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Are executive stock options associated with future earnings?☆

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Abstract

We estimate the relation between stock option (ESO) grants to the top five executives and future earnings to examine whether incentive alignment or rent extraction by top managers explains option granting behavior. The future operating income associated with a dollar of Black-Scholes value of an ESO grant is \$3.71. To understand the source of these positive payoffs, we parse out ESO grant values into components predicted by economic determinants of option grants, governance quality, and a residual grant value. The payoffs to ESOs appear to be driven predominantly by the economic determinants of option grants and not poor governance quality.

JEL classification: G30; J33; M41

Keywords: Management compensation; Stock options; Incentive alignment; Rent extraction

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1. Introduction

In this paper, we assess whether and how the Black-Scholes' value of stock options granted to the top five executives relates to future operating earnings. Although stock options comprise the fastest growing component of top management compensation, there is no consensus on the relation between employee stock option compensation and future firm performance. This lack of consensus can be distilled into two opposing perspectives.

The incentive alignment perspective typically advocated by a number of financial economists states that options are granted to reduce the moral hazard problem that stems from senior managers owning very little of the firms they manage. A substantial body of theoretical work beginning with Jensen and Meckling (1976) suggests that option contracts can align managers' incentives with that of shareholders. Consistent with this perspective, researchers (e.g., Demsetz and Lehn, 1985; Himmelberg et al., 1999; Core and Guay, 1999; Rajgopal and Shevlin, 2002) have predicated their analyses on the premise that granting options is consistent with firm value maximization.

A second perspective, popular especially among shareholder rights activists and organized labor, is that senior managers control the pay-setting process and compensate themselves in excess of the level optimal for shareholders (we label this view as the rent extraction perspective). Some researchers argue that options are an inefficient way to compensate managers (Jenter, 2001; Meulbroek, 2001; Hall and Murphy, 2002; Lambert and Larcker, 2002). Others claim that stock options do not exhibit empirical relations consistent with the economic motivations behind granting them (e.g., Yermack, 1995) and may even be a politically expedient way of cloaking senior managers' pay as such compensation is generally not recorded in the firms' financial statements (e.g., Crystal, 1991). Researchers have also presented evidence that managers abuse option grants for their own benefit (e.g., Yermack, 1997; Aboody and Kasznik, 2000; Carpenter and Remmers, 2001; Bens et al., 2002). We refer to this as the rent extraction hypothesis.

To examine these conflicting perspectives, we estimate whether a firm's Black-Scholes value of new employee stock options granted to its top five executives is associated with future operating earnings. Our sample composes 2,627 firm-year observations from years 1998 to 2000 and ESO grants from 1992 to 2000 from S&P *Execucomp* database. In our base regressions, which adjust for simultaneity bias using an industry instrumental variables approach, we find that a dollar of the Black-Scholes value of an option grant to the top five executives of the average firm is associated with future operating income (undiscounted) over the next 5 years of approximately \$3.71. The positive relation is inconsistent with pervasive rent extraction. Specification tests suggest a concave relation between ESO grant values and future operating income (the positive relation is increasing but at a decreasing rate). We find that assuming a linear relation between ESO grant values and future earnings (as done in prior studies) might result in misleading inferences about the nature of the payoff to option grants. Because the conclusions are somewhat sensitive to whether the model assumes linear or non-linear relation between future earnings and ESO grant values, researchers might want to consider this specification choice carefully in their work.

We rely on the industry instrumental variables approach to quantify ESO payoffs. However, this approach to address simultaneity bias does not specifically address the role of economic determinants and corporate governance in ESO grants. To more directly test the incentive alignment and rent extraction perspectives, we conduct a second set of analyses using a two-stage procedure in which we decompose ESO grant values into three components. Specifically, in the first stage we model ESO grant values as a function of two sets of factors: (i) economic factors that are hypothesized to motivate firms to grant options such as growth opportunities, and cash and dividend constraints, (ii) proxies for corporate governance such as the division of power between the shareholders and managers, the relation between CEO and the board of directors, and the number of board meetings, and (iii) a residual component. We find that ESO grant values are related to many of the hypothesized economic determinants in the manner predicted, consistent with incentive alignment. The observed relations between ESO grant values and proxies for the quality of governance variables provide little support for the rent extraction hypothesis.

In the second stage, we find that the predicted component of ESO grant value attributable to economic determinants exhibits a strong positive relation with future earnings. The predicted component of ESO grants attributable to governance factors is also significantly positively associated with future earnings—inconsistent with rent extraction. These results are consistent with firms with systematic economic characteristics such as strong future growth prospects granting more options and such firms also performing well in the future. We find that the ESO grant not explained by either systematic economic determinants or governance variables (that is, the residual ESO grant) accounts for only a small portion of the positive payoff associated with granting options. In sum, the evidence from our examination of the source of the positive payoffs in our initial regressions is consistent with incentive alignment and we find little evidence in support of rent extraction.

Our paper differs from and adds to the few papers in the literature that have tried to assess the relation between future firm performance and executive pay. Several studies correlate compensation measures with *ex post* stock price performance (e.g., Masson, 1971; Abowd, 1990; Defusco et al., 1991; Core et al., 1999; Kedia and Mozumdar, 2002; Ittner et al., 2003). A major difficulty with this approach is that stock returns have shareholder expectations embedded in them. An option grant, under the incentive alignment hypothesis is intended to (and under the rent extraction hypothesis might) affect the distribution of stock returns for the company. In an efficient market, the forward-looking nature of stock prices likely incorporates this shift in the distribution of returns prior to the executive taking any action induced by the option grant. For example, a stock price revision might occur well before the option grant is even announced.[1] We avoid this problem by estimating the

[1] If the stock market already incorporates the expected value of the managerial action taken in response to the option grant on the date of the grant, then there may be no incentive for the manager to follow through and actually undertake that action. However, if the manager does not take the *ex post* action, then

average return to option grants using firms' future operating earnings. Our method of estimating the payoff of ESO grants is similar to the procedure used by Lev and Sougiannis (1996) and Hand (2001) to infer operating income associated with R&D costs.

An alternative approach used in the literature is to regress stock price on ESO costs. If variables are not included to control for the future payoffs to ESOs (Aboody et al., 2004) the estimated coefficient on the ESO variable represents the net effect (payoffs less the grant cost). Such studies portray a mixed picture as some studies find that investors view options as an expense (Aboody, 1996; Chamberlain and Hsieh, 1999) while others find that investors view options as an asset (Bell et al., 2002; Rees and Stott, 1998). Aboody et al. (2004) include analysts expected earnings growth to control for expected ESO payoffs and find a negative coefficient on ESO cost. Their objective is to assess the reliability and relevance of the ESO compensation expense disclosures, and not to directly assess the net payoffs. Our research design of inferring the payoff to ESO grants from operating earnings is better equipped to compute the gross and net returns associated with granting options because (i) unlike value relevance studies it does not rely on market efficiency and (ii) using operating earnings as a measure of future benefits avoids the circular dependence of ESO values on current stock price.

In contrast to much prior work (Ittner et al., 2003 is a notable exception), we explicitly model ESO grant values (as a function of economic determinants and corporate governance variables) and then examine future earnings as a function of predicted ESO grant values and residual ESO grant values. Otherwise, we run the risk of misattributing a potential negative payoff on ESOs to rent extraction even though such negative payoff may be a manifestation of other systematic constraints such as cash shortages or unintentional mistakes from the benchmark model of granting options. Another important feature of our study is the specification of a non-linear relation between option grants and future income. We find that a linear specification can potentially lead to incorrect conclusions about the returns to granting options.

Our paper is closest in spirit to Core et al. (1999) and Ittner et al. (2003). Core et al. (1999) find, for a sample of 205 firms during 1982–1984, that CEOs of firms with poor governance structures extract greater compensation and firms with greater agency problems perform worse. Our paper differs from Core et al. (1999) in three respects. First, unlike Core et al. (1999), our focus is on documenting and

(*footnote continued*)
the stock price of the firm is likely to fall thereby increasing the chances of the option finishing out of the money. Further, we do not conduct an event study around option granting dates because grant dates are not precisely known and it is difficult to interpret what a stock price reaction means. In the absence of an a priori model to predict the reaction, the abnormal return around the event date could be positive for half the sample and negative for the other half. Even if we were to find a positive reaction, it is unclear whether that can be taken as evidence of incentive alignment or management signaling future prospects via unexpected grants. If we were to find a negative reaction, we cannot dismiss the possibility that news related to the incentive alignment component of the grant was incorporated into stock prices before the grant date.

understanding the overall net payoff to granting ESOs, not just the component attributable to governance quality. Second, we consider a substantially larger set of firms and a longer and more recent time period—the 1990s—a decade when the extent of option compensation and controversies related to such compensation exploded. Third, in contrast to Core et al. (1999), our results, using the more recent time period and larger sample, are consistent with substantial positive payoffs to option grants and offer little evidence in support of rent extraction.

Ittner et al. (2003) examine the economic determinants of equity grants (ESOs and stock combined) to CEOs and other employees in 217 new economy firms and compare the determinants to a sample of more traditional firms. They also examine the relation between the grant model residuals for the new economy firms and future firm performance (both return on assets and stock returns). In contrast, we examine a large sample of traditional firms rather than a sample restricted to new economy firms. Further, we explicitly test for rent extraction and incentive alignment by (a) incorporating corporate governance variables in addition to the economic determinant variables in the grant model and then (b) examining future earnings performance not only as a function of grant model residuals but also of grants predicted by the economic determinants and the corporate governance variables.

The remainder of the paper is organized as follows. In Section 2, we discuss the two hypotheses—incentive alignment and rent extraction—and develop a model to assess the association between ESOs and operating earnings. We describe the data and quantify the payoff to ESOs in Section 3. In Sections 4 and 5, we examine the payoff to ESOs in a two-stage approach. In the first stage in Section 4 we model the effect of various economic factors and governance variables on ESO grants. In the second stage in Section 5 we analyze the association between future earnings and the predicted and unexpected ESO grant values derived from the first stage ESO grant model. Section 6 concludes.

2. Background and empirical specification

We examine two prevalent hypotheses on the relation between stock options and future firm performance. Arguments related to these hypotheses have appeared in a number of literature surveys on compensation (e.g., Pavlik et al., 1993; Murphy, 1999; Abowd and Kaplan, 1999; Bebchuk et al., 2001; Core et al., 2003). We draw from these surveys to summarize the key ideas.

2.1. Incentive alignment hypothesis

The incentive alignment hypothesis assumes that compensation aligns managers' interests with those of shareholders mitigating agency problems.[2] A number of

[2] See, for example, Jensen and Meckling, 1976; Haugen and Senbet, 1981; Smith and Stulz, 1985; Lambert, 1986; Copeland and Weston, 1988; Lambert et al., 1991; Hirshleifer and Suh, 1992; Hemmer et al., 1999.

researchers have largely worked within the incentive alignment framework to explain various features observed in executive compensation contracts as well as variation in compensation contracts across firms. For example, Demsetz and Lehn (1985), Core and Guay (1999), and Himmelberg et al. (1999) argue that firms and managers contract optimally, and managerial ownership levels and stock option grants are set, on average across firms, at a value maximizing level. There is considerable evidence that equity ownership by managers of publicly traded firms with dispersed ownership results in improved firm performance (Morck et al., 1988; McConnell and Servaes, 1990).[3] Finally, Bryan et al. (2000) report that the intensity of option incentives is systematically associated with hypothesized economic motivations for granting options.

2.2. Rent extraction hypothesis

The rent extraction hypothesis posits that senior executives have substantial influence over their pay. As a result, executives receive pay in excess of the level that would be optimal for shareholders, and this excess pay constitutes rent. Several researchers provide evidence that members of the board of directors (some of whom are members of the compensation committee) serve at the discretion of the CEO (e.g., Hermalin and Weisbach, 1998; Shivdasani and Yermack, 1999). Some argue that outside directors lack the economic incentives to curb excessive compensation (Baker et al., 1988). In a similar vein, labor interest groups such as the AFL–CIO have long argued that options compensation paid to CEOs is excessive and is unrelated to firm performance.[4]

Several researchers point out that options are an inefficient way to compensate managers. Meulbroek (2001) argues that risk averse and undiversified managers do not attach sufficient value to the risky payout from an option to justify the cost borne by shareholders. Hall and Murphy (2002) and Jenter (2001) argue that restricted stock dominates options with non-zero exercise prices as an incentive mechanism.[5] Hall and Liebman (1998) suggest that stock options are a less visible means of increasing executive pay "in the face of public opposition to high pay levels" especially because stock option grants are not expensed for financial reporting purposes (Matsunaga, 1995). Bertrand and Mullainathan (2001) show that CEO pay responds as much to luck as to general performance. They interpret their results as evidence in support of managers benefiting at the expense of shareholders. Bebchuk et al. (2002) argue that the absence of indexed options which filter out general market increases and the near-uniform use of at-the-money options in compensation packages of all firms is consistent with the rent extraction perspective.

Another area of research highlights dysfunctional effects of stock option plans. For example, Yermack (1997) finds positive abnormal returns immediately after

[3] However, some recent research casts doubt on the link between managerial ownership and future performance (e.g., Loderer and Martin, 1997; Himmelberg et al., 1999; Zhou, 2001).

[4] See http://aflcio.org/paywatch/ for examples.

[5] See Lambert and Larcker (2002) for a counter-perspective.

option grants and presents evidence to suggest that managers time option grants prior to release of good news. Aboody and Kasznik (2000) show that firms delay disclosure of good news and accelerate the release of bad news prior to stock option grant dates presumably to lower their exercise price. Carpenter and Remmers (2001) find that managers exploit inside information to time their option exercises. Bens et al. (2002) suggest that managers cut research and development expenditure to fund share repurchases for option plans so as to avoid EPS dilution. Finally, Tufano (1996) interprets his evidence of decreased hedging behavior associated with stock options as a symptom of managerial opportunism. Whether these dysfunctional effects dominate the potential income increasing effects of options is an empirical question we investigate in this paper.

2.3. The ESO-earnings relation

In order to extract the return to granting options from the earnings stream of a firm, we adapt the procedure that Lev and Sougiannis (1996) use to estimate the average productivity of research and development spending. Lev and Sougiannis posit a production function that reflects the fundamental relation between the value of corporate assets and the operating income generated from these assets. Similarly, we define the operating income (OI_{it}) of firm i in year t, as a function of tangible, TA_{it}, and intangible assets, IA_{it}, where the latter includes the senior management team's incremental intellectual capital contributed to the firm as a result of stock options:

$$\mathrm{OI}_{it} = f(\mathrm{TA}_{it}, \mathrm{IA}_{it}). \tag{1}$$

Operating income and tangible assets are reported in financial statements (albeit at historical costs), while intangible capital, IA, is not reported and therefore has to be estimated.

Given our focus on ESOs, we concentrate on estimating the value contributed by ESOs as the sum of the payoffs (which could arise from diligent search for material information about projects, actual project selection and increased effort) associated with current and past ESO grants, measured as the Black-Scholes value of new grants. As Murphy (1999) points out, the Black-Scholes value represents the opportunity cost of an option grant to the firm i.e., the amount an outside investor would pay for the option. We recognize recent arguments (e.g., Yermack, 1995; Core and Guay, 2002) that the sensitivity of the entire option portfolio held by executives to a change in stock return (ESO portfolio slope), as opposed to Black-Scholes value of newly granted options in a given year, better captures the incentive effects of the executives' option portfolio. Nevertheless, we do not use ESO slopes for the entire option portfolio for two reasons.

First, we are interested in isolating the cost–benefit trade off to *the firm* of granting ESOs. We view the value of the ESOs granted to top executives as an investment–expenditure by the firm (similar to R&D and other capital expenditure) and are interested in estimating the return on this investment. The Black-Scholes value of the option is a reasonable estimate of the firm's opportunity cost of granting options.

The ESO slope, on the other hand, is a better measure of the incentive-intensity given to the executive rather than a measure of ESO costs to the firm. Second, we allow option grants from 5 previous years in the empirical estimation procedure to influence operating earnings of the current year. Actions taken in response to ESO grants given at time $t-5$ could impact operating earnings in time t. Although reliable data on exercise dates of various grants are not available on *Execucomp*, Aboody et al. (2004) use hand-collected SFAS 123 disclosures and report that the average ESO life appears to be 5.5 years. Hence, we include $t-5$ as the last lag in the analysis. Because the exact grant dates are not reported in *Execucomp*, we err on the side of caution and include the current year, t, grant. If grants are made on the first (last) day of the year, we ought (not) to include the year t grant.

We limit our analysis to ESO grant values of the top five executives because the actions of these executives arguably impact future income more than those of lower level employees. Further, option data related to these executives are available from the machine-readable *Execucomp* database. Moreover, prior compensation research focuses, almost exclusively, on the CEO and/or the top five executives of a firm thus allowing comparisons to prior studies.

3. Sample, variable measurement, and analyses

3.1. Sample selection

Restricting our attention to non-financial firms, we begin with an initial sample of 14,013 firm-year observations from 2,072 firms on the 2001 *Execucomp* database.[6] The database covers compensation data for the top five executives of each firm in the S&P 1500 index (comprising firms in the S&P 500 index, S&P 400 mid cap index and the S&P 600 small cap index) from December 1992 to December 2000. Data on the Black-Scholes value of options is extracted from the *Execucomp* database. The database computes the Black-Scholes value of an option grant in the conventional manner except for an adjustment that reduces the expected term of the option by 30% to account for early exercise by executives (implying for most firms a 7 year expected term). We obtain accounting data from the *Compustat* tapes. The governance data for the ESO grant model comes from *Execucomp* and the g score database compiled by Gompers et al. (2001).

We conduct two primary analyses in the paper with a consistent set of firms underlying both earnings payoff analyses. In the first analysis, we estimate baseline regressions that assess the statistical association between the current year's operating income with the current year and five annual lags of the Black-Scholes

[6] We exclude financial firms from the study for two reasons. First, operating income, the dependent variable in Eq. (1), of a financial firm may not be comparable with operating income from an industrial firm. Second, financial firms are regulated and are possibly subject to agency conflicts that are different in character than those experienced by unregulated industrial firms.

value of new executive ESO grants. In the second set of analyses, we model ESO grant values as a function of economic factors and governance variables observed at the end of the previous year. To maximize efficiency of the grant model estimates, we include all available firms with data. Many of the governance variables are drawn from *Execucomp*, which begins coverage in 1992, so 1993 is the earliest year for which we can estimate the ESO grant model. Thus, the ESO grant model is estimated over 8 years of ESO data (1993–2000) and after intersecting *Execucomp* and *Compustat* and eliminating missing observations, we have 10,803 firm-year observations covering 1,965 firms. The payoff regressions require the current year and 5 contiguous years of prior grant data. Thus, our baseline and ESO-payoff regressions using predicted ESO grant values cover operating income observations for 3 years (1998, 1999, 2000) with 2,627 usable firm-year observations covering 1,069 firms. Note that our sample data requirements result in our sample excluding firms (such as Amazon, Ebay, Yahoo, Homegrocer) that rose to prominence in the internet boom.

3.2. Descriptive statistics

Table 1 reports descriptive data for our sample (pooled over 3 years of data used in the payoff regressions). The average firm in the sample reports annual sales of $5.6

Table 1
Descriptive statistics of baseline payoff regression ($N = 2,627$)

Panel A: Distribution data

Variables	Mean	Std. deviation	Median	Q1	Q3
OI ($billion)	1.071	2.936	277	0.100	0.799
Sales ($ billion)	5.621	14.265	1.659	0.658	4.796
ESO new grants ($ million)	7.531	24.634	2.170	0.623	6.108
OI/sales	0.196	0.141	0.173	0.109	0.263
TA/sales	1.321	1.053	0.999	0.700	1.569
ESO/sales	0.005	0.017	0.001	0.0003	0.003
R&D/sales	0.040	0.146	0	0	0.025

Panel B: Correlation matrix

Variables	OI/sales	TA/sales	ESO/sales	R&D/sales
OI/sales	1			
TA/sales	0.400	1		
ESO/sales	0.094	0.309	1	
R&D/sales	0.161	0.357	0.739	1

Note: The sample of 2,627 firm-year observations from 1997 to 2000 corresponds to 1,069 firms with non-missing data and is used to estimate the baseline ESO-payoff regressions. OI is annual operating income, after SGA expenses but before R&D expenses, Sales represent annual sales, TA is the balance sheet value of total assets at year-end and ESO is Black-Scholes value of new grants for top 5 executives as per *Execucomp* and R&D refers to research and development expenditure. Missing values of R&D are set to zero. All correlations in Panel B are significant at 0.01 level.

billion and has an operating margin of 19.6% on sales. Thus, firms in the sample are large and profitable. The new ESO grant to the top five executives of an average firm is $7.53 million and corresponds to 0.5% of annual sales.

To provide descriptive evidence on the relation between current operating income and current and lagged ESO grant values we first scale the variables to enable cross-sectional aggregation of firms with different scale levels.[7] We next sort two ESO variables (current year t ESO and sum of t to $t-5$ ESO grant values) into 25 portfolios and calculate the mean of operating income and ESO grant values for each portfolio. The portfolio means are plotted in Fig. 1. Portfolio mean operating income is positively associated with ESO grant values and the association appears concave—increasing at a decreasing rate. Such a function is consistent with both the law of diminishing returns (holding constant the other inputs, as you increase one input, returns increase but at a decreasing rate) and the diminishing returns to scale (doubling all inputs does not double output).

3.3. Baseline empirical model

We estimate the following model (2) to evaluate the returns on ESO grant values.

$$\begin{aligned}(\mathrm{OI}/S)_{it} = {} & \alpha_0 + \alpha_1(\mathrm{TA}/S)_{i,t-1} + \sum_{k=0}^{5}\alpha_{2,k}(\mathrm{ESO}/S)_{i,t-k} + \sum_{k=0}^{5}\alpha_{3,k}(\mathrm{ESO}/S)^2_{i,t-k} \\ & + \sum_{k=0}^{5}\alpha_{4,k}(\mathrm{R\&D}/S)_{i,t-k} + \alpha_5\sigma(\mathrm{OI}/S)_{it-1} + \alpha_6 \text{ Industry dummies} \\ & + \alpha_7 \text{ Year dummies} + e_{it}, \qquad (2)\end{aligned}$$

where OI is the annual operating income, before R&D expenses after SGA, of firm i in year t (Compustat data item #13 + data item #46), S is the annual sales in t, TA is the balance sheet value of total assets at year t, ESO is the Black-Scholes value of new grants for top 5 executives as per *Execucomp* for year $t-k$ ($k = 0-5$), R&D is the research and development expense for year $t-k$ ($k = 0-5$), $\sigma(\mathrm{OI}/S)_{it-1}$ is the standard deviation of (OI/S) estimated over the prior 5 years, Industry dummies are based on a two-digit SIC code classification, and year dummies for the fiscal year when OI_t is measured.

We assume that all potential benefits and costs of granting ESOs are reflected in future earnings as measured by operating income. We ignore non-operating items such as financing charges because the first-order effect of ESOs on such items is not obvious. Because almost all U.S. firms do not charge stock option expense to earnings during our sample period, OI is already measured before stock option expense.

The coefficient $\alpha_{2,k}$ estimates the contribution of a dollar ESO grant in year $t-k$ ($k = 0-5$) to subsequent earnings. Thus, the expression $\sum_k \alpha_{2,\mathrm{k}}$ represents the

[7] In addition, scaling by contemporaneous sales controls for any price-level changes (inflation) across the sample period. However, given our relatively short sample period and low inflation environment during the 1990s, price-level adjustments are not a first-order concern.

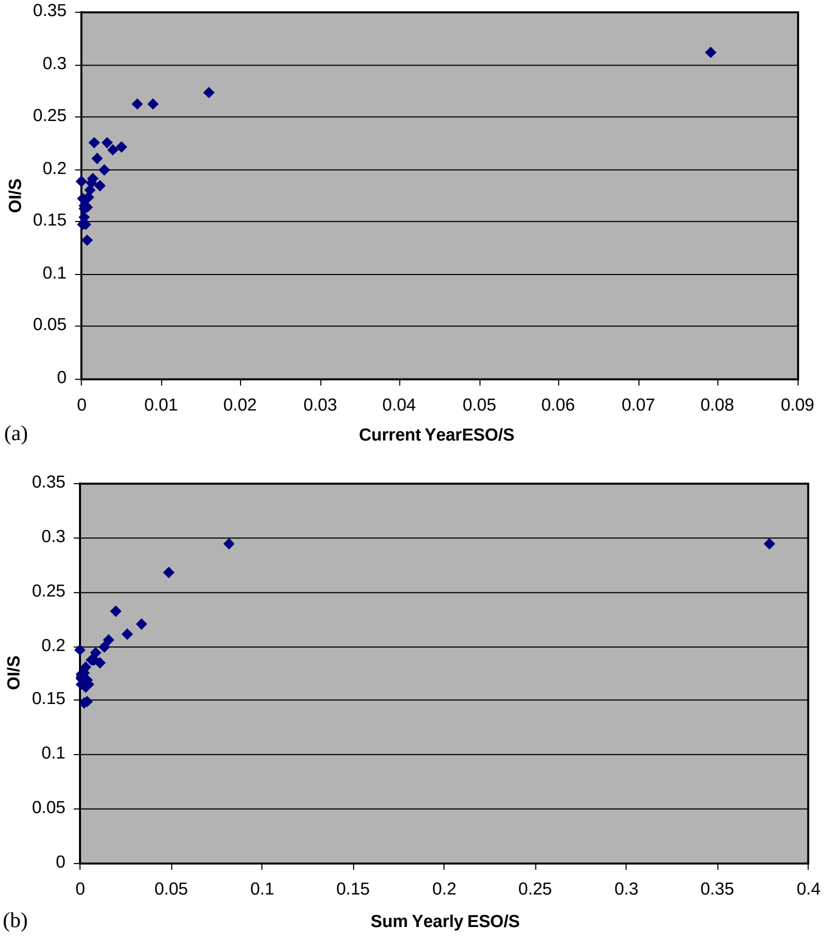

Fig. 1. Plots of operating income on ESO grant values. Note: OI/S on the Y axis refers to operating income scaled by sales while ESO/S on the X axis refers to Black-Scholes value of ESO grants as per *Execucomp*. Twenty-five portfolios are formed sorted on (a) current year ESO/S and (b) the sum of annual ESO/S (current and 5 lags). The mean values of the ESO/S and OI/S for each portfolio are plotted.

undiscounted first-order payoff to an average dollar of ESO value.[8] We include the squared ESO grant value term to reflect the concave function plotted in Fig. 1. Thus $\sum_k \alpha_{3,k}$ captures the undiscounted second-order payoff to the same average dollar of

[8] The investment costs of granting ESOs and the payoffs are estimated on a pretax basis. However, the post-tax payoffs to ESOs would be the same as that suggested by Eq. (2) assuming that the ESOs are non-qualified options—because non-qualified ESO expenses are tax deductible. Note, however, that the calculation embedded in Eq. (2) accounts for the tax deduction of ESO expense at the Black-Scholes grant value of the ESO (which can be thought of as the expected present intrinsic value of the ESO at exercise date) whereas the intrinsic value of the non-qualified ESO on exercise is the actual deduction that the firm can claim in its tax return.

ESO value. If the relation in (2) is linear, we expect the sum of coefficients related to the second power term of ESO, $\sum_k \alpha_{3,k}$, to equal zero. This specification is discussed further below. Note that throughout the paper, we label the coefficient on the linear term, $\sum_k \alpha_{2,\mathrm{k}}$, as the "first-order" effect and the coefficient on the non-linear second power term, $\sum_k \alpha_{3,k}$, as the "second-order" effect.

Tangible assets, TA_{it} in (2) consist of all assets reported on the balance sheet, including, among others, inventories and plant and equipment. The TA term excludes assets related to ESO grants because most firms do not recognize ESO expense in their books. The intangible asset, ESO payoffs, is represented here by the lag structure of annual ESO grant values in expression (2). To control for the impact of any research-related payoffs on the ESO payoff, we introduce current year's R&D expenditure and five annual lags of past R&D expense (Hall et al., 1998; Chan et al., 2001, p. 2434). Including R&D recognizes the presence of intangible assets created by R&D as per Lev and Sougiannis (1996).[9] If *Compustat* reports a missing value for R&D, we set such value to zero.[10] Consistent with Core et al. (1999) we include the standard deviation of (OI/S) to control for any relation between firm risk and future earnings. We introduce industry (year) dummies to control for unmodeled differences in operating income that may covary with industry (time). Finally, all variables are winsorized (reset) at the 1 and 99 percentiles to reduce the influence of extreme observations.

If incentive alignment is descriptive of the data, we expect ESO grant values to be positively associated with future earnings, specifically the sum of the coefficients should equal or exceed unity (a dollar of ESO grant value returns at least a dollar of earnings).[11] If the rent extraction perspective is descriptive, we expect ESO grant values to exhibit a slight positive, zero or a negative association with future earnings (the sum of the coefficients should be less than unity). The negative association is conjectured because excess ESO grants could be viewed as indicative of severe unresolved agency problems in the firm. In fact, rent extraction implied by excess ESO grants could signal perquisite consumption or opportunistic behavior in other

[9] Lev and Sougiannis (1996) assume that the relation between R&D and future earnings is linear. We examine the sensitivity of our results to that assumption in Section 5.5. Furthermore, in separate analyses we also introduce the current year's advertising expenditure (scaled by sales) as a control for any brand related intangibles. We restrict advertising to the current period expense as Lev and Sougiannis (1996) find that advertising expenditure does not fetch benefits beyond 1 year. However, the payoffs to advertising are statistically insignificant in all specifications.

[10] We acknowledge that the introduction of total assets and R&D expenditure as independent variables may potentially understate the payoffs to ESOs as ESOs might encourage firms to increase capital expenditure (resulting in higher total assets) and R&D expenditure. We report the effect of omitting total assets and R&D expenditure from the specification in Section 5.5. A similar explanation also applies as to why operating income in $t-1$ is not included as an explanatory variable: OI_{t-1} is a function of ESO grants in $t-k$, $k=1-5$. We discuss results including lagged OI in the sensitivity section.

[11] We do not explore the relation between ESO convexity and risk-taking at great length in this paper (see Rajgopal and Shevlin, 2002 for evidence on this relation in the oil and gas industry). If ESO convexity results in greater risk-taking, we would expect to observe higher returns and thus higher payoffs to granting ESOs in the payoff regression (2). However, we acknowledge that while ESOs encourage risk-taking, the risky investments may not pan out, *ex post*. If such a scenario prevailed systematically in the cross-section, we expect to observe depressed payoffs to granting ESOs.

areas. For example, it could indicate managers diverting resources away from value-enhancing productive activities to manage short-term investor perceptions (Bens et al., 2002; Bens et al., 2003).[12]

3.4. Estimating the ESO-earnings relation

We begin by estimating the ESO-payoff Eq. (2) using OLS.[13] All regressions in the paper are conducted on a pooled cross-sectional and time-series data set. We do not estimate the regression in annual cross-sections to conserve statistical power. We cannot estimate Eq. (2) using time-series data for every firm because we have access to a limited time-series of option data for any firm.

Table 2 reports results of the baseline payoff regressions. Column (1) reports the results of a linear specification of the model. The gross undiscounted payoff associated with ESO grant value, i.e., $\sum_k \alpha_{2,k}$, is a *negative* \$0.69 in column (1). However, the plots in Fig. 1 suggest a non-linear (specifically a concave) function. To further examine the functional form we conduct three specification tests (see Gujarati, 1995 for discussion of the first two tests). First we plot the residuals from the linear version of the model (2) against ESO grant values (current year t and the sum of 6 years of grants) after forming 25 portfolios based on ESO grant values. For low values of ESO grants, the portfolio residuals are negative (the fitted line is above the actual function) while for larger values of ESO grants, the portfolio residuals are positive (the fitted line is below the actual function). Second we conduct the Ramsey RESET test in which the square of the predicted dependent variable from the linear model is included as an additional explanatory variable in (2). The R^2 of the re-estimated model is significantly higher (an F test) indicating the linear model is misspecified. Our third test is to estimate a piecewise linear model (at each ESO lag). The difficulty here is in specifying kink points in the piecewise regression (and recognizing about 15% of our ESO grant values are zero). These results are, not surprisingly, somewhat sensitive to cutoff points, but when we allow the slope on the

[12] However, absence of a statistical association between ESO grants and realized future operating income could be consistent with both rent extraction and efficient contracting. A zero association could be consistent with rent extraction as the firm gave up a dollar of ESO for zero payoffs. With respect to efficient contracting, consider two firms, A and B, with the same operating income, except that firm A has greater agency problems and hence awards more options than firm B. A regression of future operating income on ESO grants would result in no association between the two variables. This result is consistent with efficient contracting as options have addressed A's agency problems. However, the perspective underlying this argument seems rather extreme to us and we believe that studying the association between options (or any other firm choice) and operating income for a cross-section of firms is an interesting exercise. The problem here is that we can only observe realized operating income, not income that would have obtained in the absence of option incentives. Ideally, we would like to observe (or extract) the increment in earnings due to issuing ESOs.

[13] An alternate approach is to use Almon-lag specifications to compute the payoff to ESOs. However, Greene (2000) notes this model is only infrequently used in contemporary applications as it imposes strong restrictions on the functional form of the model. Moreover, it is harder to accommodate non-linear squared terms in the Almon-lag specifications. Hence, we believe that an OLS version of the model is adequate for our purposes as our inferences do not depend as much on the precise estimation of individual coefficients for each ESO lag as much as the sum of these coefficients over the lags.

Table 2
Baseline estimation of payoffs using Black-Scholes values of ESO grants ($N = 2,627$)

Panel A: Regression coefficients

$$(\mathrm{OI}/S)_{it} = \alpha_0 + \alpha_1(\mathrm{TA}/S)_{i,t-1} + \sum_{k=0}^{5}\alpha_{2,k}(\mathrm{ESO}/S)_{i,t-k} + \sum_{k=0}^{5}\alpha_{3,k}(\mathrm{ESO}/S)^2_{i,t-k} + \sum_{k=0}^{5}\alpha_{4,k}(\mathrm{R\&D}/S)_{i,t-k} + \alpha_5\sigma(\mathrm{OI}/S)_{it-1} + \alpha_6 \text{ Industry dummies} + \alpha_7 \text{ Year dummies} + e_{it} \quad (2).$$

Variable	1	2	3	4
	Linear ESO	Non-linear ESOs	Linear ESO	Non-linear ESOs
	OLS Coefficients (*t*-statistic)	OLS Coefficients (*t*-statistic)	IV Coefficients (*t*-statistic)	IV Coefficients (*t*-statistic)
$\mathrm{TA}/S_{i,t-1}$	0.038 (11.480)	0.036 (11.327)	0.073 (30.667)	0.073 (31.555)
First order terms				
$(\mathrm{ESO}/S)_{i,t}$	−0.414 (−1.929)	1.251 (2.555)	−3.822 (−10.574)	−5.340 (−5.248)
$(\mathrm{ESO}/S)_{i,t-1}$	−1.010 (−3.815)	2.536 (4.765)	−1.331 (−2.661)	−0.154 (−0.102)
$(\mathrm{ESO}/S)_{i,t-2}$	0.030 (0.128)	0.064 (0.129)	2.081 (3.548)	−1.423 (−0.890)
$(\mathrm{ESO}/S)_{i,t-3}$	−0.061 (−0.254)	2.059 (4.149)	1.536 (2.786)	4.625 (3.030)
$(\mathrm{ESO}/S)_{i,t-4}$	0.444 (1.878)	0.033 (0.069)	−1.203 (−2.334)	9.805 (5.423)
$(\mathrm{ESO}/S)_{i,t-5}$	0.322 (1.644)	0.872 (1.957)	0.807 (1.719)	−3.629 (−2.512)
Second order terms				
$(\mathrm{ESO}/S)^2_{i,t}$	—	−14.639 (−5.426)	—	5.011 (0.877)
$(\mathrm{ESO}/S)^2_{i,t-1}$	—	−26.805 (−8.681)	—	−10.319 (−1.356)
$(\mathrm{ESO}/S)^2_{i,t-2}$	—	−1.561 (−0.567)	—	12.730 (1.484)

$(\mathrm{ESO}/S)^2_{i,t-3}$	—	−11.837 (−4.096)	—	−18.076 (−2.131)
$(\mathrm{ESO}/S)^2_{i,t-4}$	—	1.132 (0.413)	—	−60.471 (−6.327)
$(\mathrm{ESO}/S)^2_{i,t-5}$	—	−5.756 (−2.297)	—	25.609 (3.303)
$\sum_{k=0}^{5} \alpha_{,4k}(\mathrm{R\&D}/S)_{i,t-k}$	0.227 ($F = 47.40$)	0.355 ($F = 114.856$)	0.977 ($F = 630.72$)	0.913 ($F = 551.87$)
$\sigma(\mathrm{OI}/S)_{it-1}$	−0.634 (−10.387)	−0.641 (−10.996)	−0.333 (−6.754)	−0.331 (−6.822)
Adj. R^2 overall	0.353	0.413	—	—
Adj. R^2 without dummies	0.210	0.301	0.416	0.449
Sum of first and second order terms				
$\sum_{k=0}^{5} \alpha_{2,k}(\mathrm{ESO}/S)_{i,t-k}$	−0.689 ($F = 4.41$)	6.185 ($F = 129.93$)	−1.928 ($F = 29.66$)	3.884 ($F = 35.45$)
$\sum_{k=0}^{5} \alpha_{3,k}(\mathrm{ESO}/S)^2_{i,t-k}$		−59.467 ($F = 219.08$)		−45.516 ($F = 102.63$)

Panel B: Economic effects evaluated at various points of the ESO distribution using industry IV estimates from column 4 of Panel A

Distribution cutoff	ESO/S value	Estimated effect on OI/S	Implied sensitivity
First quartile	0.0003	0.0012	
Median	0.001	0.0038	3.71
Third quartile	0.003	0.0112	3.70

Note: Variable definitions are as per Table 1. Firm years are over 1998–2000 and cover 1,069 firms. Firms are indexed by i and years by t. To mitigate any undue influence from outliers, all variables are winsorized at the 1% level. F-statistics relate to a test of whether the sum of coefficients is statistically different from zero. The critical F value for $p<0.05$ for the sum of coefficients is 3.84. Coefficients on the individual R&D lags, intercept, industry, and time dummies are suppressed for expositional convenience. The fitted ESO from the instrumental variable Eq. (3) is used in columns (3) and (4) of panel A. Industry and time dummies are left out of the specification in columns (3) and (4) of panel A as the fitted ESO from Eq. (3) relies on industry average ESO. Implied sensitivity in panel B refers to the change in OI/S (predicted by non-linear IV based payoff estimates from column 4 in panel A) scaled by change in the ESO/S.

largest 10% of ESO grant values to differ we observe a significant positive coefficient on the lower 90% group, and a significantly lower slope on the largest 10%, with the overall slope for the largest 10% being negative. This result likely accounts for the negative overall slope documented in the linear model.

Thus, we confirm the relation is non-linear and to account for this non-linearity, we introduce the squared ESO term in Eq. (2) for several reasons. First, the squared term does not require specifying cutoff points for a piecewise regression yet allows for different slopes across the 6 ESO lags. Second, the squared term allows for a concave function consistent with diminishing marginal returns to ESO grants as we hold constant the other inputs (later we check for possible non-linearities in the other inputs). In stark contrast to the results in column (1), the undiscounted first-order effect of ESOs on future income is a *positive* \$6.18 in column (2) while the second-order effect is $-$\$59.47. Moreover, the adjusted R^2 of the concave specification is much higher at 41.3% as compared to 35.3% for the linear specification.[14,15] We discuss the individual ESO lag coefficient estimates and the economic interpretation of the squared terms below.

One of the econometric limitations of the above analysis is that the magnitude of the estimated payoff to ESOs computed using the OLS specification is subject to simultaneity bias. If a shock to the regression residual affects both operating income and ESO grants, the estimates of coefficients on ESO grant value are likely to be inconsistent. For example, an exogenous increase in the demand for a firm's products will generally increase operating income and future growth opportunities. Improved growth opportunities may motivate the firm to grant more options to managers (Smith and Watts, 1992).

[14] The gross payoffs to \$1 of R&D expense are a modest \$0.227 in our sample. We investigate this issue in greater depth and find that the low payoff occurs because (i) approximately 46% of the R&D observations in the payoff regression have zero values; and (ii) unlike Lev and Sougiannis (1996), we do not restrict our investigation to industries where R&D spending is economically important. A number of sensitivity tests related to R&D payoffs is discussed in Section 5.5.

[15] Introducing the squared terms may result in high multicollinearity among the explanatory variables. For example, the correlation among the linear and squared ESO terms range from 0.93 to 0.95 (the correlation among the linear ESO terms is 0.61–0.71 which is why we focus on the sums rather then the individual coefficients). This raises the possibility that the results in column (2) of Table 2 could be spurious and specific to the particular sample. To check this possibility, raised by several readers and our discussant, we conduct several tests. First, SAS diagnostics reveal that in the non-linear specification of the baseline model none of the condition indices related to the ESO variables exceeds 10 (indeed none exceed 4), which is the value at which dependencies may start affecting regression estimates (Belsey et al., 1980). In addition the variance inflation factors for the ESO variables range from 12.0 to 18.3. Second, we randomly select a sample of 25% of our observations (647 firm-years) from the original sample and re-estimate Eq. (2) on this randomly selected subset. We repeat this procedure 10 times. In all 10 cases, the sum of the linear terms is positive and the sum of the squared terms is negative. In 7 of the 10 subsamples, the sum of the coefficients is significant (positive and negatively, respectively). The average across the 10 replications of the sum of the linear terms is 4.029 and of the squared terms is $-$53.386. Third, to further ensure that the switch in the sign of the first order effect is not spurious we consider the possibility that a few firms give out large ESOs grants and also have large operating losses. When we eliminate firms that report losses and re-estimate Eq. (2) we find that the concave specification continues to describe the data well. Thus, we conclude that introducing the squared ESO terms does not lead to spurious results.

To address such simultaneity bias, following Lev and Sougiannis (1996) in their R&D study, we regress ESO grant values for a firm against an instrumental variable, the average ESO grant value of other firms in the same four-digit SIC code.[16] Besides computational ease, the industry average of ESO grant value is an appealing instrumental variable because it is unlikely to be affected by firm-specific shocks such as a shift in the firm's corporate strategy to respond to an increase in firm-specific product demand. Moreover, the industry-average ESO grant value is likely to be highly associated with a firm's ESO grant value because option grants in one firm are likely to be influenced by industry-wide option granting practices (see Murphy, 1999).[17] In particular, we compute a fitted value of the variable ESO/S from Eq. (3) and substitute that fitted value in place of the actual ESO/S in Eq. (2):

$$\mathrm{ESO}/S_{it} = \delta_0 + \delta_1[\text{industry average(not including firm-year } it\text{) of } \mathrm{ESO}/S]_{\mathrm{it}} + \mathrm{error}_{it}. \tag{3}$$

To maximize efficiency of our estimates, Eq. (3) is estimated using all firm-years with available data resulting in 13,426 firm-year observations covering 9 years from 1992 to 2000. In unreported results, we find that the industry-level ESO coefficient, δ_1, is positive 92% of the time and varies from -0.301 (for personal services industry two-digit SIC code of 23) to 1.319 (for transportation services two-digit SIC code 47) depending on the two-digit industry membership. The range of adjusted R^2 is zero to 0.84. Ranked on adjusted R^2, industry ESO is a strong instrumental variable for SIC codes 47 (transportation services), 28 (chemicals and allied products), 36 (electric and electronics), 51 (wholesale trade non-durable) and 29 (petroleum refining). A number of high R^2 are concentrated in high-technology industries identified by Francis and Schipper (1999) (SIC codes 28, 35-industrial and commercial machinery, 36, 48-communications, 73-business services) consistent with options being extensively used in high-growth industries.

We substitute the fitted ESO_{it} from Eq. (3) in place of ESO_{it} in Eq. (2) and report the results of estimating Eq. (2), the payoff regression, in columns 3 and 4 of panel A, Table 2.[18] The coefficient related to a dollar of ESO grant value for the average firm is smaller at $3.88 (from column 4) after controlling for simultaneity in the non-linear specification compared to $6.18 from the baseline regressions reported in column (2). Nevertheless, the key inference that ESOs appear to be positively associated with future operating income remains unchanged in both the OLS and simultaneity adjusted specification.

[16] We require a minimum of four observations to compute an industry average. If there are less than four observations in the four-digit (three-digit) SIC code, we use the three-digit (two-digit) SIC code.

[17] However, if the exogenous demand shock is industry-wide, then the industry-average ESO grant value is unlikely to be a good instrument. An exogenous industry-wide demand shock would increase growth opportunities (and hence operating income) and ESOs in the entire industry and would thereby fail the criteria required for a good instrumental variable i.e., the variable ought to be correlated with ESO grants but uncorrelated with the residual term (operating income).

[18] Note that we do not include industry and time dummies in the payoff regression (2) as the fitted ESO_{it} from Eq. (3) already controls for industry and time-based variation in ESO_{it}.

To help interpret the estimated coefficients on the squared ESO terms, Panel B shows the economic effect on operating income of changing the median ESO up or down to the next quartile cutoff using the industry-IV based specification reported in column (4) of panel A, Table 2 to generate these economic effects.[19] In particular, if we move from the first quartile ESO/S cutoff value of 0.0003 to the median of 0.001, the dependent variable, OI/S, would increase from 0.0012 to 0.0038 representing an implied sensitivity (change in OI/S scaled by change in ESO/S) of 3.71. The corresponding sensitivity for moving from the median to the third-quartile cutoff is 3.70. The small fall in implied sensitivities as we move from the median to the third quartile of ESO/S suggests that the second-order effect of ESO/S is economically minor. However, failing to consider the second-order term $(\mathrm{ESO}/S)^2$ appears to create a significant omitted variable in the linear specification as the payoff to ESOs experiences a non-trivial switch in sign and magnitude (compare columns 1 and 3 to 2 and 4 in panel A, Table 2). In sum, our evidence of such a strong positive payoff to ESOs argues, *prima facie*, against a rent extraction explanation in favor of incentive alignment.

The results above are based on the current and 5 annual lags of ESO grants. Because of multicolinearity in the annual ESO grant values (R^2 above 80%) caution is warranted in interpreting the sign and magnitude of the estimated individual lag coefficients and this is why we sum the coefficients to arrive at our interpretation of the economic magnitudes of the payoffs. As a sensitivity check, we repeat the regressions using only the current year and 3 annual lags. While the estimated individual lag coefficients change, the sum of the coefficients approximate the sum from 5 annual lags and our inferences do not change. This result is not surprising because the high correlation in annual ESO grant values results in the included variables picking up the effects of any omitted lags.[20] Thus, our results are not sensitive to 5-year lag.

Finally, note that our regression model does not estimate the payoff to the last ESO granted (or the marginal payoff) but rather the average payoff to the average grant across firms. This issue has two implications. First, we cannot make definitive statements about the relation between average and marginal payoffs because we do not explicitly specify how ESOs fit into a production function. For the average payoff to be the same as the marginal payoff, a production function would have to satisfy at least two conditions: (a) fixed costs of production are zero and (b) the production function is linear in ESO costs. Second, the regression coefficient estimates indicating a payoff of approximately \$3.71 to a \$1 ESO grant do not imply that firms necessarily under-grant ESOs—just as in the payoffs to R&D, a payoff of \$2.35 to \$1 of R&D, as reported by Lev and Sougiannis (1996, Table 2) does not imply firms under-invest in R&D and could increase firm value by increasing ESO

[19] Specifically, we calculate the change in OI/S as $\sum_{k=0}^{5}\alpha_{2,k}(\mathrm{ESO}/S)_k + \sum_{k=0}^{5}\alpha_{3,k}(\mathrm{ESO}/S)_k^2$. For purposes of this calculation we use the value of ESO/S in the current year, $k=0$, which assumes a stationary distribution in ESO/S across years. With this simplifying assumption, the change in OI/S can be rewritten as $(\mathrm{ESO/S})\sum_{k=0}^{5}\alpha_{2,k} + (\mathrm{ESO}/S)^2\sum_{k=0}^{5}\alpha_{3,k}$.

[20] This result suggests caution in trying to use our results to determine an amortization period over which ESO compensation expense might be amortized.

grants and R&D. If firms are at equilibrium in their option granting behavior, then the payoffs to the last option granted by each firm should equal the cost of the option. That is, in equilibrium, firms will grant ESOs until the marginal benefit equals the marginal cost.

4. Determinants of ESO grant values

The industry instrumental variable (IV) approach described above is a useful *econometric* tool for estimating the unbiased payoff to ESOs. However, the industry IV approach controls for exogenous shocks that affect the dependent and independent variable without articulating the specific *economic* factors that drive that exogenous shock. Recall that the IV based on industry average ESO explicitly purges ESO values of firm-specific characteristics. However, an assessment of whether incentive alignment or rent extraction describes the data cannot be accomplished without reference to firm-specific economic and corporate governance determinants of option grants. Hence, we go beyond the industry IV estimation to enhance our understanding of the firm-specific factors that drive ESO payoffs. We rely on several prior papers to identify firm-specific economic determinants of ESO grants (e.g., Core and Guay, 1999; Bryan et al., 2000).

This alternative approach is also a two-stage approach. In the first stage, we explicitly model ESO grant values as a function of firm-specific variables and in the second stage we regress future earnings on predicted and residual ESO grant values. We recognize that some of our (assumed) exogenous firm-specific economic determinants (such as book-to-market) in the first stage ESO grant model below likely violate the requirements for well-behaved instruments as they may be correlated with the residual in the payoff regression.[21] This is why we rely on the industry IV approach to quantify ESO payoffs but view the modeling of economic determinants of ESO grants as a more direct test of the incentive alignment and rent extraction perspectives. In particular, we model option grants as a function of two sets of firm-specific factors and a residual grant:

$$\begin{aligned}\text{ESO grant/sales} = f[&\text{Economic determinants(in Section 4.1)},\\ &\text{Governance factors(in Section 4.2)},\\ &\text{Residual grant value unexplained by the preceding variables}]. \qquad (4)\end{aligned}$$

The first set of factors relates to economic determinants such as growth prospects and cash constraints. The second set of factors relates to governance characteristics

[21] One way to address such correlation between the economic determinants and future operating income payoffs is to include such future operating income in the ESO grant model, i.e., model a simultaneous system of equations. We did not model a simultaneous system of equations where future operating income explains ESO grants and vice-versa for two reasons: (i) embedding such a simultaneous system with five lags of ESO grants is a challenging computational exercise and (ii) prior studies (Holthausen et al., 1995; Rajgopal and Shevlin, 2002) provide evidence that future payoffs are not endogenous to current compensation choice (that is, simultaneous equations are not descriptive).

such as CEO-board relations and an overall measure of the balance of power between shareholders and managers. If incentive alignment is descriptive, the economic determinants should dominate the corporate governance variables in explaining ESO grant values and the predicted ESO grants arising from the economic determinants should explain a large part of the positive association with future earnings documented in Table 2. If rent extraction is prevalent, we ought to observe significant explanatory power for the corporate governance variables in the ESO grant model and a zero or negative relation between the predicted ESO grant values due to corporate governance variables and future payoffs.

4.1. Economic determinants

We discuss here the rationale behind the inclusion of and the related empirical proxies in the ESO grant model. The variables are listed in Table 4. Because these variables are drawn from prior literature our discussion is relatively terse to conserve space.

4.1.1. Economic determinants

Core and Guay (1999) report that current year grants adjust deviations of the incentive effects of the CEO's existing option portfolio from some target level of incentives. This finding suggests that the current year's option grant should be related to the value of the beginning of year ESO portfolio (*Prior* ESO *portfolio)*.[22] Guay (1999) argues that *Cash compensation* (salary plus bonus) can be invested outside the firm lowering the manager's expected risk-aversion via better diversification thus reducing the need to grant more options. However, the relation could be positive if (i) firms pay a risk premium via cash compensation to compensate managers for increased risk imposed via stock options; or (ii) highly talented managers get larger amounts of both options and cash compared to other managers in the cross-section who are not paid as well. Demsetz and Lehn (1985) argue equity incentives are expected to increase with firm size (*Sales*).

Firms with greater *Investment Opportunities* are likely to award more options (Smith and Watts, 1992; Bizjak et al., 1993; Gaver and Gaver, 1993) and options may attract highly qualified less risk averse executives. We use two proxies to measure investment opportunities and expect ESO awards to be positively (negatively) related to R&D/Sales (book to market value of total assets). Yermack (1995) and Dechow et al. (1996) argue that firms with *Cash and Dividend Constraints* are expected to employ stock options as a substitute to cash compensation. We measure cash and dividend constraints as per Core and Guay (1999).

Firms with lower marginal tax rates (proxied by existence of NOL in any of 3 years prior to grant) are expected to substitute cash compensation with stock option based compensation as option awards either provide no tax deduction (for incentive

[22] Whether that relation should be positive or negative depends on whether the extant portfolio is below or above the optimal level of the portfolio of ESO incentives (as opposed to just new grants). Modeling the optimal level of portfolio ESO incentives is beyond the scope of our paper. Note also that we use the intrinsic value of the prior ESO portfolio as reported by *Execucomp*.

stock options) or provide a tax deduction that is deferred until the options are exercised (for non-qualified stock options).[23] We control for a potential association between total CEO compensation and *Firm Performance* (Baber et al., 1996) by including current year (year t) and prior year (year $t-1$) stock returns as explanatory variables.

John and John (1993) and Yermack (1995) argue that highly *Leveraged* firms (book value of long-term liabilities/MVE) will rely less on stock option awards to compensate managers as debt holders will demand a higher risk premium for supplying debt capital for the fear that managers will pursue overly risky investment projects that may transfer wealth from debtholders to stockholders. Several papers (Core et al., 1999; Ittner et al., 2003) argue that firm risk is a determinant of option compensation, thus we include the standard deviation of OI/S estimated over the prior 5 years, $\sigma(\mathrm{OI}/S)$. In addition to the above variables, we include industry and year dummies in Eq. (4) to control for any un-modeled industry or time-specific variation in ESO grants not captured by the included independent variables.

4.1.2. Governance factors

Because of the prohibitively high costs of hand-collecting governance related data for a large sample such as ours, our governance proxies are restricted to *g scores* compiled by other authors (explained below) and variables obtained from the *Execucomp* database. We proxy for overall quality of governance using *g scores*—a measure of shareholder rights compiled by Gompers et al. (2001) based on 24 corporate governance provisions collected by the Investors Responsibility Research Center. If rent-extraction is present in the data, we expect ESO grants and poor governance (high *g* scores) to be positively related.[24] Because *g* score data are not available for a large number of sample firms, we introduce a *G dummy* that is set to one (zero) if a *g* score is present (absent) for the firm-year. We then interact the *G dummy* with the *g* score and introduce both variables into the grant model.

Hermalin and Weisbach (2001) argue that the greatest factor affecting the Board of Directors's effectiveness is its independence from the CEO. Core et al. (1999) find that CEOs who are also chairmen of the board in the 1982–1984 period were paid more than other CEOs. Under rent extraction, we predict a positive relation between ESO grants and a *CEO-Chair* dummy. We also identify the proportion of the top-5 executive team that serves on the board, *On Board*, and expect under rent extraction, ESO grant values increase with such proportion. Both Core et al. (1999) and Hallock (1997) find that CEO pay increases in the presence of interlocked directors. We compute *Interlock Directors* as the proportion of the top-5 executive team subject to an interlocked relation which *Execucomp* measures as: (i) a top-5 officer serves on the

[23] We acknowledge that the NOL dummy is likely a coarse proxy for a firm's marginal tax rate (see Sevlin, 1990; Graham, 1996). However, the effect of taxes on new grants is likely a second-order effect here given that prior ESO portfolio is in the model. Hence, we believe the NOL dummy adequately serves the purpose of proxying for tax incentives in the grant model.

[24] *G* scores are available only for 1993, 1995 and 1998. We align available *g* score data for 1993 with ESO grants made in the years 1992 and 1993. *G* score data for 1995 (1998) are aligned with ESO grants made in 1994, 1995 and 1996 (1997, 1998, 1999, 2000).

board committee that makes his compensation decisions; or (ii) the top-5 officer serves on the board (and possibly compensation committee) of another company that has an executive officer serving on the compensation committee (and/or the board) of the current officer's company.

Finally, Adams (2000) and Vafeas (1999) argue that the frequency of board *Meetings* is a proxy for the monitoring and effort contributed by directors. We expect ESO grants to be inversely related to *Meetings* if more meetings indicate better governance. Alternatively, the frequency of meetings might signal the difficulty involved in monitoring the firm's operations and hence higher ESO grants to compensate for such difficulty. We lag all the board-related variables by 1 year to allow these factors to impact current year's ESO grants.

Executives with large *Prior ownership* (percentage of stock held at beginning of year) are likely to have more control over the firm's operations and board and could use this control to grant themselves more options, suggesting under rent extraction a positive association between ESO grants and prior executive stockholdings. A competing hypothesis, however, is that the interests of managers with large shareholdings and shareholders are relatively aligned already (Jensen and Meckling, 1976; Yermack, 1995; Bryan et al., 2000) suggesting a negative relation between ESO grants and prior stock ownership.

As indicated in some parts of the above discussion, a conceptual problem with the prediction related to an inverse relation between quality of governance and ESO grant values is that such relation could also proxy for manager quality if the ESO grant model is mis-specified. For example, as Mehran (1995) points out, if monitoring is difficult (as might be the case for low governance firms), the firm could choose a riskier pay package to motivate the manager, possibly via stock options. The second stage payoff regressions help disentangle this explanation from rent extraction by examining the relation between future earnings and the predicted component of ESO grant values due to the corporate governance variables—rent extraction implies a zero or negative association while manager quality implies a positive association.

4.2. Descriptive statistics

Panel A of Table 3 reports the descriptive statistics related to variables in Eq. (4). As mentioned in Section 3.1, the ESO grant model in Eq. (4) is estimated over 10,803 firm-year observations covering the years 1993 through 2000. The median prior ESO value is three times the comparable new grant value (ESO/Sales) possibly suggesting that the average executive does not hold vested options for long after vesting.[25] The average cash compensation variable is slightly higher than the ESO new grant variable suggesting that about half of the executive's annual compensation comes from ESOs. The average book to market ratio is 0.618. More than half of

[25] This statistic might suggest that three annual lags (as opposed to five) of ESO ought to be related to current earnings. As previously noted, we repeat the baseline OLS regression with three lags and find that the sum of ESO payoffs from three lags of ESO grant value are almost the same as those using five lags.

the firm-years report no R&D spending although the mean spending is 5.2% of sales. Approximately 46.5% of the firm-years are dividend constrained, and 25% of the firm-years have an NOL in the previous 3 years. Most of the distributional properties of these variables are fairly similar to those reported by other researchers that have used *Execucomp* data for similar time-periods (see Core and Guay, 1999).

Turning to the governance variables, we have a g score for 76.5% of our sample. The CEO is also the chair of the board in 66.1% of the firm-years. Approximately 3.9% of the executive team has an interlocked relation with board members while 35% of the executive team is also on the board. The average firm holds 6.84 meetings a year and the average executive team owns 4.7% of the firm's stock.

Table 4 presents results from the estimation of the determinants of the Black-Scholes value of the option grant. Findings presented in column 2 (labeled model 1 estimated including only the economic determinant explanatory variables) indicate that many of the predictions related to the association of the Black-Scholes values of the grant and the economic determinants are borne out by the data. We find that the Black-Scholes value of the grant is positively associated with the intrinsic value of the prior ESO portfolio and the statistical significance of the association is strong ($t = 28.54$). Executives with higher levels of cash compensation are awarded bigger grants ($t = 20.97$).[26] Surprisingly, grant values are negatively related to firm size, proxied as log of sales ($t = -5.20$).[27] There is a statistically significant positive (negative) relation between ESO grant values and R&D intensity (book-to-market ratio) suggesting that option grants are given to mitigate information asymmetry in firms with large investment opportunity sets. Firms with dividend constraints (but not cash constraints) appear to use options as cash substitutes ($t = 4.39$ ($t = 1.00$)). Firms with NOLs appear to award larger grants, as expected, although the association is not statistically significant ($t = 1.07$). Firms appear to strongly reward stock performance in the current year and previous year with larger option grants ($t = 9.83$ and 2.99, respectively).[28] We find no association between option grants and

[26] One could interpret the positive association between ESO grant and both prior ESO portfolio and cash compensation as indicative of rent extraction as firms that grant more ESOs in the past continue to do so in the future. To assess the merit behind this interpretation, we extract the predicted ESO grant value attributable to just prior ESOs and cash compensation (related methodology discussed more in forthcoming Section 5.1). We examine the association of such predicted ESO grant value with future earnings. We find that the first-order effect is positive but not significant while the second-order effect is negative. While we cannot definitively rule out rent extraction, the prevalence of rent extraction on a large scale is unlikely because we do not find a negative association between ESO grant and governance quality (discussed below). A related inference is that the positive association between ESO grant-economics and future earnings (in Section 5) is related to economic determinants other than the combination of prior ESOs and cash compensation.

[27] This result can be interpreted to mean that option granting is negatively related to size conditioned on the firm's growth opportunities. Recall that we have controlled for growth opportunities via the book-to-market ratio. Alternatively, sales could be a faulty measure of firm size because it only captures assets-in-place and not growth opportunities.

[28] We also inserted lagged ROE (computed as earnings before extraordinary items/average book value of common equity) in the grant model to assess whether firms award options based on past accounting performance after controlling for stock market performance. However, we find that the ROE term is not statistically significant ($p = 0.81$).

Table 3
Descriptive statistics of determinants of ESO grants ($N = 10,803$)

Panel A: Distribution data

Economic determinants	Mean	Std. deviation	Median	Q1	Q3
Prior ESOs	0.045	0.178	0.003	0.0004	0.017
Cash Comp	0.006	0.016	0.002	0.001	0.006
Log SIZE	6.792	1.586	6.745	5.766	7.841
Book-to-market	0.618	0.258	0.623	0.420	0.813
R&D intensity	0.052	0.194	0	0	0.032
Cash constraint	0.024	0.089	0.011	−0.024	0.057
Dividend constraint dummy	0.465	0.498	0	0	1
NOL dummy	0.254	0.435	0	0	1
Current RET	0.254	0.702	0.118	−0.128	0.422
Lagged RET	0.288	0.700	0.143	−0.089	0.448
Leverage	0.816	1.046	0.483	0.202	1.045
$\sigma(\mathrm{OI}/S)_{\mathrm{it}-1}$	0.046	0.099	0.021	0.011	0.040
Governance variables					
G score dummy	0.765	0.423	1	1	1
G score dummy $*g$ score	7.009	4.581	8	4	11
CEO-Chair	0.661	0.473	1	0	1
On Board	0.350	0.199	0.333	0.200	0.428
Interlock directors	0.039	0.107	0	0	0
Number of meetings	6.847	3.137	6	5	8
Prior ownership	0.047	0.093	0.004	0	0.044

Panel B: Correlation matrices

Economic determinants	Prior ESO	Cash Comp.	Log SIZE	B/M	R&D intensity	Cash Constr.	Div Constr.	NOL	Curr. RET	Lagged RET	Lever.
Prior ESOs	1										
Cash Comp	0.557	1									
Log SIZE	−0.354	−0.575	1								

Book-to-market	−0.340	−0.210	0.201	1							
R&D intensity	0.560	0.837	−0.394	−0.226	1						
Cash constraint	0.367	0.409	−0.332	−0.034	0.363	1					
Dividend constraint	0.216	0.228	−0.340	−0.125	0.188	0.248	1				
NOL dummy	0.141	0.159	−0.108	−0.033	0.170	0.113	0.188	1			
Current RET	0.065	0.111	−0.132	−0.027	0.078	0.056	0.135	0.062	1		
Lagged RET	0.348	0.071	−0.118	−0.378	0.035	0.082	0.164	0.064	0.079	1	
Leverage	−0.164	−0.160	0.255	0.613	−0.151	−0.018	0.022	*0.010*	*0.008*	−0.191	1
$\sigma(\mathrm{OI}/S)_{it-1}$	0.515	0.692	−0.436	−0.166	0.677	0.429	0.249	0.189	0.084	0.077	−0.079
Governance variables	*G* dum	*G* dum∗ *g* score	CEO-chair	On board	Interlock	Meetings					
G score dummy	1										
G score dummy ∗*g* score	0.847	1									
CEO-Chair	0.100	0.150	1								
On Board	−0.460	−0.077	−0.029	1							
Interlock directors	−0.078	−0.106	−0.040	0.244	1						
Number of meetings	0.080	0.118	0.028	−0.064	−0.091	1					
Prior ownership	−0.162	−0.231	−0.062	0.308	0.217	−0.169					

All correlations (except those italicized) are significant at $p<0.05$ level.

Note: The sample of 10,803 firm-year observations from 1993 to 2000 is used to estimate the ESO grant model. Prior ESOs is the intrinsic value of exercisable and unexercisable options held by top 5 executives at the end of the year $t-1$ scaled by sales for year $t-1$. Cash comp is the sum of salary and bonus for year $t-1$ related to the top 5 executives scaled by sales for year $t-1$. Log SIZE is logarithm of sales measured for year $t-1$. BM is the book value of assets scaled by market value of assets at the end of year $t-1$. R&D intensity is R&D expenditure for year $t-1$ scaled by sales for year $t-1$. Cash constraint is the preceding three-year average of [(cash flow used in investing activities + common and preferred dividends − cash flow from operations)/total assets]. Dividend constraint dummy is set to one if retained earnings at the end of year $t-1$ divided by year $t-1$'s dividends is less than two in any of the previous three years, otherwise the dummy is set equal to zero. NOL dummy is set to one if the firm has net operating loss (NOL) carry-forwards in any of the previous three years ($t-1$, $t-2$ and $t-3$), and zero otherwise. Current RET is stock return for year t while lagged RET is stock return for year $t-1$. Leverage is the ratio of book value of total liabilities to the market value of the firm, both at the end of year $t-1$. $\sigma(\mathrm{OI}/S)_{it-1}$ is the standard deviation of annual operating income scaled by contemporaneous sales calculated over the prior 5 years. G score is a measure of shareholder power compiled by Gompers et al. (2001). CEO-Chair is a dummy variable that is set to one (zero) if the CEO is (is not) the chair of the board of directors in year $t-1$. On Board refers to the proportion of the top-5 executive team that is on the board of directors in year $t-1$. Interlock directors is the proportion of top-5 executives that are interlocked in some way with the other directors of the board in year $t-1$. Number of meetings refers to the number of meetings held by the board during year $t-1$. Prior ownership is the proportion of firm's stock holdings held by top 5 executives of the firm at the end of year $t-1$. To mitigate any undue influence from outliers all variables are winsorized at the 1% level.

Table 4
Estimation of determinants of ESO grant values ($N = 10,803$)

$$\begin{aligned} \mathrm{ESO}/S_{it} = {} & \beta_0 + \beta_1 \text{ Prior ESO}_{it-1} + \beta_2 \text{ Cash Compensation}_{it-1} + \beta_3 \ln \text{Size}_{it-1} \\ & + \beta_4 \text{ BM}_{it-1} + \beta_5 \text{ R\&D}/S_{it-1} + \beta_6 \text{ Cash constraint}_{it-1} \\ & + \beta_7 \text{ Div constraint dummy}_{it-1} + \beta_8 \text{ NOL dummy}_{it-1} + \beta_9 \text{ RET}_{it} \\ & + \beta_{10} \text{ RET}_{it-1} + \beta_{11} \text{ Leverage}_{it-1} + \beta_{12}\, \sigma(\mathrm{OI}/S)_{it-1} \\ & + \beta_{13} \text{ g score dummy}_{it-1} + \beta_{14} \text{ g score dummy}{*}\text{g score}_{it-1} \\ & + \beta_{15} \text{ CEO-Chair}_{it-1} + \beta_{16} \text{ Interlocked directors}_{it-1} + \beta_{17} \text{ On Board}_{it-1} \\ & + \beta_{18} \text{ Meetings}_{it-1} + \beta_{19} \text{ Prior ownership}_{it-1} \\ & + \beta_{20} \text{ Industry dummies} + \beta_{21} \text{ Year dummies} + e_{it} \quad (4) \end{aligned}$$

	1	2	3	4
Variable	Predicted sign	Model 1: Economic determinants. Coeff. (t-statistic)	Model 2: Governance factors. Coeff. (t-stat)	Model 3: Full model. Coeff. (t-stat)
Economic determinants				
Prior ESO_{it-1}	$\pm$	0.032 (28.544)		0.032 (28.401)
Cash $\text{compensation}_{it-1}$	$\pm$	0.399 (20.967)		0.404 (21.161)
ln Size_{it-1}	+	−0.0007 (−5.199)		−0.0009 (−5.984)
BM_{it-1}	−	−0.003 (−4.068)		−0.004 (−4.669)
R&D/S_{it-1}	+	0.022 (14.008)		0.021 (13.264)
Cash constraint_{it-1}	+	0.002 (0.997)		0.002 (1.254)
Div constraint dummy_{it-1}	+	0.001 (4.389)		0.001 (4.366)
NOL dummy	+	0.0004 (1.073)		0.0003 (0.907)
RET_{it}	$\pm$	0.002 (9.833)		0.002 (10.084)
RET_{it-1}	$\pm$	0.0007 (2.991)		0.0007 (3.087)
Leverage_{it-1}	−	−0.0001 (−0.540)		−0.000 (−0.394)
$\sigma(\mathrm{OI}/S)_{it-1}$	$\pm$	0.013 (5.885)		0.013 (5.664)
Governance variables				
G score dummy_{it-1}	?		−0.002 (−2.519)	0.0007 (1.025)
G score dummy $*g$ score_{it-1}	+		−0.0008 (−9.612)	−0.0000 (−0.321)
CEO-chair_{it-1}	+		−0.002 (−6.209)	−0.003 (−1.118)
Interlocked directors_{it-1}	+		0.003 (1.526)	0.002 (1.648)
On board_{it-1}	+		−0.004 (−4.096)	−0.0009 (−1.153)
Meetings_{it-1}	$\pm$		−0.000 (−1.34)	0.000 (1.662)
Prior ownership $_{it-1}$	$\pm$		−0.011 (−4.624)	−0.009 (−4.921)
Adjusted R^2 overall		0.574	0.052	0.577
Adjusted R^2 without dummies		0.569	N/A	0.570

Note: The sample of 10,803 firm-year observations from 1993 to 2000 is used to estimate the ESO grant model. Industry and time dummies are not included while estimating model 2 as they are considered a part of predicted ESO from economic determinants. See notes to Table 3 for variable definitions. To mitigate any undue influence from outliers all variables are winsorized at the 1% level. Coefficients on the intercept, industry and time dummies are suppressed for expositional convenience.

leverage ($t = -0.54$). Firms with riskier earnings streams grant higher levels of options to executives ($t = 5.88$). The economic determinants explain a substantial 57.4% of the cross-sectional variation in Black-Scholes grant values to the firm. The year dummies and the industry dummies add about 1% to the adjusted R^2.[29] The included economic variables explain a significant portion of ESO granting behavior.

Turning to the results when only the governance variables are included in the model (column 3), we find that governance variables only explain about 5% of the variation in ESO grants. Contrary to expectations, ESO grants appear to be negatively related to g score and to the *CEO-Chair* and *On Board* variables. Consistent with the idea that the interests of shareholders and managers are already aligned in firms where executives have a greater level of prior ownership, and inconsistent with rent extraction, we observe a negative association between awards and prior ownership ($t = -4.62$). However, it is important to avoid over-interpreting these results as governance characteristics of firms are endogenously chosen in response to firm characteristics, many of which would be similar to the economic determinants examined in column (2). Hence, we turn to column (4) where the economic determinants and governance factors are considered together in the grant model.

The adjusted R^2 of the full model in column (4) (57.7%) is barely different from that of the economic determinants model in column (1) (57.4%). This result suggests that the governance variables are highly correlated with firm characteristics as one might expect if governance structure is an endogenous choice variable. Further, the estimated coefficients and t-statistics on the economic determinant explanatory variables are largely unchanged (suggesting that these variables are exogenous). It is interesting to note that the g score variables are insignificant in the full model as the F-statistic of the sum of g score dummy and the interaction is 1.16 ($p = 0.28$). The presence of interlocked directors on the compensation committee appears to increase ESO grants, consistent with rent extraction ($t = 1.65$, $p = 0.06$, marginally significant in a one-tailed test). However, the positive coefficient on number of meetings suggests that boards meet frequently in more complex business that need greater monitoring ($t = 1.66$). If rent extraction were prevalent in the sample, we would expect ESO grants to decrease with the number of meetings as managers would have exploited lower levels of monitoring by the board. Moreover, the negative association between ESO grants and prior ownership is also inconsistent with rent extraction ($t = -4.92$). Thus, the evidence in favor of rent extraction from relating ESO grants to governance quality appears to be, at best, weak.[30]

[29] Adding year and industry dummies to the grant model could potentially remove variation related to systematic over-granting of options over time and in specific industries from the residual of the grant model and thus make it harder to document rent extraction. However, this concern appears to be a non-issue from an empirical stand-point as these dummies add virtually nothing to the adjusted R^2. Moreover, we examine time-based variation in ESO grants in Section 5.5.

[30] If all firms in our sample were to over-grant a *constant* amount of options then the model in Eq. (4) would not capture such rent extraction. Such over-granting would be reflected in the intercept terms of Eq. (4) and would accordingly be considered a part of predicted ESO from economic determinants. However, the operating income related payoff to the predicted ESO from economic determinants would then be smaller.

5. Predicted/unexpected ESO grant values and future earnings

In this section, we parse out the ESO grant value for a firm year into a predicted and unexpected (residual) component and assess the relation between such components and future earnings. In particular, we partition the ESO grant value into three components: (i) predicted ESO grant due to systematic economic determinants; (ii) predicted ESO grant on account of governance issues; and (iii) an unexplained or a residual ESO grant value.

5.1. Predicted ESO grant due to systematic economic factors

We compute the predicted component of ESO grant value that is related to economic determinants for each firm-year, after controlling for the corporate governance factors, as follows:

$$\text{Predicted ESO grant-economics}_{it} = \sum_{j=0}^{n} \beta_j \text{ economic determinants}_{ijt}, \tag{5}$$

where β_j is the estimated coefficient on each economic determinant j reported in column (4) in Table 4. We then estimate the impact of this predicted grant on future earnings. In particular, we substitute the fitted value of Black-Scholes grant value attributable to standard economic determinants into the ESO payoff Eq. (2) to assess the relation between such predicted ESO value and future operating income. A positive payoff association is consistent with ESOs successfully resolving the incentive problems that motivate option granting. A zero or negative association, on the other hand, would imply that firms with severe economic constraints grant options and such firms perform poorly in the future. Such a negative payoff could be interpreted as the underlying cost of the agency problems and economic constraints faced by the firm.

5.2. Predicted ESO grant value due to governance

The evidence in Section 4 provides little support for the rent extraction story. Nevertheless, for the sake of completeness, we compute the predicted ESO grant value due to governance factors, after controlling for the standard economic determinants of option granting behavior, as

$$\text{Predicted ESO grant-governance}_{it} = \sum_{j=0}^{n} \beta_j \text{ governance factors}_{ijt}, \tag{6}$$

where β_j is the estimated coefficient on each governance factor j reported in column (4) in Table 4. We then estimate the impact of this predicted grant on future earnings. We would interpret a positive payoff as evidence that the predicted grant reflects some dimension of a firm's demand for a high-quality manager that was not modeled under the set of economic determinants considered in Section 5.1. However, a negative or zero association would support the idea of rent extraction by managers as a result of poor governance, assuming the predicted ESO grants are symptomatic of underlying unresolved agency problems (for example, shirking and/or low-quality managers) which lead poorly governed firms to under-perform.

5.3. Residual ESO grant value

We also examine the payoffs to residual grant values. If one were to subscribe to an extreme optimization perspective that *all* firms in the sample are optimizing with respect to their option grants *all* the time, there ought to be no reason to look for (and find) a statistically significant payoff to residual ESO grant (Demsetz and Lehn, 1985; Ittner and Larcker, 2001). In such a case, any statistically significant payoff related to the residual grant (the difference between actual ESO grant and ESO grant predicted by the economic determinants and governance variables) ought to occur only because of measurement error, misspecification of functional form or an inadequate set of controls.

Ittner and Larcker (2001) and Ittner et al. (2003) argue that such an extreme optimization perspective that fails to acknowledge the possibility of any off-equilibrium behavior is perhaps unrealistic. Instead, it is likely that all organizations are dynamically learning and moving towards the optimal level, but a cross-sectional sample will consist of firms that are distributed around the optimal choice. Thus, to allow for the possibility of such dynamic learning towards the optimal choice, they suggest that researchers assess whether the residual from the first-stage ESO value regression is associated with future operating income. If the systematic portion of the ESO grant model (fitted ESO grant value from economic determinants and governance characteristics) is the appropriate choice for a firm, then any residual deviation (positive or negative) from the first stage model should adversely affect future operating income.[31]

5.4. Future payoffs related to predicted and unexpected ESOs

We assess the contribution of each of the three components of ESO grant value in a combined regression:

$$
\begin{aligned}
(\mathrm{OI}/S)_{it} = \alpha_0 + \alpha_1(\mathrm{TA}/S)_{i,t-1} &+ \sum_{k=0}^{5}\alpha_{2,k}(\text{predicted ESO-economics}/S)_{i,t-k} \\
&+ \sum_{k=0}^{5}\alpha_{3,k}(\text{predicted ESO-economics}/S)^2_{i,t-k}
\end{aligned}
$$

[31] This statement assumes that the ESO grant model in Eq. (4) is the same for each firm-year in our sample, exhibits the correct functional form, has predictor variables that are measured without error, and includes all relevant (exogenous) predictor variables. That is, the residual is truly random error.

$$
\begin{aligned}
&+\sum_{k=0}^{5}\alpha_{4,k}(\text{predicted ESO-governance}/S)_{i,t-k}\\
&+\sum_{k=0}^{5}\alpha_{5,k}(\text{predicted ESO-governance}/S)^{2}_{i,t-k}\\
&+\sum_{k=0}^{5}\alpha_{6,k}(\text{residual ESO grant}/S)_{i,t-k}\\
&+\sum_{k=0}^{5}\alpha_{7,k}(\text{residual ESO grant}/S)^{2}_{i,t-k}\\
&+\sum_{k=0}^{5}\alpha_{8,k}(\text{R\&D}/S)_{i,t-k}+\alpha_{9}\sigma(\text{OI}/S)_{it-1}\\
&+\alpha_{10}\text{ Industry dummies}+a_{11}\text{ Year dummies}+e_{it}. \qquad (7)
\end{aligned}
$$

Based on the discussion in Sections 5.1–5.3, if options effectively address the incentive problems then the payoffs suggested by the sum of the α_2 and α_3 coefficients should be greater than or equal to unity. Smaller payoffs would indicate that firms with greater economic constraints grant more options and also perform poorly in the future. If rent extraction is descriptive, then the payoffs suggested by the sum of α_4 and α_5 coefficients should be zero or negative while positive payoffs would indicate some of the governance variables proxy for economic determinants. Finally, if all firms are at equilibrium with respect to their option granting practices, or it is not too costly to deviate from the benchmark ESO grant model, the payoffs suggested by the α_6 and α_7 coefficients ought to be zero. If deviations from such equilibrium are expensive, as conjectured by Ittner and Larcker (2001), then payoffs should increase as we move from quartile 1 to the median (undergranting) and decrease as we move from the median to quartile 3 (overgranting) of the residual grant distribution.

For completeness, we report estimates of the payoff regression including each of the three components separately in columns 1–3 of Table 5. However, we focus our discussion here on the results of estimating the model including all three components. The only difference in results is for the residual grant—discussed below. Column (4) of Table 5 reports that the first-order payoff to the predicted ESO grant component due to economic determinants is positive and significant \$8.01 ($F = 159.34$). The second-order effect is negative and significant ($F = 290.29$) suggesting a concave relation between the economic determinants and future income. Note that an increase in the portion of ESO grant attributable to economic determinants is associated with an increase in operating income. In particular, untabulated results indicate that if we move from the first quartile predicted ESO$/S$ cutoff value of 0.0008 to the median of 0.0028, the dependent variable, OI$/S$, would increase from 0.0064 to 0.0218 representing an implied sensitivity (change in OI$/S$ scaled by change in ESO$/S$) of \$7.69. The corresponding sensitivity for moving from the median to the third-quartile cutoff is \$7.23.

Column (4) reports the payoff to the predicted ESO grant component due to corporate governance is also positive and significant \$11.64 ($F = 8.29$) but the second-order effect is insignificant ($F = 0.78$). Thus, the response function of future income to governance factors appears linear. The sum of the estimated coefficients on the first term at \$11.64 is larger than the sum for economic determinants. However, the sum of governance coefficients has a larger standard error as evidenced by the much smaller F statistic. Thus, while the sum is greater than zero, the hypothesis that the sum equals one (such that the payoffs equal the ESO grant value) cannot be rejected.[32] The evidence is thus inconsistent with a rent extraction explanation.

Column (4) reports the first-order payoff to the residual ESO grant is positive and significant \$1.21 ($F = 5.39$) while the second-order effect is negative and highly significant ($F = 49.51$). This result is different than the insignificant first-order payoff reported in column (3). This difference might appear surprising because by construction OLS residuals are orthogonal to $X\beta$—the predicted ESO grant values. However, only a subset of the grant model observations (1998–2000) are included in the payoff regressions and there are small but non-zero correlations among the variables for this subset. Further, orthogonality only applies to the contemporaneous residual and grant values—the predicted values and residual grants are correlated with each other across lags. To help interpret the residual grant results in column (4), the economic effect on operating income of changing the median residual up or down to the next quartile cutoff ranges from \$1.09 to \$1.29 suggesting that \$1 of random deviations results in almost the same payback. Under this interpretation, random deviations are payoff-neutral, not costly as conjectured by Ittner and Larcker (2001). Of course, this discussion assumes that the residuals are truly random errors and not reflecting some omitted economic determinant(s).[33]

In sum, the results in Table 5 are consistent with the positive payoff to ESO grants in the baseline regressions being largely due to the economic characteristics of firms granting options. As mentioned, a \$1 increase in the ESO grant due to economic factors is associated with an increase ranging from \$7.18 to \$7.69 in future earnings. We interpret this positive payoff to indicate that if ESO grants were to increase by a dollar *due to an increase in any of the exogenous economic determinants* (such as growth opportunities), such an increased ESO grant would be associated with

[32] Note also that for the median firm, ESO grant predicted by governance variables accounts for only 9% of ESO grant predicted by a combination of both economic determinants and governance factors. Hence, the economic importance of ESO grant predicted by governance quality is relatively small.

[33] To conserve space, we do not present the linear specification and the coefficients related to each lag. In unreported results, we plotted the mean fitted ESO values and operating income for 25 portfolios sorted on each of three variables—predicted ESO grant due to economic factors, governance factors and the residual. We observe a concave relation only between operating income and ESO grant due to economic determinants. Consistent with the results in Table 5, there appears to be no systematic relation between operating income and either predicted ESO due to governance or the residual term.

Table 5
Estimation of payoffs to predicted and unexpected ESO grant values ($N = 2,627$)

$$\begin{aligned}(\mathrm{OI}/S)_{it} = {} & \alpha_0 + \alpha_1(\mathrm{TA}/S)_{i,t-1} + \sum_{k=0}^{5}\alpha_{2,k}(\text{predicted ESO-economic}/S)_{i,t-k} + \sum_{k=0}^{5}\alpha_{3,k}(\text{predicted ESO-economic}/S)^2_{i,t-k} \\ & + \sum_{k=0}^{5}\alpha_{4,k}(\text{predicted ESO-governance}/S)_{i,t-k} + \sum_{k=0}^{5}\alpha_{5,k}(\text{predicted ESO-governance}/S)^2_{i,t-k} \\ & + \sum_{k=0}^{5}\alpha_{6,k}(\text{residual ESO grant}/S)_{i,t-k} + \sum_{k=0}^{5}\alpha_{7,k}(\text{residual ESO grant}/S)^2_{i,t-k} \\ & + \sum_{k=0}^{5}\alpha_{8,k}(\mathrm{R\&D}/S)_{i,t-k} + \alpha_9\ \sigma(\mathrm{OI}/S)_{it-1} + \alpha_{10}\ \text{Industry dummies} + \alpha_{11}\ \text{Year dummies} + e_{it} \quad (7)\end{aligned}$$

	1	2	3	4
Variable	Predicted ESO-Economic	Predicted ESO-Governance	Residual Grant	Full model
$\mathrm{TA/S}_{i,t-1}$	0.038 ($t = 12.723$)	0.035 ($t = 10.865$)	0.038 ($t = 11.617$)	0.036 ($t = 11.945$)
$\sum_{k=0}^{5}\alpha_{2,k}(\text{predicted ESO-economic}/S)_{i,t-k}$	5.511 ($F = 91.29$)			8.010 ($F = 159.34$)
$\sum_{k=0}^{5}\alpha_{3,k}(\text{predicted ESO-economic}/S)^2_{i,t-k}$	−86.161 ($F = 326.79$)			−87.844 ($F = 290.29$)
$\sum_{k=0}^{5}\alpha_{4,k}(\text{predicted ESO-governance}/S)_{i,t-k}$		10.128 ($F = 5.31$)		11.635 ($F = 8.29$)
$\sum_{k=0}^{5}\alpha_{5,k}(\text{predicted ESO-governance}/S)^2_{i,t-k}$		1484.182 ($F = 0.57$)		1555.034 ($F = 0.78$)
$\sum_{k=0}^{5}\alpha_{6,k}(\text{residual ESO}/S)_{i,t-k}$			−0.420 ($F = 0.70$)	1.206 ($F = 5.39$)
$\sum_{k=0}^{5}\alpha_{7,k}(\text{residual ESO}/S)^2_{i,t-k}$			−40.250 ($F = 49.81$)	−45.896 ($F = 49.51$)
$\sum_{k=0}^{5}\alpha_{8,k}(\mathrm{R\&D}/S)_{i,t-k}$	0.503 ($F = 153.60$)	0.186 ($F = 56.49$)	0.111 ($F = 128.40$)	0.498 ($F = 130.42$)
$\sigma(\mathrm{OI}/S)_{it-1}$	−0.505 ($t = -11.04$)	−0.530 ($t = -11.48$)	−0.519 ($t = -11.03$)	−0.549 ($t = -11.64$)
Adj. R^2 overall	0.459	0.352	0.387	0.484
Adj. R^2 without dummies	0.376	0.211	0.249	0.404

Note: The predicted ESO-economic and predicted ESO-governance is the ESO grant value attributable to economic determinants and governance factors, respectively, estimated with coefficients from ESO grant model fitted in model (3) of Table 4. Other variable definitions are as per Table 1. Firm-years cover 1998–2000 and 1,069 firms. To mitigate any undue influence from outliers, all variables are winsorized at the 1% level. F-statistics relate to a test of whether the sum of coefficients is statistically different from zero. The critical F value for $p<0.05$ for the sum of coefficients is 3.84. Coefficients on the individual lags, intercept, industry, and time dummies are suppressed for expositional convenience.

greater future earnings. Thus, it appears as though firms with greater growth prospects grant more options and such firms perform well in the future. Note however that randomly increasing ESO grant by a dollar, unrelated to the exogenous determinants and governance factors, does not lead to a correspondingly large increase in future earnings as indicated by the relatively smaller payoffs to the residual grant value.

5.5. Additional analyses

5.5.1. Controls for cash compensation and restricted stock in the payoff regression

We introduce five lags of cash compensation (salary and bonus) and restricted stock grants, scaled by sales, as additional independent variables in our payoff regression (4). Because ESO grants are likely to be awarded in conjunction with cash compensation and restricted stock, these variables could be potentially omitted from the payoff specification.[34] We find that the payoff to ESO grants continues to be significantly positive and concave. We observe a negative relation between cash compensation and future income. However, the relation between restricted stock and future earnings is statistically insignificant. We also omit cash compensation as an independent variable from the grant model Eq. (4) to estimate fitted ESO grants attributable to economic determinants. When the ESO grant is decomposed into the three components related to economic determinants, governance quality and the residual, we continue to observe that the positive payoff to ESOs is dominated by the economic determinants. As a further check on the results, we added back cash compensation and restricted stock to the dependent variable OI in the payoff regression and repeated our analyses. Our inferences remain unchanged.

5.5.2. R&D and capital expenditure sensitivity

ESOs may motivate managers to increase R&D spending and capital expenditure and perhaps even the efficiency with which these expenditures are managed to generate future earnings. Hence, including R&D and total assets (TA) as independent variables in the payoff regression (2) potentially understates payoffs to ESOs. To assess the extent of such understatement, we conduct a sensitivity check where the R&D and TA terms are omitted from the payoff regression. We find that the first-order gross undiscounted payoff to ESOs after deleting R&D terms (TA term) from the baseline payoff regression is almost the same as $6.154 ($6.654) as the corresponding payoff of $6.18 reported in Table 2. However, the adjusted R^2 for the regression without R&D terms (TA terms) are smaller at 36.23% (36.25%) compared to 41.3% in Table 2 suggesting that the absence of these terms might lead to an under-specified payoff regression.

[34] We have not explicitly modeled the determinants of cash compensation and restricted stock for this analysis as our focus is on modeling ESO payoffs. However, we introduce square terms for cash compensation and restricted stock for five lags in the payoff regressions. The sum of the payoffs attributable to these squared terms is not statistically significant.

We also examine whether setting missing R&D observations to zero biases our results in any significant way. We set a R&D dummy to be one (zero) if we find (do not find) an R&D observation for that firm-year on *Compustat*. We also interact the R&D dummy with the R&D observation and introduce both the dummy and the dummy interaction with R&D in the payoff model. We find that the R&D dummy is insignificant suggesting that the future earnings for firms that report R&D expense is no different from those that do not. In another iteration, we introduce an interaction of the R&D dummy with squared R&D terms as an independent variable in the payoff regressions to assess whether the return to R&D may also be non-linear. We also added a squared term for total assets (TA/S) to check whether the returns on total assets could also be non-linear. We find evidence of a concave payoff to R&D and total assets. However, the inferences related to ESO payoffs remain qualitatively similar to those reported in the text.

5.5.3. Repriced or reload options

As a sensitivity check, we also eliminate firms that repriced options or had a reload option plan in any year during the sample period because of concerns that ESO values for a repriced or reloaded firm-year may not be comparable with ESO values for the same firm in other years. This filter eliminates 761 firm-year observations for reloads and 1,365 firm-year observations due to repricing from the grant model in Eq. (4). The payoff regressions in Eq. (2) are estimated with 2,137 observations covering 864 firms. However, we find that the inferences reported in the text are unchanged.

5.5.4. Scaler

We assess whether our results are sensitive to alternate scalers. In particular, we scale operating income and other variables in the payoff regression by total assets instead of sales (to enable an interpretation of the payoff regression in terms of return on total assets). We find that the tenor of our reported results remains unchanged.

5.5.5. Technology bubble

Due to data constraints we only examine ESO-payoffs for the later half of the 1990s—a period characterized by strong increases in overall stock prices. We conjecture that the technology bubble of the late 1990s may have affected the ESO payoffs reported here in two ways. First, the raging bull market may have resulted in higher ESO grant values without a commensurate increase in firms' earnings. Second, firms may have granted higher levels of ESOs to retain their managers. To assess the effect of the bull market, we examine the year dummies in the grant regressions. The average level of option grants in 1999 and 2000 exceed those in 1998 (minimum F statistic = 13.43).[35] However, we find that the time dummies in the

[35] As an aside, we find that the grant levels for the other years in the sample (1993, 1994, 1995, 1996, 1997) are not statistically different from one another.

baseline payoff model are insignificant. Thus, we do not observe statistically different sample earnings for the three years 1998, 1999, 2000. Recall that we include the time dummies as a part of ESO grant predicted by economic determinants and we find (as previously reported) that the payoff to that component is positive. Hence, the increased option grant during the late 1990s probably indicates a higher equilibrium wage during the bubble.

5.5.6. *Extreme earnings management*

Our tests assume reported operating earnings are an unbiased measure of firm performance. If many firms overstate earnings then our results might reflect earnings management as a function of ESO grant values rather than economic payoffs. We leave to future research an examination of the association, if any, between earnings management and ESO usage by firms. However, as a preliminary check on our results, we omit the 13 firms in our sample that have recently been publicly identified in the financial press as extreme earnings managers (which list includes Enron, Computer Associates, Worldcom, Xerox, K Mart) and re-estimate our regressions. Omission of these 13 firms has little effect on the estimated payoffs and our inferences are unchanged.

5.5.7. *Economic dilution*

The estimates of ESO related payoffs documented earlier rely on a regression of the operating income for the *entire* firm on the ESOs granted to the top 5 executives. Hence, these estimates cannot speak to payoffs related to options granted to *all* employees. To provide preliminary evidence on this issue, we approximate the Black Scholes value of *all* ESOs granted by grossing up the ESO grant value awarded to the top 5 executives by the proportion of ESOs granted to the top 5 executives (such proportion is reported in *Execucomp*). We are left with only 1,576 observations as the proportion data are often missing in *Execucomp*. We assume that all employees of a firm receive ESOs at the same terms as the top 5 executives. We replace such a grossed-up ESO value in Eq. (2) for each firm and then re-conduct the non-linear industry-adjusted IV estimations discussed in Section 3.3 to obtain unbiased payoff estimates. The sum of the estimated coefficients on the first-order term is \$0.94, which is significantly greater than zero but not significantly different than one. Including the squared term to allow for non-linearity, we find that an implied sensitivity of the undiscounted payoff to *all* ESOs is \$0.90 (\$0.83) when we move from the first quartile to median (median to third quartile) in the distribution of *all* ESOs.

The positive payoff related to *all* ESOs also sheds some light on the question of whether options cause economic dilution. Economic dilution occurs when the present value of the payoffs is less than the Black-Scholes value of ESO granted. Because future payoffs associated with an option given to all employees are not significantly different from one, a dollar of Black-Scholes grant value implies an approximately \$1 payoff, one can argue that there is little evidence of *economic dilution* due to ESOs. However, given the simplifying assumptions underlying this analysis (that the rank and file employees get ESOs at the same terms as senior managers, operating income, our measure of payoffs, approximates operating cash flows and that missing proportion data are not systematically associated with characteristics of economic dilution), a detailed analysis of the dilution issue needs to be conducted and could perhaps be pursued in future work. For example, the Black-Scholes value of all ESOs granted could be hand collected from the 10 K disclosures for a large sample of firms.

5.5.8. Including lagged firm performance

Barber and Lyon (1996) (BL) show that in certain circumstances it is important to control for firms' past performance in tests examining the association between some event and subsequent firm performance. Specifically, BL show that problems (bias and/or low power tests) arise when the treatment (event) is correlated with the firm's past performance—past good performance leads firms to initiate dividend payments, undertake IPOs or SEOs. Because earnings are generally mean reverting, failure to control for this mean reversion could result in false inferences. BL suggest matching the treatment firms with a set of control firms matched on pre-event earnings performance and then examine differences in subsequent firm performance. In our setting there are very few non-ESO granting firms to act as controls. In lieu of matching, it is possible to include each firm's lagged earning performance, (OI/S) from $t-1$, in the earnings payoff regression model. However, in our setting including lagged earnings performance will "soak up" some, if not all, of the payoffs to the lagged ESO grants. That is, earnings in $t-1$ in our model are a function of ESO grants in $t-1$ through $t-5$. Thus inclusion of lagged performance will lead to downward biased estimates on the lagged ESO terms. Note further that including lagged performance as an independent variable masks the relation between ESO grant values and such lagged performance and as such, detracts from our research objective of quantifying the relation between ESO grant values and future earnings. When we include lagged performance in Eq. (2), its estimated coefficient is 0.80, R^2 increases to 70% (from 40%) and more importantly as expected, the sum of the estimated coefficients in both the linear and non-linear specifications are reduced in magnitude towards zero. Thus, we do not include lagged performance in our main tests.

6. Conclusions

We examine whether the Black-Scholes value of new ESO grants to the top five executives is associated with future operating income. We allow the current year and five annual lags of ESO grants to impact future operating income and allow for non-linearity in the payoff function. We find that the payoff associated with ESO grants is markedly positive. We employ two stage least squares using the industry average of ESO grants as an instrument for each firm's grant to address simultaneity concerns. We find similar results in this modified specification.

To understand the origin of this positive payoff, we employ another two stage approach. In the first stage we model ESO grant value as a function of growth opportunities, cash constraints, other economic determinants, and proxies for quality of governance. We find strong associations between ESO grant values and the economic determinants but not with the proxies for corporate governance in directions predicted by rent extraction. In the second stage we regress future earnings on predicted and residual ESO grant values derived from the first stage grant model. We find that the earnings payoff to predicted ESO grants attributable to economic determinants is strongly positive consistent with the incentive alignment perspective. The payoff to ESO grants due to governance characteristics is also positive, inconsistent with rent extraction, but consistent with some of the governance variables, such as prior equity ownership and number of board meetings, reflecting economic determinants rather than low quality governance. Finally, there appears to be little penalty to deviating from the benchmark ESO granting model given the estimated positive payoffs associated with residual ESO grants.

Our results have important implications for future research. Using a non-linear specification enables us to document fairly sizeable payoffs, in terms of future earnings, to granting ESOs. Extant research (e.g., Bens et al., 2002; Bens et al., 2003; Core et al., 2002; Huson et al., 2001) appears to focus on the number of additional shares that need to be issued due to outstanding options without fully accounting for the future payoffs from option issuance. Future research might fruitfully explore the possibility that the economic dilution of earnings caused by options is perhaps smaller than previously thought. Furthermore, the non-linear relation between ESOs and future earnings may also have a bearing on the mixed results in value-relevance research on ESOs. Most extant research on the value-relevance of ESOs assumes a linear association between ESOs and firm value.

Our findings are subject to several caveats. First, our results are sensitive to whether the researcher imposes a linear or a non-linear payoff structure to ESO grants. We provide several tests in the paper to justify the non-linear specification. Moreover, the positive payoff to ESO granting looks more economically plausible to us than the systematic large negative payoff indicated by the linear specification. Second, we examine a relatively small time-series of option grants (8 years) and payoffs (3 years). Hence, the payoff structure documented here may be driven by data availability constraints and our results may not generalize to other time-periods. Third, the ESO grant model that we use in our two stage analysis may not correspond to the model that firms use to optimally set ESO grants. Fourth, the list of economic determinants and governance variables we consider is potentially incomplete. Fifth, we do not endogenize the other elements of executive compensation besides ESOs. Sixth, we assume that reported earnings are an unbiased measure of firm performance. Despite these limitations, we present some of the first evidence on the payoffs to granting ESOs and whether managers grant themselves more ESOs than the level required to mitigate agency conflicts.

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