Capital Structure and Managerial Compensation Contract Design: Theory and Evidence

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Abstract

From a compensation contract designers' perspective, including incentive instruments in a manager's contract not only positively motivates the employed manager but also creates a negative dilution effect for existing shareholders. This study investigates this dilemma by conducting a benefit–cost analysis under a proposed structural form framework. We assume (and empirical results confirm) that managers are capable of influencing the risk level of firm assets and that this influence is positively and exponentially dependent on the incentive intensity of the compensation contract. Our design mechanism shows that, given their firms' current capital structure, shareholders are always capable of designing an optimal compensation contract to maximize their wealth. Unlike previous studies, our model proposes that in a firm with a higher leverage ratio, shareholders should provide more incentive instruments for managers, and this proposition is supported by the empirical analyses which examine the sample of S&P index firms over the period 1992–2006.

Keywords: Capital structure; Dilution effect; Compensation contract; Fixed effects model

JEL Classifications: G32; J33

1. Introduction

Previous studies have investigated the agency conflicts between managers and shareholders. How to mitigate such conflicts has remained an important issue in accounting and finance literature, with numerous researchers demonstrating that properly designed managerial compensation contracts can ease these conflicts (Brickley, Bhagat, and Lease, 1985; DeFusco, Johnson, and Zorn 1990). In general, the executive compensation structure consists of several components: a basic salary, bonuses, and stock options, and other long-term incentive arrangements. Indeed, executive stock options (ESOs), in particular, are heavily used by U.S. corporations. According to Jones and Burchman (2002) and Weisbenner (2000), by the mid-1990s, more than nine out of ten companies issued stock options to managements. Hall and Murphy (2002) report that options represent the most popular method utilized to compensate managements of S&P 500 firms; for example, stock options accounted for 47% of total compensation granted to chief executive officers (CEOs) in 1999, up from 21% of total compensation in 1992. As a result, much of the recent literature on executive compensation tends to focus on the issue of stock options.[1]

ESOs give managers the right to buy their own firms' stocks at predetermined strike prices. In most cases, ESOs are in the form of European call options, that is, at-the-money options (Murphy, 1999), with strike prices equal to the stock prices at the ESOs' time of issuance. This paper's ESO design aims to motivate managers to provide better operating performance and pursue higher stock prices for their companies. Higher stock prices not only benefit managers through ESOs, but also shareholders

[1] See, for example, Hall and Murphy (2003) and Bebchuk and Fried (2003) for succinct discussions on the recent literature which tends to focus on stock options.

through stock holdings. Hence ESO grants align the interests of managers and shareholders, alleviating agency problems. The weight of such instruments in a managerial compensation contract therefore represents the contract's incentive intensity.

Although incentive instruments such as ESOs indeed provide a direct linkage between managers' expected utility and shareholders' wealth and work as an efficient interest-aligning device, they are not without disadvantages. For shareholders, the greatest concern with granting managers stock options is likely the dilution effect (Bens, Nagar, and Wong, 2002; Kahle, 2002; Bens, Nagar, Skinner, and Wong, 2003; Hribar, Jenkins, and Johnson, 2006), in which the increase in shares from managers exercising their stock options dilutes the equity value per share. Granting such incentive instruments to managers therefore leads to the dilemma of the advantage of the motivational effect versus the disadvantage of the dilution effect, with shareholders having to decide upon the optimal level of incentive intensity in a managerial compensation contract that will maximize their wealth.

Unlike most related studies, which focus on eliminating agency costs, this paper investigates the dilemma by conducting a benefit–cost analysis within a structural form framework. In this construct, managers are assumed to be capable of influencing firm asset risk; however, this influence depends on how incentive intensive the compensation contracts are, and these contracts are carefully devised by shareholders. This mechanism thus shows that shareholders are able to make optimal decisions on managerial compensation contracting to maximize their wealth, given their firms' current capital structure patterns.

Our model suggests that the optimal incentive intensity in a managerial compensation contract is positively related to the firm's leverage ratio. We empirically examine this, determining whether a firm's capital structure affects CEO stock option compensation using a sample of U.S. S&P index firms over the period 1992–2006. We find that the performance sensitivity induced by CEOs' new stock option awards increases with debt leverage, suggesting that firms with higher debt leverage tend to design CEO compensation themes with greater incentive intensity. We also find a positive relation between financial leverage and the percentage of CEO pay in the form of stock options. Our results are robust to alternative leverage measures, different control variables, and various model specifications and estimation techniques. Moreover, using a simultaneous equations approach where managerial stock option awards both affect capital structure (Coles, Daniel, and Naveen, 2006) and are influenced by the latter, we confirm that our results are not driven by the endogeneity of capital structure or that of CEO compensation policies.

This major contribution of this paper is that, instead of making specific assumptions on managers' utility functions, as in most related studies, we simply assume and further empirically confirm an exponential relation between pay-for-performance sensitivity (PPS) and asset risk. Therefore, in our model, to achieve an optimal compensation contract based on the firm's current capital structure, shareholders do not have to conjecture on the managers' ambiguous utility type, which is indeed unobservable in reality, but need only recognize the observed pattern that providing greater incentive intensity in the compensation contract would exponentially increase managerial asset risk taking levels. Empirically, we examine the pooled data with fixed effect regressions to control for any firm-specific effects. The results strongly support a positive relation between a firm's leverage ratio and PPS in the contract proposed by our model.

The remainder of the paper is organized as follows. Section 2 discusses the relevant literature. Section 3 builds the theoretical model. Section 4 describes simulation results of the relation between the PPS and firm leverage and develops the hypothesis. Section 5 presents data, variable measurement and methodologies. Section 6 reports empirical results and additional analyses for robustness. Section 7 summarizes and concludes the paper.

2. Literature Review

Because of the separation of ownership and management in modern corporation formation, interest conflicts always exist between managers and shareholders. Jensen and Meckling (1976) suggest that managers may not work in shareholders' best interests if insufficient or no incentive is provided. Previous studies have demonstrated that the incentive compensation contract is an important instrument with which shareholders can mitigate managers' incentive problems and should be carefully devised (Jensen and Meckling, 1976; Beck and Zorn, 1982; Ofek and Yermack, 2000).

In recent decades, besides salaries and cash bonuses, ESOs have become widely adopted by companies (Defusco, Zorn, and Johnson, 1991; Hall and Murphy, 2002). Many studies propose that granting ESOs is an efficient method of providing enough motivation for managers to align their interests with those of shareholders and mitigate agency problems (Haugen and Senbet, 1981). Smith and Watts (1992) and Gaver and Gaver (1993) show that firms with greater investment opportunities have higher executive compensation and a higher incidence of ESO plans. The authors argue that such firms often face more severe agency problems, and that granting more ESOs is likely to be more beneficial to these firms' shareholders.

Due to the convex payoff structure of options, many studies propose that incorporating stock options in managerial compensation would create the desired effect of motivating managers to invest in riskier projects (Jensen and Meckling, 1976; Haugen and Senbet, 1981; Murphy, 1999). This increase in risk taking is not necessarily excessive if managers were initially investing in projects that were too safe from the stockholders' point of view. Agrawal and Mandelker (1987) find that managers with more option holdings tend to choose variance-increasing investments. A large body of literature shows, both theoretically (e.g., John and John, 1993; Jin, 2002) and empirically (e.g., Knopf, Nam and Thornton, 2002; Coles, Daniel and Naveen, 2006), that granting ESOs motivates managers to take higher risks since the values of managers' stock option portfolios increase when stock return volatility increases. Cheng and Farber (2008) suggest that equity incentives, especially option holdings, are important for inducing risk-averse managers to choose riskier positive net present value projects.

The literature on the structure of executive compensation contracts offers two complementary perspectives on ESOs (Dittmann and Maug, 2007). One highlights the fact that stock options are "expensive" because they are risky (Oyer and Schaefer, 2005). For instance, for typical parameter values, an option worth $100 to diversified investors may be worth only $20 to $40 to an undiversified, risk-averse CEO. This perspective emphasizes the CEO's participation constraint but neglects incentives. The other perspective suggests that stock options are "cheap" because they provide more incentives for the same dollar outlay as an equivalent investment in stock, enabling companies to save on compensation costs associated with providing incentives (Hall and Murphy, 2000). This perspective focuses only on the incentive compatibility constraint.

To shareholders, granting stock options as managerial compensation generates a trade-off dilemma between the incentive effect of managers and the dilution effect of shareholders (Bens, Nagar, and Wong, 2002; Kahle, 2002; Bens, Nagar, Skinner, and Wong, 2003; Hribar, Jenkins, and Johnson, 2006). As stock option compensation increases, the dilution effect increases at a constant rate, but the incentive effect may not (Kaplan and Atkinson, 1998). A decreasing incentive effect with increasing stock option grants can result from the risk aversion problem, where the greater the stakes managers have in a firm, the more likely they will avoid risks that shareholders would prefer them to take.

This paper investigates how shareholders make optimal managerial compensation decisions by solving the trade-off problem between the incentive and dilution effects derived from granting incentive instruments (e.g., ESOs and other stock-based compensation), given their firm's capital structure. In a similar vein, several studies focus on the potential impact of the agency problems of debt on the firm's choice of managerial compensation. For example, John and John (1993) develop a theoretical model illustrating that greater amounts of equity-based compensation will exacerbate agency problems of debt and thus predict a negative relation between a firm's leverage and its use of equity-based compensation while Yermack (1995) and Bryan, Hwang, and Lilien (2000) find no empirical relation. Recently, Ortiz-Molina (2007) offers empirical support for the significance of these effects that pay-performance sensitivity is inversely related to leverage. He interprets this finding as consistent with the notion that boards offer more muted incentives to CEOs when the potential for expropriation of creditors' wealth is high. One way in which our analysis contributes to this literature is by offering both a theoretical analysis with distinct assumptions and an improved empirical model specification. As such, we intend to provide an alternative rationale for the impact of a firm's capital structure on its optimal managerial compensation contract design.

3. The Model

3.1. Model Development

We first assume a one-period model in which shareholders make a compensation contract with managers at time 0. The compensation contract contains only two components: incentive instruments and non-incentive instruments. Incentive instruments provide incentive for managers to take more asset risks, while non-incentive instruments do not. At time 0, shareholders decide not only how much total compensation to distribute to managers from the expected incremental equity value, but also the weights of incentive and non-incentive instruments in the contact.[2] At time 1, managers obtain their compensation following the shareholders' contract design. The assumed job market for managers is dominated by existing shareholders, as in a buyer's market; that is, shareholders are always able to find appropriate managers to maximize their investment wealth.

We further define k as the percentage of expected incremental equity value granted as compensation to managers, and s as the percentage of total compensation paid by incentive instruments. In this study, $k > 0$ and $s \geq 0$, and both are decided by shareholders in the contract at time 0. Therefore, the PPS p in our study is defined as

[2] The expected incremental equity value is the expected increase of the firm's market capital from time 0 to time 1, which translates to the amount of additional wealth managers can bring to shareholders. It can be seen as a measure of manager performance.

(1) $p = k \times s = \dfrac{TC}{MP} \times \dfrac{II}{TC}$,

where $k = \dfrac{TC}{MP}$, $s = \dfrac{II}{TC}$, II is the expected value of incentive instruments granted, TC is expected total compensation, and MP is the expected incremental equity value.[3] In other words, when $II = 0$, $s = 0$ and $p = 0$, meaning that no incentive instruments are granted to managers. However, TC can never be zero, which means that managers should be given at least basic compensation when they are recruited. Moreover, p should not exceed 100%, because it would be unreasonable if managers not only were granted all of the incremental equity value and but also asked more from shareholders, that is, $0 \le p \le 1$.[4]

Next, we assume that without incentive instrument grants ($p = 0$), managers will operate the firm as the firm's asset value A follows the process

(2) $\dfrac{dA}{A} = \mu_B dt + \sigma_B dW$,

where μ_B is the asset's base expected return rate, σ_B is the asset's base volatility, and dW is a Wiener process. Since granting stock options as compensation provides managers more incentive to take risks (Agrawal and Mandelker, 1987; Knopf, Nam, and Thornton, 2002; Cheng and Farber, 2008), we assume that with incentive instruments grants ($p > 0$), managers will operate the firm as the firm's asset value A follows the following alternative process:

(3) $\dfrac{dA}{A} = \mu_A dt + \sigma_A dW$,

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3 Here $TC = II + NII$, where NII is the expected value of non-incentive instruments.

4 Previous studies generally assume a linear compensation contract for managers and directly search for the optimal PPS (e.g., Jin, 2002). The major difference is that we decompose the PPS p into the weight of incentive instrument grants s and the generosity rate k because of the necessary derivation process in our model.

where μ_A is the expected return rate corresponding to the asset risk level σ_A and the volatility of asset σ_A is defined as

(4) $\sigma_A = \sigma_B e^p$.[5]

A very important assumption implied in Equation (4) is that the motivational effect of the PPS p on managers' risk taking is not linear but exponential. In other words, we can think of σ_B as the minimum asset risk managers are willing to take if no incentive for additional risk taking is provided, and σ_A as the actual or observed volatility of the asset implicitly determined by the base volatility σ_B and the exponent e^p. In addition, σ_A can be thought of as the eventual asset risk managers will take when incentive instruments are incorporated into their compensation contacts. When $p = 0$, managers are only willing to take the minimum level of risk, $\sigma_A = \sigma_B$.[6] When $p > 0$, managers are willing to take on a higher asset risk, and $\sigma_A > \sigma_B$. Defusco, Zorn, and Johnson's (1990) find that the variance of a firm's stock return increases after the approval of stock option plans, supporting our construct.

We subsequently assume that the firm currently has an outstanding discount debt due at time 1 and its par value is D, which implies that the debt's time to maturity is equal to the length of the contracting period, from time 0 to time 1. Following the structural form model, if the firm asset is the underlying asset, the equity value of the firm (E) can be denoted as a European call option formation, and its value at time 1 is

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[5] Here μ_A is the corresponding rate of return of the asset risk level σ_A following the capital asset pricing model (CAPM). This study assumes that the return–risk relation in the market always follows the security market line. The variables σ_A and σ_B represent systematic risks. This study does not consider unsystematic risks. Under the one-price theory, the price of market risk is $\frac{\mu_A - r}{\sigma_A} = \frac{\mu_B - r}{\sigma_B}$, which is in market equilibrium.

[6] If $k = 0$, $\sigma_A = \sigma_B$ too. However, since the zero compensation case is rarely observed and not the focus of this paper, we do not consider this condition. We only consider cases where $0 < k \leq 1$.

(5) $E_1 = Max(A_1 - D,\ 0)$.

Applying the solution from Black and Scholes (1973) and Merton (1974), under a risk-neutral measure, if r is the risk-free rate, σ is the volatility of the asset, and T is the outstanding debt's time to maturity (the length of the compensation contract period as well), the equity value at time 0 can be written as

(6) $E_0 = A_0 N(d_+) - De^{-rT} N(d_-)$,

where $d_+ = \dfrac{\ln(\frac{A_0}{D}) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}$, $d_- = d_+ - \sigma\sqrt{T}$, and $N(\bullet)$ is the cumulative probability distribution function of a standardized normal distribution.

From the shareholders' standpoint, granting incentive instruments bears both an advantage and a disadvantage. The advantage of granting incentive instruments is the motivational effect. Due to its option-like characteristic, the equity value increases with asset volatility. Therefore, the more incentive instruments shareholders promise managers, the higher the asset volatility managers will pursue, and shareholder wealth from equity investment will increase. On the other hand, the disadvantage of granting incentive instruments is the dilution effect. The more incentive instruments shareholders promise managers, the more severe the dilution problem becomes, and shareholder stock wealth decreases accordingly. These two opposing effects of motivation and dilution hence create a trade-off dilemma for shareholders. Shareholders should accordingly optimize managerial compensation contracts to maximize their expected wealth. Following our construct, they are able to achieve their goal by controlling p. Table 1 exhibits the expected benefit–cost effects of granting incentive instruments at time 0 from the shareholders' perspective, with "payoff" being the expected total equity value of the firm and "cost" being the expected compensation value distributed to managers. We also assume that managers' compensation is paid from the equity value; therefore, "benefit" is the remaining portion of equity value shareholders obtain after paying managers' compensation.

According to Table 1, when managers' are fully compensated through non-incentive instruments ($p=0$), they operate the firm so that the firm asset value follows Equation (2) and the expected equity value at time 0 is equal to $\left[E_0^{payoff} \mid p=0\right]$. Since our model is built under the assumptions of risk-neutral measure and no-arbitrage argument, the compensation grant format (whether cash based or stock based) is irrelevant as long as the meaning of *incentive* or *non-incentive* can be exhibited. Under the risk-neutral measure, the grant of non-incentive instruments under the condition $p=0$ is determined as Fe^{-rT} at time 0, where F is the fixed amount distributed to managers at time 1. Following the no-arbitrage argument, we claim that $Fe^{-rT}=k\left[E_0^{cost} \mid p=0\right]$, where Fe^{-rT} is the expected compensation value in a cash-based format and $k\left[E_0^{cost} \mid p=0\right]$ is that in a stock-based format. Here $\left[E_0^{cost} \mid p=0\right]$ represents the expected incremental equity value in an at-the-money European call option format, meaning shareholders expect managers' performance at time 1 to reach at least the current asset level A_0, and k is the generosity rate defined formerly.[7] The strike A_0 set here is greater than D, meaning that managers are supposed to achieve a much better operating performance (at least A_0) than just barely above the firm's survival level (D).[8] Therefore, $F=ke^{rT}\left[E_0^{cost} \mid p=0\right]$,

[7] At time 1, managers obtain $k\left(A_T-A_0\right)$ if $A_T>A_0$, and obtain nothing if $A_T \leq A_0$. Therefore, at time 1, the compensation contract in a stock-based format is $kE_1^{\cos t}=kMax(A_T-A_0,0)$. Applying the Black–Scholes–Merton solution, we obtain $k\left[E_0^{cost} \mid p=0\right]$.

[8] Unless the firm is in a badly financially stressed condition, $A_0>D$. This paper only considers $A_0>D$.

meaning that F is indeed a function of k, A_0, σ_B, r, and T; it should not be an arbitrarily chosen "fixed" fixed amount but, rather, a "variable" fixed amount optimally chosen because shareholders determine this fixed amount F to be paid at time 1, given the firm's financial condition at time 0.[9]

When incentive instruments are granted ($p>0$), managers will operate the firm so that the firm asset value follows Equation (3). The expected equity value at time 0 is thus equal to $\left[E_0^{payoff}\,|p>0\right]$, and managers' compensation is partially paid in incentive instruments (s) and partially in non-incentive instruments ($1-s$). According to similar logic as earlier, the expected compensation value paid in incentive instruments is equal to $sk\left[E_0^{cost}\,|p>0\right]$ and the expected value of compensation paid in non-incentive instruments is equal to $(1-s)Fe^{-rT}$, which is also equal to $(1-s)k\left[E_0^{cost}\,|p=0\right]$. We note that F here is not affected by changes in p, because F is implicitly determined by shareholders as if the condition were $p=0$.[10] The change in p ($p>0$) only affects the portion of compensation paid by incentive instruments, $sk\left[E_0^{cost}\,|p>0\right]$.

According to Table 1, we clearly see that the net payoff effect (motivational effect) is $\left[E_0^{payoff}\,|p>0\right]-\left[E_0^{payoff}\,|p=0\right]$ and the net cost effect (dilution effect) would be $sk\left[E_0^{\cos t}\,|p>0\right]-sFe^{-rT}$. Eventually, the total net benefit (NB) would be

(7) $NB=\{\left[E_0^{payoff}\,|p>0\right]-\left[E_0^{payoff}\,|p=0\right]\}-p\{\left[E_0^{\cos t}\,|p>0\right]-\left[E_0^{\cos t}\,|p=0\right]\}$,

where

$\left[E_0^{payoff}\,|p>0\right]=A_0N(d_1)-De^{-rT}N(d_2)$,

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[9] Here F is called a fixed amount because the amount is unchangeable through the entire contracting period (time 0 to time 1).

[10] Here F is still the same amount obtained with the condition s = 0 and still equal to $ke^{rT}\left[E_0^{cost}\,|p=0\right]$.

$$\left[E_0^{payoff} \,|p = 0\right] = A_0 N(d_3) - De^{-rT} N(d_4) \,,$$

$$\left[E_0^{\cos t} \,|p > 0\right] = A_0 N(d_5) - A_0 e^{-rT} N(d_6) \,,$$

$$\left[E_0^{\cos t} \,|p = 0\right] = A_0 N(d_7) - A_0 e^{-rT} N(d_8) \,,$$

$$d_1 = \frac{\ln(\frac{A_0}{D}) + (r + \frac{(\sigma_B e^p)^2}{2})T}{(\sigma_B e^p)\sqrt{T}} \,,$$

$$d_2 = d_1 - (\sigma_B e^p)\sqrt{T} \,,$$

$$d_3 = \frac{\ln(\frac{A_0}{D}) + (r + \frac{{\sigma_B}^2}{2})T}{\sigma_B \sqrt{T}} \,,$$

$$d_4 = d_3 - \sigma_B \sqrt{T} \,,$$

$$d_5 = \frac{(r + \frac{(\sigma_B e^p)^2}{2})T}{(\sigma_B e^p)\sqrt{T}} \,,$$

$$d_6 = d_5 - (\sigma_B e^p)\sqrt{T} \,,$$

$$d_7 = \frac{(r + \frac{{\sigma_B}^2}{2})T}{\sigma_B \sqrt{T}} \,,$$

$$d_8 = d_7 - \sigma_B \sqrt{T} \,,$$

and $N(\bullet)$ is the cumulative probability distribution function of a standardized normal distribution. Since shareholders are able to control p to maximize their net benefit, the objective function becomes

$$\text{(8)} \quad \begin{array}{ll} & \underset{\{p\}}{Max}[NB] \\ s.t. & 0 \leq p \leq 1 \end{array}$$

In the range $0 \leq p \leq 1$, when other financial factors are given, an optimal choice p^* to achieve the maximum net benefit level is always available to shareholders.

If NB is concave to p in the range $0 \le p \le 1$, the first-order condition $\frac{dNB}{dp^*} = 0$ exists in this range.[11] In this case, if we further investigate the first-order condition, it can be exhibited as

$$\begin{aligned} \frac{dNB}{dp^*} &= A_0\sqrt{T}N'(d_1^*)(\sigma_B e^{p^*}) - \{[A_0N(d_5^*) - A_0e^{-rT}N(d_6^*)] - [A_0N(d_7) - A_0e^{-rT}N(d_8)]\} \\ &\quad -p^*A_0\sqrt{T}N'(d_5^*)(\sigma_B e^{p^*}) \\ &= 0 \ , \end{aligned} \tag{9}$$

where

$$d_1^* = \frac{\ln(\frac{A_0}{D}) + (r + \frac{(\sigma_B e^{p^*})^2}{2})T}{(\sigma_B e^{p^*})\sqrt{T}},$$

$$d_5^* = \frac{(r + \frac{(\sigma_B e^{p^*})^2}{2})T}{(\sigma_B e^{p^*})\sqrt{T}},$$

$$d_6^* = d_5^* - (\sigma_B e^{p^*})\sqrt{T},$$

$$N'(d_1^*) = \frac{1}{\sqrt{2\pi}}e^{-\frac{(d_1^*)^2}{2}},$$

and $N'(d_5^*) = \frac{1}{\sqrt{2\pi}}e^{-\frac{(d_5^*)^2}{2}}$.

Following Equation (9), the first-order condition is decided by three major components: the product of $A_0\sqrt{T}N'(d_1^*)$ (vega of the equity value $\left[E_0^{payoff} | p > 0\right]$) and σ_A^*; a call spread of $\left[E_0^{\cos t} | p > 0\right]$ and $\left[E_0^{\cos t} | p = 0\right]$; and the product of p^*, $A_0\sqrt{T}N'(d_5^*)$ (vega of the expected incremental equity value $\left[E_0^{\cos t} | p > 0\right]$), and σ_A^*.[12] This decomposition proposes that, from the perspective of our structural form construct, vega of the expected

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[11] For some conditions, the relation between NB and p can be monotonic increasing or decreasing in the range $0 \le p \le 1$. In those circumstances, p^* is either 100% or 0%, and $\frac{dNB}{dp^*} = 0$ would not occur in the range $0 \le p \le 1$.

[12] Here $\sigma_A^* = \sigma_B e^{p^*}$.

equity value and that of the expected incremental equity value play important roles in deciding the optimal managerial compensation contract. Since there is no closed-form solution for p^*, we can solve for p^* by using a numerical method and further investigating how the optimal choice of p^* is affected, given a firm's current capital structure.

3.2. Further Discussion

Single-Period Framework

Since this is a single-period model, the time to maturity of outstanding debts, T, is identical to the length of the managerial compensation contracting period, as previously assumed. Figure 1 provides a clearer picture of the distribution of firm assets among debt holders, managers, and shareholders. At time 0, the contracting time, given a firm's leverage level, a well-designed managerial compensation contract is made by shareholders and accepted by managers; in other words, the distribution of the expected firm asset value among debt holders, managers, and shareholders is already decided. At time 1, the maturity time of debt and the realization time of compensation, both repayments to the debt holders and the promised compensation to managers are paid simultaneously. Note that although the due times of debt and managerial compensation are identical, the payment order is not. This model assumes the distribution of firm assets follows the absolute priority rule, where debt obligations are always fulfilled first, and then shareholders and managers share the rest of the assets, or the total equity value.

Risk-Driven Model

Based on previous studies, we assume that greater incentive instrument grants increase managers' willingness to take riskier but positive net present value investment projects and therefore increase the firm's asset risk ($\sigma_A = \sigma_B e^p$). Because of option structure characteristics, taking on higher asset risk positively impacts equity value, which is also a measure of managerial performance.[13] Because of the risk-neutral measure, both the corresponding expected asset return μ_B of the base asset volatility σ_B and the corresponding expected asset return μ_A of the actual asset volatility σ_A, following CAPM, are irrelevant to performance in our model.[14] While previous studies generally assume a direct return–performance relation, in our model performance is indeed asset risk driven. However, the meaning is identical: In the equilibrium CAPM model, taking higher asset risks corresponds to higher expected returns and results in better managerial performance.

Agency Problems between Shareholders, Managers, and Debt Holders

Unlike most related studies, we do not make assumptions about managers' utility functions and use them as constraints when shareholders optimize their decisions. Instead, we assume that shareholders are fully aware of the positive exponential relation between p and managers' willingness to take risk and are able to completely control the level of managerial firm asset risk taking through p.[15] This implies that we recognize the ability of incentive instrument grants to alleviate agency problems between shareholders and managers; hence agency problems between these two parties are trivial in this study.

Moreover, unlike the theoretical models of John and John (1993), which focus on eliminating the agency costs of debt, our study focuses on how to find the optimal

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[13] That is, payoff in Table 1.

[14] The Black–Scholes–Merton characteristic.

[15] Instead of making assumptions on the managers' unobservable utility function, we assume that shareholders are able to observe the relation between incentive instrument grants and managers' risk taking from the market. We confirm the validity of this assumption in the empirical test that follows.

solution for the trade-off between the positive motivational effect and the negative dilution effect from the shareholder perspective. Therefore the agency problem of debt is not an issue, because in our one-period model a firm's leverage is given at time 0 and will not change during the contract period. Our model does not investigate the residual loss of agency problem but focuses more on the distribution problem between the three parties, which is the main reason our results are different from those of most related studies.

4. Numerical Simulation and Hypothesis Development

This section provides numerical examples for our analyses and further develops a testable hypothesis on a firm's capital structure and optimal compensation contract design. We first decide the base case as the following:

A_0	150
D	100
r	0.05
T	1
σ_B	0.6

Figure 2 shows the concave relation between p and NB in the base case: NB first increase as p increases until it reaches a maximum of 4.41, decreasing thereafter. When p is greater than around 71%, greater incentive grants will result in a negative NB, which is a level shareholders would never choose. Therefore, for the base case, our model suggests that, given the firm's current leverage ratio of 66.7% (D/A_0), shareholders should choose an optimal p^* of 38.65% in the compensation contract, because this choice will bring them a maximum net benefit of 4.41. Since shareholders are always able to find an optimal p^* in our framework, we can examine the influence of the firm's current capital structure on determining the optimal p^*.

The relation between capital structure and the optimal PPS is further shown in Figure 3, where each observation point is an optimal case. The finding from Figure 3 suggests that shareholders' optimal choice of p^* should be positively related to their firm's leverage ratio. In other words, all other factors being equal, a firm with a higher leverage ratio should have a higher optimal p^* for its shareholders. The implication here corresponds to the empirical findings of DeFusco, Zorn, and Johnson (1991), which show that an increase in a firm's stock variability can be influenced by an increase in its leverage. Since an increase in leverage results in an increase in p^*, and thus increases the observed asset volatility $\sigma_A = \sigma_B e^p$, our model actually provides a theoretical rationale for the findings of DeFusco, Zorn, and Johnson (1991).[16] According to our model's proposal, we therefore develop the following hypothesis: *All other things being equal, the shareholders of a firm with higher leverage should choose a compensation contract with greater incentive intensity.*

5. Sample and Methodology

5.1. Data

The initial sample starts with all large-, mid-, and small-cap firms from the S&P ExecuComp database over the period 1992–2006, which provides data on roughly 1,500 firms per year from the S&P 500, S&P MidCap 400, and S&P SmallCap 600 indices, as

[16] According to Ito's lemma, a firm's stock variability is positively derived from the firm's asset volatility.

well as detailed compensation information on each company's CEO. Firms in the financial and regulated industries are excluded due to their unique financial structure (SIC 4900–4999 and 6000–6999). Stock returns and accounting variables are drawn from the CRSP and Compustat, respectively. Table 2 presents the distribution of 9,905 firm-year observations by year and highlights that there may be a mild clustering of sample firms over the period 1994–2005. Untabulated results indicate that our sample exhibits some industry concentration, with firms in commodity production and manufacturing accounting for approximately 50% of the sample. Subsequent analyses thus include year and industry fixed effects to capture time variations and industry clustering.

5.2. Dependent Variables

Incentive intensity of new option granted

To assess the relation between financial leverage and CEO new equity incentive intensity (used to measure PPS), we use the *ex ante* measure of PPS using newly granted stock options. Following Yermack (1995) and Core and Guay (1999), we define the PPS of newly granted stock options as the hypothetical dollar change in the value of a CEO's new stock options that would result from a 1% increase in firm equity value. Specifically, this measure of incentive intensity is estimated as the product of the partial derivative of the Black–Scholes option value with respect to a 1% change in stock price and the number of new options granted, scaled by the sum of the CEO salary and bonus:

$$Incentive\ Intensity \approx \left(\frac{\partial(Option\ Value)}{\partial P}\right)\times\left(\frac{P}{100}\right)\times New\ Options\ Granted$$

where ∂ denotes the partial derivative operator; the first term is the option delta, given by the Black–Scholes (1973) model as $e^{-dT}N\left(\frac{\ln(\frac{P}{X})+(r-d+\frac{\sigma_E^2}{2})T}{\sigma_E\sqrt{T}}\right)$, where $N(\bullet)$ is the cumulative probability distribution function of a standardized normal distribution; P is the stock price on the date of the CEO stock option grant; X is the exercise price; r is the risk-free interest rate; d is the expected dividend yield; σ_E is the stock return volatility; and T is the option's time to maturity, all calculated from data drawn from the ExecuComp database.

Option Grant Mix

To make further inferences regarding the effect of firm leverage on the weight of the options component in a CEO's compensation package, we measure the mix of new option awards as the ratio of the value of stock option awards to cash compensation (salary plus bonus). To minimize the effect of outliers, we delete observations that are in the top or bottom 1% of the distributions of the above dependent variables.

5.3. Explanatory Variables

To test our hypotheses, we use two basic definitions of leverage to carry out our regression models. First we use book leverage, defined as book debt to total assets, with book debt defined as book assets minus book equity,[17] and book equity as common equity plus deferred taxes. We drop firm–year observations where the resulting book leverage is above one. Second, we use market leverage, defined as book debt divided by the market value of the firm's assets, which is book assets minus book equity plus

[17] This measure of book debt includes all current liabilities. An alternative measure, where book debt is calculated as long-term debt plus debt in current liabilities, yields qualitatively similar results.

market equity, where market equity is defined as common shares outstanding times price. These two definitions of leverage are mostly consistent with the measures used in the vast literature on capital structure (e.g., Baker and Wurgler, 2002; Fama and French, 2002).

We include several control variables in the regression analysis to account for firm and CEO characteristics that influence compensation. Prior research indicates that firm size is related to the structure of CEO compensation (Murphy, 1985; Core and Guay, 1999). To capture firm size, we use the natural logarithm of the firm's market value. Investment opportunities are included as a control variable, since firms with abundant investment opportunities are likely to rely heavily on incentive compensation (Smith and Watts, 1992). To measure investment opportunities, we employ the market-to-book ratio (M/B), defined as the market value of assets (equity market capitalization plus the book value of other liabilities) divided by the book value of assets. Holmstrom and Milgrom (1987) find that the sensitivity of compensation to performance should fall as risk rises. We control for the effects of firm idiosyncratic risk using the standard deviation of daily stock returns over the 252 trading days preceding the end of the fiscal year in which the grant was made.

We additionally control for liquidity constraints, since firms facing a scarcity of cash may use stock option compensation to preserve liquidity. We measure liquidity constraints in two ways. The first measure is free cash flow, defined as operating cash flow minus capital expenditure and common dividends, divided by total assets. The second measure is the payment of dividends, coded as one if the firm pays cash dividends, and zero otherwise. As CEOs approach retirement, option awards should increase to mitigate the horizon problem and induce older CEOs to take on value-maximizing projects. To measure CEO closeness to retirement, we use CEO age, in years, as is consistent with prior studies (e.g., Bryan, Hwang, and Lilien, 2000). Finally, we control for firm performance using return on assets, defined as earnings before interest, taxes, depreciation, and amortization (EBITDA) divided by total assets. In the following regressions, all explanatory variables are measured at the end of the fiscal year prior to the option grant date, assuming a three-month reporting lag.

5.4. Empirical Methods

Some firms do not pay their CEOs with stock options, and even those firms that do not necessarily grant them every year. Thus, new option grants comprise a non-trivial fraction of zero-valued observations and have a truncated distribution, which suggests the need to estimate a Tobit model. As additional concerns of heteroskedasticity arise from our unbalanced data, we also conduct a pooled regression and apply the Huber–White procedure with clustering by firm, which can control not only for heteroskedasticity but also for arbitrary residual autocorrelation (Petersen, 2009). Finally, we include firm fixed effects to mitigate the omitted variable problem pertaining to unobservable CEO- and firm-specific characteristics, such as CEO opportunity costs, perceived ability, and firm governance mechanisms. The methodology is similar to that of Himmelberg, Hubbard, and Palia (1999) and Bryan, Hwang, and Lilien, (2000).

The following regression is then estimated:

$$\begin{aligned} &Option\ Awards_{i,t} = \beta_0 + \beta_1 (Book\ \ Leverage\ or\ Market\ Leverage)_{i,t-1} \\ &+\beta_2 Firm\ Size_{i,t-1} + \beta_3 M\ /\ B\ ratio_{i,t-1} + \beta_4 Volatility_{i,t-1} + \beta_5 Free\ Cash\ Flows_{i,t-1} \\ &+\beta_6 Dividend_{i,t-1} + \beta_7 CEO\ Age_{i,t-1} + \beta_8 ROA_{i,t-1} + Firm\ Dummies_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{10}$$

where *Incentive Intensity* or *Option Grant Mix*. The expected signs of the coefficients are $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 > 0$, $\beta_4 > 0$, $\beta_5 < 0$, $\beta_6 < 0$, $\beta_7 > 0$, and $\beta_8 < 0$.

5.5. Test for the Nonlinear Relation between PPS and Firm Asset Volatility

Before reporting the results of our tests on the relation between a firm's capital structure and CEO PPS, we empirically test the validation of our assumed exponential model of asset volatility, a key argument underlying our hypothesis.[18] That is, we consider whether asset volatility is related to PPS in a nonlinear way. We regress asset volatility on two proxies for CEO pay-performance sensitivity (e.g., incentive intensity of new options granted and option grant mix) and use the logarithm of asset volatility to account for the nonlinear relation. Unfortunately, asset volatility is not directly observable. We thus use the following two equations from the Black–Scholes–Merton model and Ito's lemma to simultaneously solve for two unknowns, the estimated market value of asset A_0 and the asset volatility σ_A:

$$(11)\quad \begin{cases} E_0 = A_0 N(d_+) - De^{-rT} N(d_-) \\ \sigma_E E_0 = \dfrac{\partial E}{\partial A} \sigma_A A_0 = N(d_+) \sigma_A A_0 \end{cases}$$

where E_0 is the equity value, σ_E is the equity return volatility, D is the firm's total liabilities, r is the risk-free interest rate, T is the time to maturity, $d_+ = \dfrac{\ln(\frac{A_0}{D}) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}$, $d_- = d_+ - \sigma\sqrt{T}$, and $N(\bullet)$ is the cumulative probability distribution function of a standardized normal distribution.

Table 3 shows the results, and the Davidson–MacKinnon (1981) test rejects the linear form in favor of this log-linear model. In the first column of Table 3, the only explanatory variable, besides year, industry, and firm dummies, is the CEO new equity incentive intensity. The coefficient of equity incentive intensity is positive and highly significant. In column 2 of Table 3, we use an option mix of CEO pay as our key

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[18] Equation (4).

explanatory variable and find that the coefficient of the option mix is also positively related to the natural logarithm of asset volatility, thus confirming an exponential relation between asset volatility and PPS. The next section tests our hypothesis.

6. Empirical Results

6.1. Summary Statistics

Table 4 reports summary statistics for the main variables used in the analysis. The mean (median) of the CEO new option incentive intensity and of the option mix is 0.027 (0.016) and 1.555 (0.921), respectively, comparable to figures reported in earlier studies (e.g., Bryan, Hwang, and Lilien, 2000; Yermack, 1995). Book leverage has a mean of 0.239 and the mean market leverage is slightly lower, at 0.168. The standard deviation of stock returns, a measure for firm risk, has an average of 0.026, with a standard deviation of 0.013. Free cash flow scaled by total assets, a proxy for liquidity constraints, averages 0.064. The average CEO age is 56 years, ranging from 29 to 89. Return on assets averages 0.043. The M/B has a mean of 1.786. About 60% of the firm–year observations are coded as dividend payers. The mean market value of total assets is $1.875 billion (exponential of 21.351).

6.2. Comparison with Prior Literature

Agency theory suggests that debt leverage mitigates the shareholder–manager agency problem by inducing lenders to monitor managers, reducing managers' available free cash flow and forcing them to maximize value when facing the threat of bankruptcy (Jensen, 1986; Stulz, 1990). Hence, leverage serves as a substitute monitoring device, which implies that the incentive to align managerial with shareholder objectives is less critical. Consistent with these arguments, Ortiz-Molina (2007) shows that PPS appears to be inversely related to leverage. Our analyses provide new insights into the relation between firm leverage and CEO incentive that are in stark contrast to the abovementioned theoretical and empirical literature.

Before reporting the results of our tests of the relation between leverage and CEO stock option compensation, we replicate the results obtained by Ortiz-Molina (2007) and estimate Equation (12) using ordinary least squares (OLS):

$$\begin{aligned} &Incentive\ Intensity_{i,t} = \beta_0 + \beta_1 (Book\ \ Leverage\ or\ Market\ Leverage)_{i,t-1} \\ &+\beta_2 Firm\ Size_{i,t-1} + \beta_3 Volatility_{i,t-1} + \beta_4 M\ /\ B\ ratio_{i,t-1} + Industry\ Dummies_{i,t} \\ &+Year\ Dummies + \varepsilon_{i,t} \end{aligned} \tag{12}$$

The dependent variable is CEO PPS, measured as the dollar change in value of a CEO's new stock options that would result from a 1% increase in firm value, scaled by cash compensation. Following Ortiz-Molina (2007), we include financial leverage, firm size, stock return volatility, and M/B and also control for industry and year fixed effects. Based on the author's results, we expect β_1 to be negative.

The replication results are reported in columns 1 and 2 of Table 5 and are nearly identical; that is, we find that financial leverage is negatively associated with CEO PPS, confirming the results in Ortiz-Molina (2007). It should be noted, however, that CEO pay structure is complicated by the fact that company histories, attitudes, cultures, and traditions, as well as the complexity of tasks the CEO faces, vary across companies (Chhaochharia and Grinstein, 2009). We thus estimate the CEO PPS model by including firm fixed effects. For example, if a particular firm required unique management skills, the firm-specific intercept in the fixed effect regression would capture the additional equity incentive compensation needed to employ a CEO with such skills.

In other words, the fixed effects model adjusts the CEO compensation contract for unobserved firm characteristics that are time invariant, thus mitigating possible omitted variable problems. In addition, this adjustment helps control for the endogenous nature of the relation between financial leverage and CEO incentive compensation.[19]

We now turn to regressions that introduce firm fixed effects and present our results in columns 3 and 4 in Table 5. We find that the relation between financial leverage and CEO PPS becomes positive, and unreported results show that firm fixed effects are significant at better than the 1% level in the pooled regression, with an *F*-statistic above six. This appears that the correlation with unobservable firm time-invariant heterogeneity leads to a biased coefficient for leverage in the OLS estimates. Therefore, we use a firm fixed effect methodology to test our hypothesis.[20]

6.3. Analysis of the Relation between Leverage and Incentive Intensity

This section uses multiple regression analysis to test the impact of book and market leverage on the PPS using the sensitivity of new options to a 1% change in stock price as the dependent variable. Table 6 reports the regression results. Models 1 and 2 present the maximum likelihood estimates from Tobit analysis, and Models 3 and 4 present the results from the OLS estimation. Models 1 and 3 include book leverage and the control variables. Consistent with our expectation, both the Tobit and OLS estimations suggest that the relation between book leverage and the sensitivity of new options to stock price is positive and significant at the 1% level. Models 2 and 4 report the results of regressing PPS on market leverage and control variables. These results reinforce those for book

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[19] Campa and Kedia (2002) also use the fixed effect model in the context of examining the endogenous nature of the relation between industrial diversification and value discount.

[20] The fixed effect adjustment helps the test approach the condition of "all other things being equal" in our hypothesis.

leverage. With either the Tobit or the OLS estimation, the PPS for firms with higher market leverage is significantly higher than for firms with lower market leverage.

The results for the control variables are similar to those reported in prior research (e.g., Murphy, 1999; Bryan, Hwang, and Lilien, 2000; Bryan, Nash, and Patel, 2006; Ryan and Wiggins, 2001). The CEO new stock option incentive intensity is positively correlated with firm size, investment opportunities, and return volatility, and negatively correlated with firm performance. Firms with relatively low free cash flow and non-dividend-paying firms have significantly higher new stock option incentives, consistent with a higher liquidity pressure on these firms. Also, we find that new stock option awards are negatively related with CEO age.

In summary, the multivariate regression analyses are consistent with our expectation that CEO pay policy sensitivity to firm performance increases with financial leverage, irrespective of the leverage metric or estimation method used.

6.4. Analysis of the Relation between Leverage and Option Mix

Table 7 presents the results from the Tobit and OLS regressions using the mix of CEO stock option awards as the dependent variable. In Models 1 and 3, the explanatory variables include, besides firm dummies, book leverage and control variables that may affect options compensation. The control variables are the same as in the PPS model (see Table 6), and their coefficients are similar to those reported earlier. The results imply that CEOs of firms with greater size, growth opportunities, financial liquidity and risk are granted by higher options-based compensation. When measuring option awards to cash compensation, we also find that firm performance has a negative impact. The coefficient of CEO age is statistically negative, suggesting that firms tend to offer older

CEOs less compensation in the form of stock options. Most importantly, the coefficients of book leverage are both positive and significant in the Tobit and OLS specifications.

When using market leverage instead of book leverage as the capital structure proxy, we find that the relation between market leverage and the stock option awards mix is also positive and significant after including control variables, as shown in Models 2 and 4. The results on control variables are similar to those reported earlier and are thus not addressed. Overall, they suggest that firms rely more on stock option awards as part of the CEO compensation package when their financial leverage is higher than when it is lower, supporting our theoretical prediction.

6.5. Alternative Estimation Methods and Extended Models

6.5.1. Results for Subperiods and Subsamples

To compare our results with the literature and as a robustness check, we run tests for two separate subsamples, one comprised of S&P 500 firms and the other of "non–S&P 500" firms. The four leftmost columns of Table 8 present the results of Tobit regressions using a dependent variable that proxies for CEO new equity incentive intensity. The independent variable is either book leverage or market leverage, and we also include other control variables for firm and CEO characteristics, as described in Section 5.3. The results for the S&P 500 subsample are presented in columns 1 and 3 of Table 8, and those for the non–S&P 500 subsample in columns 2 and 4. The coefficients for book leverage in both subsamples are positive. When using market leverage in place of book leverage, we find that its coefficient is positive, although the effect is statistically insignificant for S&P 500 firms. Overall, the results show that the positive relation between CEO stock option incentive intensity and financial leverage is similar for S&P 500 and non–S&P 500 firms.

The four rightmost columns of Table 8 summarize the results when the dependent variable is the option grant mix. All regressions also include year, industry, and firm dummies as independent variables. Columns 5 and 7 of Table 8 present the results for the S&P 500 subsample, and columns 6 and 8 present those for the non–S&P 500 subsample. We find that book leverage is positively related to the option grant mix in both S&P 500 and non–S&P 500 firms. In addition, the coefficients for market leverage are positive and significant for the firms of both subsamples. These results are consistent with the view that, as expected, financial leverage increases the use of stock options as part of CEO compensation packages, irrespective of whether an S&P 500 or non–S&P 500 firm.

In unreported regressions, we re-estimate cross-sectional analyses on (1) a subsample of 8,990 firm–years that eliminates firm–years with negative free cash flow, to exclude the effect of financial distress, and (2) a sample of 8,992 observations that eliminates firm–years in which firms change their CEOs, to exclude the effect of CEO turnover. All results are robust to subsample regressions. These additional results are available from the authors upon request.

To determine whether the results hold for different sample periods, we redo all regression analyses for two sub-periods, 1992–1999 and 2000–2006, and find similar results regarding book and market leverage for each sub-period. We also run yearly regressions over the sample periods and base our results on the average of yearly coefficients and associated *t*-statistics with Newey–West correction (Fama and MacBeth, 1973; Newey and West, 1987). The results are similar to those reported previously.

6.5.2. Simultaneous Equation Model

Results from the single-equation regressions indicate a positive relation between financial leverage and CEO stock option awards. There are econometric and economic reasons for adopting a simultaneous equations approach, however. First, it is possible that stock option grants and certain explanatory variables are simultaneously influenced by the same omitted variables. Although the fixed effect model used can control for unobserved characteristics as long as the unobservables are relatively time invariant, some of the unobserved determinants are likely to change significantly over time, leading to a correlation between the explanatory variables and the error term in the investment equation. An instrumental variable technique can be used to control for the omitted variable bias. Second, theoretical and empirical evidence indicates that managerial incentives influence a firm's financing policies. For example, Berger, Ofek, and Yermack, (1997) argue that firms with weak managerial incentives tend to avoid debt. Coles, Daniel, and Naveen, (2006) demonstrate that leverage decreases with the sensitivity of CEO compensation to stock prices.

This section introduces a simultaneous equation model of market leverage and two measures of CEO stock option awards (i.e., *Incentive Intensity* and *Option grant mix*), and estimates it with the two-stage least squares (2SLS) technique[21]:

$$\begin{aligned} & \textit{Option Awards}_{i,t} = \beta_0 + \beta_1 \textit{Leverage}_{i,t-1} + \beta_2 \log(\textit{market capitalization})_{i,t-1} \\ (13)\quad & + \beta_3 \textit{M / B ratio}_{i,t-1} + \beta_4 \textit{Volatility}_{i,t-1} + \beta_5 \textit{Free Cash Flow}_{i,t-1} \\ & + \beta_6 \textit{Dividend}_{i,t-1} + \beta_7 \textit{CEO Age}_{i,t-1} + \beta_8 \textit{ROA}_{i,t-1} + \textit{Firm Dummies}_{i,t} + \eta_{i,t} \end{aligned}$$

[21] Our results are similar if we use book leverage instead. For the sake of brevity, the results are not reported here but are available upon request.

$$
(14) \quad \begin{aligned}
&Leverage_{i,t} = \beta_0 + \beta_1 Option\ Awards_{i,t} + \beta_2 \log(market\ capitalization)_{i,t} \\
&+\beta_3 RD\ ratio_{i,t} + \beta_4 SGA\ ratio_{i,t} + \beta_5 Free\ Cash\ Flow_{i,t} \\
&+\beta_6 Dividend_{i,t} + \beta_7 M\ /\ B\ ratio_{i,t} + \beta_8 Tangibility_{i,t} \\
&+\beta_9 ROA_{i,t-1} + Year\ Dummies_{i,t} + Industry\ Dummies_{i,t} + \sigma_{i,t}
\end{aligned}
$$

The independent variables used in the CEO stock option awards model (e.g., Equation (13)) are the same as those in Equation (10). Following prior studies of capital structure (e.g., Berger, Ofek, and Yermack, 1997; Hovakimian, Hovakimian, and Tehranian, 2004; Rajan and Zingales, 1995), the control variables for the leverage Equation (14) are chosen to include R&D ratio, SGA ratio, M/B ratio, tangibility, firm size, free cash flow, dividend-payment dummy, and firm performance. SGA ratio is defined as selling, general, and administrative expenses divided by net sales. Tangibility is calculated as the book value of plant, property, and equipment divided by the book value of total assets, and all other variables are as defined earlier.

Panel A of Table 9 reports the first-stage regression results where the dependent variable is either book leverage or market leverage: Columns 1 and 2 include CEO option incentive intensity along with other control variables affecting firm leverage. Our results show that the coefficient of CEO option incentive intensity in the book leverage equation is significantly positive. Columns 3 and 4 of Table 9 show the option grant mix has a significantly positive impact on firm leverage. As a result, CEOs' compensation schemes with higher equity incentive intensity seem to encourage them to take on more debt.

Panel B of Table 9 reports the estimation results of the 2SLS regression approach, where the two leftmost columns present the results using CEO new equity incentive intensity as the dependent variable. We find that the coefficient of book leverage or market leverage is positive and significant after controlling for potential endogeneity between leverage and incentive intensity, indicating that higher debt leverage leads to a greater intensity of stock options incentives granted to CEOs in subsequent periods. The two rightmost columns report regressions where the dependent variable is the mix of CEO option awards. Book leverage and market leverage are significantly positively related to the next-period option mix granted to a CEO, suggesting that higher-leveraged firms tend to rely more on stock options as a part of next-period CEO compensation packages. These findings support the position that the positive relation between equity incentive instruments and financial leverage is robust to simultaneous equation analysis.

6.5.3. Firm Fixed Effect Regression Using the Dynamic GMM Model

This section addresses the potential endogeneity of CEO stock option awards and capital structure by estimating a dynamic panel GMM model. In particular, such endogenous relations may be dynamic. For example, a firm's current leverage affects future CEO stock option incentive intensity, which will in turn affect the firm's future leverage. To control for such dynamic endogeneity, unobservable heterogeneity, and simultaneity, we re-estimate Equation (10) using the dynamic GMM estimator as proposed by Arellano and Bover (1995) and Blundell and Bond (1998). In untabulated results, we find that the significance of the coefficients of book leverage or market leverage remains unchanged. Detailed empirical results are also available from the authors upon request.

7. Conclusion

Unlike most relevant studies, which focus on alleviating the agency problems, our study aims to solve the trade-off dilemma of the motivational effect versus the dilution effect resulting from incentive instrument grants in managers' compensation contracts.

Under the structural form framework, we build a model to examine the influence of a firm's capital structure on its optimal managerial compensation contract design. Our model proposes that, all other things being equal, shareholders of a firm with a higher leverage level should choose a compensation contract with a higher incentive intensity.

We further use regression analyses to test our model using the fixed effect adjustment. Specifically, we empirically examine the relation between a measure of a firm's capital structure and two alternative measures of a firm's CEO stock compensation: (1) new stock option incentive intensity and (2) the mix of stock option awards. The new stock option incentive intensity captures the dollar change of a CEO's new option grants for a 1% change in firm value, namely, PPS. The mix of stock option awards measures the use of stock options as part of CEO compensation packages. We consider both book leverage and market leverage as proxies for a firm's capital structure. Our empirical results strongly support our predication that firm leverage is positively related to CEO new stock option awards and that the higher a firm's leverage, the higher the intensity of incentives provided by CEO stock option awards and the mix of option awards to cash compensation. This relation is robust to different subsample groups and sub-periods, as well as alternative model specifications and estimation techniques.

With respect to the theoretical issue, our incremental contribution lies in building a compensation contract model without making assumptions on managers' utility functions to develop the relation between CEO stock option compensation and capital structure. The belief behind this model comes from the convex payoff structure of stock options, which implies that granting incentive instruments will exponentially increase managers' risk taking. We empirically show that this belief is indeed the case. Turning next to the empirical work, we also improve on compensation model specification by augmenting it with firm fixed effects to take into account unobservable firm characteristics that are time invariant such as its unobservable complexity of CEO tasks. We argue that this augmented compensation model is more appropriate for evaluating the effects of financial leverage on PPS. Taken together, our results strongly support the model proposition that firms use more incentive instruments for managers when their leverage level is high.

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Table 1: Benefit–Cost Analysis from the Shareholders' Perspective

	$s > 0$	$s = 0$	Net
Payoff	$\left[E_0^{payoff} \mid p > 0\right]$	$\left[E_0^{payoff} \mid p = 0\right]$	$\left[E_0^{payoff} \mid p > 0\right] -$ $\left[E_0^{payoff} \mid p = 0\right]$
Cost	$sk\left[E_0^{cost} \mid p > 0\right] +$ $(1-s)Fe^{-rT} =$ $sk\left[E_0^{cost} \mid p > 0\right] +$ $(1-s)k\left[E_0^{cost} \mid p = 0\right]$	$Fe^{-rT} = k\left[E_0^{cost} \mid p = 0\right]$	$sk\left[E_0^{\cos t} \mid p > 0\right] -$ $sFe^{-rT} =$ $sk\{\left[E_0^{\cos t} \mid p > 0\right] -$ $\left[E_0^{\cos t} \mid p = 0\right]\}$
Benefit	$\left[E_0^{payoff} \mid p > 0\right] -$ $\{sk\left[E_0^{cost} \mid p > 0\right] +$ $(1-s)Fe^{-rT}\} =$ $\left[E_0^{payoff} \mid p > 0\right] -$ $\{sk\left[E_0^{cost} \mid p > 0\right] +$ $(1-s)k\left[E_0^{cost} \mid p = 0\right]\}$	$\left[E_0^{payoff} \mid p = 0\right] - Fe^{-rT}$ $= \left[E_0^{payoff} \mid p = 0\right] -$ $k\left[E_0^{\cos t} \mid p = 0\right]$	$\{\left[E_0^{payoff} \mid p > 0\right] -$ $\left[E_0^{payoff} \mid p = 0\right]\} -$ $p\{\left[E_0^{\cos t} \mid p > 0\right] -$ $\left[E_0^{\cos t} \mid p = 0\right]\}$

where

$$\left[E_0^{payoff} \mid p > 0\right] = A_0 N(d_1) - De^{-rT} N(d_2),$$

$$\left[E_0^{payoff} \mid p = 0\right] = A_0 N(d_3) - De^{-rT} N(d_4),$$

$$\left[E_0^{\cos t} \mid p > 0\right] = A_0 N(d_5) - A_0 e^{-rT} N(d_6),$$

$$\left[E_0^{\cos t} \mid p = 0\right] = A_0 N(d_7) - A_0 e^{-rT} N(d_8),$$

$$d_1 = \frac{\ln(\frac{A_0}{D}) + (r + \frac{(\sigma_B e^p)^2}{2})T}{(\sigma_B e^p)\sqrt{T}},$$

$$d_2 = d_1 - (\sigma_B e^p)\sqrt{T},$$

$$d_3 = \frac{\ln(\frac{A_0}{D}) + (r + \frac{\sigma_B{}^2}{2})T}{\sigma_B \sqrt{T}},$$

$$d_4 = d_3 - \sigma_B \sqrt{T},$$

$$d_5 = \frac{(r + \frac{(\sigma_B e^p)^2}{2})T}{(\sigma_B e^p)\sqrt{T}},$$

$$d_6 = d_5 - (\sigma_B e^p)\sqrt{T},$$

$$d_7 = \frac{(r + \frac{\sigma_B{}^2}{2})T}{\sigma_B\sqrt{T}},$$

$$d_8 = d_7 - \sigma_B\sqrt{T},$$

and $N(\bullet)$ is the cumulative probability distribution function for a standardized normal distribution.

Table 2: Sample Distribution by Year

Year	Number of Firms	Percentage
1992	24	0.24
1993	496	5.01
1994	684	6.91
1995	695	7.02
1996	763	7.70
1997	754	7.61
1998	841	8.49
1999	783	7.91
2000	753	7.60
2001	803	8.11
2002	766	7.73
2003	845	8.53
2004	801	8.09
2005	767	7.74
2006	130	1.31
Total firm–years	9,905	100.00

Table 3: Regression of Asset Volatility on CEO Option Awards

Dependent Variable: Asset Volatility		
Variable	Coefficients (t-Statistics)	Coefficients (t-Statistics)
Option Incentive Intensity	1.196***	
	(4.13)	
Option grant mix		0.029***
		(5.36)
Industry dummies	Included	Included
Year dummies	Included	Included
Firm dummies	Included	Included
Adjusted R^2	0.880	0.880
Observations	9,905	9,905

This table provides estimation results from an ordinary least squares log-linear model of asset volatility for the sample period 1992–2006. The dependent variable is asset volatility, defined as the standard deviation of asset returns estimated from the Merton (1974) model. The independent variables include the incentive intensity of newly granted options and the option grant mix separately, where the former is measured as the change in the value of options newly granted to a CEO for a 1% change in firm equity value scaled by cash compensation, with the sensitivity of an option's value to the stock price calculated using the partial derivative of the Black–Scholes option value with respect to price. Cash compensation is salary plus bonus. The CEO option grant mix is defined as the stock option compensation awarded scaled by cash compensation. Our model includes firm fixed effects to control for many sources of unmeasured heterogeneity between firms, reducing the potential for omitted variables problems, but does not report coefficient values. Here *t*-statistics robust to serial correlation and heteroskedasticity are in parentheses, and ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 4: Descriptive Statistics

Variables	Mean	Std. Dev.	Quartile 1	Median	Quartile 3
Option incentive intensity	0.027	0.033	0.008	0.016	0.033
Option grant mix	1.555	1.778	0.470	0.921	1.896
Book leverage	0.239	0.149	0.126	0.235	0.340
Market leverage	0.168	0.130	0.066	0.144	0.244
Firm size	21.351	1.479	20.305	21.209	22.297
M/B	1.786	0.903	1.169	1.484	2.064
Volatility	0.026	0.013	0.018	0.023	0.031
Free cash flow	0.064	0.081	0.028	0.065	0.105
Dividend	0.601	0.490	0.000	1.000	1.000
CEO age	55.606	6.783	51.000	56.000	60.000
Return on assets	0.043	0.075	0.016	0.044	0.078

This table reports descriptive statistics for variables used in subsequent analyses. The sample consists of 9,905 firm–year observations of all S&P large-, mid-, and small-cap firms from 1992 to 2006. New equity incentive is measured as the change in the value of options newly granted to a CEO for a 1% change in firm equity value scaled by cash compensation, where the sensitivity of an option's value to the stock price is calculated using the partial derivative of the Black–Scholes option value with respect to price. Cash compensation is salary plus bonus. The option grant mix is defined as the stock option compensation awarded scaled by cash compensation. Book leverage is defined as total debt (long-term debt plus debt in current liabilities) divided by the book value of total assets. Market leverage is defined as total debt divided by firm value, where firm value is the book value of assets minus the book value of common equity plus the market value of equity and deferred taxes. Firm size is defined as the natural logarithm of market capitalization. Here M/B is the market-to-book ratio, defined as the market value of assets (equity market capitalization plus the book value of other liabilities) divided by the book value of assets. Volatility is defined as the standard deviation of daily stock returns over the 252 trading days preceding the end of the fiscal year in which the grant was made. Free cash flow is the ratio of operating cash flow less capital expenditure and dividends paid to the firm's book value of assets. Dividend is an indicator variable equal to one if the firm pays cash dividends, and zero otherwise. Here CEO age is in years and return on assets is the ratio of EBITDA to the book value of assets.

Table 5: Relation between CEO Option Incentive Intensity and Leverage, before and after Controlling for Firm Fixed Effects

	Ortiz-Molina Model		Add Firm Fixed Effects	
Variable	Coeff.	t-Stat.	Coeff.	t-Stat.
Book leverage	-0.012***	-5.71	0.009**	2.39
Firm size	0.001***	10.42	0.009***	14.24
Volatility	0.445***	16.75	0.515***	15.69
M/B	0.003***	23.41	0.003***	14.14
Industry dummies	Included		Included	
Year dummies	Included		Included	
Firm dummies	Not Included		Included	
Adjusted R^2	0.489		0.544	
Observations	9,905		9,905	

This table provides estimation results from an OLS model of CEO PPS during the sample period 1992–2006. The dependent variable is measured as the change in the value of options newly granted to a CEO for a 1% change in firm equity value scaled by the sum of salary and bonus, where the sensitivity of an option's value to the stock price is calculated using the partial derivative of the Black–Scholes option value with respect to price. Cash compensation is salary plus bonus. Book leverage is defined as total debt (long-term debt plus debt in current liabilities) divided by the book value of total assets. Firm size is defined as the natural logarithm of market capitalization. Here M/B is the market-to-book ratio, defined as the market value of assets (equity market capitalization plus the book value of other liabilities) divided by the book value of assets. Volatility is defined as the standard deviation of daily stock returns over the 252 trading days preceding the end of the fiscal year in which the grant was made. Coefficient estimates for the industry and year dummies are not reported for brevity. Our model includes firm fixed effects to control for many sources of unmeasured heterogeneity between firms, reducing the potential for omitted variables problems, but does not report coefficient values. Here *t*-statistics robust to serial correlation and heteroskedasticity are in parentheses, and ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 6: Relation between CEO Incentive Intensity and Leverage

Dependent Variable: Option Incentive Intensity				
	Tobit Estimation		OLS Estimation	
Variable	Model 1	Model 2	Model 3	Model 4
Book leverage	0.008***		0.018***	
	(16.70)		(4.73)	
Market leverage		0.006**		0.010**
		(4.82)		(2.02)
Firm size	0.006***	0.006***	0.009***	0.009***
	(743.12)	(723.75)	(14.66)	(14.73)
M/B	0.008***	0.008***	0.009***	0.009***
	(391.23)	(316.69)	(15.39)	(14.82)
Volatility	0.510***	0.490***	0.485***	0.491***
	(335.60)	(305.09)	(14.83)	(14.96)
Free cash flow	0.004	-0.002	-0.030**	-0.031***
	(0.53)	(0.19)	(-4.62)	(-4.69)
Dividend	-0.009***	-0.008***	-0.004***	-0.004***
	(157.17)	(111.18)	(-2.92)	(-3.03)
CEO age	-0.001***	-0.001***	-0.001***	-0.001***
	(55.36)	(53.64)	(-5.59)	(-5.63)
Return on assets	-0.015***	-0.010*	-0.009	-0.012*
	(7.54)	(3.46)	(-1.43)	(-1.90)
Industry dummies	Included	Included	Included	Included
Year dummies	Included	Included	Included	Included
Firm dummies	Included	Included	Included	Included
Adjusted R^2			0.5469	0.5459
Observations	9,905	9,905	9,905	9,905

This table provides estimation results from Tobit and OLS models of CEO PPS during the sample period 1992–2006. The dependent variable is measured as the change in the value of options newly granted to a CEO for a 1% change in a firm equity value scaled by cash compensation, where the sensitivity of an option's value to the stock price is calculated using the partial derivative of the Black–Scholes option value with respect to price. Cash compensation is salary plus bonus. Book leverage is defined as total debt (long-term debt plus debt in current liabilities) divided by the book value of total assets. Market leverage is defined as total debt divided by firm value, where firm value is defined as the book value of assets minus the book value of common equity plus the market value of equity and deferred taxes. The remaining independent variables are as follows. Firm size is defined as the natural logarithm of market capitalization. Here M/B is the market-to-book ratio, defined as the market value of assets (equity market capitalization plus the book value of other liabilities) divided by the book value of assets. Volatility is defined as the standard deviation of daily stock returns over the 252 trading days preceding the end of the fiscal year in which the grant was made. Free cash flow is the ratio of operating cash flow less capital expenditure and dividends paid to the firm's book value of assets. Dividend is an indicator variable equal to one if the firm pays cash dividends, and zero otherwise. Here CEO age is given in years. Return on assets is the ratio of EBITDA to the book value of assets. Coefficient estimates for the industry and year dummies are not reported for brevity. We include firm fixed effects to control for many sources of unmeasured heterogeneity between firms, reducing the potential for omitted variables problems, but do not report coefficient values. For the Tobit model, χ^2 values are given in parentheses below each estimated coefficient. For the OLS model, *t*-statistics robust to serial correlation and heteroskedasticity are in parentheses. Here ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 7: Relation between Option Grant Mix and Leverage

Dependent Variable: Option Grant Mix				
	Tobit Estimation		OLS Estimation	
Variable	Model 1	Model 2	Model 3	Model 4
Book leverage	0.750***		0.758***	
	(17.01)		(3.68)	
Market leverage		1.086***		1.096***
		(21.74)		(4.12)
Firm size	0.421***	0.441***	0.413***	0.433***
	(211.96)	(226.63)	(12.56)	(13.00)
M/B	0.125***	0.150***	0.125***	0.150***
	(18.41)	(24.68)	(3.81)	(4.41)
Volatility	22.718***	22.502***	23.633***	23.425***
	(213.50)	(208.78)	(13.26)	(13.12)
Free cash flow	-1.369***	-1.367***	-1.334***	-1.328***
	(19.54)	(19.49)	(-3.75)	(-3.73)
Dividend	-0.245***	-0.251***	-0.243***	-0.248***
	(13.83)	(14.53)	(-3.24)	(-3.31)
CEO age	-0.017***	-0.018***	-0.017***	-0.017***
	(30.51)	(31.78)	(-4.81)	(-4.91)
Return on assets	-0.844***	-0.816***	-0.885**	-0.859**
	(8.09)	(7.56)	(-2.57)	(-2.49)
Industry dummies	Included	Included	Included	Included
Year dummies	Included	Included	Included	Included
Firm dummies	Included	Included	Included	Included
Adjusted R^2			0.5411	0.5414
Observations	9,905	9,905	9,905	9,905

This table provides estimation results from Tobit and OLS models of CEO option pay during the sample period 1992–2006. The dependent variable is CEO option grant mix, defined as stock option compensation awarded scaled by cash compensation. Cash compensation is salary plus bonus. Book leverage is defined as total debt (long-term debt plus debt in current liabilities) divided by the book value of total assets. Market leverage is defined as total debt divided by firm value, where firm value is defined as the book value of assets minus the book value of common equity plus the market value of equity and deferred taxes. The remaining independent variables are as follows. Firm size is defined as the natural logarithm of market capitalization. Here M/B is the market-to-book ratio, defined as the market value of assets (equity market capitalization plus the book value of other liabilities) divided by the book value of assets. Volatility is defined as the standard deviation of daily stock returns over the 252 trading days preceding the end of the fiscal year in which the grant was made. Free cash flow is the ratio of operating cash flow less capital expenditure and dividends paid to the firm's book value of assets. Dividend is an indicator variable equal to one if the firm pays cash dividends, and zero otherwise. Here CEO age is in years. Return on assets is the ratio of EBITDA to the book value of assets. Coefficient estimates for the industry and year dummies are not reported for brevity. We include firm fixed effects to control for many sources of unmeasured heterogeneity between firms, reducing the potential for omitted variables problems, but do not report coefficient values. For the Tobit model, χ^2 values are given in parentheses below each estimated coefficient. For the OLS model, *t*-statistics robust to serial correlation and heteroskedasticity are in parentheses. Here ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Relation between CEO Option Awards and Leverage across Market Indexes

	Option Incentive Intensity				Option Grant Mix			
Variable	S&P 500 Index	Non–S&P 500 Index	S&P 500 Index	Non–S&P 500 Index	S&P 500 Index	Non–S&P 500 Index	S&P 500 Index	Non–S&P 500 Index
Book leverage	0.030***	0.013***			1.913***	0.344*		
	(15.27)	(13.10)			(21.85)	(2.90)		
Market leverage			0.004	0.010**			1.860***	0.842***
			(0.43)	(4.95)			(10.64)	(10.86)
Firm size	0.008***	0.009***	0.008***	0.009***	0.452***	0.378***	0.474***	0.397***
	(78.88)	(185.73)	(76.91)	(189.08)	(83.95)	(104.77)	(89.44)	(112.72)
M/B	0.011***	0.009***	0.011***	0.009***	0.189***	0.099***	0.222***	0.125***
	(108.22)	(195.54)	(97.57)	(186.08)	(11.04)	(8.42)	(14.08)	(12.47)
Volatility	0.589***	0.438***	0.607***	0.441***	32.719***	19.858***	32.672***	19.602***
	(89.00)	(183.74)	(92.96)	(185.16)	(96.01)	(124.60)	(94.32)	(121.34)
Free cash flow	-0.041***	-0.025***	-0.041***	-0.025***	-2.225***	-0.988***	-2.232***	-0.966***
	(9.20)	(15.79)	(9.43)	(16.10)	(9.71)	(8.12)	(9.74)	(7.77)
Dividend	-0.008***	-0.003*	-0.008***	-0.003*	-0.440***	-0.159**	-0.459***	-0.161**
	(8.90)	(3.32)	(9.97)	(3.56)	(10.03)	(4.46)	(10.89)	(4.65)
CEO age	-0.001	-0.001***	-0.001	-0.001***	-0.011*	-0.019***	-0.012**	-0.020***
	(2.03)	(44.25)	(2.42)	(44.54)	(3.20)	(27.77)	(3.84)	(28.65)
Return on assets	-0.055***	-0.001	-0.065***	-0.002	-1.725**	-0.663**	-2.021**	-0.576**
	(13.23)	(0.02)	(18.85)	(0.12)	(4.63)	(4.17)	(6.38)	(3.16)
Industry dummies	Included	Included	Included	Included	Included	Included	Included	Included
Year dummies	Included	Included	Included	Included	Included	Included	Included	Included
Firm dummies	Included	Included	Included	Included	Included	Included	Included	Included

This table provides Tobit estimation results of CEO option compensation for “S&P 500” and “non-S&P 500” two subsamples during the sample period 1992–2006. The dependent variable is incentive intensity of newly granted options and the option grant mix, where the former is measured as the change in the value of options newly granted to a CEO for a 1% change in firm equity value scaled by cash compensation, with the sensitivity of an option’s value to the stock price calculated using the partial derivative of the Black–Scholes option value with respect to price. Cash compensation is salary plus bonus. The CEO option grant mix is defined as stock option compensation awarded scaled by cash compensation. Book leverage is defined as total debt (long-term debt plus debt in current liabilities) divided by the book value of total assets. Market leverage is defined as total debt divided by firm value, where firm value is defined as the book value of assets minus the book value of common equity plus the market value of equity and deferred taxes. The remaining independent variables are as follows. Firm size is defined as the natural logarithm of market capitalization. Here M/B is the market-to-book ratio, defined as the market value of assets (equity market capitalization plus the book value of other liabilities) divided by the book value of assets. Volatility is defined as the standard deviation of daily stock returns over the 252 trading days preceding the end of the fiscal year in which the grant was made. Free cash flow is the ratio of operating cash flow less capital expenditure and dividends paid to the firm's book value of assets. Dividend is an indicator variable equal to one if the firm pays cash dividends, and zero otherwise. Here CEO age is in years. Return on assets is the ratio of EBITDA to the book value of assets. Coefficient estimates for the industry and year dummies are not reported for brevity. We include firm fixed effects to control for many sources of unmeasured heterogeneity between firms, reducing the potential for omitted variables problems, but do not report coefficient values. The χ^2 values are given in parentheses below each estimated coefficient. Here ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 9: Simultaneous Equations Examining the Relation between CEO Option Awards and Leverage

Panel A. Dependent Variable: Financial Leverage

Variable	Book Leverage Model 1	Market Leverage Model 2	Book Leverage Model 3	Market Leverage Model 4
Incentive intensity	0.153***	-0.038		
	(5.50)	(-1.02)		
Option grant mix			0.004***	0.001**
			(4.83)	(2.20)
Firm size	0.107**	-0.002***	0.003**	-0.002**
	(2.21)	(-2.80)	(2.48)	(-2.10)
RD ratio	0.003***	-0.455***	-0.535***	-0.491***
	(3.03)	(-16.80)	(-15.21)	(-17.60)
SGA ratio	-0.525***	0.001***	0.001***	0.001
	(-14.94)	(2.71)	(2.84)	(1.63)
Volatility	0.141	0.206*	0.063	0.195
	(0.88)	(1.68)	(0.39)	(1.54)
Free cash flow	0.035	-0.034**	0.038*	-0.076***
	(1.56)	(-1.97)	(1.66)	(-4.20)
Dividend	0.023***	0.010***	0.024***	0.011***
	(6.84)	(4.02)	(7.24)	(4.04)
M/B	-0.021***	-0.040***	-0.022***	-0.034***
	(-13.40)	(-33.92)	(-13.86)	(-27.89)
Tangibility	0.097***	0.061***	0.097***	0.044***
	(13.41)	(11.01)	(13.43)	(7.72)
Return on assets	-0.169***	-0.183***	-0.170***	-0.110***
	(-9.06)	(-12.71)	(-9.16)	(-7.44)
Industry dummies	Included	Included	Included	Included
Year dummies	Included	Included	Included	Included
Adjusted R^2	0.1452	0.3140	0.1471	0.2522
Observations	9,905	9,905	9,905	9,905

Panel B. Dependent Variable: Option Awards

	Option Incentive Intensity		Option Grant Mix	
Variable	Model 1	Model 2	Model 3	Model 4
Book leverage	0.232***		20.329***	
	(15.70)		(28.74)	
Market leverage		0.022**		12.100***
		(2.49)		(15.11)
Firm size	0.003***	0.005***	0.323***	0.456***
	(5.11)	(7.78)	(10.43)	(14.24)
M/B	0.007***	0.013***	0.685***	0.663***
	(11.78)	(19.95)	(25.08)	(18.03)
Volatility	0.267***	0.522***	4.220**	11.772***

	(6.66)	(14.17)	(2.15)	(5.57)
Free cash flow	-0.010***	-0.031***	-1.101***	-0.671*
	(-1.37)	(-4.39)	(-3.11)	(-1.82)
Dividend	-0.007***	-0.003*	-0.693***	-0.378***
	(-4.87)	(-1.69)	(-9.07)	(-4.81)
CEO age	-0.004***	-0.001***	-0.019***	-0.020***
	(-5.98)	(-5.81)	(-5.40)	(-5.50)
Return on assets	0.012***	-0.014**	-0.694**	-1.752***
	(1.83)	(-2.08)	(-2.09)	(-3.33)
Industry dummies	Included	Included	Included	Included
Year dummies	Included	Included	Included	Included
Firm dummies	Included	Included	Included	Included
Adjusted R^2	0.5300	0.5410	0.6104	0.5760
Observations	9,905	9,905	9,905	9,905

This table provides two-stage least squares (2SLS) estimation results for the interaction of CEO option compensation and financial leverage during the sample period 1992–2006. Panel A reports the estimates of the first-stage regression of financial leverage. The dependent variables are book leverage and market leverage, respectively. Book leverage is defined as total debt (long-term debt plus debt in current liabilities) divided by the book value of total assets. Market leverage is defined as total debt divided by firm value, where firm value is defined as the book value of assets minus the book value of common equity plus the market value of equity and deferred taxes. Panel B presents the second-stage regression estimates from the 2SLS analysis where we treat the firm's financial leverage as endogenous. The dependent variables are incentive intensity of newly granted options and option grant mix, respectively. The incentive intensity is measured as the change in the value of options newly granted to a CEO for a 1% change in firm equity value scaled by cash compensation, where the sensitivity of an option's value to the stock price is calculated using the partial derivative of the Black–Scholes option value with respect to price. Cash compensation is salary plus bonuses. The CEO option grant mix is defined as stock option compensation awarded scaled by cash compensation. The independent variables are as follows. Firm size is defined as the natural logarithm of market capitalization. The R&D ratio is the ratio of research and development expenditures to net sales. The SGA ratio is defined as selling, general, and administrative expenses divided by net sales. Tangibility is equal to the book value of plant, property, and equipment divided by the book value of total assets. Here M/B is the market-to-book ratio, defined as the market value of assets (equity market capitalization plus the book value of other liabilities) divided by the book value of assets. Volatility is defined as the standard deviation of daily stock returns over the 252 trading days preceding the end of the fiscal year in which the grant was made. Free cash flow is the ratio of operating cash flow less capital expenditure and dividends paid to the firm's book value of assets. Dividend is an indicator variable equal to one if the firm pays cash dividends, and zero otherwise. Here CEO age is in years. Return on assets is the ratio of EBITDA to the book value of assets. Coefficient estimates for the industry and year dummies are not reported for brevity. We include firm fixed effects to control for many sources of unmeasured heterogeneity between firms, reducing the potential for omitted variables problems, but do not report coefficient values. Here *t*-statistics robust to serial correlation and heteroskedasticity are in parentheses, and ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Appendix

Figure 1: Distribution Framework among the Three Parties

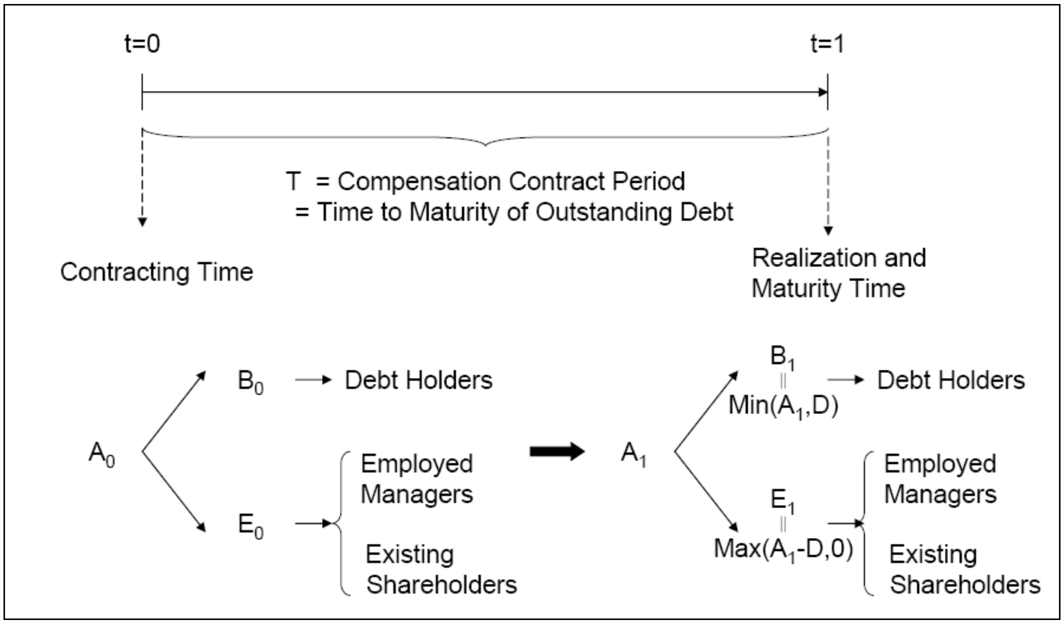

Figure 2: The Base Case Example

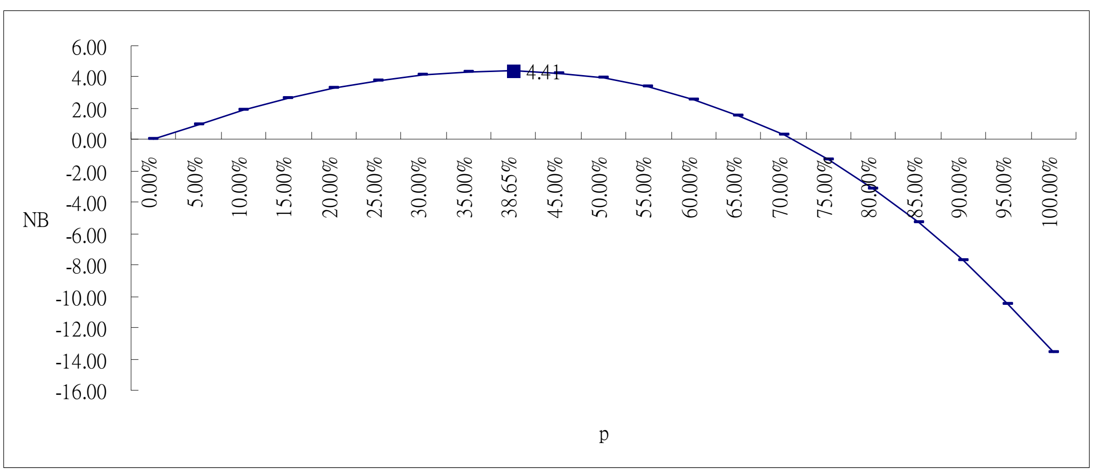

Figure 3: Capital Structure and the Optimal PPS