FEATURE

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STATISTICS CORNER

How Statisticians Discovered the Options Backdating Scandal

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8.1 Introduction

A **stock option grant** is a contract made between a corporation and another entity in which, on a specified **exercise date**, the corporation agrees to buy or sell a specified number of shares of its stock for a fixed price called the **exercise price**. Such a contract can be quite valuable if the difference between the exercise price and the stock's trading price on the exercise date is large. For example, suppose that a company executive received the option of purchasing $100{,}000$ shares of a company at an exercise price of $\$35$ on January 31. If the stock trades at $\$55$ a share on January 31, then this contract is worth $100{,}000 \times (\$55 - \$35) = \$2{,}000{,}000$. Thus, it is to the executive's advantage for his options to have a low exercise price, coupled with a high share market price on the exercise date. The latter point is the purpose of the stock option grants—such grants incentivize executives to increase the fundamental value of their companies. The former point is the root of the options backdating debacle.

Options backdating is the practice of marking the grant date of an option with a date prior to date on which the decision to grant the option was made. This is not in general a problem—companies have the right to enter into any agreement and award any compensation according to their internal compensation policies so long as they properly report such awards to their shareholders and the IRS. So that options grants are not counted against company earnings, they must be issued with exercise prices at or above the stock price on the grant date. In the vernacular, these are called **out-of-the-money** (or **at-the-money**) option grants. By contrast, options have a positive value on their grant date are counted against earnings and are called **in-the-money** grants.

Executives desire higher compensation. However, by receiving stock options with grant dates on which stock prices were at a minimum, executives are able to obtain maximal compensation without having to report reduced earnings. Of course, it is difficult to predict stock price minima in the short-term before they occur. Unsurprisingly, however, it is easy to determine such minima *ex post*.

Prior to the 2002 Sarbanes-Oxley reforms, stock option grants could be reported months after the actual grant date, leaving a situation ripe for abuse. The empirical evidence of Lie [L2] demonstrates that, statistically speaking, the probability that such abuse did not occur is impossibly small. Although initial studies such as Yermack [Ye] suggested that executives used insider information to inform the scheduling of option grant dates, Lie's analysis shows conclusively that this explanation is not sufficient to explain the data and that the only reasonable possibility proposed so far is that many option grants were backdated in order to maximize executive compensation. This analysis will be the subject of the remainder of this article.

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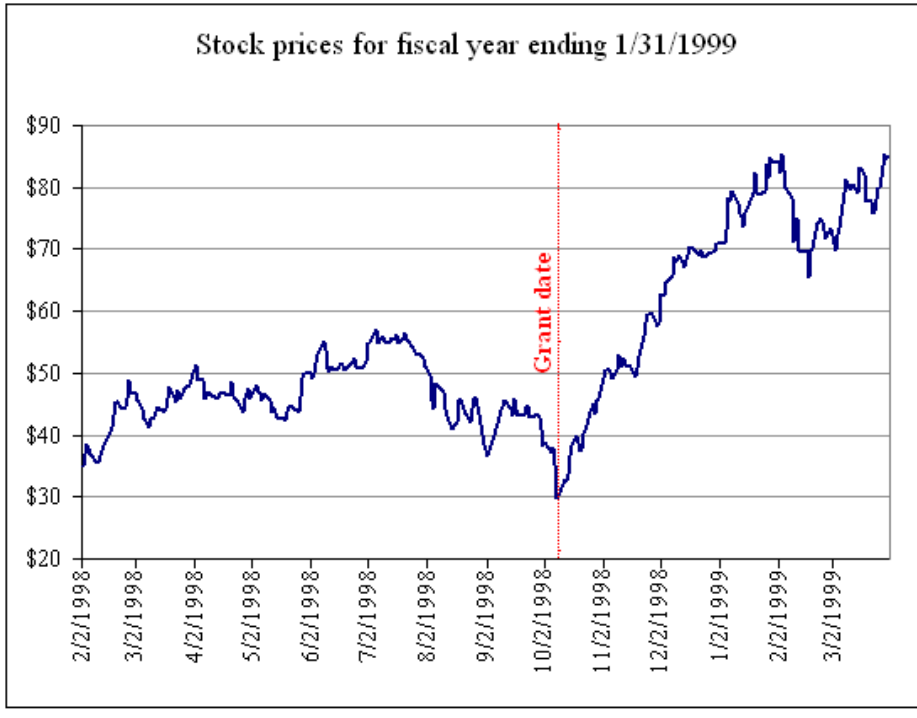

Figure 8.1: Used with permission from Lie [L1].

8.2 Evidence of Option Backdating

Several studies including Chauvin and Shenoy [CS], Yermack [Ye], and Aboody and Kasznik [AK] examined the periods around stock option grants, yielding conflicting results regarding abnormal stock returns before and after stock option grants. However, all of these studies focused on scheduled stock option grants, making their data less reactive to the opportunistic behavior of company executives. Lie [L2] innovatively focused on **unscheduled grants** during the period from 1992–2002, *i.e.*, those grants which were not dated within a week of the grant dates from the previous year.

Lie [L2] sought to answer two questions:

1. Were stock prices on days surrounding stock option grants abnormal?

2. If so, could this abnormality be explained by company executives having inside information about the future returns of their stock?

A negative answer to the second of these questions implies the practice of option backdating.

The first question is reasonably straight forward to answer. Lie used the three factor Fama-French model (see [FF]) to create a baseline for each stock's expected market returns and then compared each company's actual returns to those predicted by the model. This allowed Lie to test whether the stock price was significantly lower at the option grant date than the market would otherwise predict. Abnormal returns in this test would prove that abnormal returns occurred around the grant date but not whether insider information was being used. After all, abnormal returns are being compared to the market, so relative returns are specific to individual companies. The

literature has not shown whether or not company executives can accurately predict short term stock price patterns.

The Fama-French three factor model (8.1) was proposed in 1993 by Eugene Fama and Ken French [FF] as a generalization to the widely known Capital Asset Pricing Model (CAPM):

$$R_s - R_f = \beta_1 \times (K_m - R_f) + \beta_2 \times (\mathrm{SMB}) + \beta_3 \times (\mathrm{HML}) + \alpha \tag{8.1}$$

It predicts a stock's returns R_s by a regression of previous returns against overall market returns R_m, the difference between high book-value to price and low book-value to price stock returns HML and the difference in returns between small and large cap stocks SMB (after standardizing using the riskless interest rate R_f). The intercept term for the stock returns is denoted α. As SMB and HML are differenced terms, the R_f standardization cancels out in both cases. This model (8.1) is widely accepted; it is effective as an approximate prediction of returns for individual stocks given knowledge of the returns of other stocks and of general market behavior.

Lie calculated the regression coefficients using the stock price information from the year prior to fifty days before the option grant date. He then used these coefficients to calculate predicted stock prices during the interval surrounding the stock option grant, using standard linear regression techniques. These estimates theoretically allow for a reasonable comparison between the actual stock value and the overall behavior of the market, allowing Lie to isolate firm-specific trends from overall market behavior.

The graph in Figure 8.2 shows the dramatic statistical deviation of average stock prices from their predicted levels around the option grant date for nonscheduled option grants before and after the 2002 Sarbanes-Oxley reforms regulating the use of stock options for executive compensation. The interpretation of the observed patterns is unmistakable. Grants are frequently awarded on dates which correspond to local minima of stock prices and are correlated with the reporting requirements of their corresponding firms. We thus have an answer to the first question: stock prices on days surrounding stock option grants are statistically abnormal.

Having answered the first question, Lie then turned to the second. Could Yermack's [Ye] theory of executive insider information and option grant timing explain the apparent predictive ability of the executives receiving the stock grants? In order to test this, Lie used a logistic regression to determine the factors defining the choice to grant stock options on a particular day, regressing against not only the individual stock's returns but also the returns of the market as a whole. The logic was simple: If executives are working off of inside information, they should be able to predict changes in returns that on the individual firm level but not those on the market level. If, however, the grant appears to be decided not only by the individual stock returns but also by the returns of the market as a whole, the executive options must have been granted *ex post*.

In general, a logistic regression is used when a binary outcome (0 or 1) is being determined. In this case, the binary decision is whether to grant options on a particular date. For the dataset, Lie used the actual option grant dates, and then randomly selected five dates in the six-month range surrounding the option grant for each company (resulting in a total of $10,003$ observations) and set the dependent variable equal to 1 for the actual grant dates and to 0 for the random dates.

For regression coefficients, Lie used both the abnormal (stock-specific) stock market returns and the predicted (market level) stock returns for the intervals of 30–10 days before, 10–5 days before, 5–2 days before, 2–0 days before, 0–2 days after, 2–5 days after, 5–10 days after, and 10–30 days after the grant. He controlled for seasonality by adding dummy variables for each month of the year (eight actual return variables, eight predicted return variables, and eleven month variables in total). In the equation (8.2) below, (MONTHS) is the column vector of seasonal dummy controls, $(\mathrm{ABNORMAL})$ is the column vector of stock-specific returns for each of the listed intervals, and $(\mathrm{PREDICT})$ is the column vector of predicted (market level) stock returns, and $X = (x_{i,j})$ is a data matrix with observations as rows, with the appropriate values for each observation component.

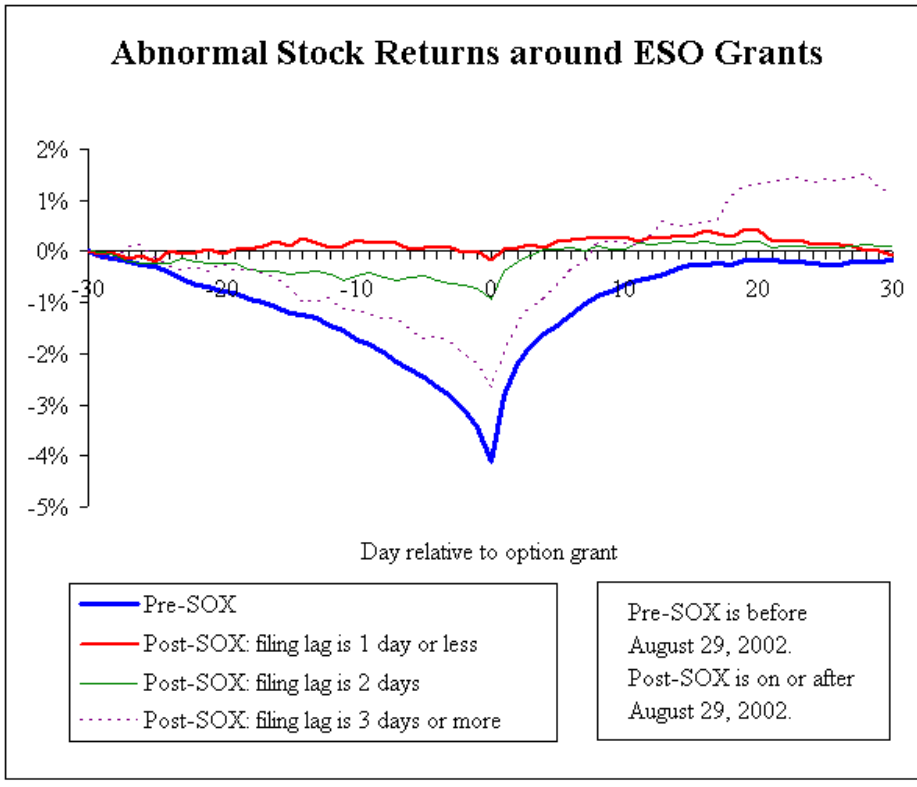

Figure 8.2: Used with permission from Lie [L1].

$$\begin{aligned}\text{logit}(p_i) = \ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 &+ (\text{MONTHS}) \cdot (x_{1,j}, \ldots, x_{11,j}) \\ &+ (\text{ABNORMAL}) \cdot (x_{12,j}, \ldots, x_{19,j}) \\ &+ (\text{PREDICT}) \cdot (x_{20,j}, \ldots, x_{27,j})\end{aligned} \tag{8.2}$$

Using the estimates derived from this regression, Lie found that the abnormal returns for the regressed intervals to be significant in predicting the "decision" to grant options. He also determined that the overall market predicted returns were very significant in the four days surrounding the option grants. This result conclusively showed that unless executives can effectively predict market level fluctuations in stock price, they must be backdating the options to minimize the grant date price.

8.3 Conclusion

By using standard OLS regression in the Fama-French model and then using logistic regression on the stock returns surrounding the dates of option grants to model the option grant decision, Lie was able to uncover a multi-billion dollar fraud that was occurring in a recently estimated 18.9% of

all ESO grants. These simple applications of statistical models have sent shockwaves through the corporate landscape, reinforcing the need for the Sarbanes-Oxley reforms of 2002.

Acknowledgements

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References

[AK] David Aboody and Ron Kasznick: CEO stock option awards and the timing of corporate voluntary disclosures, *Journal of Accounting Economics* **29** (2001), 73–100.

[CS] Keith W. Chauvin and Catherine Shenoy: Stock price decreases prior to executive stock option grants, *Journal of Corporate Finance* **7** (2001), 53–76.

[FF] Eugene F. Fama and Kenneth R. French: Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* **33** (1993), 3–56.

[L1] Erik Lie: Backdating of executive stock option (ESO) grants, `http://www.biz.uiowa.edu/faculty/elie/backdating.htm`.

[L2] Erik Lie: On the timing of CEO stock option awards, *Management Science* **51** #5 (2005), 802–812.

[Ye] David L. Yermack: Good timing: CEO stock option awards and company news announcements, *Journal of Accounting Economics* **34** (1997), 449–476.