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**Large Sample Evidence on the Relation Between Stock Option Compensation and Risk Taking**

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## **Large Sample Evidence on the Relation Between Stock Option Compensation and Risk Taking**

### **Abstract:**

A distinctive feature of stock options is that they create incentives for managers to take risks. For a sample of 3,723 CEO-year observations over 1992-1996, we find that risk-taking incentives offered by CEO's stock options (the sensitivity of ESO values to stock return volatility) are statistically associated with greater risk-taking behavior proxied by future earnings and future cash flow volatility. However, the economic magnitude of such option-induced risk taking on the CEO's wealth is relatively modest. Moreover, there appears to be a zero to negative association between option risk-taking incentives and future operating performance. Our results call into question the incentive efficacy of the distinctive feature of ESOs relative to restricted stock, i.e., risk-taking incentives.

# Large Sample Evidence on the Relation Between Stock Option Compensation and Risk Taking

## 1. Introduction

Stock options represent a fast growing component of executive compensation in recent years (Murphy 1999). Hence, managerial incentives can no longer be well understood without a deep understanding of employee stock options (ESOs) (Hall 2000). A distinctive feature of ESOs is that unlike other forms of compensation, the value of ESOs is sensitive to risk-taking actions that managers take. It is widely believed that managerial risk aversion, combined with excessive concentration of firm-specific human and financial capital, inhibits managers from taking risky positive net present value (NPV) projects on behalf of the risk-neutral shareholders (e.g., Jensen and Meckling 1976; Milgrom and Roberts 1992; Parrino, Poteshman and Weisbach 2002). ESOs can be an effective device for encouraging risk taking due to their convex payoffs - the value of ESOs is increasing in stock return volatility (e.g., Jensen and Meckling 1976; Haugen and Senbet 1981; Smith and Stulz 1985; Lambert 1986; and Hemmer, Kim, and Verrecchia 1999). While a number of studies have examined the effect of ESOs on firm performance (see Bebchuk, Fried and Walker 2002 for cites, Ittner, Lambert and Larcker and 2003, Hanlon, Rajgopal and Shevlin 2002), there is very little direct large-sample evidence on the link between ESOs and the *ex post* outcomes of risk taking actions. The objective of our study is to provide such evidence.

Using a sample of 3,723 CEO-year observations covering 1,101 firms with option data from the *Execucomp* database for the years 1992-1996, we examine two research questions:

(i) To what extent are ESO risk taking incentives (the sensitivity of ESO values to stock return volatility) for Chief Executive Officers (CEOs) associated with future earnings and operating cash flow volatility estimated over the subsequent five years, our measures of *ex*

*post* risk taking outcomes? and (ii) To what extent are ESO risk taking incentives associated with subsequent operating performance measured as earnings and operating cash flows?

To examine the first research question, we employ a simultaneous equations approach to reflect the joint and endogenous nature of risk taking by managers and executive compensation decisions by the compensation committee. We find that ESO risk taking incentives exhibit a strong statistical association with the volatility of future earnings and operating cash flows, consistent with our hypothesis that option grants induce risk taking. However, the economic impact of such risk taking on the CEO's firm-related wealth is, on average, quite modest. An increase of one standard deviation in earnings volatility is associated with a 3.08% increase in stock return volatility increasing mean (median) CEO wealth by \$98,560 (\$43,120). This wealth change compares to the mean (median) CEO stock and option holdings of \$34.349 (\$8.059) million. With regard to our second question, following Barber and Lyon (1996), Holthausen and Larcker (1996) and Larcker (2003), we match firms on current operating performance and regress the *difference* in future operating performance between the experimental and control firm on the *difference* in current year ESO risk incentives between the experimental and control firm. We find a zero to negative relation between ESO risk-taking incentives and future performance measured as realized future earnings and operating cash flows. Thus, we find evidence that ESO risk-taking incentives do not map into superior relative performance, at least not in terms of future earnings or cash flows. In sum, to have an effect on their ESO-related wealth, CEOs must dramatically increase risk-taking, but such actions appear to have a non-positive effect on future performance.

Extant empirical research related to the link between ESOs and risk-taking is limited. For example, Defusco, Johnson and Zorn (1990) find that the adoption of stock option plans between 1978 and 1982 is associated with an increase in stock return variance while Agrawal and Mandelker (1987) show that managers that have ESOs with higher intrinsic value are associated with greater acquisitions. However, the presence of an option plan or the intrinsic value of options, the measures used in these papers, are arguably poor measures of risk taking incentives offered by ESOs (Core and Guay 2002). Using hand-collected proxy statement data for 1988, Guay (1999) computes the actual ESO risk taking incentives i.e., the sensitivity of option values to stock return volatility, for a number of CEOs and finds that such risk taking incentives are higher for firms with greater investment opportunity sets (IOS). Guay also documents a positive association between ESO risk taking incentives and *contemporaneous* stock return volatility. In addition, Rajgopal and Shevlin (2002) document a positive association between ESO risk taking incentives and exploration risk for a small sample of firms in the oil and gas industry while Tufano (1996) shows that in the gold industry managers with larger holdings of ESOs hedge a smaller magnitude of commodity price risk. Knopf, Nam and Thornton (2002) find that Tufano's result is broadly generalizable to hedges of financial price risk in non-financial firms.

Two unpublished working papers are also relevant. Cohen, Hall and Viceria (2000) find a positive association between ESO risk taking incentives for a hand-collected sample of 478 firms and *subsequent* stock price volatility while Coles, Daniel and Naveen (2003) document an association between ESO risk incentives and one-year ahead R&D and higher leverage and focus on a fewer lines of business.

Our study differs from prior research in several ways. First, a number of papers implicitly assume that CEOs cannot affect their firms' risk levels in response to incentive schemes (e.g., Lambert and Larcker 1987, Garen 1994, Yermack 1995, Bushman et al. 1996, Aggarwal and Samwick 1999, Li 2002 and Prendergast 2002). In contrast, we explicitly examine that assumption in this paper. Second, use of *Execucomp* option data from the 1990s – a decade when option usage exploded – enables us to provide large-sample evidence spanning several industries on the link between options and risk taking. Most prior studies rely on small datasets either because they focus on specific industries (e.g., Rajgopal and Shevlin 2002), specific transactions (e.g., Knopf et al. 2002) or specific time periods (e.g., Guay 1999). Third, earnings volatility is an appealing summary measure of the outcome of various risk-taking actions across a broad sample of firms. As a result, in contrast to prior literature, we do not need to focus on one set of risk-taking actions such as mergers, hedging, R&D investment, diversification or oil and gas exploration at the exclusion of other actions nor do we need to model the interactions among these actions. Of course, managers may have incentives to reduce earnings volatility for job security (Defond and Park 1997) or for higher price-earnings multiples (Barth, Elliot and Finn 1999, Skinner and Myers 1999). To abstract from these confounding issues, we also examine the association between ESO risk taking incentives and subsequent *operating cash flow* volatility.

The fourth way in which our study differs from prior literature is that prior work generally assumes that stock return volatility is *exogenous* to setting ESO risk taking incentives while we treat both ESO risk taking incentives and future earnings (or operating cash flow) volatility as endogenous variables. By using a simultaneous equations approach, we address some of the difficulties associated with making inferences about the relation

between executive compensation contracts and investment decisions when either of those constructs is treated as exogenous (Larcker 1983, Holthausen, Larcker and Sloan 1995). Finally, most extant papers do not investigate whether ESO risk taking incentives, even if they were effective, are desirable for shareholders. Cohen et al.'s working paper (2000) is an exception but they examine future stock return performance. Focus on future stock returns provides a weak test, at best, of the effects of ESO risk taking incentives on risk-taking actions by managers. In an efficient stock market, the forward-looking nature of stock prices likely incorporates the expected return outcomes prior to the executive taking any action. We avoid this problem by examining the association between ESO risk taking incentives and future earnings and operating cash flows, as opposed to future stock returns.

The remainder of the paper is organized as follows. Section 2 presents the hypothesis and model development. Section 3 discusses the data, variables and the empirical model to test the association between earnings volatility and ESO risk taking incentives. Section 4 presents the results from estimating that empirical model while section 5 discusses follow-up analyses related to the performance consequences of inducing ESO risk taking incentives in the compensation contract. Section 6 provides concluding remarks.

## **2. Hypotheses and Model Development**

In this section, we formulate a hypothesis that predicts a positive association between ESO risk taking incentives and *ex post* evidence of risk taking outcomes.

### **2.1 ESO risk taking incentives and firm risk**

Researchers and practitioners have long recognized that besides the slope of the relation between stock price and manager's wealth, the risk taking incentives or convexity of the relation between stock price and manager's wealth must also be managed in the

compensation contract to induce managers to make optimal investment and financing decisions (see Guay 1999 for references). Although risk-neutral shareholders would like firm managers to undertake all positive NPV projects, risk-averse managers are likely to avoid some risky positive NPV projects. ESOs offer incentives to mitigate such risk-related incentive problems because the value of an ESO increases with both stock price (hereafter the ESO slope effect) and stock return volatility (hereafter the ESO risk taking incentives). Controlling for the ESO slope effect, greater risk taking incentives in the wealth-performance relation offered by ESOs are expected to reduce manager's aversion toward firm risk and encourage the manager to choose *risky* positive NPV projects.

Managers can take several actions to assume more risk. Examples include investing in riskier capital projects, investing in R&D or advertising, increasing financial leverage, assuming floating rate debt, acquiring riskier targets, or hedging a smaller portion of their financial price risk exposures. We expect such decisions to result in higher levels of future earnings volatility and operating cash flow volatility because, as mentioned earlier, earnings and operating cash flows are important summary statistics of firm performance. Hence, we posit the following hypothesis (in alternate form):

*H1: Future earnings (or cash flow) volatility is positively associated with the magnitude of ESO risk taking incentives.*

The null hypothesis is that the magnitude of ESO risk incentives is not associated with future earnings (or cash flow) volatility. The null hypothesis is consistent with the following three arguments. First, Core, Guay and Larcker (2001) conjecture that ESO slope (the sensitivity of ESO value to change in stock price) and not ESO risk taking incentives is the first-order incentive effect offered by ESOs. Moreover, Aggarwal and Samwick (2003) argue



that CEOs do not seem to optimize their firms' risk characteristics in response to incentive schemes. Second, several critics of executive compensation (e.g., Crystal 1991, Bebchuk et al. 2002) have argued that ESOs may not be related to future performance because they are merely a politically convenient device for managers to pay themselves because ESO expense is not reported in the firm's income statement.<sup>1</sup> Third, Milgrom and Roberts (1992) suggest that risk-averse managers who have significant human capital tied up with their companies are likely to take fewer risky decisions that will get them fired, especially when they enjoy substantial rents from their positions. Thus, it is quite plausible that ESO risk taking incentives may not be effective at motivating managers to take risk-increasing actions although the small sample results of Tufano (1996) and Rajgopal and Shevlin (2002) suggest otherwise.

## 2.2. Model development

We posit that ESO risk taking incentives at time  $t$  affect managerial actions that are reflected in future earnings volatility measured over years  $t+1$  to  $t+5$ . We assume that future earnings (or cash flow) volatility can be characterized in the following form:

$$\text{Earnings volatility}_{t+1, t+5} = f(\text{ESO risk taking incentives}_t, \text{Capex}_t, \text{R\&D}_t, \text{Leverage}_t, \text{MVE}_t, \text{Financial distress}_t) \quad (1)$$

We introduce capital expenditure (Capex) and R&D intensity as control variables because Kothari, Laguerre and Leone (2002) show that firms with greater levels of current capital expenditure and research and development intensity have higher future earnings

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<sup>1</sup> However, results reported by Hanlon et al. (2002) do not support this claim. They document a positive concave association between past ESO grants and current performance.

volatility as a result of uncertain future benefits.<sup>2</sup> Financial leverage is also included as a control variable and is expected to increase earnings variability, all else equal (Beaver, Kettler and Scholes 1970 and White, Sondhi and Fried 1994).<sup>3</sup> We recognize these variables are likely determined by firm management in response to prior ESO and stock incentives.<sup>4</sup> However, because they are measured at date  $t$ , we treat these variables as predetermined in the model.

We include financial distress in our model because Minton and Schrand (1999) find that firms with higher levels of financial distress tend to have a higher coefficient of variation in earnings and operating cash flows. We also include size as a control variable. Earnings variability is expected to decrease with firm size for three reasons. First, larger firms are likely to be more diversified with resulting lower earnings volatility. Second, larger firms face greater capital market scrutiny and hence have greater incentives to report a smoother earnings stream (Loomis 1999, Levitt 1998). Third, size serves as a proxy for market beta. For example, Beaver, Kettler and Scholes (1970) show that earnings variability and beta are positively correlated. In addition, Kothari et al. (2002) argue that size is a better proxy for beta because of the empirical difficulties associated with computing a beta measure such as sampling error in the regression estimate and stale economic conditions in time-series of past return data used to compute beta.

In examining the effect of ESO risk incentives on managers' risk taking activities, both the theoretical and empirical literatures suggest that ESO risk incentives are *endogenously* set by the compensation committee in response to the investment opportunity

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<sup>2</sup> In sensitivity analyses we also introduce advertising intensity as a control variable with no change in inferences.

<sup>3</sup> However, if interest charges are fixed, there ought to be no relation between earnings variability and leverage. Moreover, firms may have incentives to smooth earnings in the presence of high leverage to reduce financing costs if such costs depend on reported earnings (possibly via debt covenants).

<sup>4</sup> We ran a sensitivity analysis after excluding R&D, capital expenditure and leverage, and find that the reported inferences are unaffected.

set and contracting environment faced by the firm. Smith and Watts (1992), Gaver and Gaver (1993), Bryan, Hwang, and Lilien (2000) and Guay (1999) argue that because management of investment opportunities is difficult to monitor, firms with greater investment opportunity sets (measured as book-to-market ratio or B/M, capital expenditure and R&D) are expected to tie managers' wealth more closely to firm performance. Hemmer, Kim, and Verrecchia (1999), and Hirshleifer and Suh (1992) show that options help mitigate the effects of executive risk aversion by giving managers incentives to adopt, rather than avoid, risky projects.

Thus to allow for endogeneity of ESO risk incentives and to model simultaneity of both endogenous variables, we use a system of two equations by adding equation (2) to the model:

$$\text{ESO risk taking incentives}_t = f(\text{Earnings volatility}_{t+1,t+5}, \text{Investment opportunity set}_t, \text{CEO risk aversion}_t, \text{Cash constraints}_t, \text{Dividend constraints}_t, \text{Firm size}_t, \text{Total slope}_t) \quad (2)$$

In equation (2), the firm's future earnings volatility can be thought of as an additional proxy for the firm's investment opportunity set (see Holthausen et al. 1995 and Rajgopal and Shevlin 2002 for similar reasoning). More important, the introduction of future earnings volatility in (2) allows for the possibility that compensation committees set ESO risk taking incentives to encourage future risk taking by managers. We introduce cash constraints and dividend constraints to allow for the possibility that firms facing such constraints are more likely to use stock options in compensation packages (Core and Guay 2001). We also include total slope as an independent variable as ESO risk taking incentives are likely set (by the compensation committee) along with the slope effects of ESOs and stock ownership. Empirically, CEOs that have greater total slope tend to have greater ESO risk taking incentives, although that relation is likely driven by the number of options (a size proxy)

underlying the calculation of both total slope and ESO risk taking incentives. We discuss the empirical measurement of the remaining variables in the model in the next section.

Although the basic specifications outlined in (1) and (2) are framed in terms of earnings volatility, there is a case for examining the robustness of the specification to cash flow volatility. In particular, employing earnings as the accounting performance measure is subject to three potential issues: First, managers may have incentives to manage reported earnings, especially to report smoother earnings streams, either to preserve their jobs (Defond and Park 1997) or to garner higher price-earnings multiples (Barth et al. 1999, Skinner and Myers 1999). Second, it is well known that the accrual accounting process, regardless of managerial incentives, tends to smooth reported earnings relative to cash flows (Dechow 1994). Third, reported earnings depend on the accounting standards regime that is prevalent during the sample period. For example, our sample period covers years before goodwill had to be impaired but it might include in-process R&D write-offs. Hence, we also present results after substituting operating cash flow volatility in place of earnings volatility in equations (1) and (2).

Two other methodological issues deserve emphasis. First, although we use a system of simultaneous equations to allow for simultaneity and endogeneity of our two dependent variables, only these two variables are treated as endogenous in the system. Other firm-specific variables, such as total slope incentives are treated as exogenous. Ideally we would like to treat this variable (and possibly others) as a third (or more) endogenous variable(s) by adding a third (or more) equation(s) to the system. However, this would involve the difficult task of specifying an exogenous variable or variables for this (and each) additional equation

so as to allow identification and estimation of the system. Thus we recognize that our system is likely incomplete.

Second, as a caution to the reader regarding interpretation of our results, we include in the appendix a discussion of a second problem endemic to research that aims to relate firm choices to future firm performance; namely, the claim that if all firms are at equilibrium it is not possible to predict or meaningfully interpret the sign of the relation between firm performance and the firm choice variable. We do not accept this extreme view, but rather take the position that firms are learning, and proceed to examine such relations (see Ittner and Larcker 2001 and Larcker 2003 for more on this position).

### **3. Sample, Empirical Model, Variable Measurement and Descriptive Statistics**

#### **3.1 Sample**

We obtain data on CEO option and stockholdings from the *Execucomp* database. This database contains compensation (and financial) data starting in 1992 for the top 5 executives of over 1,500 U.S. publicly traded corporations. We obtain quarterly earnings and cash flow data (used to estimate earnings and operating cash flow volatility) from Compustat, with such data available until fiscal year-end 2001. Our final sample for the tests of CEO risk taking consists of 3,723 CEO-year observations corresponding to 1,101 firms.

Our sample is obtained as detailed in panel A of Table 1. We start with all available CEO years on *Execucomp* for the years 1992-1996. Because we associate ESO risk taking incentives with future earnings (or cash flow) volatility over five future years, we use only risk taking incentives measured in the years 1992-1996. More specifically, the ESO risk taking incentives computed from *Execucomp* as of the end of fiscal 1992, (1993 and so on), are tested for an association with earnings (or cash flow) volatility measured over the future

five-year periods for each year, 1993-1997, (1994-1998, and so on). This results in 12,510 CEO-year observations related to 2,502 firms. We exclude 6,331 observations that have a missing value for the number of new option grants, unexercisable ESOs, and exercisable ESOs because we need data on the CEO's ESO portfolio holdings at date  $t$ . Note that we do not delete firms that have zero option grants or zero option holdings. We exclude 1,010 observations from the financial services industry (because these firms investment opportunity sets differ and for consistency and comparability with prior compensation research). After eliminating 124 observations missing on *Compustat* and 1,332 observations without the necessary data necessary to estimate our empirical models, we are left with 3,723 CEO-year observations.

Panel B of Table 1 provides general descriptive data about our sample firms. The mean firm in the sample is large with \$2.363 billion in sales, total assets of \$2.454 billion, net income of \$103.27 million, and return on assets of 4.9%. The mean market value of equity is \$2.360 billion compared to mean book value of equity of \$0.865 billion. When compared to the average *Compustat* firm, our sample firms, on average, are significantly larger, more profitable, less levered and have lower B/M ratios. It is interesting to note that the annual stock return volatility for the average sample firm is significantly lower than that for the average *CRSP* firm (0.362 versus 0.540).

We focus on CEO compensation to be consistent with a long tradition in compensation research. Descriptive statistics on the CEOs annual compensation are presented in panel C of Table 1. The average CEO receives \$428 thousand in annual salary, \$327 thousand in bonus

and \$1.259 million in Black-Scholes' value (as estimated and reported by Execucomp) of new option grants.<sup>5</sup>

### 3.2 Empirical Specification

Based on the conceptual model in the systems of equations (1) and (2), the following two equations are estimated simultaneously to test our hypothesis (with firm subscripts omitted for convenience):

$$\text{Earnings (or operating cash flow) volatility}_{t+1, t+5} = \beta_0 + \beta_1 \text{ ESO risk taking incentives}_t + \beta_2 \text{ Capex}_t + \beta_3 \text{ R\&D dummy}_t + \beta_4 \text{ R\&D dummy}_t * \text{R\&D}_t + \beta_5 \text{ Leverage}_t + \beta_6 \ln \text{ MVE}_t + \beta_7 \text{ Financial distress proxies}_t + \beta_8 \text{ Industry dummies}_t + \beta_9 \text{ Time dummies}_t + \text{error}_{t+1, t+5} \quad (3)$$

$$\text{ESO risk taking incentives}_t = \gamma_0 + \gamma_1 \text{ Earnings (or operating cash flow) volatility}_{t+1, t+5} + \gamma_2 \text{ Capex}_t + \gamma_3 \text{ R\&D dummy}_t + \gamma_4 \text{ R\&D dummy}_t * \text{R\&D}_t + \gamma_5 \text{ B/M}_t + \gamma_6 \text{ Cash compensation}_t + \gamma_7 \text{ Cash constraint}_t + \gamma_8 \text{ Dividend constraint dummy}_t + \gamma_9 \ln \text{ MVE}_t + \gamma_{10} \text{ Total slope}_t + \gamma_{11} \text{ Industry dummies}_t + \gamma_{12} \text{ Time dummies}_t + \text{error}_t \quad (4)$$

where:

Earnings (operating cash flow) volatility<sub>t+1, t+5</sub> = the natural logarithm of the coefficient of variation in quarterly operating income or CVINC (operating cash flows or CVCFO) over years t+1 to t+5, explained in greater detail below.

ESO risk taking incentives<sub>t</sub> = the sensitivity of the CEO's option portfolio value at time t to a one percent change in the underlying stock return volatility using the Core and Guay (2002) method, explained in greater detail below.

Capex<sub>t</sub> = Capital expenditure (annual Compustat #128) for year t deflated by total sales (data item #12) in year t.

R&D dummy<sub>t</sub> = an indicator variable set to one for firm-years that have a non-missing value for R&D in Compustat (data item #46) for year t and set to zero for firms with a missing value for R&D in Compustat for year t.

R&D<sub>t</sub> = R&D expenditure (annual Compustat #46 with a missing treated as zero) for year t deflated by total sales in year t (data item #12).

Leverage<sub>t</sub> = Leverage is the sum of long-term debt (annual Compustat #9) and debt in current liabilities (annual Compustat #34) divided by the sum of long-term debt and the market value

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<sup>5</sup> Because inflation was not a first-order concern during the 1992-1996 period, we do not adjust compensation data for price-level changes.

of equity (MVE, data item #199 X data item #25) where all variables are measured at the end of year t.

$\ln MVE_t$  = the natural log of the product of fiscal year closing price and common shares outstanding, both measured at the end of year t (data item #199 X data item #25).

Financial distress proxies<sub>t</sub> = a distress dummy set to one if the firm satisfies any of three conditions in year t: the firm has (i) speculative grade debt (S&P bond ratings greater than 13 on Compustat, data item #280); (ii) a negative E/P ratio (Compustat item #18/MVE); and (iii) a negative B/M (Compustat item #216/MVE).

$B/M_t$  = book value of equity (data #216) scaled by MVE where both variables are measured at the end of year t.

Cash compensation<sub>t</sub> = dollar value of CEO cash compensation, salary and bonus, for year t.

Cash constraint<sub>t</sub> = the preceding three-year (t-3, t-2, t-1) average of [(cash flow from operations (Compustat #308) - common and preferred dividends (Compustat #127) + cash flow used in investing activities (Compustat #311))\*(-1)] (see Core and Guay 2001).

Dividend constraint dummy<sub>t</sub> = an indicator variable 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 dividend constraint dummy is set to zero (see Core and Guay 2001).  
((Compustat #36 + Compustat #115)/(Compustat #127 + Compustat #115)).

Total slope<sub>t</sub> = the sensitivity of the CEO's option and stock ownership (including restricted stock) portfolio value at time t to a one percent change in the stock price using the Core and Guay (2002) method, explained in greater detail below.

Industry dummies = based on 2 digit SIC codes, discussed below.

Time dummies = indicator variables set equal to one for particular time period based on windows of the variation in quarterly operating income. Thus, we have a time dummy for the year 1992 which corresponds to the time period of calculation of the variation of income over 1993-1997, and a time dummy for the year 1993 which corresponds to the time period of calculation of the variation of income over 1994-1998 and so on.

As indicated above, some of the variables need further development and discussion.

#### *Earnings (cash flow) volatility*

We operationalize earnings volatility as the coefficient of variation in operating income (CVINC) calculated as the standard deviation of earnings using quarterly income before extraordinary items (quarterly Compustat #8) for years t+1 through t+5 scaled by the absolute



value of mean earnings during the same time period. We use quarterly earnings observations to improve the efficiency of estimating the coefficient of variation measure. The design choice of a five-year window represents a trade-off of competing forces. On the one hand, we would like to have a long time-series of quarterly observations for every firm to compute reliable variance measures. Moreover, the time window ought to be long enough for the outcomes of risky projects to show up in earnings numbers. On the other hand, excessively long time-windows make the connection between ESO risk incentives and future outcomes tenuous. Moreover, excessively long time windows impose restrictive sample filters and reduce the number of firms studied. The five-year window allows 20 quarterly observations to compute variance measures and enough time for the outcomes of risky projects to be reflected in future earnings. To avoid losing too many firms, a firm is included in the sample for a given year if it has at least 10 non-missing observations during the 20 quarters.

However, as described later, we find that the CVINC measure suffers from small denominator problems caused by small absolute mean earnings levels. Such small denominator issues cause considerable skewness in the CVINC measure. Hence, we employ the natural logarithm of the CVINC measure in our empirical analyses. We operationalize cash flow volatility as the coefficient of variation in reported cash flows from operations (CVCFO) as per SFAS 95 (Compustat quarterly #108) adjusted for extra ordinary items (Compustat quarterly #78) and analogous to CVINC, we employ a logged version of CVCFO in our empirical tests.<sup>6</sup>

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<sup>6</sup> Note that Compustat reports cash flow for the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> quarter on a cumulative basis. Thus, for the 3<sup>rd</sup> quarter, the operating cash flow number is the difference between the cumulative cash flow for 3<sup>rd</sup> quarter and the cumulative cash flows for the 2<sup>nd</sup> quarter.

### *ESO risk taking incentives*

ESO risk taking incentives are measured as the sensitivity of the Black-Scholes value of the CEO's option portfolio at time  $t$  to a 1% change in the underlying stock return volatility.<sup>7</sup> Specifically, we estimate the sensitivity of the change in option value to a 1% change in annual stock return volatility,  $\sigma$ , as

$$[\partial w / \partial \sigma] * 0.01 = e^{-\delta T} N'(d) S T^{1/2} * 0.01 \quad (5)$$

where  $w$  is the Black-Scholes value of a European call option as modified to account for dividends by Merton (1973)<sup>8</sup>;  $S$  is the price of the underlying stock at the valuation date;  $\delta$  is expected annual dividend rate over the life of the option;  $T$  is time to maturity of the option in years;  $N'$  is the normal density function;  $d$  is  $[\ln(S/X) + (r - \delta + \sigma^2/2)T] / \sigma T^{1/2}$ ,  $X$  is the exercise price of the option; and  $r$  is annual risk free interest rate.

The ESO risk incentives of the current year's grant can be computed using the number of options, exercise price, and time to maturity from *Execucomp* for the most recent year's grant (hereafter labeled new grants). However, for previously granted options, data on each series of grants are not readily available. Hence, we use the Core and Guay (2002) one-year approximation method to estimate ESO risk incentives for previously granted options. This method is convenient in that it requires information only from the most recent proxy statement. The algorithm uses the three ESO series reported by *Execucomp* – new grants,

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<sup>7</sup> Equity can be viewed as a call option on the firms' assets and might be important for manager's risk incentives especially in financially distressed firms (because the call option is close to the money). Our reported tests ignore convexity that stems from CEO-owned equity understating our risk incentive measure if the firm is financially distressed and biases against finding any predicted relations. Note however that we are able to document relations between ESO risk incentives (convexity) and future earnings (or cash flow) volatility, ignoring any ownership-related convexity. In unreported sensitivity analyses, we omit firms where the Financial Distress dummy was set to one and drop the Financial Distress variable in equation (2). The number of observations drops to 3007, but the inferences drawn from Table 3 are robust to such omission.

<sup>8</sup> It is well known that the assumptions underlying the Black-Scholes model are not fully descriptive when applied to ESOs (for example, risk averse managers exercise their ESOs before maturity). However, following and for comparability with Core and Guay (2002), Guay (1999) and Rajgopal and Shevlin (2002) we rely on the Black-Scholes model using expected term to exercise while recognizing that this likely introduces measurement error into our ESO risk incentives measure.

unexercisable, and exercisable.<sup>9</sup> We estimate equation (5) for an option in each of the three series and then multiply by the number of ESOs held by the CEO within each series and aggregate across the three sums to derive the total dollar measure of ESO risk incentives. Thus the greater the number of options held, *ceteris paribus*, the larger the ESO risk incentives. Core and Guay (2002) show that their method yields estimates of ESO risk incentives that are both unbiased and highly correlated (more than 95%) with the measures that would be obtained if the parameters of each set of prior grants in the CEO's option portfolio were known.

We also calculate the change in CEO's wealth from a 1% change in stock price. This change in wealth consists of the sum of the change in the value of the CEOs ESO portfolio (ESO slope), restricted stock holdings and normal stock holdings. The latter two wealth changes are estimated simply by multiplying the market value of the stock holdings at year end *t* by 1%. The ESO slope is estimated for each ESO as

$$[\partial w/\partial S] * [\text{price} * 0.01] = e^{-\delta T} N(d) * [\text{price} * 0.01] \quad (6)$$

where *N* is the cumulative normal probability function. The same algorithm used to aggregate ESO risk taking incentives across ESOs is used to aggregate each ESO slope across the ESO portfolio.

Panel D of Table 1 provides descriptive data on ESO risk incentives and some of its components. To reduce the influence of extreme observations, all variables are winsorized (reset) at the 1<sup>st</sup> and 99<sup>th</sup> percentiles. The mean change in the value of CEO options portfolio for a 1% change in stock return volatility is \$32 thousand with a standard deviation of \$53 thousand. Thus, there appears to be reasonable cross-sectional variation in the ESO risk

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<sup>9</sup> It is important to note that Execucomp includes new grants in the totals for unexercisable and exercisable options (if new grants vest quickly). Thus, we adjust the unexercised and exercisable totals to reflect new grants.

incentives measure and hence in the options' incentive effects. The median ESO risk incentives in our sample (\$14 thousand) are somewhat smaller than the median risk incentive for a broad cross-section of industries (\$28 thousand) reported by Core and Guay (2002) but are comparable to the numbers (mean \$30, median \$18 thousand) reported by Rajgopal and Shevlin (2002) for oil and gas CEOs over the 1990s. The mean sensitivity of ESO value to a 1% change in stock price (ESO slope) is \$81 thousand. Given that our sample period 1992-1996 over which ESO incentives are estimated coincides with a bull market, it is perhaps not surprising to observe smaller ESO risk incentive measures relative to ESO slope measures in the CEO's portfolio. During a period of rising stock prices, ESOs are likely to be deeper in-the-money (as reported in panel D, the mean price-to-strike ratio is 1.689) and hence less responsive to changes to stock price volatility (i.e., the options will be viewed more like stock by the executive).

The mean (median) change in the value of a CEO's stock (both common and restricted stock holdings) and options for a 1% change in stock value (total slope incentive) is \$378 (\$99) thousand. Guay (1999) reports a median change of \$90 thousand for a 1% change in stock value for a set of randomly chosen firms.

#### *Cash compensation*

We include cash compensation to control for potential differences in the risk aversion of managers. Following Guay (1999), we argue that the greater the cash compensation that can be invested outside the firm, the better diversified the manager is likely to be, and the lower his/her expected risk aversion. Hence, the compensation committee needs to give a more diversified manager fewer stock option awards as compared to a less diversified manager to take the same level of firm risk. However, if firms wish to impose more risk on

their managers via stock option awards, their managers may seek employment elsewhere. To avoid this eventuality, firms may pay a risk premium in the form of cash compensation. Because of the conflicting arguments, we leave the direction of the relation between ESO risk taking incentives and cash compensation as a two-sided prediction.

#### *Industry dummies*

We introduce industry dummies in equations (3) and (4) to account for unobservable aspects of the firm's performance (earnings volatility) or contracting environment (ESO risk taking incentives) that may co-vary with industry membership (see Himmelberg, Hubbard and Palia 1999). However, we recognize that introducing industry dummies can understate or even eliminate the treatment effect of ESO risk taking incentives on future earnings volatility (see Zhou 2001). However, we persist with such dummies as a precaution in our reported results and discuss results excluding the industry dummies below.

#### **3.4. Descriptive statistics on remaining variables**

Panel E reports the descriptive statistics on the remaining variables in the system of equations. The first two rows highlight some of the differences in the distributional properties of the coefficient of variation in operating income (CVINC) and its natural logarithm (LNCVINC). In particular, the standard deviation of CVINC is 2.11 times its mean. Unreported tabulations indicate (i) that the skewness of CVINC (4.537) is substantially greater than the skewness of LNCVINC (0.854); and (ii) the kurtosis of CVINC is far in excess of the acceptable level of three at 23.011 while the kurtosis of LNCVINC is only 0.367. Thus, LNCVINC as a measure of earnings volatility appears to be a better-behaved variable to use in regression analysis. Similar comments apply to LVCVCFO, the natural logarithm of the coefficient of variation in operating cash flows.

Turning to the other variables, we find that the capital expenditure of the average firm is 9.80% of its sales. More than half of the firms do not report R&D expense while the mean R&D spending is 5.7% of sales. To segregate the systematic differences between firms that report R&D and those that do not, our empirical tests employ an R&D dummy that is set equal to 1 (zero) if the firm reports (does not report) R&D expense. We also employ an interaction term where R&D dummy is multiplied with the reported R&D measure. Roughly 19.2% of the firm-years are classified as distressed. However, only 12% of the firms appear to be dividend-constrained.

Panel F presents the correlation matrix of the variables in equations (3) and (4). As expected, LNCVINC and LNCVCFO are highly correlated ( $\rho = 0.39$ ,  $p = 0.00$ ). The univariate correlation between ESO risk incentives and LNCVINC is positive as expected ( $\rho = 0.07$ ,  $p = 0.00$ ). Positive and significant univariate correlations are also observed between ESO risk incentives and LNCVCFO ( $\rho = 0.10$ ,  $p = 0.00$ ).

#### **4. Results**

The empirical analysis is presented in three parts. First, in section 4.1 we provide evidence on the link between earnings (or cash flow) volatility and stock return volatility. This analysis examines the implicit assumption in the paper that ESOs offer sufficient incentives for managers to affect earnings (or cash flow) volatility. The second analysis, presented in section 4.2, assesses whether ESO risk taking incentives are associated with future earnings (or cash flow) volatility. Finally, section 5 presents the performance consequences of ESO risk taking incentives.

#### 4.1. Economic importance of volatility on CEO wealth

The tests that relate ESO risk incentives to future earnings or cash flow volatility in Section 4.2 rely on two important premises. First, earnings and cash flow volatility capture important aspects of risky actions that are reflected in stock return volatility. Second, ESOs offer adequate economic incentives to CEOs to alter their firm's earnings and cash flow volatility.

We provide evidence regarding the first premise by estimating the following regression:

$$\sigma_{t-2,t+2} = \theta_0 + \theta_1 \text{LNCVINC (LNCVCFO)}_{t+1,t+5} + \theta_2 \text{B/M}_t + \theta_3 \text{Leverage}_t + \theta_4 \ln \text{MVE}_t + \theta_5 \text{Industry dummies} + \theta_6 \text{Time dummies} + \text{error} \quad (7)$$

where  $\sigma_{t-2,t+2}$  is the annual standard deviation of monthly stock returns computed for 60 months covering the years t-2 to t+2 and B/M, leverage, and a size proxy (Ln MVE) are included as controls.<sup>10</sup> Correlating market measures of stock return volatility to accounting measures of volatility requires an assumption about the time lag with which accounting measures incorporate information relative to when such information is impounded in stock prices. We opt to measure return volatility using returns over the t-2 to t+2 time period to accommodate the fact that stock returns lead accounting earnings (Kothari 2001). We predict  $\theta_1$ , the coefficient on LNCVINC (LNCVCFO), to be positive.

Results from estimating equation (7) are reported in Table 2. Column A shows that LNCVINC exhibits a strong positive association with stock return volatility. This suggests that greater earnings volatility is associated with greater stock return volatility providing

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<sup>10</sup> We use the variable Black-Scholes volatility from Execucomp as the measure of stock return volatility for this test - the volatility figure used by Execucomp in calculating Black-Scholes values for new ESO options. Execucomp estimates volatility as the standard deviation of stock returns calculated over 60 months. A detailed description of the calculation can be found in the variable definitions of Execucomp at [http://umi.compustat.com/docs-mi/help/execdefs\\_alpha.htm](http://umi.compustat.com/docs-mi/help/execdefs_alpha.htm).

evidence consistent with our first premise above. The coefficient of 0.026 implies that a one standard deviation increase in LNCVINC (equivalent to 1.184 from panel E of Table 1) translates to a 3.08% increase in the standard deviation of stock returns. Given that the mean (median) ESO risk incentive for a 1% increase in stock return volatility is \$32,000 (\$14,000) (panel D of Table 1), a unit standard deviation change in earnings volatility would increase the value of the mean (median) CEO's options portfolio by \$98,560 (\$43,120). This speaks to the second premise above. To place this economic impact in perspective, we compare the percentage increase in stock price required to make the CEO's ESOs as valuable via ESO slope. The mean (median) ESO slope is \$81,000 (\$29,000) as per panel D, Table 1. Thus, the average (median) CEO can earn the same dollar amount equivalent by either changing LNCVINC by one standard deviation or by increasing the firm's stock price by 1.22% (1.49%).<sup>11</sup> The economic effects related to CVCFO are in the same neighborhood as the CVINC results. Although the unique feature of an option is that it creates incentives for managers to take on risks, it may be that managers can increase wealth more by increasing stock price in which case the slope incentives of the option dominate the risk taking incentives (as argued by Core et al. 2001).

While the overall economic importance of increasing earnings volatility on CEO's wealth and the feasibility of such an action might appear relatively small, three caveats are in order. First, risk increases, measured as increases in LNCVINC, do not completely account for the ESO slope effect from increasing risk, which might enhance the wealth effect of risk taking actions on the CEO's portfolio. As a result, our estimation above may understate the true economic relation. Second, as mentioned earlier, ESO risk incentive measures are likely

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<sup>11</sup> Un-tabulated regressions using CVINC (the un-logged version of LNCVINC) also confirm the general inference that the CEO has to increase return volatility by a substantial amount to profitably gain from such increase.



to be smaller during a period of rising stock prices as ESOs are likely to be deeper in-the-money in such times. Hence, the bull market prevalent during our sample period likely understates the economic importance of ESO risk incentives in the CEO's wealth portfolio in our tests. Third, the average firm in the population of listed U.S. firms is riskier than the average firm in our sample. Recall that panel B of Table 1 reports that the average annual stock-return volatility for the average sample firm is 0.362 while the corresponding volatility for the average *CRSP* firm is 0.540. It is plausible that riskier (non-sample) firms award a greater number of ESOs and thus the use of the *Execucomp* database in this study might understate the economic importance of risk taking on the CEO's wealth.

#### **4.2. ESO risk taking and future volatility**

Results from estimation of equations (3) and (4) are presented in columns A1 and A2, respectively, of Table 3. The system of simultaneous equations is estimated using two-stage least-squares (2SLS) because ordinary least squares procedure results in inconsistent estimates of the coefficients in the structural equations. In the first stage, each endogenous variable is regressed on all the remaining variables in the system. The fitted value of each endogenous variable is then included as an instrument in the second stage of the 2SLS approach. The first stage regression R-squareds are 17.02% for the earnings volatility regression and 40.81% for the ESO risk taking incentives regression. Both R-squareds are reasonable suggesting that the models do a fair job of instrumenting for the two endogenous variables. The Hausman test for assessing simultaneity is statistically significant in both equations consistent with earnings volatility and ESO risk taking incentives being both endogenously determined justifying our simultaneous equations approach.<sup>12</sup>

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<sup>12</sup> In particular, we follow Kennedy (1992, 169) to test for endogeneity. To briefly illustrate the procedure, consider an equation  $Y_1 = aY_2 + cX_1 + \text{error}$  and  $Y_2 = dY_1 + gX_3 + \text{error}$  where  $Y_2$  is simultaneously

We report the predicted signs on each variable in the table to facilitate interpretation of the results. In column A1, for the earnings volatility model, the coefficient on ESO risk taking incentives is 3.248 ( $t = 3.56$ ): firms in which CEOs have higher ESO risk incentives exhibit higher future earnings volatility. This coefficient can be used to assess the economic effect of induced risk taking via ESO risk incentives. In particular, if ESO risk taking incentives were to be increased by one standard deviation (\$0.053 million as per panel D, Table 1), as a result of an increase in the underlying exogenous variables, then the consequent increase in LNCVINC is 0.172 ( $3.248 * 0.053$ ). Such a change is approximately 14.5% of the standard deviation of LNCVINC of 1.184 – an effect some might consider relatively small.<sup>13</sup>

Turning to the other variables in the earnings volatility regression, we find, consistent with predictions, that firms with greater capital expenditure ( $t = 2.08$ ) and those with higher leverage ( $t = 9.40$ ), smaller in size ( $t = -7.12$ ), and greater likelihood of financial distress ( $t = 7.38$ ) have greater earnings volatility. The adjusted R-squared of the earnings volatility regression is 17.02%.

Column A2 reports results from an estimation of equation (4) – the ESO risk incentive regression. Consistent with expectations, the coefficient on earnings volatility is positive and significant ( $t = 4.96$ ). This result suggests that compensation committees seek to induce future risk taking while designing the CEO's ESO risk taking incentives. Consistent with the spirit of Guay 's (1999) findings, we observe that firms with larger investment opportunity

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determined with Y1. We regress Y2 on all exogenous variables X1 and X3 and then insert the fitted Y2 from such a regression into the first equation as follows:  $Y1 = aY2_{\text{fitted}} + bY2 + cX1 + \text{error}$ . A statistically significant coefficient on the fitted Y2, i.e., a, indicates that Y2 is endogenous.

<sup>13</sup> If R&D, Capex and Leverage are excluded from equations (3) and (4), the coefficient on ESO risk taking incentives is higher at 4.070 ( $t = 6.22$ ) and the consequent increase in LNCVINC is higher at 0.215 which is approximately 19% of the standard deviation of LNCVINC. Thus, including R&D, Capex and Leverage does dampen the effect of ESO risk taking incentives on earnings volatility but not by much.

sets, proxied by non-zero R&D spending ( $t = 4.00$ ), grant greater ESO risk incentives.<sup>14</sup> CEOs that receive greater cash compensation ( $t = 23.62$ ) and total slope ( $t = 5.45$ ) also appear to receive greater ESO risk taking incentives. The results related to cash flow volatility, reported in columns B1 and B2 are similar in spirit to those related to earnings volatility. Hence, managerial incentives and GAAP related forces associated with smoothing cash flows via accruals do not appear to dominate the link between earnings volatility and ESO risk incentives. In sum, the results in Table 3 suggest that ESO risk taking incentives are associated with greater risk taking. However, the economic magnitude of the risk taking induced by ESOs appears (debatably) modest.

#### *Robustness tests*

Our reported results are robust to three (untabulated) specification checks. First, we include total ESO slope in the earnings (cash flow) regression in equation (3) to control for the stock-market related incentive to smooth earnings (Barth et al. 1999, Skinner and Myers 1999). The total ESO slope variable turns out to be insignificant and the other reported results remain unchanged. Thus, the stock-market related incentives to smooth earnings does not appear to overwhelm the role of ESO risk-taking incentives in encouraging risk taking.

Second, to ensure that our results are not driven by extreme outlier observations, we transform the independent variables (including the two endogenous variables) in equations (3) and (4) into an empirical cumulative distribution function using the procedure detailed in Aggarwal and Samwick (1999). We find that the resultant inferences remain qualitatively similar to those reported.

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<sup>14</sup> Excluding the industry dummies lowers the R squareds to 9.5% and 34.2% in models (3) and (4) respectively, but the results on estimated coefficients are similar to those reported in the tables.

In the final robustness check, we substitute stock return volatility calculated over 60 months comprising years  $t+1$  to  $t+5$  in place of  $LNCVINC_{t+1 \text{ to } t+5}$  and  $LNCVCFO_{t+1 \text{ to } t+5}$  in equations (3) and (4) and re-estimate the system of simultaneous equations.<sup>15</sup> Consistent with the reported results, we continue to find statistically consistent associations between ESO risk incentives and future return volatility.

## 5. Performance Consequences

Thus far, we have concentrated on examining the link between ESO risk taking incentives and firm risk. However, this link does not address whether such risk taking is firm value increasing in nature. Although a number of papers have examined the association between ESOs and firm performance, in general (see Bebchuk et al. 2002, Ittner et al. 2003 and Hanlon et al. 2002 for references), there is very limited evidence on the association between risk-taking incentives induced by ESOs and future performance. The ultimate objective of granting greater ESO risk taking incentives ought to be an increase in firm-value from increasing managers' investments in risky positive NPV projects. However, if ESO risk taking incentives encourage excessive risk-taking then such incentives are likely to be associated with value-decreases in the future. In particular, increasing earnings (or cash flow) volatility may increase firm's cost of capital (Beaver, Kettler and Scholes 1970, Minton and Schrand 1999, and Gebhardt, Lee and Swaminathan 2001). Hence, it is important to examine whether ESO risk incentives are associated with increases or decreases in future operating performance.

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<sup>15</sup> Note that even in an efficient stock market, there ought to be a relation between ESO risk taking incentives and *future* stock return *volatility* although one should not expect an association between ESO risk taking incentives and *future* stock *return*. At the time ESO risk taking incentives are granted, stock prices would instantaneously impound the expected return from managers' risk-taking actions and prices of traded-options would instantaneously impound expected increases in stock return volatility due to such actions. However, such expected increases in return volatility would be reflected in realized stock return volatility only in subsequent time periods.

Assessing the performance consequences of ESO risk incentives is affected by the choice of a benchmark for expected performance. Note that we cannot find a credible control sample of firms that do not award ESOs against which to compare our sample as ESO usage is widespread among U.S. firms. Larcker (2003) recommends modifying the matching approach suggested by Holthausen and Larcker (1996) and Barber and Lyon (1996) as one solution to this problem. In particular, Larcker (2003) recommends matching firms with one another within the sample. Each pair is formed by identifying the closest matching firm based on two-digit SIC code industry membership and operating performance in year 0 [Firm 1 (2) is labeled the experimental (control) firm]. While we recognize we do not technically have an experimental and control group of firms as both sets of firm-years have ESOs, we label the subsets of these firms as experimental and control groups for expositional ease. Once a matched pair is identified, the difference in operating performance for the following five years between the experimental and control firm is regressed on the difference in ESO risk incentives between the experimental and control firm in year 0. A firm-year observation can appear only once as an experimental or control firm.

The matched-pairs design explicitly controls for the impact of time period, industry and the effect of prior operating performance on future operating performance. We include potential year 0 differences in other important variables such as size and total slope between the experimental and control firm as independent variables in the regression specification.

Thus, the regression specification is as follows:

$$(\Delta \sum_{n=1}^5 E(or CFO)_{t+n})/BVE_{t-1} = \beta_0 + \beta_1 \Delta ESO \text{ risk taking incentives}_t + \beta_2 \Delta \text{Total slope}_t + \beta_3 \Delta \text{Cash compensation}_t + \beta_4 \Delta \text{Ln (MVE)}_t + \text{error}_{t+n} \quad (8)$$

where  $\Delta$  refers to the difference operator between the experimental and control firm and  $\Delta \sum_{n=1}^5 E(\text{or } CFO)_{t+n} / BVE_{t-1}$  is the difference between the experimental and control firms' future five years earnings (or cash flow) performance scaled by book value of equity at the end of year t-1 ( $BVE_{t-1}$ ). The independent variables in equation (8) refer to the difference in that variable at year 0 (year t in equation 8) between the experimental and matching firm. To ensure as close a match as possible, we restrict the mean difference in year 0 earnings and cash flows (scaled by lagged book value) between the experimental and matching firm to be within +/- 0.10. This data restriction results in 1,555 (1,495) earnings (cash flow) matched pairs out of a maximum possible 1,861 pairs (3,723 firm year observations/2). As shown in panel A of Table 4, the mean difference for year 0 earnings (cash flows) scaled by BVE at the end of year -1 is fairly small at 0.019 (0.023). These statistics indicate that the matching procedure was successful in ensuring that there are no major year 0 related differences between the experimental and control firm with regard to prior operating performance. For ease of exposition, summary statistics for the remaining variables regarding the matched sample are reported only for the earnings-based matched pairs.

Panel B of Table 4 reports the correlation statistics related to variables in equation (8). There are significant correlations between  $\Delta$ ESO risk taking incentives<sub>0</sub> and (i)  $\Delta \ln MVE_0$  (correlation of 0.42) perhaps because  $\Delta$ ESO risk taking incentives<sub>0</sub> is not scaled; and (ii) the other two components of the compensation package i.e.,  $\Delta$ Total slope<sub>0</sub> (correlation of 0.28) and  $\Delta$ Cash compensation<sub>0</sub> (correlation of 0.54).

If ESO risk taking incentives are associated with risky but firm-value enhancing investments, we ought to observe a positive relation between future performance and ESO risk taking incentives, or in equation (8), a positive  $\beta_1$  coefficient. The estimation results from

this matching approach are presented in panel C of Table 4. There appears to be a negative association between future earnings and ESO risk incentives ( $t = -2.62$  in column A1) when size is the control variable. The negative coefficient appears to imply that ESO risk incentives, in general, tend to decrease future earnings. This inference remains robust to the inclusion of total slope and cash compensation as seen from column A1. However, there is no relation between ESO risk incentives and future cash flows ( $t = -0.49$  in column B1 and  $t = -0.71$  in column B2). Thus, we do not find conclusive evidence that ESO risk incentives are detrimental to the firm's future performance. The positive association between future performance and total slope, marginally significant for earnings ( $t = 1.61$  in column A2) but strongly significant for cash flows ( $t = 3.15$  in column B2), is consistent with the spirit of Hanlon et al. (2002) that ESOs are associated with positive future operating performance.<sup>16</sup> Note that the adjusted R-squareds of the estimated models is low (1.23% for earnings in column A2 and 0.55% for cash flow regression in column B2). This is not surprising because a regression of differences on differences is usually associated with low explanatory power (Larcker 2003). In sum, there appears to be a zero or a small negative association between ESO risk incentives and future operating performance.

#### *Robustness tests*

We verify whether our results in Table 4 are sensitive to our desire to closely match the experimental and treatment firm. In particular, we drop the requirement that year 0 earnings (cash flows) scaled by book value at  $t-1$  needs to fall within the  $\pm 0.10$  band. Relaxing the close-fit filter increases the number of matched firm-pairs to 1,792, out of a

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<sup>16</sup> Hanlon et al. (2002) estimate the association between current earnings and the current and five annual lags of the Black-Scholes value of new ESO grants to the top-5 executive team. Their methodology differs from that employed here, but the basic inferences are consistent – ESOs offer incentives to firm managers to increase earnings (and firm value).

possible 1,861 pairs, while the mean difference between the experimental and matching firm for year 0 earnings (cash flows) widens to 0.20 (0.32).<sup>17</sup> Nonetheless, the results of estimating equation (8) with these 1,792 matched firms are identical to those obtained on the tightly matched sample reported in panel C of Table 4.

In the second untabulated test, we estimate the firm's future performance over 3 years instead of 5 years reported in Table 4 and find that the resultant inferences are similar to those reported. In the third test, we also transform ESO risk incentives into an empirical cumulative distribution function using the procedure detailed in Aggarwal and Samwick (1999) and find that the resultant inferences stay unchanged. In a final untabulated sensitivity test, we assess the link between subsequent operating performance and ESO risk incentives without following the matching firm procedure. In particular, we regress future 5-year earnings and cash flows scaled by book value of equity at time  $t-1$  on ESO risk incentives at time  $t$ . We include total slope, cash compensation, size, year and industry-dummies as controls. We continue to find a negative (no) association between future earnings (cash flows) and ESO risk incentives.

We realize that the non-matched OLS specification used for this last sensitivity test is open to the criticism that subsequent operating performance is itself likely endogenously determined with ESO risk incentives. For this reason we relegate this specification to a robustness check and instead report our main results based on the matching procedure. The matching procedure, on which the reported results in Table 4 are based, mitigates the endogenous association between operating performance and ESO risk incentives if the match

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<sup>17</sup> We are unable to use all pairs because we encounter a few firms that cannot be paired with a treatment firm. In particular, when we match by industry, year and past performance, we come across an odd number of observations (not divisible by two) for a particular industry or year. We leave out these odd, unpaired observations from the analysis because we want to maintain a one-to-one correspondence between a treatment and control firm.



variables such as industry membership, past operating performance and time are correlated with the omitted determinants of ESO risk incentives (and ESO slope). As shown in panel A of Table 4, the year 0 mean difference in total risk incentives between the experimental firm and control firm is a small \$2,000 while the median difference is zero.

#### *Interpretation of the results*

One inference from the results in Table 4 is that, on average, firms could increase their future earnings by reducing the CEO's ESO risk incentives. This is a strong casual interpretation of the data. Further, this interpretation assumes that ESO risk incentives are exogenous or the matching procedure adequately controls for any endogeneity in ESO risk incentives (i.e., any correlated omitted economic determinants of ESO risk incentives). Moreover, decreasing ESO risk incentives by reducing the number of ESOs granted would decrease ESO slope and hence, the incentive to increase stock price, as well.

However, it is quite possible that some exogenous shock (for example, changes in the investment opportunity set) affects both the firm's compensation structure and its performance (i.e., both compensation and performance are *endogenous*). Since we have not identified these potential exogenous shocks, it is possible that the observed relation between ESO risk incentives and earnings performance is due to the same exogenous shock, and that performance and ESO risk incentives are not causally related. In other words, if changes in ESO risk incentives are endogenous (and if the matching procedure does not completely control for such endogeneity), there is no reason to believe that decreases in ESO risk incentives would improve earnings performance, unless the exogenous determinants of compensation change in a way to support the lower level of ESO risk incentives.

## 6.0 Conclusions

We investigate whether risk taking incentives created by ESOs are (i) associated with the *ex post* outcomes of increased risk taking behavior, proxied by future earnings and cash flow volatility, and (ii) whether such risk taking is associated with future realized earnings and cash flow performance. Although ESOs are the most prominent incentive used to encourage CEOs to shed their risk aversion and undertake risky positive NPV projects, there is little large-sample evidence on whether ESO-induced risk taking actually results in investment in riskier positive NPV projects. Our evidence, covering 3,723 CEO-year observations from 1,101 firms over the years 1992-1996, suggests that firms with CEOs that have higher ESO risk taking incentives (larger changes in the value of the CEO's ESO portfolio as stock price volatility changes) exhibit higher future earnings and cash flow volatility. However, the economic magnitude of such option-induced risk taking is debatably small.

We probe deeper to assess whether option-induced risk taking incentives generate greater earnings and cash flows in the future. Based on a matched-pair design suggested by Barber and Lyon (1996), Holthausen and Larcker (1996) and Larcker (2003), we find that ESO risk incentives have a zero or a negative effect on future operating performance. Although ESO risk incentives represent a unique feature of executive stock options, as compared to stock ownership, ESO risk incentives are associated only with modest increases in firm risk, and such increases are not associated with positive subsequent earnings or cash flow performance.

If ESOs are not effective at mitigating CEO risk aversion, then the distinctive feature of ESOs relative to stock i.e., the risk-taking incentives, is called into question. While ESOs

offer risk-incentives due to convexity in payoffs, as pointed out by Lambert, Larcker and Verrecchia (1991), and Hall and Knox (2002), these incentives are fragile especially when the stock price falls relative to the option's exercise price. Thus, our paper provides evidence to inform the current debate about the relative efficiency of restricted stock versus options in motivating manager behavior.

## **Appendix: Equilibrium Firm Behavior and Future Firm Performance**

In this appendix we discuss a problem endemic to research that aims to relate some firm choice (such as ESO grants, EVA or balanced scorecard adoption, or strengthening the board of directors, or choosing a Big 4 auditor) to future firm performance. This problem is touched upon in Ittner and Larcker (2001) and Larcker (2003). The problem occurs because while the firm choice is endogenous (which can be modeled), researchers using archival data cannot observe (nor generally estimate) what firm performance would have been in the absence of the firm action choice. An analogy will help illustrate the problem.<sup>18</sup> Suppose a growth hormone is given to children suffering from growth problems. After the child reaches adult age, the archival researcher (as opposed to the experimental researcher who assigns subjects randomly) then collects measurements of those subjects receiving the treatment and of a control sample of those not receiving the treatment. It is very likely that in a regression of adult height on treatment (or even degrees of treatment within the treatment group), a negative coefficient is observed on the treatment because the treatment group still ended up shorter on average than the control group. This is because the archival researcher requires an estimate of what the treatment groups' height would have been in the absence of the treatment. Note that modeling the choice to give the treatment in a two stage approach does not solve this problem because the instrument for the endogenous variable is not an estimate of what the outcome would have been in the absence of the treatment.

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<sup>18</sup> A second analogy is estimating the increase in future earnings from obtaining a college degree. The problem here is people who attend college are likely to be smarter, work harder and would have earned higher income even in the absence of going to college. Researchers include these variables as additional control variables and examine the incremental earnings on the college indicator variable (or adopt a two stage self-selection model in which they include the inverse Mills ratio estimated from the first stage model of college attendance in the second stage regression). But if all students are at equilibrium, it is not possible to isolate or obtain a reasonable estimate of what college attendees' earnings would have been in the absence of attending college.

Traditionally the control group is a set of firms (or individuals) that have similar characteristics as the treatment firms but which did not undergo or elect the treatment. It is the existence of these control firms/subjects that allow identification of what an outcome what have been among the treatment firms if they did not elect the treatment. However, if firms are at equilibrium, then firms with similar characteristics as the treatment firms should have elected the treatment (so these firms represent misclassifications) or they are not really appropriate matches. In other words, if we assume all firms are at equilibrium, all firms that should have elected for the treatment would have and thus there are simply no control firms with similar characteristics that did not elect the treatment. Thus the researcher cannot estimate what the outcome would have been in the absence of the treatment by using a control sample of firms. That is, it is not possible to directly estimate the incremental effect of the treatment.

Using changes in the outcome (or first differences for the same firm) does not solve the problem. Differencing only removes the effect of stationary correlated omitted variables – it does not provide an estimate of what the outcome what have been in the absence of the treatment. With respect to the growth hormone, a change design still does not identify what the expected growth (change) was in the absence of the treatment. The change approach effectively treats the pre-treatment level of height or earnings as the expected post-treatment outcome in the absence of treatment. This is not a good expectation for the growth hormone (because subjects are expected to grow some more) and for firms adopting EVA or the balanced scorecard, current earnings is likely a poor proxy for expected earnings in the absence of adoption – for example, firms might adopt because they expect firm performance to worsen. And when studying ESO risk incentives or slope incentives, the additional

problem is that there is simply no pre-treatment observation because these programs are ongoing (unless one restricts oneself to studying ESO adoption).

As discussed by Ittner and Larcker (2001), including control variables as additional explanatory variables results in the researcher examining the incremental or residual effect of the choice. And if firms are at equilibrium, and the researcher's model includes the complete set of controls (or exogenous variables), the estimated coefficient on the "residual" (i.e., the choice of interest after the exogenous determinants are controlled for) should be zero (because if firms are at equilibrium, the deviations from the optimal choice are random, Demsetz and Lehn 1985) or negative (because off-equilibrium behavior could represent firms struggling to reach their equilibrium and the deviations are costly, Ittner and Larcker 2001, Milgrom and Roberts 1992). However, these two predictions impose the restrictive assumption that there is no benefit to adopting EVA or ESO incentives per se (that is, independent of the exogenous reasons to adopt).

Thus if one adopts the perspective that all firms are at equilibrium, then little can be learned from examining the relation between future outcomes and current firm choices (because a negative, zero or positive relation are all possible, even if the treatment is effective). This is an extreme position to adopt. While we recognize some merit to the equilibrium argument, we proceed with our examination now that the reader has been made aware of the problem and appropriately cautioned.

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**Table 1****Sample selection details and descriptive data on select financial characteristics of sample****Panel A: Sample selection criteria**

	# Firms	# Firm- years
CEO-years on Execucomp 1992-1996	2,502	12,510
Less: Exclusions		
CEO-years with missing information on option grants or option holdings	826	6,331
CEO-years in the financial services industries	262	1,010
CEO-years not on Compustat	29	124
CEO-years with missing data items necessary to estimate regression model	284	1,322
Final sample	1,101	3,723
Sample by year	<u>1992</u> 587	<u>1993</u> 685
	<u>1994</u> 759	<u>1995</u> 815
	<u>1996</u> 877	<u>Total</u> 3,723

**Panel B: Selected financial data over the sample period 1992-1996 (\$millions except when stated, N=3,723)**

	Mean	Standard deviation	Q1	Median	Q3	Compustat Mean	Difference of means t-stat
	(1)	(2)	(3)	(4)	(5)	(6)	t-stat (1-6)
Sales	2,363.310	3,970.830	301.474	723.513	2,275.200	667.231	25.62
Total assets	2,454.070	4,777.110	270.680	655.420	2,039.60	849.360	20.06
Net income	103.27	222.772	9.809	29.216	94.029	27.573	20.36
ROA	0.049	0.105	0.027	0.056	0.912	-0.108	54.72
Book value of equity	865.524	1,544.317	130.017	284.048	813.741	289.714	22.23
Market value of equity	2,360.456	4,265.971	300.498	718.254	2,178.49	679.26	23.51
Ln (MVE)	6.735	1.404	5.705	6.576	7.686	4.207	96.28
B/M (Book-to-market)	0.475	0.284	0.279	0.418	0.611	0.526	9.20
Leverage	0.216	0.201	0.046	0.166	0.330	0.276	14.02
Variance of stock returns	0.362	0.141	0.257	0.334	0.435	0.540*	26.11

\*relates to the average CRSP firm

**Panel C: Descriptive data on annual CEO compensation over the sample period 1992-1996  
(\$ millions, N=3,723 except as noted)**

	Mean	Standard deviation	Q1	Median	Q3
Salary	0.428	0.233	0.261	0.375	0.539
Bonus	0.327	0.426	0.062	0.200	0.427
Black Scholes value of new option grants (n=2,579)*	1.259	4.725	0.190	0.463	1.088
Value of new restricted stock grants	0.139	0.883	0.000	0.000	0.000

**Panel D: Calculation of ESO risk incentives and other stock-based incentives (\$ millions)**

	Mean	Standard deviation	Q1	Median	Q3
ESO risk incentives	0.032	0.053	0.004	0.014	0.035
Number of options	0.307	0.464	0.050	0.151	0.350
Mean price-to-strike ratio	1.689	1.112	1.096	1.346	1.800
Variance of stock returns	0.362	0.141	0.257	0.334	0.435
ESO slope incentive	0.081	0.149	0.009	0.029	0.082
Black-Scholes value of total option portfolio	5.520	10.554	0.505	1.827	5.345
Restricted stock slope incentive	0.004	0.013	0.000	0.000	0.001
Market value of restricted stock holdings	0.423	1.320	0	0	0.058
Stock slope incentive	0.281	0.761	0.006	0.031	0.147
Market value of stock holdings	28.097	76.069	0.624	3.147	14.728
Total slope incentive	0.378	0.843	0.035	0.099	0.291
Total firm-specific CEO wealth	34.349	78.905	2.668	8.059	24.994

\* Note that n=2579 does not omit zero grant observations. We do not eliminate observations with zero ESO risk incentives from our sample.

**Panel E: Descriptive data on variables (other than compensation) used in the volatility and ESO risk incentive regressions**

	Mean	Standard deviation	Q1	Median	Q3
CVINC	2.555	5.405	0.426	0.819	2.037
LNCVINC	0.034	1.184	-0.852	-0.199	0.711
CVCFO	2.215	4.510	0.574	0.937	1.867
LNCVCFO	0.129	0.969	-0.554	-0.065	0.625
Capex	0.098	0.139	0.031	0.053	0.101
R&D	0.057	0.230	0.000	0.000	0.028
B/M (Book-to-market)	0.475	0.284	0.279	0.418	0.611
Leverage	0.216	0.201	0.046	0.166	0.330
Financial distress proxies	0.192	0.394	0	0	0
Cash constraint	0.022	0.086	-0.026	0.008	0.053
Dividend constraint	0.120	0.325	0	0	0

**Panel F: Pearson correlation matrix of variables used in the volatility and ESO risk incentive regressions**

	ESO risk inc.	LN CVINC	LN CVCFO	Capex	R&D dum.	Lev	LnMVE	Fin. dis.	B/M	Cash Comp	Cash const.	Div const.
LNCVINC	<b>0.07</b>	1										
LNCVCFO	<b>0.10</b>	<b>0.39</b>	1									
Capex	<b>0.03</b>	<b>0.07</b>	<b>-0.22</b>	1								
R&D dummy	<b>0.04</b>	-0.02	-0.01	<b>0.26</b>	1							
Leverage	<b>0.04</b>	<b>0.19</b>	<b>0.13</b>	0.02	<b>-0.18</b>	1						
Ln (MVE)	<b>0.44</b>	<b>-0.14</b>	<b>-0.36</b>	0.00	<b>0.06</b>	<b>-0.06</b>	1					
Financial distress	0.01	<b>0.24</b>	<b>0.18</b>	<b>0.15</b>	-0.00	<b>0.31</b>	<b>-0.20</b>	1				
B/M	<b>-0.12</b>	<b>0.18</b>	<b>0.22</b>	<b>-0.03</b>	<b>-0.01</b>	<b>0.47</b>	<b>-0.37</b>	<b>0.17</b>	1			
Cash comp.	<b>0.57</b>	-0.02	<b>-0.08</b>	<b>-0.07</b>	<b>-0.01</b>	<b>0.05</b>	<b>0.55</b>	<b>-0.07</b>	<b>-0.10</b>	1		
Cash constraint	0.01	<b>0.17</b>	<b>0.07</b>	<b>0.33</b>	<b>0.04</b>	<b>0.05</b>	<b>-0.16</b>	<b>0.29</b>	0.01	<b>-0.14</b>	1	
Dividend constraint	0.01	<b>0.13</b>	<b>0.06</b>	<b>0.04</b>	-0.02	<b>0.11</b>	<b>-0.10</b>	<b>0.17</b>	-0.01	0.01	0.01	1
Total slope	<b>0.26</b>	-0.01	<b>-0.05</b>	-0.01	-0.02	<b>-0.12</b>	<b>0.26</b>	<b>-0.07</b>	<b>-0.18</b>	<b>0.29</b>	<b>0.29</b>	<b>-0.02</b>

Notes: In panel F, correlations that are significant at  $p < 0.05$ , two-tailed, are bolded. ESO risk incentives is measured as the sensitivity of the change in Black-Scholes option value to a 1% change in stock return volatility multiplied by the number of options in the CEO's portfolio (see Core and Guay 2002). Earnings volatility = LNCVINC = the natural logarithm of the coefficient of variation of operating income computed as the standard deviation of quarterly operating income (quarterly Compustat data item #8) over five years (t+1 to t+5) scaled by the absolute value of mean operating income over the same period. Cash flow volatility = LNCVCFO = the natural logarithm of the coefficient of variation of operating cash flows computed as the standard deviation of quarterly operating cash flows as per SFAS 95 (quarterly Compustat data item #108) adjusted for extra-ordinary items (Compustat quarterly # 78) over five years (t+1 to t+5) scaled by the absolute value of mean operating cash flows over the same period. Stock return volatility is volatility from 60 months of monthly returns. R&D dummy is an indicator variable set to one for firms that have a non-missing value for R&D in Compustat and set to zero for firms with a missing value for R&D in Compustat. R&D is a firm's R&D expenditure (annual Compustat #46 with a missing treated as zero) for year t deflated by total sales in year t (#12). Leverage is the sum of long term debt (annual Compustat #9) and debt in current liabilities (annual Compustat #34) divided by the sum of long-term debt and the MVE where all variables are measured at the end of year t. Ln MVE = the natural log of the market value of equity (annual Compustat #199\*#25). Financial distress is a distress dummy set to one if the firm satisfies any of three conditions in year t: the firm has (i) speculative grade debt (S&P bond ratings greater than 13 on Compustat, data item #280); (ii) a negative E/P ratio (Compustat item #18/MVE); and (iii) a negative B/M (Compustat item #216/MVE).  $B/M_t$  is book value of equity (annual Compustat #216) divided by the market value of equity (annual Compustat #199\*#25). Cash comp is the sum of salary and bonus. Cash constraint is the preceding three-year (t-3, t-2, t-1) average of [(cash flow from operations (Compustat #308) - common and preferred dividends (Compustat #127) + cash flow used in investing activities (Compustat #311))\*(-1)]. Dividend constraint is a dummy 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 dividend constraint dummy is set to zero ((Compustat #36 + Compustat #115)/(Compustat #127 + Compustat #115)). Total slope, the sensitivity of wealth to stock price, is the sum of the three slope components; stock option slope, stock slope, and restricted stock slope. Price-to-strike ratio is the year-end stock price divided by the exercise price of an option. The mean strike-to-price ratio is the weighted average of the price-to-strike ratio for all options in the CEO's option portfolio at fiscal year-end. The ESO slope incentive, restricted stock slope incentive and stock slope incentive are the change in value of the CEOs' holding of that equity instrument given a 1% change in stock price. The total slope incentive, the sensitivity of wealth to stock price, is the sum of the three slope components. Total firm-specific CEO wealth is the sum of the market value of the CEO's option holdings, restricted stock and common stock holdings). Note all variables in panels D and E are winsorized at the 1% and 99% percentiles.

**Table 2**  
**Evidence on the importance to managers of volatility:**  
**Results of regressing stock return volatility on earnings and cash flow volatility**

$$\sigma_{t-2, t+2} = \theta_0 + \theta_1 \text{LNCVINC}_{+1, t+5} \text{ (and LNCVCFO}_{+1, t+5}) + \theta_2 \text{B/M}_t + \theta_3 \text{Leverage}_t + \theta_4 \text{Ln MVE}_t + \theta_5 \text{Industry dummies} + \theta_6 \text{Time dummies} + \text{error} \quad (7)$$

N = 3,723

		Earnings volatility	Cash flow volatility
Column		A	B
Explanatory variables	Prediction	Slope estimate (t-statistic)	Slope estimate (t-statistic)
Intercept	?	0.693** (30.62)	0.654** (27.87)
LNCVINC <sub>t+1, t+5</sub>	+	0.026** (16.78)	-
LNCVCFO <sub>t+1, t+5</sub>	+	-	0.028** (12.42)
B/M <sub>t</sub>	-	-0.067** (-8.64)	-0.059** (-7.49)
Leverage <sub>t</sub>	+	-0.038 (-3.49)	-0.029 (-2.62)
Ln (MVE) <sub>t</sub>	-	-0.048** (-33.66)	-0.044** (-29.54)
Adjusted R-squared (%)		43.43	41.51
F-statistic (p-value)		46.16** (0.00)	42.73** (0.00)

Notes:  $\sigma_{t-2, t+2}$  = volatility figure used by Execucomp in calculating the Black-Scholes values for options. This is the standard deviation of returns calculated over 60 months covering years t-2 to t+2. See Table 1 for other variable definitions. Coefficients on industry and year dummies not reported.



**Table 3: Regression of future earnings/cash flow volatility and ESO risk incentives**

$$\text{Earnings/Cash flow volatility}_{t+1, t+5} = \beta_0 + \beta_1 \text{ ESO risk taking incentives}_t + \beta_2 \text{ Capex}_t + \beta_3 \text{ R\&D dummy}_t + \beta_4 \text{ R\&D dummy}_t * \text{ R\&D}_t + \beta_5 \text{ Leverage}_t + \beta_6 \ln \text{ MVE}_t + \beta_7 \text{ Financial distress proxies}_t + \beta_8 \text{ Industry dummies}_t + \beta_9 \text{ Time dummies}_t + \text{error}_{t+1, t+5} \quad (3)$$

$$\text{ESO risk taking incentives}_t = \gamma_0 + \gamma_1 \text{ Earnings/cash flow volatility}_{t+1, t+5} + \gamma_2 \text{ Capex}_t + \gamma_3 \text{ R\&D dummy}_t + \gamma_4 \text{ R\&D dummy}_t * \text{ R\&D}_t + \gamma_5 \text{ B/M}_t + \gamma_6 \text{ Cash compensation}_t + \gamma_7 \text{ Cash constraint}_t + \gamma_8 \text{ Dividend constraint dummy}_t + \gamma_9 \ln \text{ MVE}_t + \gamma_{10} \text{ Total slope}_t + \gamma_{11} \text{ Industry dummies}_t + \gamma_{12} \text{ Time dummies}_t + \text{error}_t \quad (4)$$

N= 3,723

Column	Earnings volatility regression		ESO risk incentive regression		Cash flow volatility regression	ESO risk incentive regression
	A1		A2		B1	B2
	Pred. Sign	Coeff. (t-statistic)	Pred. Sign	Coeff. (t-statistic)	Coeff. (t-statistic)	Coeff. (t-statistic)
Intercept	?	1.039** (4.33)	?	-0.065** (-6.85)	2.292** (13.47)	-0.114 (-7.47)
<b>Endogenous variables</b>						
ESO risk incentives	+, H1	3.248** (3.56)			3.447** (5.33)	
LNCVINC			+,H1	0.017** (4.96)		
LNCVCFO			+,H1			0.027** (4.69)
<b>Instruments</b>						
Capex	+	0.353* (2.08)	+	0.005 (0.75)	-0.824 (-6.86)	0.033** (3.76)
R&D dummy	+	0.041 (0.85)	+	0.007** (4.00)	-0.026 (-0.77)	0.008** (4.44)
R&D dummy * R&D	+	-0.019 (-2.16)	+	0.0001 (0.53)	-0.003 (-0.49)	-0.001 (-0.15)
Ln (MVE)	-	-0.148** (-7.12)	+	0.008** (11.70)	-0.255** (-17.30)	0.013** (9.27)

**Table 3: Regression of future earnings/cash flow volatility and ESO risk incentives (cont'd)**

Column	Pred.	Earnings volatility regression A1	Pred.	ESO risk incentive regression A2	CFO volatility regression B1	ESO risk incentive regression B2
Leverage	+	1.046** (9.40)	N/A		0.561** (7.12)	
Financial distress	+	0.386** (7.38)	N/A		0.207** (5.60)	
B/M			-	-0.006 (-1.56)		0.001 (0.02)
Cash compensation			+/-	0.036** (23.62)		0.033** (19.36)
Cash constraint			+	0.015 (1.36)		0.017 (1.50)
Dividend constraint			+	-0.003 (-1.17)		0.000 (0.01)
Total slope			?	0.005** (5.45)		0.005** (5.60)
Hausman (1978) simultaneity test p value				0.00		0.00
Adjusted R <sup>2</sup> – first stage regression (%)		17.02		40.81	40.81	39.16
Adjusted R <sup>2</sup> – second stage regression (%)		15.66		41.33	38.23	35.53

Notes: The equations are estimated using two-stage least squares. Earnings (cash) volatility is the natural logarithm of the coefficient of variation in future quarterly operating income (operating cash flows) as defined in notes to Table 1. See notes to Table 1 for the definitions of the remaining variables. Coefficients on industry and year dummies are not reported.

**Table 4: Operating Performance Regressions**

**Panel A: Descriptive data on variables used in operating performance regressions**

N = 1,555 matched firm pairs

	Mean	Std. Devn	Q1	Median	Q3
$\Delta \sum_{n=1}^5 E_{t+n} / BVE_{t-1}$	0.042	1.344	-0.577	0.051	0.614
$\Delta \sum_{n=1}^5 CFO_{t+n} / BVE_{t-1}$	0.115	1.902	-0.663	0.064	0.808
$\Delta$ ESO risk incentives <sub>0</sub>	0.002	0.071	-0.016	0.000	0.018
$\Delta$ Total slope <sub>0</sub>	0.036	1.126	-0.127	0.000	0.141
$\Delta$ Cash compensation <sub>0</sub>	0.042	0.805	-0.753	0.020	0.381
$\Delta$ Ln (MVE) <sub>0</sub>	0.130	1.767	-0.996	0.141	1.292
$\Delta E_0 / BVE_{-1}$	0.019	0.021	0.003	0.010	0.027
$\Delta CFO_0 / BVE_{-1}$	0.023	0.022	0.005	0.015	0.033

**Panel B: Pearson correlation matrix of variables used in operating performance regressions**

N = 1,555 matched firm pairs

	$\Delta \sum_{n=1}^5 E_{t+n} / BVE_{t-1}$	$\Delta \sum_{n=1}^5 CFO_{t+n} / BVE_{t-1}$	$\Delta$ ESO risk incentive <sub>0</sub>	$\Delta$ Total slope <sub>0</sub>	$\Delta$ Cash comp <sub>0</sub>
$\Delta \sum_{n=1}^5 CFO_{t+n} / BVE_{t-1}$	<b>0.31</b>	1			
$\Delta$ ESO risk incentives <sub>0</sub>	-0.02	0.00	1		
$\Delta$ Total slope <sub>0</sub>	<b>0.04</b>	<b>0.08</b>	<b>0.28</b>	1	
$\Delta$ Cash compensation <sub>0</sub>	0.03	0.01	<b>0.54</b>	<b>0.25</b>	1
$\Delta$ Leverage	<b>-0.09</b>	0.03	<b>0.09</b>	<b>-0.09</b>	<b>0.14</b>
$\Delta$ Ln (MVE) <sub>0</sub>	<b>0.09</b>	0.03	<b>0.42</b>	<b>0.25</b>	<b>0.47</b>

**Table 4 (Cont'd)**

**Panel C: Regression of future operating performance on ESO risk incentives for sample of firms matched on calendar year, industry and past operating performance**

$$(\Delta \sum_{n=1}^5 E(or\ CFO)_{t+n})/BVE_{t-1} = \beta_0 + \beta_1 \Delta ESO\ risk\ taking\ incentives_t + \beta_2 \Delta Total\ slope_t + \beta_3 \Delta Cash\ compensation_t + \beta_4 \Delta Ln\ (MVE)_t + error_{t+n} \quad (8)$$

Dependent variable		$(\Delta \sum_{n=1}^5 E_{t+n})/BVE_{t-1}$	$(\Delta \sum_{n=1}^5 E_{t+n})/BVE_{t-1}$	$(\Delta \sum_{n=1}^5 CFO_{t+n})/BVE_{t-1}$	$(\Delta \sum_{n=1}^5 CFO_{t+n})/BVE_{t-1}$
Column		1	2	4	3
	Pred. Sign	Coeff. (t-statistic)	Coeff. (t-statistic)	Coeff. (t-statistic)	Coeff. (t-statistic)
Intercept	?	0.328 (0.96)	0.031 (0.93)	0.112** (2.28)	0.116** (2.36)
<b>Treatment variables</b>					
$\Delta ESO\ risk\ incentives_t$	?	-1.361** (-2.62)	-1.591** (-2.75)	-0.369 (-0.49)	-0.586 (-.71)
<b>Controls</b>					
$\Delta Ln\ (MVE)_t$	?	0.942** (4.47)	0.086** (3.87)	0.046 (1.50)	0.032 (0.99)
$\Delta Total\ slope_t$	+		0.051 (1.61)		0.143** (3.15)
$\Delta\ Cash\ compensation_t$	?		0.013 (0.26)		-0.033 (-0.43)
Adjusted R <sup>2</sup> (%)		1.19	1.23	0.02	0.55
F-stat		10.34**	5.86**	1.13	3.05**
No. of matched pairs		1,555	1,555	1,495	1,495

Notes:  $\Delta$  refers to the difference between the experimental firm and a control firm matched on calendar year, industry and prior operating performance.  $\Delta \sum_{n=1}^5 E_{t+n} / BVE_{t-1}$  ( $\Delta \sum_{n=1}^5 CFO_{t+n} / BVE_{t-1}$ ) is the difference between the experimental and matching firms' future five years earnings (or cash flow) performance scaled by book value of equity at the end of year t-1 ( $BVE_{t-1}$ ).  $\Delta ESO\ risk\ incentives_0$  ( $\Delta Cash\ compensation_0$ ) is the difference between year 0 ESO risk incentives between the experimental and control firm,  $\Delta Total\ slope_0$  is the difference between year 0 Total slope between the experimental and control firm,  $slope_0$  is the difference between year 0 Total slope between the experimental and control firm  $\Delta Ln\ (MVE)_0$  is the difference between year 0 Ln (MVE) between the experimental and control firm,  $\Delta E_0/BVE_{-1}$  ( $\Delta CFO_0/BVE_{-1}$ ) is the difference between year 0 earnings (CFO) scaled by year -1 book value between the experimental and control firm. Correlations significant at  $p < 0.05$  are bolded in panel B.