exercises on whether the shares are sold within 30 days, “keep-all” if no shares are sold and “sell-all” if all shares are sold, we found strong evidence that the keep-all sub-sample is associated with positive private information and weaker evidence that the sell-all sub-sample is associated with negative private information.

To enhance the power of tests and identify situations where it is more likely to find private information motivated options exercises and subsequent trades, we consider several factors that may be important when executives make portfolio decisions. We identify two factors for which we can create proxies from options data. First, given that executives must incur opportunity costs by sacrificing time-value of options when they exercise early to exploit private information, we hypothesize that profits to informed trading are weighed against opportunity costs, measured as the ratio between time-value lost and total option value; the greater the opportunity cost, the higher the expected profits as measured by abnormal returns must be for options to be exercised. Second, to the extent that executives can justify their exercise and sell decisions as motivated by consumption or diversification when their options are deeply in the money, the depth of the options (deflated by the stock price) can be said to proxy for disguise when executives exploit negative private information. Therefore, we hypothesize that the higher the depth of the options, the more negative abnormal returns will be following exercise and sell transactions. We find strong evidence in support of these two hypotheses. This is in sharp contrast with the general null result for sell transactions in the insider trading literature.

The data reveal that not all executives sell their shares after option exercises. However, the explanation for such behavior is unclear. MacDonald (2003) demonstrates that, under positive private information and current tax policies, it is only optimal to exercise the options and hold the shares if the firm also pays sizeable dividends. Otherwise the executives can profit more by holding the options and purchasing additional shares. This is true in spite of the ordinary income versus capital gains tax differentials. We find mixed results for the dividend capture conjecture: the average dividend yields are significantly higher for the keep-all sub-sample than for the sell-all sub-sample; 1.26% and 0.55%, respectively. However, we do not find significant differences in abnormal returns when we further partition the exercise and hold firms based on dividend yield. Apart from our findings for an exercise-and-hold strategy, the results for a non-exercise strategy of holding the option rather than the stock are consistent with MacDonald’s (2003) theoretical prediction. We believe that this aspect of inquiry is both novel and worth special notice.

While not theoretically optimal as shown by MacDonald (2003), the exercise-and-hold strategy as a tax-planning tool should not be completely ruled out. Given

that we are examining the investment decisions of individual (albeit sophisticated) investors, they may make mistakes similar to those made by tax professionals (for example, Scholes et al. 2005). Another possibility is that investors are influenced by psychological factors (Heath et al. 1999; Thaler and Benartzi 2004; Barber and Odean, 2000 and 2001). Finally, although we found little evidence to support such a possibility, it could be that some firms impose shareholding requirements on their executives so that the executives cannot sell the shares acquired through option exercises.

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