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Market valuation of employee stock options

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Abstract

This study investigates whether investors incorporate the value of a firm's outstanding employee stock options into its stock price. I estimate the outstanding options' value for a sample of firms for which outstanding fixed options exceed 5% of outstanding common shares in 1988. I find a negative correlation between the value of outstanding options and a firm's share price. The correlation is stronger (i) for the option's intrinsic value than for the option's time value, (ii) for options that are later in their vesting stage than earlier in their vesting stage, and (iii) for large firms than for small firms. In addition, the FASB's method for calculating compensation expense has no explanatory power in the presence of this paper's calculation of the options' value.

Key words: Employee stock options; Option pricing models; Firm value

JEL classification: G3; J3

1. Introduction

During the 1980s, the number and size of employee stock option (ESO) plans increased dramatically. One reason for the prevalence of stock option plans is their favorable accounting treatment. According to current Generally Accepted Accounting Principles (GAAP), a charge to earnings is not required at the grant date if the option's exercise price is at least as high as the stock price. In June

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1993, the Financial Accounting Standards Board (FASB) issued an exposure draft entitled *Accounting for Stock-Based Compensation.* The draft would have required companies to calculate the value of an ESO grant by using an option pricing model and charging this value to earnings. The exposure draft met with strong opposition that focused on the difficulty of accurately estimating the value of an ESO at the grant date if existing option pricing models were used. In October 1995, the FASB issued Statement of Accounting Standard (SFAS) No. 123, in which it modified its position by allowing firms discretion over whether the estimated value of options would be charged to earnings or disclosed in footnotes to the financial statements. However, the FASB reaffirmed its decision that firms are required to use an option pricing model for calculating the value of ESO grants.

This study investigates whether and how investors incorporate the value of ESOs into stock prices, and the valuation implications for the FASB's proposal. Unique characteristics of ESOs, such as vesting schedule and nontransferability, distinguish them from traded stock options. Because of these differences, the available option pricing models are inappropriate for pricing ESOs. In the first step of my paper, I modify the binomial model (developed by Cox, Ross, and Rubinstein, 1979) so that it can be used to price an ESO.[1]

In addition to the question of how to price ESOs, there is currently a dispute on whether or not the value of ESOs really affects security valuation.[2] For example, Robert Saldich, chief executive officer of Raychem Corp., argued: 'Granting a stock option to an employee is a nonevent from the standpoint of the stock market' (*The San Francisco Chronicle*, November 2, 1993). In contrast, Bernard Marcus, founder and CEO of Home Depot, said: 'If the proposal becomes effective, Home Depot stock price will fall' (*BNA Pensions & Benefits*, Daily, March 14, 1994).

To investigate this issue, my first analysis tests whether investors incorporate the value of a firm's outstanding ESOs into its share price. The market valuation

[1]Additional papers pertaining to estimation of ESO price include Wygandt (1977), who suggests applying the Black–Scholes model without modifications when estimating ESO price. A lower bound for ESO value is suggested by Smith and Zimmerman (1976). Huddart (1994) constructs a theory that implies that existing option pricing models are inadequate for estimating ESO price since risk-averse employees will exercise their options before expiration. Investigations on whether early exercise can be predicted are conducted by Carpenter (1994) and Huddart and Lang (1995). Rubinstein (1994) shows that different assumptions can lead to material deviations in ESO prices. Cuny and Jorion (1995) perform an analysis that shows that incorporating the probability of departure as a function of stock price increases the option's price. Alford and Boatsman (1995) use an empirical approach to examine the prediction of long-term stock return volatility.

[2]An earlier study by Foster et al. (1991) investigates the materiality of ESO compensation expense, but provides no evidence on whether investors incorporate the value of outstanding ESOs into a firm's share price.

test is conducted by estimating the value of all outstanding options for each firm at the end of its fiscal year by applying my modified option pricing model (hereafter termed ESO value). Subsequently, I examine the association between ESO value and stock prices through a cross-sectional price-level regression. Compensating employees with ESOs rather than cash can be attractive to firms, since ESOs provide long-term incentives and might reduce agency problems. Therefore, ESO value affects share prices in two opposing ways: it dilutes the value of the firm's outstanding stock, and yet provides incentives to employees to increase the firm's stock price.[3] Accordingly, we expect a negative (positive) association between ESO value and firms' share prices if the dilution is larger (smaller) than the expected impact on future performance.

The results from the price-level regression show that a dollar of ESO value reduces firm value by $1.35 on average. This suggests that the dilution effect dominates the incentive effect. Further investigation reveals that there is a positive relation between firm value and options that are early in the vesting stage, and a negative relation between firm value and options that are later in the vesting stage. One explanation for this is that the more time passes from the option's original grant date, the more its benefits are incorporated into earnings and book value, while earnings and book value do not include the cost. In addition, I find that the intrinsic value of vested options is the major factor leading to the negative association between ESO value and stock prices. This evidence is consistent with the interpretation that once an option is vested, it is likely to be exercised. Therefore, the expected value of the remaining incentive effect diminishes, and the unexercised vested option becomes a net cost to the firm's shareholders.

In my second analysis, I reestimate ESO value precisely as suggested by the FASB's staff draft. Specifically, the FASB's proposal does not allow firms to adjust over time the ESO value for changes in the underlying stock parameters. Retesting the association between the FASB's ESO value and stock price yields a significant association in only three out of eight years. In contrast, when firms can change the underlying parameters, the ESO value calculation leads to a significant association with share prices in all eight years.

The second analysis concentrates on the balance sheet, an approach that does not precisely reflect the FASB's stated motivation for valuing ESO grants. The FASB staff draft advocates an income statement approach that discloses the value of option grants. This approach is intended to improve investors' understanding of reported income. Hence, I investigate whether an income statement approach has an incremental explanatory power beyond that of the balance sheet approach. I calculate the compensation expense according to the FASB's method and find it has no explanatory power in the presence of this paper's

[3]In addition, ESO grants might be used to signal firm value to investors.

calculation of ESO value. This result suggests that the requirement that firms use the FASB's method to charge the value of granted options to earnings might reduce the informativeness of the reported income.

Since 1979, accounting and finance literature has documented several anomalies related to firm size. The final portion of my paper examines whether there is a firm-size effect. The results show that in small firms there is no significant association between ESO value and stock prices, but there is a significant negative association for large firms. There are two possible reasons: small firms are followed by less sophisticated investors who have difficulty interpreting the valuation implications of ESOs.[4] An alternative reason for this result is that ESOs in small firms generate stronger incentives than ESOs in large firms, causing their benefit in small firms to offset their cost.[5]

The remainder of the study is organized as follows. The empirical design is presented in Section 2. Section 3 describes the modified option pricing model. Section 4 describes the sample selection and data, and Section 5 presents descriptive statistics for the sample. The valuation analysis results are described in Section 6, and Section 7 presents the summary and discussion.

2. Empirical design

In June 1993, the FASB issued an exposure draft that required firms granting ESOs to employees to recognize compensation expense. However, due to unprecedented opposition, the FASB issued SFAS 123 in October 1995, allowing firms discretion over whether compensation expense is charged to earnings or disclosed in footnotes to the financial statements. The standard reaffirmed the FASB's position that whether firms choose to disclose or recognize compensation expense, they must use an option pricing model to estimate the fair value of ESOs at the grant date. I design this paper's empirical analysis to provide evidence on the following two issues.

2.1. Is ESO value associated with a firm's share price?

To address this question, I use a model that includes book value of equity, accounting earnings, and ESO value for firm valuation. ESO value is calculated

[4]The following assertion was made by the FASB in its exposure draft: 'Only the most sophisticated users of financial statements can reasonably estimate the impact of recognizing all compensation costs. Many individual investors and other users of financial statements could not.'

[5]Another possible explanation is a size-related bias in the estimation of ESO value. Sensitivity analysis results that are not reported in the paper do not support this conjecture.

by applying a modified option pricing model to each firm's outstanding options for each year between 1983 and 1990.

Empirical evidence documents a positive correlation between contemporaneous firms' performance and executives' total compensation, but evidence regarding improved firms' performance due to incentive plans for nonexecutive employees is inconclusive.[6,7] Therefore, assuming the cost and benefit of outstanding options are incorporated into the current stock price, the following conjecture can be investigated: in a cross-sectional price-level regression, a negative (positive) association between ESO value and firms' share prices is expected if ESO value is larger (smaller) than its future benefit. No association will be observed if the future benefit from ESOs exactly offsets their value or if ESO value is irrelevant to investors in valuing a firm.[8]

In testing the above conjecture, I assume the net value of outstanding options is incorporated into the firm's share price. Therefore, the current stock price already reflects the effect of compensating with stock options. However, when pricing the options I ignore future options grants that should increase future stock prices. Consequently, the option pricing model applied in this study underestimates the current outstanding options' value. However, as long as this paper's valuation of options is monotonic in the unobservable investors' calculation of the option price, the above conjecture can be investigated.

In addition, I conduct several investigations to determine which attributes of ESOs investors consider when determining their net value. First, I test whether investors' estimate of ESO value depends on the option's vesting stage. Benefits from granting options include savings on training new employees by binding current employees to the firm, and increased productivity by employees who would like the share price to rise. Therefore, more of the options' benefits are incorporated into earnings and book value as time passes from the initial grant date, while the cost of outstanding options is not reflected in earnings or book value. Consequently, it is possible that with the passage of time the option's cost is greater than its benefit. In contrast, it is also possible that the market perceives the incentives created by options to be larger than their cost independent of the option's vesting stage.

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[6]The classification of an employee as an executive officer is provided by the firm in its proxy statement. I therefore classify nonexecutive officers as nonexecutive employees.

[7]A partial list of papers concentrating on CEO compensation includes Murphy (1985), Lewellen et al. (1992), and Jensen and Murphy (1990). Some studies focusing on top and mid level executives are Gerhart and Milkovich (1990) and Lambert et al. (1993). Examples of papers on merit pay schemes for nonexecutive employees are Greene and Podsakoff (1978), Latham and Dossett (1978), Pearce and Perry (1983), and Cohen and Murnane (1985).

[8]The conclusions that can be drawn from the accounting valuation model regarding the size of the coefficient on ESO value are limited to the extent of the measurement error in the calculation of ESO value.

Second, I investigate whether investors value the intrinsic value of the option (share price minus exercise price) differently than the option's time value (total option's value minus intrinsic value). The intrinsic value is calculated by using the current share price and the option's exercise price. In contrast, the time value calculation requires estimation of the option pricing model parameters. Therefore, the time value calculation creates significant measurement difficulties compared to the intrinsic value calculation.

Third, in the last 20 years, several anomalies related to firm size have been documented in various accounting and finance studies. I therefore investigate whether firm size affects the association between ESO value and firms' share prices.

2.2. How value-relevant is the FASB's suggested method?

The method proposed by the FASB for calculating the option's price allows several adjustments to the option's price. The method accounts for early exercise by using the option's expected life rather then its maximum term. Reduction in ESO price due to employment termination can be incorporated by estimating the number of options expected to vest or by recognizing the effect of actual forfeitures when they occur. However, the FASB's method does not allow for adjustment due to changes in stock price, dividend yield, risk-free interest rate, or stock price volatility. I therefore estimate the value of firms' outstanding options by applying the FASB method, and test how the FASB's estimate of ESO value correlates with share prices. Furthermore, I investigate whether the FASB's method for calculating compensation expense has explanatory power in the presence of this paper's calculation of ESO value.

3. The modified option pricing model

This section provides a modified option pricing model, for use in the valuation analysis, to estimate ESO value. Although option pricing models are widely used by options traders, special provisions attached to ESOs require the modification of such models to measure ESO price. The basic model used in this paper is the binomial (CRR) model developed by Cox, Ross, and Rubinstein (1979). To price an ESO, the CRR model must be modified to account for the following differences between ESOs and traded stock options.

Premature Job Termination: The ESO price must be adjusted downward to account for the probability of employment termination. I obtain this probability from a 1977 census survey that contains employee tenure by industry.[9] Job

[9]This is the last survey conducted that explicitly obtained information on job tenure. All other government publications contain information on employee turnover, which is influenced by

tenure is the number of years that workers stay employed in a certain industry, and the annual probability of employment termination is set equal to one over the job tenure. This simplification is made because the survey contains insufficient observations to measure the actual tenure distribution.[10]

Vesting Schedule and Premature Job Termination: ESOs can be exercised only after the employee holds them for a previously specified period. Therefore, during the vesting period, the ESO price is equal to the price of an unexercised ESO multiplied by the probability the employee remains with the firm until the option vests.

Nontransferability: Since ESOs cannot be transferred, the employee must exercise the ESO and sell the stock in order to realize the gain. To estimate the reduction in a vested option's price attributable to nontransferability, I construct an early exercise distribution for each year. I do this by observing each firm's past years' early exercise conditioned on the proportion of vested in-the-money options. Subsequently, the early exercise distribution is the average of the early exercise of all firms in the sample. Therefore, the probability of early exercise is adjusted as we progress in time. The assumption of fixed probability for early exercise is supported by a study conducted by Carpenter (1994) who shows that a model assuming constant probability for cancellation of options predicts actual early exercise as well as a model that considers wealth and risk aversion.[11] Thus, the price of a vested ESO is equal to the price of an unexercised option multiplied by the probability the employee holds the option plus the intrinsic value of the option multiplied by the probability of early exercise.

Taxes: For an option classified as a nonqualified stock option (NQSO), the difference between the share price and the exercise price at the exercise date is

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seasonal hiring of temporary workers which generally receive no options. The survey includes nonexecutive employees and reports a range of tenure between 10 and 20 years (the Coopers and Lybrand, 1993, survey reports similar forfeiture rates). A discussion of the issue with consulting firms yielded a report of a 30-year executive tenure, which is consistent with the Coopers and Lybrand finding that companies with broad-based plans had higher forfeiture rates. As such, I underestimate the value of executives' options. However, sensitivity analysis results indicate a low estimation error. This is because of the short vesting schedules exhibited by the sample firms.

[10]Cuny and Jorion (1995) develop a theory in which they argue that the probability of executive employment termination is negatively correlated with stock price performance. However, they provide no empirical evidence regarding the size of stock performance correlation with nonexecutive employment termination. Moreover, in this paper's specific sample, I find no significant association between employment termination and stock price performance.

[11]Huddart and Lang (1995) find several variables that explain early exercise (recent stock price movement, market-to-strike ratio, remaining option term, vesting schedule, and the proportion of grant remaining unexercised). In this paper, the early exercise distribution is conditional on stock price increase since the option's grant date, but not on the magnitude of that increase. The amount of noise introduced by this assumption is difficult to measure, because Huddart and Lang do not provide evidence on the predictive ability of their variables.

a tax deduction for the firm. Thus, assuming a constant tax rate, we need only multiply the option's price by one minus the current statutory tax rate.[12]

Long-term to Expiration: ESOs are generally granted with a term to expiration of ten years. During the life of the option, the underlying stock volatility and the payout ratio are not likely to remain stable. Nevertheless, I assume a constant stock volatility and payout ratio in this paper, since estimating their stochastic process is highly subjective.

In addition, the following parameters are needed for applying the CRR model: 1) current share price (S) and the dividend yield (δ), obtained from Center for Research in Security Prices (CRSP), 2) exercise or strike price (K), acquired from firms' financial statements, 3) time to expiration (N), extracted from the specific proxy statement that includes the stock options plan description, 4) stock volatility (σ), calculated by taking the standard deviation of the underlying stock returns for 100 trading days before the fiscal year end, 5) risk-free interest rate (r), retrieved from the CRSP bonds file. The interest rate is the average yield of zero-coupon U.S. government bonds with the same term to maturity as the option. The CRR model assumes that the stock price follows a binomial process over discrete periods. I choose a monthly period for this paper. Therefore, for a 10-year option, the CRR model is calculated for 120 periods.

The following formulae describe a two-period procedure for pricing an option:

$$C_u = (1 - \Gamma)(\max\{[pC_{uu} + (1 - p)C_{ud}]/r, uS(1 - \delta) - K\}) + \Gamma(\max\{uS(1 - \delta) - K, 0\}),$$

$$C_d = (1 - \Gamma)(\max\{[pC_{ud} + (1 - p)C_{dd}]/r, dS(1 - \delta) - K\}) + \Gamma(\max\{dS(1 - \delta) - K, 0\}),$$

$$C_v = \max\{[pC_u + (1 - p)C_d]/r, S\text{–}K\},$$

where $u = e^{\sigma^*\sqrt{N/n}}$, the probability of a share price increase; e = approximately 2.71828; $d = 1/u$, the probability of share price decrease; n = number of time periods in the option's life; Γ = probability of early exercise during the one-month period; $p = (r - d)/(u - d)$; C_u = price of the option in period 1 given that share price increased; C_d = price of the option in period 1, given that share price

[12]A time-dependent schedule of tax rates can be easily incorporated into the model. However, because predicting future statutory tax rate change is difficult, the current statutory tax rate is used. In addition, I do not adjust the tax savings for firms with tax-loss carryforwards, since that will involve predicting whether those carryforwards will exist in the future. Furthermore, I would also have to predict the probability that a currently profitable firm would be unable to use the tax savings in the future.

decreased; C_{uu}, C_{ud}, C_{dd} = three possible payoffs for the option at expiration (period 2) according to the share price path; and C_v = price of a vested option at the calculation date.

If the option has not yet vested, then the following formula is used: $C_{nv} = C_v * r^{-t/12} * (1 - \Phi)^t$ where C_{nv} = price of a nonvested option; t = number of months between the option's calculation date and the first vesting date; and Φ = monthly probability of employment termination. The final price of an option classified as NQSO is multiplied by one minus the current statutory tax rate.

The two-period procedure described above can be extended to price an ESO with any number of periods to expiration.

4. Sample selection and data

I construct the sample by locating all public firms with outstanding options at the end of fiscal year 1988. The firms are located by searching the NAARS library on the LEXIS/NEXIS services. I then extract from the financial statements' footnotes the number of outstanding fixed options at that date. These firms are then ranked by the ratio of outstanding fixed options to outstanding common stock. Finally, I choose only firms having a ratio over 5%, thus reducing the chance that immaterial dilution could obscure the valuation performed by investors.[13] The outcome of this process yields a sample of 672 firms.

Subsequently, I gather the following information for each firm in the sample for fiscal years 1980 to 1990:

1) Data pertaining to stock options is collected from two sources. The first is firms' financial statement footnotes, which contain tables detailing the number and prices of options granted, canceled, exercised, and outstanding, for the last three years. The second source is firms' proxy statements. The SEC requires that proxy statements contain the number and prices of ESOs granted and exercised by the top five executives. In addition, the proxy statements contain detailed terms of each proposed stock option plan, including the option's contractual term and its classification (incentive or nonqualified stock option).

2) Accounting information, obtained from the 1993 Compustat Industrial File.

3) Share data, extracted from the 1993 CRSP files.

[13]The valuation model and option pricing model are not precise; thus, firms with small amounts of stock options could obscure the valuation.

It is necessary to make (somewhat arbitrary) decisions to estimate ESO value:

1) *Exercise price for granted options*: When a range of prices is shown (approximately 60% of the firms), I choose the midpoint of the range. When the aggregate value of granted ESOs is disclosed (approximately 20% of the firms), the exercise price is the aggregate value divided by the number of ESOs.

2) *Exercised options*: Approximately 90% of the firms show a range of exercise prices. For these firms, I subtract the number of options exercised by the top five executives from the total number of exercised options. In addition, I subtract the number of options exercised by all other executives (around 32% of the firms provide explicit information regarding the exercise by all other executives). For nonexecutive employees, I calculate the average exercise price by using information from the statement of changes in owners' equity. In addition, firms provide information on the range of exercise prices that includes the minimum and maximum exercise price. I then subtract proportionally from the outstanding options that are in the range of prices of the exercised options, thus maintaining the average exercise price.

3) *Forfeitures*: Approximately 45% of the firms disclose no price information. Here, the canceled options are subtracted proportionately from the number of outstanding options.[14]

4) *Grant date*: Approximately 85% of the cases provide no grant date in the financial statements. For 45% of the firms the grant dates to executives are used (obtained from the proxy statement). The end of the fiscal year is used for the remaining 40%.

5) *Vesting schedule*: Approximately 18% of the firms specify no vesting schedule. In that case, the most common vesting schedule is chosen.[15]

6) *Classification of the stock option plan*: Approximately 35% of the cases specified the plan as both incentive and nonqualified stock option (ISO and NQSO). The plan is assumed to be ISO up to December 1986, and NQSO thereafter. This assumption is made because plan classification is at the firms' discretion.[16]

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[14]For example, consider a firm with 10 outstanding options with 10 years to expiration and 20 outstanding options with nine years to expiration. If three outstanding options are canceled, I subtract one option from the 10 outstanding options and two options from the 20 outstanding options.

[15]For firms specifying in the plan description that the vesting schedule is at the discretion of the compensation committee, the options are assumed to vest 25% per year beginning one year after the grant date.

[16]The Tax Reform Act of 1986 eliminated most of the benefits to employees from classifying ESOs as ISOs. Specifically, after December 1986 the capital tax rate was set equal to the income tax rate. Consequently, firms classified exercised ESOs as NQSOs, which allowed them to benefit from tax deductions.

I perform an analysis using the ESOs data retrieved from firms' footnotes and proxy statements, and the above decisions. The result is a database for every fiscal year from 1983 to 1990. The database contains the number of outstanding options, grant dates, exercise prices, terms to expiration, vesting schedules, and the ESO classification. I use the data available for fiscal years 1980 to 1982 to create the database for the 1983 fiscal year. Of the original 672 firms I eliminated 162 firms strictly abiding by APB 25, and 32 firms not available on Compustat. This yielded a final sample of 478 firms.[17]

Elimination of these 194 firms could yield a selection bias, since their average market value is smaller than the final sample's average market value. Furthermore, ESO value for these firms cannot be calculated, even by sophisticated investors. Therefore, the bias is toward accepting the hypothesis that information regarding employee stock options is impounded in prices. SFAS 123 requires extensive disclosure regarding options granted, canceled, exercised, and outstanding. As such, the standard, if adopted, will supply new information even for sophisticated users of financial statements.

5. Descriptive statistics for the sample

This section provides descriptive statistics for the sample of 478 firms. The section details the patterns found in the sample concerning reissuing and early exercise of options. In addition, the section includes analyses on the impact on net income of charging compensation expense and the accuracy of the modified option pricing model and the Black–Scholes model estimates for ESO value.

Descriptive statistics detailing ESO are presented in Table 1, panels A through F. Panel A reports the vesting schedules of ESOs. Since one objective of an option grant is to bind key employees to the firm, it is surprising that about 10% of the firms in the sample (48 firms) allow immediate exercise of stock options.

Panel B reports the sample's industry distribution and compares it with the Compustat population. Comparing my sample's industry distribution to Compustat's population reveals the frequency of manufacturing firms in my sample is higher than that in Compustat. Further investigation reveals that the higher frequency is mainly driven by the Electronic Components and Instruments industries (two-digit SIC codes 36 and 38).

[17]APB 25 requires the following disclosures: number of shares covered by each option, exercise price, number of shares that could be exercised, number of shares exercised, option price of exercised shares. This information is insufficient for conducting the analysis in this paper.

Table 1
Descriptive statistics for a sample of 478 public firms with broad-based ESO plans, 1983–1990

Panel A: Vesting schedule for 478 stock option plans

	Percentage of ESOs that vest each year							
NYEAR	0.17	0.2	0.25	0.3	0.33	0.5	1.0	Total
0	1	38	29	0	21	11	48	148
0.5	0	1	0	0	1	0	5	7
1	0	23	208	1	18	3	39	292
1.5	0	1	0	0	2	0	0	3
2	0	0	2	0	3	1	10	16
2.5	0	0	1	0	0	0	0	1
3	0	1	0	0	2	0	2	5
4	0	1	0	0	2	0	1	4
5	0	0	0	0	0	0	2	2
Total	1	65	240	1	49	15	107	478

NYEAR = number of years after the grant date that the employee needs to hold the ESO before it can be exercised. For example, *NYEAR* = 1 and percentage equals 0.25 indicates that the employee has to hold the options one year prior to exercise. Subsequently he can exercise them at a rate of 25% per year.

Panel B: Industry distribution based on two-digit SIC code

Industry classification	SIC code	# of firms	% in sample	% in Compustat
Agriculture	0–9	2	0.420	0.480
Mining & Construction	10–19	13	2.720	8.050
Food & Chemicals	20–29	74	15.48	13.37
Manufacturing	30–39	189	39.54	25.62
Transportation & Utilities	40–49	23	4.810	7.670
Wholesale & Retail	50–59	53	11.09	11.46
Finance, Insurance & Real Estate	60–69	43	9.000	19.72
Services	70–99	81	16.94	13.63
		478	100.0	100.0

% in sample = number of firms in each two-digit SIC code divided by the total number of firms in the sample (478). % in Compustat = number of firms in the two-digit SIC code in Compustat (includes the NYSE, Nasdaq, and Research files) divided by the total number of firms in Compustat.

Table 1 (continued)

Panel C: Number of occurrences of firms canceling out-of-the-money options and issuing new options with a lower exercise price (termed reissuing)

Fiscal year	1984	1985	1986	1987	1988	1989	1990	Total
Number of reissuings	3	8	12	33	16	21	23	116

In this panel 19 firms reissued twice, 4 firms reissued three times, and 1 firm reissued four times.

Panel C (continued): Description of the annual industry-adjusted return for reissuing firms

	All reissuing firms	Firms reissuing from 10/87 to 9/88
Number of observations	116	31
Mean	− 0.390	− 0.210
Median	− 0.372	− 0.282
First quartile (25 percentile)	− 0.177	− 0.017
Third quartile (75 percentile)	− 0.598	− 0.381
Industry-adjusted return > 0	10	6
t-statistic for mean = 0	− 11.72	− 4.599

Industry-adjusted return is the reissuing firm's raw return minus the mean return for firms in the same four-digit SIC code. The size-adjusted return is calculated using 253 trading days before the day the reissuing is announced.

Panel D: ESO value as a function of firm's age

Age in years	% in CRSP	% in sample	ESO value divided by MV		ESO value divided by earnings	
			Median	Mean	Median	Mean
0–5	40.5	52.9	0.0295	0.0376	0.100	0.266
6–10	7.80	9.40	0.0347	0.0429	0.076	0.490
11–15	32.4	21.4	0.0277	0.0363	0.064	0.253
16–20	4.50	4.80	0.0296	0.0390	0.060	0.217
21–66	14.8	11.5	0.0247	0.0281	0.062	0.306

Age in years is calculated by taking the fiscal year end date, subtracting from it the date of the firm's initial public offering and dividing by 365. The resulting number is rounded to the nearest integer. % in CRSP = percentage of firms in each age category divided by all publicly traded companies in the NYSE and Nasdaq stock exchanges on December 31, 1983. % in sample = percentage of firms in each age category divided by 478 firms (each firm appears only once in the table based on its age at its first appearance in the sample). ESO value divided by market value = ESO value calculated by the modified option pricing model scaled by the firm's market capitalization. ESO value divided by earnings = ESO value calculated using the FASB's suggested method divided by the firm's net earnings. The FASB's suggested method allows no adjustment in the option's value for changes in stock price, dividend yield, risk-free interest rate, or stock price volatility. To adjust for employment termination I use the actual forfeitures. To adjust for the expected life I use the mean of the early exercise distribution calculated for the modified option pricing model.

Table 1 (continued)

Panel E: Mean and median percentages of options which are exercised from one to ten years after the grant date

Number of years after the grant date	ESO granted with 10 years to expiration		ESO granted with 5 years to expiration	
	Mean	Median	Mean	Median
1	1.70%	0.00%	5.70%	0.00%
2	18.9%	15.1%	25.7%	20.7%
3	18.8%	16.8%	25.6%	19.3%
4	14.8%	11.7%	19.1%	12.0%
5	9.90%	8.60%	11.5%	6.70%
6	6.60%	4.20%	NA	NA
7	5.00%	1.70%	NA	NA
8	2.50%	0.00%	NA	NA
9	1.30%	0.00%	NA	NA
10	0.40%	0.00%	NA	NA
Sum	79.9%	58.1%	87.6%	58.7%

The mean and median percentages of granted options that are exercised are calculated by observing each firm's past years' actual exercise conditional on the proportion of vested in-the-money options. The percentage is calculated for each year between 1983 and 1990. This panel presents a summary statistic for the whole sample (478 firms) and for all fiscal years.

Panel F: Testing the accuracy of the modified option pricing model and the Black–Scholes model by comparing the ex-ante estimate for ESO value to its ex-post realization

Years of ex-post data	1	2	3	4	5	6
Number of observations	2718	2362	1899	1468	1050	665
Panel 1 – Error from Black–Scholes model: abs(Black–Scholes ESO value – ex-post ESO value)						
Mean	0.0228	0.0249	0.0280	0.0277	0.0260	0.0239
Median	0.0106	0.0125	0.0132	0.0117	0.0111	0.0112
Standard deviation	0.0481	0.0441	0.0524	0.0550	0.0414	0.0353
Ex-ante > ex-post	65.3%	73.7%	81.5%	83.6%	85.4%	87.5%
Panel 2 – Error from modified model: abs(modified model ESO value – ex-post ESO value)						
Mean	0.0214	0.0183	0.0173	0.0162	0.0143	0.0129
Median	0.0105	0.0086	0.0076	0.0066	0.0055	0.0051
Standard deviation	0.0376	0.0314	0.0369	0.0380	0.0278	0.0227
Ex-ante > ex-post	30.2%	44.0%	55.1%	60.6%	63.7%	59.9%

Table 1 (continued)

Panel 3 – Error from modified model – error from the Black–Scholes model						
Median	0.0004	– 0.0024	– 0.0044	– 0.0049	– 0.0047	–0.0046
Mean	– 0.0014	– 0.0066	– 0.0108	– 0.0115	– 0.0117	–0.0109
BS more accurate	54%	39%	27.3%	22%	11.8%	7.8%

All the variables are deflated by the firm's market capitalization.
Years of ex-post data = number of years of data subsequent to the ex-ante estimation that are used for observing the ex-post realization of the options' value.
Number of observations = number of firm years available for the analysis; each year of ex-post realized data added for calculating the ex-post ESO value reduces the sample by a year of data for which the analysis is impossible.
The ex-post ESO value is the aggregate value of exercised options during the period of the ex-post data plus the Black–Scholes value for the outstanding options at the end of the period.
Modified model = estimates of ESO value taking into account the option's special characteristics.
Black–Scholes model = estimating ESO value with an adjustment for dividends.

In panels 1 and 2, ex-ante > ex-post is the percentage in the sample in which the ex-ante estimate of ESO value exceeds the ex-post realized ESO value.

In panel 3, the error from the modified option model is abs(ESO value from the modified model minus the ex-post ESO value). The error from the Black–Scholes model is abs(ESO value from the Black–Scholes model minus the ex-post ESO value). The percentage in the sample in which the Black–Scholes model is more accurate than the modified model is called BS more accurate.

Panel C reports the number of reissuings in the sample, announced between 1983 and 1990.[18] I identify the set of firms reissuing options by reading their financial statements, particularly the proxy statements. Thus, I obtain the date, number, and prices of reissued options. Panel C shows that approximately 18% of the sample firms (116) reissued at least once between 1984 and 1990. Moreover, 5% of the sample firms reissued more than once during the period. Saly (1994) analyzes the repricing of employee stock options after a market-wide crash and finds that firms renegotiated after the crash on October 19, 1987. To extend Saly's research, I investigate whether the reissuing of options is a result of a market-wide downturn or of firm-specific performance. I therefore calculate the reissuing firm's annual raw return (based on 253 trading days before the reissuing date announcement) minus the average annual return for firms in the same four-digit SIC code (termed industry-adjusted return). Panel C shows that, on average, all firms that reissued options have an industry-adjusted return of

[18]Reissuing, often termed repricing, is the procedure of canceling out-of-the-money options and issuing new options with a lower exercise price. The reissuing decision often requires approval of the board of directors alone, and is justified by the fact that out-of-the-money ESOs have lost their incentive value.

− 39% (t-statistic of − 11.72). For firms reissuing up to a year after the 1987 stock market crash, the average industry-adjusted return is − 21% (t-statistic of − 4.599). Panel C results are consistent with the observation that industry-wide movement is not the sole reason for reissuing options.[19]

Panel D shows the value of firms' outstanding options and the impact of charging compensation expense to earnings as a function of firm age. Firm's age is calculated by subtracting the firm's initial public offering date from the first date the firm is included in the sample. The frequency of emerging firms (trading less than ten years) in my sample is higher than their frequency in the universe of publicly traded companies. Hence, a higher proportion of emerging firms grants substantial amounts of options to their employees compared to mature firms. However, for the firms included in this study, the average and median proportion of ESO value scaled by market value does not decline significantly with firm age. In addition, I calculate the expected impact on the net earnings if the FASB's method for calculating ESO value is adopted.[20] Panel D shows that the median impact on net earnings declines as a firm matures. However, the mean impact on net earnings is substantial (approximately 27%) and does not decline with a firm's age.

Panel E reports for the whole sample and for all fiscal years the mean and median percentages of options that are exercised between one and ten years after the grant date. The options' exercise is determined by observing each firm's history of options' exercise conditional on the proportion of vested in-the-money options. Interestingly, a large portion of ESOs (more than 50%) is exercised one to three years following the grant date. This suggests that early exercise is a prevalent practice that should be accounted for when valuing ESOs.[21] Moreover, if stockholders expect the grants of long-term options to provide long-term incentives, then the extensive amount of early exercise seems to work against this objective. In addition, 15% of outstanding options are canceled, on average, because of employment termination (median of 12%).[22] The average number of options canceled due to employment termination during

[19]I repeat the analysis with size-adjusted (decile), market-adjusted, and risk-adjusted return. Size-adjusted return is the reissuing firm's annual raw return minus the average annual return for firms in the same size decile. Market-adjusted return is the reissuing firm's annual raw return minus the average annual return for firms in the same stock exchange. Risk-adjusted return is the annual CAPM-adjusted return for the reissuing firm. The results of the three performance measures for all reissuing firms are similar to those reported in panel C.

[20]The FASB's suggested method allows no adjustment in the option's value for changes in stock price, dividend yield, risk-free interest rate, or stock price volatility. To adjust for employment termination during the vesting period I use the actual forfeitures. To adjust for the expected option life I use the mean of the early exercise distribution.

[21]Huddart and Lang (1995) also find that early exercise is a pervasive phenomenon.

[22]Options that were canceled as a result of reissuing are not included in this statistic.

the vesting schedule is 11.05% (median number 4.05%). The average number of out-of-the-money vested options canceled is 5.32% (median number 3.3%). Cuny and Jorion (1995) conjecture that the probability of executive employment termination decreases as a firm's stock price increases. If this conjecture is true, we should find that the amount of canceled, nonvested out-of-the-money options is significantly higher than canceled, nonvested in-the-money options. I find that on average 6.06% (median of 2.2%) of the canceled nonvested options are out-of-the-money. The average cancellation rate of in-the-money nonvested options is around 5% (median of 1.85%). Both the mean and median numbers do not significantly differ from one another. Therefore, in my sample, the probability of employment termination is not significantly correlated with stock price performance.

Panel F presents the results of testing the accuracy of the modified option pricing model and the Black–Scholes model. To conduct the analysis I compare the ex-ante ESO value estimates from both models to the ex-post ESO value. The ex-post ESO value, based on up to six years of future actual data, is the aggregate value of exercised options during the ex-post period plus the Black–Scholes value of the remaining outstanding options. For example, the ex-ante ESO value is calculated for a firm in December 1983. The ex-post value using six years of future actual data will include the value of options outstanding in December 1983 that were exercised between January 1984 and December 1989. In addition, the ex-post value will include the Black–Scholes value for options that are still outstanding in December 1989 (e.g., options that were not canceled or exercised between December 1983 to December 1989). The absolute difference between the ex-ante and ex-post estimate, deflated by the firm's market capitalization, is termed error. The panel shows that as more years of actual data are added to the ex-post calculation, the mean, median, and standard deviation of the error from the modified option model decreases. No clear pattern emerges for the error of the Black–Scholes model. Moreover, with only two years of actual data, the modified model is more accurate for 61% of the sample, with six years of actual data the percentage increases to 92.2%. The difference between the error of the modified model and the error of the Black–Scholes model stabilizes after three years of actual ex-post data. The mean (median) error from the Black–Scholes model is larger than the error from the modified model by 1% (0.5%).[23] The results in this panel support the conclusion that, for the majority of sample firms, the ex-ante distribution of early exercise and employment termination are consistent with their ex-post realization. Therefore, a model incorporating those probabilities displays less measurement error than a model which does not.

[23] When the error is deflated by the ex-post option's value, the mean error from the Black–Scholes is larger than the error from the modified model by 33%.

Table 2
Descriptive statistics on firms' characteristics, 3078 firm years, 1983–1990

Variable	Mean	Standard deviation	Median	First quartile	Third quartile
NOPTIONS	0.094	0.086	0.075	0.044	0.120
NEMP	8.106	33.22	0.738	0.219	3.000
NOPTOP5	0.311	0.299	0.233	0.047	0.494
NOPTOPALL	0.395	0.320	0.353	0.113	0.618
MARKETCAP	685.1	2644	51.16	16.45	173.7
SIGMA	0.571	0.351	0.462	0.322	0.661

The 3078 firm years include 1530 observations in NASDAQ and 1548 in NYSE.

NOPTIONS = number of options outstanding per share.
NEMP = number of employees (in thousands).
NOPTOP5 = percentage of ESOs grants to the top five executives out of the total ESOs grants.
NOPTOPALL = percentage of ESOs grants to all current executive officers out of the total ESOs grants.
MARKETCAP = market value in millions (number of common shares outstanding multiplied by price three months after fiscal year end).
SIGMA = annual volatility of stock return calculated using 100 trading days prior to fiscal year end.

Table 2 presents descriptive statistics on sample firms' characteristics. The median market capitalization for the sample is approximately $51 million, compared to a median market capitalization of $37 million for all public firms in the United States. The mean ratio of outstanding options divided by outstanding shares is 9.4%. The average grant of options to all current executive officers is around 39% of the total grant of options, indicating that most of the grants of options in my sample are to nonexecutive employees. Finally, the estimates of ESO value reported in this paper are based on volatility estimates calculated using stock returns for 100 days before fiscal year end. Alford and Boatsman (1995) examine empirically which past volatility measure best predicts future long-term stock return volatility. I find that the median volatility estimate using my method for calculating volatility is similar to the methods proposed by Alford and Boatsman.[24]

[24]In addition, I calculate the ESO value by applying both my method and the Alford and Boatsman methods. I find that calculating the volatility using the different methods does not materially affect the value of a firm's outstanding options.

6. Empirical tests and results

6.1. Testing the association between ESO value and share prices

To investigate whether ESO value is reflected in share prices of public firms with a broad-based option plan, I use a valuation model that relates the value of the firm to the information provided in the financial statements. The model used in this paper is similar to Ohlson (1991), and includes both accounting earnings and book value of equity for firm valuation.[25] The valuation model can be written as follows:

$$P_{it} = \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t} Y_{it} + \beta v_{it}, \tag{1}$$

where P_{it} is the market value of a firm's common stock at time t, X_{it} is the firm's accounting earnings over the period $(t-1, t)$, d_{it} is the firm's dividends over the period $(t-1, t)$ multiplied by $r/1+r$ (r is the one-year risk-free interest rate),[26] Y_{it} is the firm's book value at time t, and v_{it} is a vector of other value-relevant information. To mitigate heteroscedasticity, all the variables in Eq. (1) are deflated by the number of common outstanding shares.

The first investigation tests whether investors account for ESO value when determining a firm's market value, and is conducted by using the following model:

$$P_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t} Y_{it} + \delta_{1t} ESO_{it} + \mu_{it}, \tag{2}$$

where ESO_{it} is the estimated ESO value per share of firm i at time t.

The individual year's results (1983 to 1990) of testing Eq. (2) indicate that δ_{1t}, the coefficient on the ESO value, ranges between 5.95 and 10.06. The coefficient estimates significantly differ from zero in all fiscal years (two-tailed p-value of 0.001). However, these coefficient estimates are biased and inconsistent, since ESO_{it} is correlated with the error term (μ_{it}). This follows from the observation that Eq. (2) does not adequately explain the variation in P_{it}. Therefore, the error term includes omitted variables that explain P_{it}, and P_{it} is a component of the option pricing model that calculates the ESO value.[27]

An alternative to directly investigating whether ESO value is associated with firms' share prices is to examine whether investors consider firms' outstanding

[25] This paper does not adhere strictly to the Ohlson model, as I do not restrict the coefficients to equal the model's predictions.

[26] I use r equal to 10%. The results are insensitive to values of r between zero and 20%.

[27] The Hausman–Taylor test rejects the null of no correlation between ESO value and the error term at the 100% level for all eight fiscal years.

options when determining firms' share prices. This examination is conducted by applying the following model:

$$P_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t} Y_{it} + \rho_{1t} NOPTSUM_{it} + \mu''_{it}, \tag{3}$$

where $NOPTSUM_{it}$ is the number of outstanding options per share of firm i at time t.

The yearly results (1983 to 1990) of testing Eq. (3) show that the coefficient on firms' outstanding options is between -3.7 and -7.56. The coefficient estimate is significantly different from zero for seven out of the eight years (two-tailed p-value of 10%), suggesting that investors do consider firms' outstanding options when deciding share prices.[28] However, this test does not answer the more interesting question of whether and how investors value ESOs.

To address the market valuation of ESOs, I apply the technique of instrumental variables estimation. This estimation replaces ESO value with new variables that are both correlated with it and not correlated with the error term. Natural candidates for the instrumental variables are the number of options with one to ten years to expiration, as suggested by the following formula for calculating ESO value:

$$ESO\ value = \sum_{j=1}^{10} NOPTION_j * PRICE_j,$$

where $NOPTION_j$ is the number of outstanding options that expire in one to ten years and $PRICE_j$ is the price of those options calculated by the modified option pricing model.

There are two potential candidates for ESO value: The options' value as calculated by the modified option pricing model and the options' value calculated by the use of the Black–Scholes model. Using the Black–Scholes model (adjusted for dividends) is consistent with previous accounting literature. However, panel F results indicate that the modified option pricing model gives a more accurate estimate of ESO value compared with the Black–Scholes model. I therefore, in this study, use the ESO value calculated by applying the modified option pricing model.

The instruments chosen are well specified, since they satisfy both conditions mentioned above. First, they are correlated with ESO value (coefficient of multiple correlation between 0.349 and 0.472). Second, they are not correlated with the error term (orthogonality test results are presented in Table 3).

I use the two-stage least-squares (2SLS) estimation procedure to implement the instrumental variables approach. In the first stage, the option's value is

[28] Heteroscedasticity is detected in 1986 and 1990 (using the Breusch–Pagan test). To correct for this, the White standard errors are used in those years.

Table 3
Pooled fixed-effects estimation results for regression of price on net income, book value, and an instrumental variables approach for ESO value, separate intercept for each firm and each year, 478 public firms with broad-based ESO plans, 1983–90

Panel A: ESO value calculated using the modified option pricing model

$P_{it} = \alpha_0 + \alpha_1(X_{it} - d_{it}) + \alpha_2 Y_{it} + \beta_1 E\hat{S}O_{it} + \mu'_{it}$

	α_1	α_2	β_1	N	$\bar{R}^2$	$ORTH$
Coefficient estimates	1.584	0.734	− 1.315	3078	0.866	0.912
Two-tailed p-value	0.000	0.000	0.013			

Panel B: ESO value calculated using the Black–Scholes option pricing model

$P_{it} = \alpha_0 + \alpha_1(X_{it} - d_{it}) + \alpha_2 Y_{it} + \beta_1 ES\hat{O}BS_{it} + \mu'_{it}$

	α_1	α_2	β_1	N	$\bar{R}^2$	$ORTH$
Coefficient estimates	1.554	0.737	− 0.770	3078	0.866	0.884
Two-tailed p-value	0.000	0.000	0.027			

P_{it} = market value of common equity for firm i three months after fiscal year end.
X_{it} = net income for firm i during fiscal year t.
d_{it} = dividend for firm i during fiscal year t multiplied by $r/(1 + r)$, where r is the one-year risk-free rate.
Y_{it} = book value for firm i at fiscal year end t.
$E\hat{S}O$ = predicted value resulting from the following regression: $ESO_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10}\alpha_{jt}NOPTION_{jit} + \mu^*_{it}$, where ESO is the value of all outstanding options for each firm at the end of its fiscal year calculated by applying the modified option pricing model, $NOPTION$ is the number of outstanding options per share with one to ten years to expiration for firm i at fiscal year end t.
$ES\hat{O}BS$ = predicted value resulting from the following regression: $ESOBS_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10}\alpha_{jt}NOPTION_{jit} + \mu^*_{it}$, where $ESOBS$ is the value of all outstanding options for each firm at the end of its fiscal year calculated by applying the Black–Scholes (adjusted for dividends) model.
All variables are deflated by the number of common shares outstanding.
$ORTH$ is the two-tailed p-value for testing whether the error term (μ'_{it}) is orthogonal to the instruments used in the first-stage regression.

Observations with three or more standard deviations from the mean were removed; this reduces the sample by 68 firm years (2.16% of the original sample).

regressed on all predetermined variables and instruments, yielding the following equation:

$$ESO_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10} \lambda_{jt}NOPTION_{jit} + \mu^*_{it}, \qquad (4)$$

where $NOPTION_{jit}$ is the instruments – that is, the number of outstanding options per share that expire in one to ten years of firm i at time t.

In the second-stage regression, Eq. (2) is estimated, and ESO_{it} from Eq. (2) is replaced with the predicted value of ESO calculated in the first-stage regression (termed $E\hat{S}O$), yielding the following valuation model:

$$P_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t} Y_{it} + \beta_{1t} E\hat{S}O_{it} + \mu'_{it}. \tag{5}$$

To reexamine the association between ESO value and firms' share prices, I test Eq. (5). This examination is possible because the use of the instrumental variable technique yields a consistent estimator for ESO value. Moreover, the bias in the coefficient on ESO value is eliminated, because there is no correlation between the instruments and the error term.

The results of testing Eq. (5) for individual years (1983 to 1990) indicate that the coefficient on $E\hat{S}O$ fluctuates from -1.44 to -3.25 and is significant at the 10% level for all fiscal years (using a two-tailed p-value).[29] However, ESO value explains only a small part of the variation in the dependent variable. Adding $E\hat{S}O$ to the individual year regression that already includes book value and earnings increases the R^2 adjusted between 2% and 4%. In addition, I test whether the error term is orthogonal to the instruments.[30] The results show that the hypothesis of zero correlation between the error term and the instruments fails to be rejected at the 10% level for five out of the eight years. The orthogonality test results show that the instruments are well specified.[31]

The individual year results regarding the coefficient on $E\hat{S}O$ might be influenced by the correlation of ESO value with an omitted variable. To address this possibility, I pool all firms across years and estimate a fixed-effects regression, which includes a separate intercept for each firm and each year. Table 3 shows that the coefficient on $E\hat{S}O$, using the fixed-effects regression, is -1.315 (p-value of 0.013), suggesting that the coefficient on $E\hat{S}O$ is not driven by a fixed,

[29]Adding industry dummies, earnings growth, firm size, advertising expense, and research and development expense to Eq. (5) did not materially change the coefficient on $E\hat{S}O$.

[30]The test is described in the *Handbook of Econometrics*, edited by Griliches and Intriligator.

[31]The orthogonality test results show that a shock to price does not affect the instruments. To investigate this, I regress contemporaneous, lagged, and lead annual stock returns on the changes in options granted to executive and nonexecutive employees. Both regression results yield no significant coefficients on firms' contemporaneous, lagged, and lead annual stock returns. Moreover, the F-test for both regressions is insignificant in all eight years. These results indicate that the annual changes in ESOs granted to employees are poorly explained by firms' stock returns. However, the above test results are not comparable to the compensation literature that regresses firms' stock returns on the changes in the *value* of ESOs.

firm-specific omitted variable.[32] Furthermore, consistent with the individual year analysis, the increase in R^2 adjusted attributed to $E\hat{S}O$ is 1.96%.

The theoretical coefficient on ESO value should be close to minus one if the following conditions are met. First, investors estimate ESO value in an unbiased manner. Second, this paper's option pricing model is unbiased. Third, outstanding options generate no incentives. If ESOs generate incentives, then the coefficient on ESO value should be more positive. The result for the pooled regression shows that the coefficient on $E\hat{S}O$ is not significantly different from minus one (p-value of 0.719). However, in three out of the eight individual years, the coefficient on $E\hat{S}O$ is significantly smaller than minus one at the 10% level. Several explanations for the size of the coefficients on $E\hat{S}O$ are possible. First, there might be errors in measuring the parameters needed for estimating ESO value. Second, the ESO value might be correlated with investors' expectations regarding future ESOs grants. Third, my modified option pricing model might underestimate the ESO value because investors are using the unadjusted Black–Scholes model.

To test the third conjecture, I calculate the ESO price by using the Black–Scholes formula adjusted for dividends. The results, presented in Table 3, show that \$1 of option value calculated using the Black–Scholes formula reduces the firm's stock price by 77¢. Since the Black–Scholes formula does not account for the special characteristics of ESOs (such as the vesting period and nontransferability), it is not surprising that the coefficient on $E\hat{S}O$ is above minus one. However, the coefficient size is not significantly different from minus one (p-value of 0.509). In addition, I cannot determine which model investors are using for estimating ESO price. This is because the correlation between the option price calculated using the Black–Scholes model and the option price using this paper's valuation model is high (around 0.8). Therefore, it is plausible that both methods for estimating ESO price used in this paper are correlated with the method used by investors for estimating ESO price.

I conduct the following two investigations to test the robustness of the results presented in Table 3. The first investigation tests whether, for various economic reasons, small firms have higher ESO value per share than do large firms. If so, Table 3 results could be affected by a negative correlation between firms' size and ESO value. To examine this, I test for the correlation between total assets per share, book value per share, and ESO value per share. The Spearman correlation results indicate that a significant positive correlation exists between

[32]The fixed-effects regression results represent a conservative estimate in that if the ESO value is relatively stable over time, the intercept term will capture some explanation power associated with it, yielding a smaller observed coefficient on ESO value. In addition, replicating the analysis using the stock return volatility suggested by Alford and Boatsman (1995) slightly decreased the fit of the regressions presented in this paper.

total assets per share, net equity per share, and ESO value per share in seven of the eight years.[33] This result could be explained by the observation that firms grant ESOs to a broad class of employees. Therefore, as firm size increases, so does the number of employees covered by a stock option plan, resulting in an increase in ESO value.

The second investigation concentrates on the observation that a return regression is less sensitive to omitted factors. Therefore, I test the following equation:

$$RET_{it} = \alpha_0 + \alpha_1 \frac{X_{it}}{P_{it-1}} + \alpha_2 \frac{\Delta X_{it}}{P_{it-1}} + \beta_1 \frac{\Delta E\hat{S}O_{it}}{P_{it-1}} + \mu''_{it}, \tag{6}$$

where RET_{it} is the annual return of firm i over the twelve months extending from nine months before the fiscal year end to three months after the fiscal year end, ΔX_{it} is the change in the accounting earnings of firm i at time t; $\Delta E\hat{S}O_{it}$ is the change in the predicted value of ESO of firm i at time t, and P_{it-1} is the price per share of firm i at time $t-1$.

I test Eq. (6) by using a pooled fixed-effects regression. I find that the coefficient on $\Delta E\hat{S}O$ is -0.1646 (p-value of 0.133).[34] There are several possible explanations for the reduction in the significance of the coefficient on $\Delta E\hat{S}O$. First, a return regression may have less power compared to a price-level regression, because ESO value can be anticipated from year to year. Second, in contrast to information content studies that carefully identify unexpected earnings, I have no method for establishing expectations for ESO value. However, the return regression results support the conclusion that the negative coefficient on ESO value is not driven by correlated omitted variables.

The results of Table 3, combined with the results of testing the alternative economic explanations, suggest that for the sample of firms for which ESO value can be estimated, investors take ESO value into account when valuing a firm. However, Table 3 does not help us understand which attributes of ESOs investors consider when assessing their value, and what forces cause the observed negative correlation between ESO value and firms' share prices.

[33]The analysis is replicated by investigating the correlation between total assets per share, book value per share, and the number of ESOs per share. The results are similar, but only four out of the eight years have a significant positive Spearman correlation.

[34]Since reissuing causes a substantial portion of outstanding out-of-the-money ESOs to be replaced with at-the-money ESOs, we could observe a negative correlation between contemporaneous stock returns and the change in the predicted value of ESO value. Hence, I remove all reissuing firms from the sample for the year reissuing occurred, and for all subsequent years. This removal causes only minor changes to the reported results.

6.2. Further investigation into investors' estimate of ESO value

The following investigations show that there are (at least) two forces leading to Table 3's results.

I first test whether investors' estimate of ESO value depends on the option's vesting stage. Benefits from granting options include savings on training new employees by binding current employees to the firm, and increased productivity by employees who would like the share price to rise. Therefore, more of the options' benefits are incorporated into earnings and book value as time passes after the initial grant date, while the cost of outstanding options is not reflected in earnings or book value.[35] Consequently, it is possible that with the passage of time the option's cost is greater than its benefit. In contrast, it is also possible that the market perceives the incentives created by options to be larger than their cost independent of the option's vesting stage.

To conduct this investigation, I divide the options into four groups. The first includes currently granted options and outstanding options that have progressed up to and including 25% of the vesting period. The second includes outstanding options that have progressed more than 25% of the vesting period, up to and including 50% of the vesting period. The third includes outstanding options that have progressed more than 50% of the vesting period, up to and including 75% of the vesting period. The fourth includes outstanding options that have progressed more than 75% of the vesting schedule, up to and including 100% of the vesting period (e.g., options that are fully vested are included in this group).

To test the coefficient sign on ESO value for the four groups, I perform the following procedure. First, I calculate the ESO value for each of the four groups. Subsequently, for each group I regress book value, net earnings, and the instruments that belong to each group on their ESO value. These four regressions yield predicted values for the options' value of the four groups (termed $E\hat{S}O_{25}$, $E\hat{S}O_{50}$, $E\hat{S}O_{75}$, and $E\hat{S}O_{100}$). Finally, a fixed-effects regression is estimated by regressing net income, book value, $E\hat{S}O_{25}$, $E\hat{S}O_{50}$, $E\hat{S}O_{75}$, and $E\hat{S}O_{100}$ on price.

The results, presented in panel A of Table 4, show that the coefficient on $E\hat{S}O_{25}$ is positive but insignificant. The coefficient turns negative as the options progress in their vesting schedule. The mean time for the coefficient on $E\hat{S}O$ to turn from positive to negative is 15 months (18 months for the median). Assuming that the market values the net benefit or cost of outstanding options

[35]The cost of the intrinsic value of in-the-money options is reflected in *EPS* since they increase the number of outstanding shares. I therefore use, in this study, the reported net income rather than the reported *EPS*.

Table 4
Pooled fixed-effects estimation results of testing whether the market valuation is dependent on the ESO's vesting stage, separate intercept for each firm and each year, 478 public firms with broad-based ESO plans, 1983–1990

Panel A

$$P_{it} = \alpha_0 + \alpha_1(X_{it} - d_{it}) + \alpha_2 Y_{it} + \beta_1 E\hat{S}O25_{it} + \beta_2 E\hat{S}O50_{it} + \beta_3 E\hat{S}O75_{it} + \beta_4 E\hat{S}O100_{it} + \mu'_{it}$$

	α_1	α_2	β_1	β_2	β_3	β_4	N	$\bar{R}^2$
Coefficient estimates	1.662	0.741	1.335	− 0.173	− 0.939	− 1.308	3078	0.871
Two-tailed p-value	0.001	0.001	0.257	0.191	0.096	0.014		

P_{it} = market value of common equity for firm i three months after fiscal year end.
X_{it} = net income for firm i during fiscal year t.
d_{it} = dividend for firm i during fiscal year t multiplied by $r/(1 + r)$ where r is the one-year risk-free rate.
Y_{it} = book value for firm i at fiscal year end t.
$E\hat{S}O25_{it}$, $E\hat{S}O50_{it}$, $E\hat{S}O75_{it}$, $E\hat{S}O100_{it}$ = predicted values from the following regressions: $ESO25_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10} \alpha_{jt} NOPTION25_{jit} + \mu^*_{it}$, $ESO50_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10} \alpha_{jt}\, NOPTION50_{jit} + \mu^*_{it}$, $ESO75_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10} \alpha_{jt} NOPTION75_{jit} + \mu_{it}$, $ESO100_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10} \alpha_{jt} NOPTION100_{jit} + \mu^*_{it}$.
ESO value = value of options for each firm at the end of its fiscal year calculated by applying the modified option pricing model.
ESO25 = ESO value of currently granted options and outstanding options that have progressed up to and including 25% of the vesting period and *NOPTION25* is the number of those outstanding options. *ESO50* = ESO value of outstanding options that have progressed more than 25% of the vesting period, up to and including 50% of the vesting period and *NOPTION50* is the number of those outstanding options. *ESO75* = ESO value of outstanding options that have progressed more than 50% of the vesting period, up to and including 75% of the vesting period and *NOPTION75* is the number of those outstanding options. *ESO100* = ESO value of outstanding options that have progressed more than 75% of the vesting period, up to and including 100% of the vesting period and *NOPTION100* is the number of those outstanding options.
All variables are deflated by the number of common shares outstanding.

Observations with three or more standard deviations from the mean were removed. This reduces the sample by 68 firm years (2.16% of the original sample).

Mean/Median number of months from the grant date until the ESO are vested 25%, 50%, 75%, and 100%

	25% vested	50% vested	75% vested	100% vested
Mean	7	15	25	44
Median	6	18	30	42

in an unbiased method, the panel's result suggests that from the market's perspective, as time passes from the initial grant date, the value of outstanding options is larger than their future expected benefit. Moreover, the cost of outstanding options is larger than their future expected benefit much earlier than the options' maximum term to expiration.

Table 4 (continued)

Panel B

$P_{it} = \alpha_0 + \alpha_1(X_{it} - d_{it}) + \alpha_2 Y_{it} + \beta_1 E\hat{S}OI_{it} + \beta_2 E\hat{S}OT_{it} + \beta_3 E\hat{S}ONV_{it} + \mu'_{it}$

	α_1	α_2	β_1	β_2	β_3	N	$\bar{R}^2$
Coefficient estimates	1.533	0.737	− 0.817	− 0.297	− 0.435	3078	0.871
Two-tailed p-value	0.001	0.001	0.021	0.298	0.113		

P_{it} = market value of common equity for firm i three months after fiscal year end.
X_{it} = net income for firm i during fiscal year t.
d_{it} = dividend for firm i during fiscal year t multiplied by $r/(1 + r)$ where r is the one-year risk-free rate.
Y_{it} = book value for firm i at fiscal year end t.
$E\hat{S}OI_{it}$, $E\hat{S}OT_{it}$, and $E\hat{S}ONV_{it}$ = predicted values from the following regressions: $ESOI_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10}\alpha_{jt}NOPTIONI_{jit} + \mu^*_{it}$, $ESOT_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10}\alpha_{jt} NOPTIONT_{jit} + \mu^*_{it}$, $ESONV_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10}\alpha_{jt} NOPTIONNV_{jit} + \mu^*_{it}$.
$ESOI$ = intrinsic value (stock price minus exercise price) of vested options and $NOPTIONI$ is the number of those outstanding options. $ESOT$ = time value (total ESO value minus intrinsic value) of vested options and $NOPTIONT$ is the number of those outstanding options. $ESONV$ = ESO value of nonvested options and $NOPTIONNV$ is the number of those outstanding options.
ESO value = value of options for each firm at the end of its fiscal year calculated by applying the modified option pricing model
All variables are deflated by the number of common shares outstanding.

Observations with three or more standard deviations from the mean were removed. This reduces the sample by 68 firm years (2.16% of the original sample).

Panel C

$P_{it} = \alpha_0 + \alpha_1(X_{it} - d_{it}) + \alpha_2 Y_{it} + \beta_1 E\hat{S}OG_{it} + \beta_2 E\hat{S}OO_{it} + \mu'_{it}$

	α_1	α_2	β_1	β_2	N	$\bar{R}^2$
Coefficient estimates	1.467	0.725	1.530	− 1.664	3078	0.882
Two-tailed p-value	0.001	0.001	0.105	0.000		

P_{it} = market value of common equity for firm i three months after fiscal year end.
X_{it} = net income for firm i during fiscal year t.
d_{it} = dividend for firm i during fiscal year t multiplied by $r/(1 + r)$ where r is the one-year risk-free rate.
Y_{it} = book value for firm i at fiscal year end t.
$E\hat{S}OG_{it}$ and $E\hat{S}OO_{it}$ = predicted values calculated from the following regressions: $ESOG_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10}\alpha_{jt}NOPTIONG_{jit} + \mu^*_{it}$, $ESOO_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10}\alpha_{jt}NOPTIONO_{jit} + \mu^*_{it}$.
$ESOG$ = ESO value of options granted in the current year and $NOPTIONG$ is the number of those outstanding options. $ESOO$ = ESO value of previously granted options and $NOPTIONO$ is the number of those outstanding options.
ESO value = value of options for each firm at the end of its fiscal year calculated by applying the modified option pricing model
All variables are deflated by the number of common shares outstanding.

Observations with three or more standard deviations from the mean were removed. This reduces the sample by 68 firm years (2.16% of the original sample).

In the second investigation, I concentrate on the observation that an option's value consists of two parts: the intrinsic value (share price minus exercise price) plus the time value (total option's value minus intrinsic value). The intrinsic value is calculated by using the current share price and the option's exercise price. In contrast, the time value calculation requires estimation of the option pricing model parameters. Therefore, the time value calculation creates significant measurement difficulties compared to the intrinsic value calculation. This investigation examines whether investors estimate a time value when valuing firms' share prices.

To conduct the investigation, I separate each firm's ESO value into three parts. The first part is the intrinsic value of the vested options (ESO_I). The second part is the time value of the vested options (ESO_T). The third part is the total value of options that are less than 100% vested (ESO_{NV}). Subsequently, I estimate predicted values for the three groups by regressing book value, net earnings, and the instruments that belong to each group on the corresponding ESO value (ESO_I, ESO_T, and ESO_{NV}). These regressions yield predicted values for the three groups' ESO value ($\hat{ESO}_I$, $\hat{ESO}_T$, and $\hat{ESO}_{NV}$). I then estimate the coefficients on $\hat{ESO}_I$, $\hat{ESO}_T$, and $\hat{ESO}_{NV}$ by using a fixed-effects regression.

Table 4, panel B, shows that the coefficient on the intrinsic value of vested options is -0.817 (p-value of 0.021), the coefficient on the time value of vested options is -0.297 (p-value of 0.298), and the coefficient on the ESO value of nonvested options is -0.435 (p-value of 0.113). Assuming that the market values the net benefit or cost of outstanding options in an unbiased method, the panel's results are consistent with the interpretation that vested options, on average, decrease firm value. Several explanations might cause investors to consider a vested option as a net cost. First, once the options vest, the employees are not bound to the firm; key employees can retire or be hired by a competitor. Second, the prevalence of early exercise patterns might influence investors to considerably reduce the incentive effects associated with vested options. Moreover, Table 4, panel B, results show that investors put more weight on the intrinsic value of a vested option than they do on its time value.[36] The current accounting treatment classifies variable stock options (also called performance-based stock options) as a liability. As such, compensation expense for vested variable options is equal to their intrinsic value. Panel B's results are consistent with investors estimating compensation expense by marking to market vested ESOs every year.

The final investigation tests through both book value and earnings whether options can have a valuation effect. It is possible that investors refine their beliefs about current earnings by differentiating between current year's grants

[36]Since option value is nonlinearly related to stock price, the time value results could also be influenced by the linear specification applied in this paper.

and previous years' grants. To conduct this investigation, I divide a firm's ESO value into two parts, the value of options granted by the firm in the current year (ESO_G) and the value of presently outstanding options (ESO_O). I subsequently estimate $E\hat{S}O_G$ and $E\hat{S}O_O$ by regressing book value, net earnings, and the instruments of each group on ESO_G and ESO_O. I then estimate the coefficients on $E\hat{S}O_G$ and $E\hat{S}O_O$ by using a fixed-effects regression.

The results of this investigation are reported in Table 4, panel C. I find that the coefficient on the value of options granted in the current year is 1.53 (p-value of 0.105), while the coefficient on the value of presently outstanding options is -1.664 (p-value of 0). These results extend the results reported in Table 4, panel A, suggesting that at the grant date, the options' expected future benefits are larger than their cost. Therefore, at the grant date, investors appreciate the incentive value of options granted to employees. However, the orthogonality test requires more than one instrument to test the instrument's validity. It is possible, then, that the instrument used for replacing the value of currently granted options has some correlation with the error term.

6.3. Investigation of the FASB's proposal

Table 5 presents the results of my investigation of the value-relevance of the FASB's proposed method for calculating ESO value. The FASB's suggested method allows no adjustment in the option's value for changes in stock price, dividend yield, risk-free interest rate, or stock price volatility. To account for employment termination during the vesting period I use the actual forfeitures of options. To account for early exercise the method recommends estimating the option's expected life. I use the mean of the early exercise distribution as the option's expected life. The ESO value calculated according to the FASB's method is termed *ESOFASB*. In contrast, Table 3 reports the estimates for ESO value that are calculated by applying my modified option pricing model each year. The two calculations are similar only for the year in which the options are granted.

To test the coefficient on *ESOFASB*, I use Eq. (4) replacing *ESO* with *ESOFASB*. The coefficient on the predicted value of *ESOFASB* (termed $ESO\hat{F}ASB$) is estimated by using Eq. (5). The individual year results show that the coefficient on $ESO\hat{F}ASB$ is significant in only three out of the eight years at the 10% level.

Table 5, panel A, reports the fixed-effects regression. I find a significant coefficient on $ESO\hat{F}ASB$ (two tailed p-value of 0.077), showing that over the entire period the FASB estimate for ESO value is correlated with stock prices. A further investigation reveals that for three of the years, the FASB method overestimates the ESO value, and for five of the years it underestimates it.

However, the FASB staff draft emphasizes the effect of recognizing compensation expense rather than the valuation implication of outstanding options.

Table 5
Pooled fixed-effects estimation results of testing the market valuation of the ESO value calculated by applying the FASB's suggested method, separate intercept for each firm and each year, 478 public firms with a broad-based ESO plans, 1983–1990

Panel A

$P_{it} = \alpha_0 + \alpha_1(X_{it} - d_{it}) + \alpha_2 Y_{it} + \beta_1 ESO\hat{F}ASB_{it} + \mu'_{it}$

	α_1	α_2	β_1	N	$\bar{R}^2$
Coefficient estimates	1.491	0.743	− 0.964	3078	0.846
Two-tailed p-value	0.000	0.000	0.077		

P_{it} = market value of common equity for firm i three months after fiscal year end.
X_{it} = net income for firm i during fiscal year t.
d_{it} = dividend for firm i during fiscal year t multiplied by $r/(1 + r)$ where r is the one-year risk-free rate.
Y_{it} = book value per share for firm i at fiscal year end t.
$ESO\hat{F}ASB$ = predicted value calculated from the following regression: $ESOFASB_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10}\alpha_{jt}NOPTION_{jit} + \mu^*_{it}$.
$ESOFASB$ = ESO value calculated using the FASB's suggested method. The FASB's suggested method allows no adjustment in the option's value for changes in stock price, dividend yield, risk-free interest rate, or stock price volatility. To adjust for employment termination I use the actual forfeitures. To adjust for the expected life I use the mean of the early exercise distribution calculated for the modified option pricing model. $NOPTION$ = number of outstanding options per share with one to ten years to expiration for firm i at fiscal year end t.
All variables are deflated by the number of common shares outstanding.

Observations with three or more standard deviations from the mean were removed. This reduces the sample by 68 firm years (2.16% of the original sample).

Panel B

$P_{it} = \alpha_0 + \alpha_1(X_{it} - d_{it}) + \alpha_2 Y_{it} + \beta_1 COM\hat{P}EXP_{it} + \beta_2 E\hat{S}O_{it} + \mu'_{it}$

	α_1	α_2	β_1	β_2	N	$\bar{R}^2$
Coefficient estimates	1.635	0.756	0.320	− 1.438	3078	0.871
Two-tailed p-value	0.001	0.001	0.610	0.014		

P_{it} = market value of common equity for firm i three months after fiscal year end.
X_{it} = net income for firm i during fiscal year t.
d_{it} = dividend for firm i during fiscal year t multiplied by $r/(1 + r)$, where r is the one-year risk-free rate.
Y_{it} = book value for firm i at fiscal year end t.
$COM\hat{P}EXP_{it}$ and $E\hat{S}O_{it}$ = predicted values from the following regressions: $COMPEXP_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10}\alpha_{jt}NOPTIONCOMPEXP_{jit} + \mu^*_{it}$, $ESO_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t}Y_{it} + \sum_{j=1}^{10}\alpha_{jt}NOPTION_{jit} + \mu^*_{it}$.
$COMPEXP$ = compensation expense calculated by applying the FASB method. The FASB's suggested method allows no adjustment in the option's value for changes in stock price, dividend yield, risk-free interest rate, or stock price volatility. To adjust for employment termination I use the actual forfeitures. To adjust for the expected life I use the mean of the early exercise distribution calculated for the modified option pricing model. The compensation expense is the calculated ESO value divided by the option's vesting schedule. $NOPTIONCOMPEXP$ is the corresponding number of outstanding options.
ESO = value of all outstanding options for each firm at the end of its fiscal year calculated by applying the modified option pricing model and $NOPTION$ is the corresponding number of those outstanding options.
All variables are deflated by the number of common shares outstanding.

Observations with three or more standard deviations from the mean were removed. This reduces the sample by 68 firm years (2.16% of the original sample).

Hence, I investigate whether the FASB's method for calculating compensation expense has incremental explanatory power beyond the calculation of ESO value. I therefore calculate the compensation expense according to the FASB's method (termed $COMPEXP$). Subsequently, I estimate $COM\hat{P}EXP$ by regressing book value, net income, and the outstanding options that are involved in calculating the compensation expense on $COMPEXP$. The coefficient on the predicted value of the compensation expense is tested by using the following pooled fixed-effects regression:

$$P_{it} = \alpha_0 + \alpha_1(X_{it} - d_{it}) + \alpha_2 Y_{it} + \beta_1 COM\hat{P}EXP_{it} + \beta_2 E\hat{S}O_{it} + \theta'_{it}, \quad (7)$$

where $COM\hat{P}EXP_{it}$ is the predicted value for compensation expense of firm i for period t.

The results of a pooled fixed-effects regression, presented in Table 5, panel B, show that the coefficient on $COM\hat{P}EXP_{it}$ is insignificant (p-value of 0.61) while the coefficient on $E\hat{S}O_{it}$ is significant at the 1.4% level. This result suggests that firms that adopt the FASB method for recognizing compensation expense might not improve the informativeness of their net earnings. The result is not surprising considering that Table 4 shows that investors adjust ESO value as they obtain new information.

Feltham (1995) discusses how existing accounting methods for ESOs are consistent with clean surplus. Feltham defines three levels of 'cleanliness' in the accounting for ESOs: super-clean, contingently-clean, and dirty. Under super-clean the compensation cost is updated each period; this corresponds to my method of adjusting ESO value each year. Under contingently-clean accounting the compensation expense equals the value of the options at the contract date; this corresponds to the FASB method which does not allow adjustments to the compensation expense. Feltham proves that the accounting-value relation holds for the super-clean but fails for contingently-clean for the period that the options are outstanding. The results presented in Table 5 are consistent with Feltham's result.[37]

The results presented in Table 5, panel A, show that the FASB's suggested method is not as significant in a price-level regression as a method that recalculates the ESO value each year. Moreover, Table 5, panel B, results indicate that charging the option's value to earnings without allowing firms to adjust the compensation expense might decrease the ability of investors to value firms relying on the reported net income.

[37]However, the accounting value relation states that price equals the book value plus the net present value of the risk-adjusted expected abnormal earnings. Since this model is not used in this paper, the conclusions are limited to the extent that the model used in this paper is comparable to the accounting value relation model.

6.4. Testing whether firm size affects the association between ESO value and share prices

Over the last 20 years, several anomalies related to firm size have been documented in various accounting and finance studies. In this paper, I investigate whether firm size affects the association between ESO value and firms' share prices.[38] To conduct this investigation, I rank the sample by firms' market capitalization (stock price times the number of common outstanding shares). I then divide the sample into two groups: the first consists of firms in the lower quartile of market capitalization and the second consists of firms in the upper quartile. The average firm in the small-firms group is in the first firm-size decile in NYSE (fourth firm-size decile in Nasdaq). The average firm in the large-firms group is in the eighth firm-size decile in NYSE (tenth firm-size decile in Nasdaq).

The results of this investigation show that the small-firms group has an insignificant coefficient on $E\hat{S}O$ in all fiscal years. In contrast, the coefficient on $E\hat{S}O$ for the large-firms group is negative and significant in five out of the eight years (at the 10% level). F-test results show that the two groups' coefficients on $E\hat{S}O$ significantly differ from one another at the 1% level in all eight years. Table 6 reports pooled fixed-effects regressions for the small-firm and large-firm groups. The results are consistent with the year-by-year analysis. The coefficient on $E\hat{S}O$ for the large-firms group is -1.924 (p-value of 0.001) compared to a coefficient of 0.373 (p-value of 0.845) for the small-firms group.

Table 4 provides evidence that the coefficients for ESO value differ according to the options' characteristics. Therefore, Table 6 results for the small-firms group could be caused by a higher proportion of nonvested ESOs or by a lower proportion of intrinsic value over total ESO value. A t-test between the two groups on both measures determines that the small-firms group had a higher proportion of vested ESOs and the same proportion of intrinsic value over ESO value. Table 4 indicates that vested options have a larger coefficient (in absolute value) on ESO value than do nonvested options. Therefore, Table 6 results for the small-firms group are not caused by a larger proportion of vested options.

If firm size is an indicator of the sophistication of investors, Table 6 results are consistent with a conclusion that less-sophisticated investors are unable to perceive the value implications of ESOs. Alternatively, since the coefficient on ESO value is a result of the interaction between the options' costs and benefits, the results in Table 6 could be caused by stronger incentives generated by

[38] Firm size, institutional holdings, and the number of analysts following a firm are highly correlated. I find that the median firm in the small-firms group has no analysts following it, while the median firm in the large-firms group has 16 analysts following it. Similar patterns exist for institutional holdings.

Table 6
Pooled fixed-effects estimation results of testing whether there is a size effect in the market valuation of the ESO value, separate intercept for each firm and each year, 478 public firms with a broad-based ESO plans, 1983–1990

$P_{it} = \alpha_0 + \alpha_1(X_{it} - d_{it}) + \alpha_2 Y_{it} + \beta_1 E\hat{S}O_{it} + \mu'_{it}$

	α_1	α_2	β	N	$\bar{R}^2$
Q1 coefficient estimates	0.517	0.419	0.373	770	0.851
Two-tailed p-value	0.002	0.000	0.845		
Q4 coefficient estimates	2.579	1.065	− 1.924	770	0.876
Two-tailed p-value	0.001	0.000	0.001		
$PROB > F$ 0.0000					

This table divides the firms into two groups by the following procedure: first the firms are ranked by market capitalization. Second, firms with market capitalization less than or equal to the 25 percentile are formed into one group (termed Q1) and firms over or equal to the 75 percentile are formed into a second group (termed Q4).

P_{it} = market value of common equity for firm i three months after fiscal year end.
X_{it} = net income for firm i during fiscal year t.
d_{it} = dividend for firm i during fiscal year t multiplied by $r/(1 + r)$ where r is the one-year risk-free rate.
Y_{it} = book value for firm i at fiscal year end t.
$E\hat{S}O$ = predicted value calculated from the following regression: $ESO_{it} = \alpha_{0t} + \alpha_{1t}(X_{it} - d_{it}) + \alpha_{2t} Y_{it} + \sum_{j=1}^{10} \alpha_{jt} NOPTION_{jit} + \mu^*_{it}$, where ESO is the value of all outstanding options for each firm at the end of its fiscal year calculated by applying the modified option pricing model, $NOPTION$ is the number of outstanding options with one to ten years to expiration per share for firm i at fiscal year end t.
All variables are deflated by the number of common shares outstanding.
$PROB > F$ represents the probability that the coefficients on $E\hat{S}O$ for the two groups are equal.

Observations with three or more standard deviations from the mean were removed. This reduces the sample by 68 firm years (2.16% of the original sample).

options granted by the small-firms group compared to those granted by the large-firms group.

7. Summary and discussion

Financial reporting of ESO value is being considered by accounting standard-setters and regulators. The purpose of my study is to examine the association between ESO value and firms' share prices and the value-relevance of the FASB's method for calculating compensation expense.

I analyze a sample of 478 firms that granted ESOs to a broad base of employees during the period 1980–1990. For each firm, I collect data pertaining

to the number of outstanding options, grant dates, exercise prices, terms to expiration, vesting schedules, and ESO classification (ISO or NQSO).

The main findings are as follows. First, firms' ESO value is negatively correlated with their stock prices. Further examination reveals evidence consistent with the interpretation that options in their early vesting stages have, on average, a positive effect on firm value, but vested in-the-money options are considered by the firms' shareholders to be net cost. In addition, the results concerning vested options are consistent with investors estimating the cost of ESOs by marking them to market. Finally, for small firms, ESO value is not associated with the firms' share prices. Second, the measure proposed by the FASB for calculating compensation expense has no explanatory power beyond a balance-sheet approach.

The paper's sample selection process concentrates on firms granting large amounts of ESOs. It is possible that this paper's results cannot be applied to firms that grant smaller amounts of ESOs. Moreover, it is reasonable to assume that investors form expectations about future ESO grants, and that those expectations might be correlated with this paper's estimate of ESO value. Thus, the coefficient on the value of ESOs could reflect both current and future expectations concerning ESOs grants. Finally, this paper's premise is that when the ESO price is calculated by applying the option pricing model, it correlates with investors' calculation of ESO price. Therefore, the conclusions that can be drawn from the size of the coefficients on ESO value are governed by the extent of this correlation.

This paper focuses on the market valuation of ESOs and provides a framework for calculating ESO price by detailing an option pricing model. Further analysis, representing a potentially valuable area for future research, might concentrate on why firms focus on ESO grants to a broad base of employees as the choice for long-term compensation, and the effect of those grants on firms' economic performance.

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