

The influence of firm- and manager-specific characteristics on the structure of executive compensation

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Abstract

We analyze the influence of firm and managerial characteristics on executive compensation. Consistent with theory, we find monitoring difficulties result in greater use of options while CEO and blockholder ownership result in less. Risky investment is positively related to options and negatively related to cash bonus and restricted stock, suggesting that firms use options to encourage managers to take risks. We find a negative (positive) relation between options and leverage (convertible debt) consistent with minimizing the agency costs of debt. Finally, we provide new evidence on managerial horizon and incentives, documenting a concave relation between cash bonus and CEO age. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

In publicly held firms, sub-optimal investment decisions are possible because the actions of managers are largely unobservable and the objectives of the

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managers and their shareholders are not necessarily aligned. Financial economists (e.g., Jensen and Meckling, 1976; Holmstrom, 1979; Shavell, 1979) argue that tying compensation to the firm's stock price performance better aligns the interests of managers and shareholders, which mitigates these agency problems. Beginning with Jensen and Murphy (1990a,b), many financial researchers have examined the sensitivity of a manager's wealth to changes in stock price and generally agree that pay-for-performance sensitivity (PPS) is essential to effective corporate governance.

Yet, there are circumstances where tying compensation to stock price performance will not produce the desired alignment effect. For example, consider a risk-averse manager with two projects, one safe and one risky. The manager's wealth and human capital are both undiversified. For a diversified shareholder, both projects have a positive net present value and should be accepted. The manager, however, must bear the total risk of his investment choice and thus has the incentive to forego the risky project. Awarding this manager restricted stock ties his pay to stock price performance, but his wealth could decrease depending on the outcome of the project. Stock options, however, limit his downside exposure, which should encourage risky investment.¹

The example above suggests that the type of incentive compensation that is best for one firm may not be best for another. Consistent with this premise, Kole (1997) documents significant variation in compensation contracts and finds that these plans vary systematically according to the type of assets being managed. In this article, we propose that the variation in compensation plans is consistent with efficient contracting by firms with different firm- and manager-specific characteristics. To shed light on these issues, we study the relations between the different types of incentive compensation (cash bonus, restricted stock, and stock options) and attributes of firms and their managers. We specifically analyze the influence of a firm's investment opportunities, monitoring mechanisms, ownership structure, capital structure, and the CEO's age and tenure on the chief executive's incentive compensation structure.

Firms with high growth opportunities derive much of their value from future investments and have a large market capitalization relative to the value of their existing assets. Since these firms derive a large portion of their value from assets not yet in place, controlling agency problems by monitoring managers' activities is difficult. Thus, agency theory predicts that growth firms should mitigate these

¹ There is evidence that managers who receive equity-based compensation bear a substantial wealth penalty due to their inability to diversify their holdings. Meulbroek (2000) estimates that for Internet firms the value of stock options to managers is only 53% of the cost to their firm due to a lack of diversification.

monitoring problems by offering equity-based awards. The extant empirical research generally supports this *investment opportunity hypothesis*.²

We posit, however, that differences in the nature of firms' growth opportunities are also important determinants of incentive compensation structure. Consider two firms, a high growth discount retailer and a small biotechnology company. Both firms have high growth opportunities and derive most of their value from future investments, but the types of investments they make are different. The retail firm primarily invests in real assets (e.g., infrastructure and inventory) and the biotech firm focuses on research and development. Investment in real assets results in observable performance benchmarks (for instance, inventory turnover) that can be monitored. R&D expenditures represent greater investment in human capital which, if successful, will lead to future investment opportunities. Hence, more uncertainty and longer horizons characterize the investment opportunities of research firms, resulting in greater potential for agency conflicts.

One type of agency conflict occurs when the manager's horizon is shorter than the firm's investment horizon. A manager might have a short horizon for several reasons. An older manager might be near retirement while a younger manager might want to build his reputation to enhance his value in the labor market. Both of these managers have the incentives to focus on projects that will pay off in the short-term. Firms should offset these incentives by offering stock-based awards to managers who have incentives to focus on short-term horizons.³ We refer to this prediction as the *managerial horizon hypothesis*.

Another agency conflict results when risk-averse managers bear residual risk. Fama (1980) and Lambert (1986) argue that since managers' human capital is inalienable and difficult to diversify, managers have the incentives to avoid investing in risky projects. This problem will be more severe for firms with riskier investment opportunities. In this case, the optimal incentive contract should limit the risk borne by the manager. We argue that firms with risky investments or volatile operating cash flows will use incentive compensation with non-linear

² See Clinch (1991), Smith and Watts (1992), Gaver and Gaver (1993, 1995), and Baber et al. (1996) for studies that support this hypothesis. Bizjak et al. (1993), however, find conflicting results. Consistent with the premise, they report that the ratio of salary and bonus to total incentives is negatively related to investment opportunity. Failing to support the premise, however, they also find a negative relation between total PPS and growth opportunity. Also contrary to the prediction, Yermack (1995) reports a negative relation between incentives from CEO stock option awards and an investment opportunity proxy.

³ The effect of short-term horizons on investment has been discussed by several researchers including Narayanan (1985a,b), Holmstrom and Ricart i Costa (1986), Dechow and Sloan (1991) and Gibbons and Murphy (1993). See Hirshleifer (1993) for a review of the influence of a manager's reputation concerns on investment choice. The existing empirical evidence is limited. For instance, Gibbons and Murphy (1993) find that the growth rate of R&D intensity slows in a CEO's final years; the magnitude of this metric is greatest as a CEO nears retirement.

payoffs to limit a manager's downside risk. We call this proposed relation the *efficient risk-sharing hypothesis*.

Incentive compensation should also depend on other characteristics that increase the potential for agency conflicts as well as the presence of other incentive alignment mechanisms or external monitors. For instance, if the CEO is also the chairman of the board of directors, the ability of the board to exert control over the decision-making process may be compromised, increasing the potential for agency conflicts. On the other hand, large CEO stock ownership, outside directors, or external monitors such as large blockholders, reduces the need for incentive compensation. Finally, capital structure may affect the mix of compensation since equity-based awards provide managers with the incentive to expropriate wealth from bondholders. Ultimately, these costs will be borne by the shareholders, suggesting that firms should use compensation policy as a pre-commitment device to minimize the agency costs of debt (John and John, 1993).

Analyzing 1095 firms in 1997, we find support for the premise that firm and manager characteristics influence executive compensation. Supporting the investment opportunity hypothesis, we find that the use of stock options is positively related to market-to-book assets, capital expenditure intensity, and R&D intensity. However, R&D intensity exerts a negative influence on the use of restricted stock, consistent with the efficient risk-sharing hypothesis.⁴ Providing additional evidence that a manager's risk aversion influences principal-agent contracting, we document a negative relation between cash bonuses and the volatility of operating cash flows, but a positive relation between stock options and cash flow volatility.

We find mixed evidence regarding the managerial horizon hypothesis. Previous researchers, focusing on horizon problems as CEOs near retirement, examined a proposed linear relation between age and incentive compensation. We argue that the youngest managers have the incentives to focus on short-term outcomes to build their reputations. Consistent with our premise, we document a concave relation between cash bonus and age. This finding suggests that firms pay smaller cash bonuses to both the youngest and the oldest managers. Inconsistent with the managerial horizon hypothesis, however, we find that stock options are negatively related with the CEO's age. We also find that restricted stock, like cash bonus, has a concave relation with CEO age. Thus, it appears that there is room for policy improvements or the need for a better understanding of the influence of CEO horizon on managerial decisions.

Our results also provide evidence regarding the tradeoff between incentive alignment and external monitoring. Consistent with a substitution hypothesis, we find a negative relation between both stock options and restricted stock and the CEO's stock ownership. We also find a negative relation between stock options and blockholder ownership. Contrary to the premise that an independent board

⁴ A recent paper developed independently by Bryan et al. (2000) finds a similar relation.

substitutes for incentive compensation, we find a positive relation between restricted stock grants and the percentage of outsiders on the board of directors.

Finally, we find evidence suggesting that debt agency costs influence the compensation structure and that convertible debt mitigates the equity-debt agency conflict. Consistent with John and John (1993), we document a negative relation between the use of stock options and the debt-to-equity ratio, but a positive relation between options and convertible debt. Others (e.g., Bryan et al., 2000) have documented a negative relation between debt and stocks options, but are silent on any relation between stock options and convertible debt.

The remainder of this article is organized as follows. Section 2 presents our proxies for the determinants of incentive compensation and the predicted relations between these variables and the compensation components. Our sample selection process and the sources of our data are described in Section 3. Section 4 presents our results and Section 5 concludes the article.

2. The determinants of incentive compensation

In this section, we develop expected relations between the structure of incentive compensation and the firm's investment opportunities, the CEO's age and tenure, firm size, monitoring mechanisms, CEO stock ownership, cash flow volatility, capital structure, and CEO/board chair duality. Table 1 presents the definitions of our proxies and the predicted relations with the components of incentive compensation.

2.1. *Investment opportunities*

Firms with high growth opportunities derive a larger portion of their value from future investments than from existing assets. Managers of high growth firms are more difficult to monitor since efficient management of existing assets is less important than future investment decisions. The outcomes of these future decisions and perhaps even the decisions that will need to be made are uncertain. Thus, high growth firms should use equity-based awards to encourage managers to maximize shareholder wealth. We use the market-to-book value of assets, defined as the market value of equity plus the book value of debt divided by the book value of assets, as a proxy for growth opportunities.⁵ The investment opportunity hypothesis predicts that this ratio should be positively related to equity-based compensation and negatively related to cash bonus.

⁵ Proxies for investment opportunity include market-to-book assets (Smith and Watts, 1992; Bizjak et al., 1993), market-to-book equity (Lewellen et al., 1987), and a factor-adjusted measure comprised of market-to-book equity, market-to-book assets, R&D intensity, and total firm return (Gaver and Gaver, 1993, 1995).

Table 1
Variable definitions, what they proxy, and their predicted relations

Variables	Definition	Predicted relation		
		Bonus	Stock options	Restricted stock
<i>Investment opportunity</i>				
Capital expenditure intensity	Capital expenditures ÷ by book value of total assets	Negative	Positive	Negative
R&D intensity	Research and development expenses ÷ by book value of total assets	Negative	Positive	Negative
Market-to-book assets	Market value of equity + book value of debt ÷ by book value of assets	Negative	Positive	Positive
<i>Managerial horizon</i>				
CEO tenure	Number of years as the CEO as of the end of FY 1997	Uncertain	Uncertain	Uncertain
CEO age	Age of the CEO as of the end of FY 1997	Concave	Convex	Convex
<i>Firm size</i>				
Total assets	Book value of total assets	Uncertain	Uncertain	Uncertain
<i>Monitoring</i>				
Board composition	Percentage of outsiders on the board of directors	Negative	Negative	Negative
Block ownership	Percentage of shareholders owning at least 5% of the equity	Uncertain	Uncertain	Uncertain
Institutional investors	Percentage of outstanding equity owned by institutional investors	Negative	Negative	Negative
<i>Incentive alignment</i>				
CEO ownership	Percentage of outstanding equity owned by the CEO	Negative	Negative	Negative
Founder/founding family	Equals 1 if CEO is the founder or a member of the founding family	Negative	Negative	Negative
<i>Efficient risk sharing</i>				
Volatility of cash flows	Coefficient of variation on the firm's operating cash flows	Negative	Positive	Negative
<i>Agency cost of debt</i>				
Long term debt ratio	Book value of long-term debt ÷ by market value of equity	None	Negative	Negative
Convertible debt ratio	Book value of convertible debt ÷ by market value of equity	None	Positive	Positive
<i>Shareholder – manager agency costs</i>				
Duality	Equals 1 if CEO is also the chair	Uncertain	Uncertain	Uncertain

Predicted relation can be negative, positive, concave, convex, uncertain, or none. Concave or convex are indicative of a curvilinear relation. An *uncertain* expectation indicates that there are theoretical arguments for both a negative and a positive relation. When theory does not provide any insight in terms of a relational direction we indicate *none* expected.

Previous researchers have noted that R&D is riskier than capital expenditures (Bhagat and Welch, 1995), harder to value due to its long horizon (Bange and DeBondt, 1998), and more uncertain (Pisano, 1989). We posit that investment horizon and uncertainty create agency conflicts that influence the compensation structure. To capture these effects, we construct measures of R&D intensity (R&D expense divided by total assets) and capital expenditure intensity (capital expenditures divided by total assets). We predict both R&D and capital expenditures will be positively related to stock options since options tie pay to stock price but limit downside risk, and negatively related to cash bonus. Since managers have the incentives to underinvest when they bear residual risk, we expect negative relations with restricted stock. These relations should be stronger for R&D due to its longer horizon and greater uncertainty.

2.2. CEO age and tenure

We use the CEO's age to proxy for the 'CEO horizon problem.' We propose that horizon conflicts are more likely for the oldest and the youngest CEOs. Older CEOs have the incentives to choose projects that pay off before retirement (Gibbons and Murphy, 1993; Dechow and Sloan, 1991), and younger CEOs have the incentives to focus on short-term goals to build their reputations (Hirshleifer, 1993). Kole (1997) suggests that firms use their compensation plans to mitigate myopic behavior. Thus, we argue that firms should offer more equity-based incentives and less cash bonus to the youngest and the oldest managers. This logic suggests a convex relation between equity-based pay and CEO age but a concave relation between cash bonus and CEO age. Prior researchers (e.g., Yermack, 1995 or Bryan et al., 2000) have focused only on retirement-related horizon conflicts and, counter to expectations, find a negative or no relation.

We also control for the CEO's tenure, defined as the number of years he has been CEO. CEOs with long tenures are more likely to be entrenched and thus capable of pursuing personal agendas. On the other hand, a CEO may owe his tenure to the fact that he creates shareholder value or he may have large stock ownership from previous grants. We include CEO tenure as a control variable, but do not predict any specific relation with incentive compensation structure.

2.3. Firm size

We include the natural logarithm of a firm's total assets to control for size. As a firm gets larger, managers have more assets at their disposal, operations become more complex and the possibility of agency conflicts increases. Alternatively, large firms receive more publicity and coverage by analysts, which reduces asymmetric information. The increased possibility of agency conflicts suggests the need for more incentive alignment, but the reduction in asymmetric information suggests that large firms should be easier to monitor. Thus, theory does not

provide a clear prediction regarding the relation between firm size and incentive compensation structure.

2.4. Monitoring mechanisms

Effective monitoring reduces the need for incentive alignment. We use three proxies for external monitoring—the total percentage ownership by 5% blockholders (excluding the CEO), the percentage of institutional ownership, and the fraction of outsiders on the board of directors. If monitoring reduces the need for incentive alignment, we expect all types of incentive compensation to be negatively related to our monitoring proxies. Alternatively, Mehran (1995) argues that outsider (insider) dominated boards are aligned with shareholders (CEOs) and structure compensation contracts to include more (less) equity-based awards.

Previous evidence on external monitoring and compensation is mixed. Mehran (1995) finds a negative relation between equity-based awards and blockholder ownership consistent with a monitoring hypothesis, and a positive relation between outside directors and stock-based pay consistent with his board alignment premise. Krole (1997), however, finds little relation between board composition and the structure of compensation contracts. Though researchers find institutional investors influence policy decisions such as poison pill adoption (Smith, 1996), there is scant evidence on the relation between institutional ownership and compensation policy.

2.5. CEO stock ownership and founding family membership

As a CEO owns more stock, his interests become more aligned with shareholders and there is less need for incentive compensation. We use the percentage of a firm's shares held by the chief executive to measure CEO stock ownership, and expect a negative relation with all forms of incentive compensation. We also expect that managers who are members of the founding family own more equity due to their familial attachments and are subject to scrutiny by other family members. Thus, like stock ownership, membership in the founding family should be negatively related to all forms of incentive compensation.

2.6. Operating cash flow volatility

As a firm's cash flows become more volatile, it becomes harder to monitor management, increasing the need for incentive alignment (Demsetz and Lehn, 1985). A manager, however, has the incentive to avoid risky projects if he is subject to downside risk. Thus, we posit that stock options, which provide managers with incentives but limit downside risk, will be positively related to cash flow volatility and that restricted stock, which expose managers to downside risk, will be negatively related. Additionally, efficient contracting suggests that pay sensitivity should be negatively related to the volatility of performance measures

(Holmstrom and Milgrom, 1987) since a noisy metric increases measurement error. Hence, we expect a negative relation between cash bonus, which depends on short-term accounting measures, and cash flow volatility.

To measure the cash flow volatility, we collect operating cash flow (earnings before interest, taxes, and depreciation and amortization) for 1978–1997 and estimate a 19-period time series model. We then calculate the coefficient of variation of the model's residuals to isolate cash flow uncertainty from variation associated with predictable growth or decline over time.

2.7. Capital structure

When managers are compensated with stock options, the non-linear payoff provides the incentives to choose risky projects, benefiting shareholders at the expense of bondholders. In support of this argument, DeFusco et al. (1990) document increased stock return variance following the adoption of stock option compensation plans and a significant positive (negative) stock market (bond market) reaction to the announcement of the plan. Ultimately, shareholders will bear the debt agency cost in the form of higher interest rates and/or restrictive covenants. Recognizing this relationship, John and John (1993) propose that compensation contracts pre-commit shareholders (and managers) to value maximizing investment choices. Specifically, they predict that the use of equity-based compensation should be negatively related to the firm's leverage ratio, but positively related to the use of convertible debt.

To proxy for the extent of equity-debt agency conflicts, we use the firm's leverage ratio (the book value of long-term debt divided by the market value of equity) and a convertible debt ratio (the book value of convertible debt divided by the market value of equity). Following John and John (1993), we expect a negative relation between stock-based incentives, and particularly stock options, and the leverage ratio, but a positive relation with the convertible debt ratio.

2.8. Duality

When the CEO chairs the board of directors, he has the responsibility for both making decisions and monitoring those decisions. Thus, the ability of the board to objectively monitor the CEO's activities may be impaired and the potential for agency conflicts increased, resulting in greater need for incentive compensation. In contrast, Vancil (1987) contends that CEO/Chair duality is a natural consequence of "passing the baton" following an initial probationary period. If CEO/Chair duality represents "passing the baton," dual CEO/Chairs would own more stock than other CEOs since their past performance would have resulted in more performance grants, reducing the need for additional incentive compensation.

In support of the "passing of the baton" hypothesis, Brickley et al. (1997) find that dual CEOs hold substantially more stock than CEOs who are not board chairs. In contrast, Pi and Timme (1993) find a weak negative relation between ownership and dual management structure for commercial banks. While Brickley et al. find

that dual CEOs receive more total compensation, there is little evidence on their incentive compensation structures. To explore this relation, we use a dummy variable to control for CEO/Chair duality in our tests.

3. Sample selection and data

3.1. Sample construction

We obtain compensation data for 1997 from the ExecuComp database, which provides information on firms in the S&P 500, the Midcap 400, and the Smallcap 600. Our data includes the dollar values of salary, bonus, restricted stock, stock options (including stock appreciation rights), and other compensation. Options are valued using the modified Black–Scholes formula.⁶

Information on board composition, CEO stock ownership, blockholder ownership (5% or more of outstanding shares), and institutional ownership is collected from the *Disclosure* database. *Disclosure* gathers board, CEO, and blockholder stock ownership from proxy statements, and institutional stock ownership from SEC 13-f filings.⁷ The CEO's age, tenure, and membership in the founding family are obtained from the ExecuComp database when available, and from proxy statements or news articles on the Academic Universe databases when not. Financial and accounting data are from the *Compustat* database.

To be included in the sample, compensation data must be available from *ExecuComp*, ownership and board data must be available from *Disclosure*, financial data must be available from *Compustat*, and proxy statements must be available for fiscal year 1997. Regulated utilities, financials and firms with negative equity are deleted.⁸ The final sample consists of 1095 firms.

⁶ ExecuComp provides option values based on the modified Black–Scholes formula and the following assumptions. The relevant market price per share is the closing price the day of the grant. The strike price is the price disclosed by the company in their proxy statement or the market price if the strike price is not disclosed. The term of the grant is calculated as the time between July 1st of the grant year and the expiration date reported in the company proxy, rounded to the nearest year. The expected dividend yield is estimated as the previous period's dividend yield. The risk-free rate is equal to 6.29% for the 1997 grants and is the approximate average yield in 1997 from investing in a zero-coupon U.S. Treasury bond with 8 years to maturity. The estimated stock price volatility is the standard deviation of month-end closing market prices (adjusted for dividends) for 37 months before December 31, 1997.

⁷ We define inside board members as members who are also officers of the firm. Our definition does not account for 'gray' board members who are not officers but may have other beneficial dealings with the firm.

⁸ Negative equity is an indication of financial distress. Firms in financial distress have different motivations than non-distressed firms and place a larger weight on the incentives of debtholders when structuring compensation. See Gilson and Vetsuypens (1993) for an analysis of the compensation policies of financially distressed firms.

3.2. Sample characteristics

Table 2 presents descriptive statistics on compensation structures and the characteristics of CEOs in our sample. Compensation components are presented as dollar values in Panel A and as a percent of total compensation in Panel B. Panel C contains CEO characteristics.

Total compensation for our sample averages US\$3.6 million, and ranges from US\$3230 to US\$106.4 million. The mean (median) value of base salary is US\$575,551 (US\$520,288). Cash bonus averages US\$582,102. CEOs in our sample receive an average of US\$1.9 million dollars in stock options and

Table 2

Descriptive statistics of the structure of CEO incentive compensation, CEO tenure and age, membership in the firm's founding family, and position as chairman of the board of directors for 1095 firms in 1997

	Mean	Median	Maximum	Minimum	Standard deviation
<i>Panel A: Dollar value of the components of CEO compensation</i>					
Base salary	US\$575,551	US\$520,288	US\$6,648,652	US\$0	US\$326,174
Cash bonus	US\$582,102	US\$350,000	US\$17,031,250	US\$0	US\$1,010,610
Stock options	US\$1,910,990	US\$527,368	US\$82,616,370	US\$0	US\$5,380,172
Restricted stock	US\$222,398	US\$0	US\$12,918,750	US\$0	US\$1,014,869
Other compensation	US\$335,735	US\$41,112	US\$96,422,870	US\$0	US\$3,013,750
Total compensation	US\$3,626,776	US\$1,908,758	US\$106,404,800	US\$3230	US\$6,927,939
<i>Panel B: Components of CEO compensation as a percentage of total compensation</i>					
Base salary	34.40%	27.97%	100%	0%	24.09%
Cash bonus	20.51%	18.13%	92.92%	0%	17.23%
Stock options	33.64%	29.76%	100%	0%	29.04%
Restricted stock	3.92%	0%	93.32%	0%	11.30%
Other compensation	7.54%	2.27%	99.97%	0%	12.96%
<i>Panel C: CEO age, tenure, and position characteristics</i>					
CEO age	56.99	57	91	34	7.81
Tenure as CEO	9.39	7	59	0	8.65
Serves as both CEO and chairman of the board of directors	43.56%				
Founder or member of the founding family	18.17%				

Compensation is classified as base salary, cash bonus, restricted stock, stock options (including stock appreciation rights), and other compensation. Other compensation cannot be classified as one of the other categories and includes payouts from long-term incentive plans, annual compensation not paid through salary and bonus, and certain 'one time' or special transactions between firms and their CEOs. Total compensation equals sum of these components. The age and the tenure of the CEO are as of the end of FY 1997.

US\$222,398 in restricted stock grants. Maximum equity-based grants for 1997 are US\$8.3 in options and US\$12.9 million in restricted stock. Other compensation averages just over US\$335,000.⁹ The minimum for each compensation component is US\$0. Salary is the largest source of pay on a percentage basis averaging approximately 34%, followed by options (33.6%) and cash bonus (20.5%). Restricted stock and other compensation average 3.92% and 7.54%, respectively. The large percentage of stock options in the compensation mix relative to the level of restricted stock is consistent with firms' using non-linear payoffs to limit managers' downside risk.

The CEOs in the sample average 57 years of age. Nathaniel Siles of Standard Motors Products is the oldest at 91, while Michael Dell, the founder of Dell Computers, is the youngest at 34. Tenure as CEO ranges from less than 1 year to a maximum of 59 years. The average tenure is slightly over 9 years. Almost 40% of our sample serve as both CEO and Chair of the Board of Directors, and 18% are either the founder or a member of the firm's founding family.

Descriptive statistics of the firms in our sample are shown in Table 3. These firms average US\$4.1 billion in assets with a median asset size of US\$0.9 billion. Firm assets range from just over US\$6 million to US\$304.0 billion. Capital expenditures average 7.83% of total assets while R&D spending averages 3.70% of total assets.¹⁰ Market-to-book value of assets average 1.97 and range from just over 45.0 to a low of 0.30. These firms have mean debt-to-equity ratios of 26%, with convertible debt ratios averaging 2%. Outside board membership is about 70% on average, and ranges from no outside members to 100% outside dominated. Mean institutional ownership is 56% and average blockholder ownership is 34%. The CEOs have ownership positions ranging from no ownership to almost 58% of outstanding shares, averaging 2.02%.

⁹ Other compensation cannot be classified as one of the other categories and includes payouts from long-term incentive plans, annual compensation not paid through salary and bonus, and certain 'one time' or special transactions between firms and their CEOs. For example, the maximum amount of US\$96,422,870 includes US\$95 million for restructuring the employment contract of Occidental Petroleum's CEO. Other examples include US\$43,425 to cover club memberships and a car allowance (Nordson), US\$6.7 million for severance and termination payments (Apple Computer), and US\$4.0 million as a merger implementation bonus (Bell Atlantic). Other compensation is negligible when 'one-time' transactions are excluded.

¹⁰ R&D is *Compustat* item A46 and represents all costs related to the development of new products or services including software expenses and amortization of software costs. Capital expenditures are *Compustat* item A128 and represent investment in property, plant, and equipment including expenditures for capital leases and increases in construction funds. Missing R&D data from *Compustat* is set to zero as in Bizjak et al. (1993). Omitting firms that do not report R&D expense from the sample results in a sample size of 730 with an average R&D expenditure of 5.5% of assets. We conducted all of our tests on this smaller sample and obtained similar results to those reported. Therefore, we only present the results for the full sample in the tables.

Table 3

Descriptive statistics of firm characteristics proposed to explain the structure of executive compensation

	Mean	Median	Maximum	Minimum	Standard deviation
Capital expenditures/assets	7.83%	6.09%	45.10%	0%	6.50%
R&D/assets	3.70%	0.02%	101.46%	0%	8.30%
Market-to-Book assets	1.97	1.47	45.17	0.30	2.00
Total assets (000)	US\$4,089,965	US\$911,596	US\$304,012,000	US\$6755	US\$16,024,050
% Outside board members	70.83%	75.00%	100%	0%	20.46%
% Institutional ownership	56.28%	58.95%	99.99%	0%	21.43%
% Blockholder ownership	33.79%	29.73%	99.99%	0%	23.28%
% CEO stock ownership	2.02%	0.19%	57.43%	0%	5.34%
Cash flow volatility	0.3702	0.1484	23.78	0.01	1.44
Debt-to-equity ratio	0.26	0.12	5.65	0	0.45
Convertible debt ratio	0.02	0	1.05	0	0.07

Capital expenditures/assets, R&D/assets, and market-to-book assets (market value of equity + book value of debt ÷ book value of assets) measure investment opportunity, and log (total assets) represents firm size. The % outside board members (the percentage of non-affiliated members), the % blockholder ownership (total fraction of shares held by 5% owners) and the % institutional ownership measure firm monitoring, and the % CEO stock ownership measures incentive alignment. Cash flow volatility is the coefficient of variation trend-adjusted operating cash flows. The debt-to-equity (convertible debt) ratio is the book value of long-term debt (convertible debt) over the market value of equity.

To examine our premise that R&D investment is more risky than capital expenditures, we divide the sample into firms with R&D (capital expenditure) intensity above and below the sample median and compare the firms' monthly betas, standard deviation of returns, and cash flow volatility measures.¹¹ In results not reported in the table, we find that the average beta for high R&D firms is 1.12 vs. 0.94 for low R&D firms ($T = 5.60$) and that the average standard deviation of returns is 0.11 vs. 0.10 ($T = 2.98$). High R&D firms have a cash flow volatility measure of 0.50 vs. 0.24 for low R&D firms ($T = 3.00$). For high and low capital expenditure firms, the average beta (1.04 vs. 1.01) and standard deviation of returns (0.10 vs. 0.10) are not statistically different ($T = 0.84$ and $T = 0.69$). Furthermore, cash flow volatility is lower for high capital expenditure firms than for low capital expenditure firms (0.26 vs. 0.48, $T = 2.48$). For the entire sample, R&D is positively correlated with beta, the standard deviation of returns, and cash flow volatility (0.30, 0.44, and 0.11, respectively, all significant at the 1% level) while capital expenditure intensity is not significantly correlated with any of the uncertainty measures. These results are consistent with our premise that R&D

¹¹ Beta and standard deviation are calculated using 60 months of returns and the CRSP value-weighted index.

investment exposes managers to greater risk and suggests that compensation structure may systematically vary along these dimensions.

4. Empirical results

To test our hypotheses, we estimate regressions of the components of incentive compensation as functions of our proxies for investment opportunity, monitoring substitutes, ownership structure, capital structure, CEO age, CEO tenure, and CEO/Chair duality. We divide incentive compensation into cash bonus, stock options, or restricted stock and express each as a percentage of total compensation.¹² Since our dependent variables are truncated at 0% (and at 100% for options), we estimate our regressions using a Tobit specification for truncated data with a correction for heteroscedasticity.¹³

4.1. Firm- and manager-specific determinants of incentive compensation

The results of our regression analysis are presented in Table 4. We include two regressions for each incentive component, one that examines compensation as a linear function of age and another that tests for a curvilinear relation.¹⁴

Consistent with the investment opportunity hypothesis, we find a negative relation, significant at the 10% level, between cash bonus and R&D intensity.

¹² As noted previously, other compensation is difficult to classify as incentive pay, salary or benefits and is heavily influenced by one-time events. For completeness, however, we estimated our regressions with other compensation as the dependent variable and found a positive relation with age, the percentage of outside board members, CEO stock ownership, and a negative relation with tenure. It appears that other compensation is used to accommodate special situations involving older executives or dual CEO/Chairs when the potential for entrenchment is low (less tenure) and there are other significant alignment and monitoring mechanisms (CEO stock ownership and more outside board members).

¹³ Log (1 + R&D) and log (1 + cash flow volatility) are used to control for skewed distributions and improve the fit. Following Greene (1990, p.733) we correct for heteroscedasticity by modeling the residuals as a function of the independent variables in our model, $\sigma_i = \sigma_e^{\alpha' w_i}$ where w_i is the vector of independent variables and α_i is the vector of model parameters for heteroscedasticity. We then estimate a parsimonious model using only those variables that were significant predictors of the error terms and compare all three models using likelihood ratio tests. For restricted stock, the tests fail to reject the null hypothesis of spherical disturbance terms, but reject the homoscedastic model in favor of the parsimonious models for both bonus and stock options at the 1% level. For bonus w_i = (R&D, CEO Tenure, % Outside Board members, % Block Ownership, Cash Flow Variability). For stock options w_i = (Capital Expenditures, Market-to-Book Assets, % Outside Board Members, % CEO Stock Ownership).

¹⁴ To check for the robustness of our specification we estimated the univariate correlations among our independent variables and between each dependent and independent variable. All univariate relations between dependent and independent variables are the same sign as estimated in the Tobit regressions. We also conducted a stepwise procedure in which we systematically dropped correlated dependent variables (e.g., R&D and market-to-book assets) from the regressions. Results were essentially the same as those reported.

Table 4
Tobit regressions of CEO compensation structure for 1095 firms in 1997

	% Cash bonus		% Stock options		% Restricted stock	
Intercept	0.0975 (1.41)	−0.4201* (−1.73)	0.2513*** (2.06)	0.4359 (1.17)	−0.7723*** (−3.64)	−2.2221*** (−2.67)
Capital expenditures/assets	−0.1416 (−1.44)	−0.1359 (−1.40)	0.3628*** (2.42)	0.3168*** (2.12)	−0.3635 (−1.22)	−0.3461 (−1.16)
Log (1 + R&D/assets)	−0.1350* (−1.65)	−0.1356* (−1.70)	1.0027*** (5.62)	0.9924*** (5.40)	−1.1193*** (−2.64)	−1.1860*** (−2.62)
Market-to-book assets	−0.0003 (−0.09)	−0.0001 (−0.03)	0.0233*** (2.49)	0.0221*** (2.34)	0.0043 (0.31)	0.0038 (0.27)
CEO tenure	0.0003 (0.33)	0.0007 (0.71)	−0.0026* (−1.73)	−0.0028* (−1.91)	−0.0031 (−1.09)	−0.0020 (−0.69)
CEO age	0.0010 (1.04)	0.0198*** (2.32)	−0.0068*** (−4.19)	−0.0144 (−1.13)	0.0013 (0.44)	0.0531* (1.85)
CEO age ²		−0.0002*** (−2.24)		0.0006 (0.60)		−0.0005* (−1.82)
Log (total assets)	0.0081* (1.72)	0.0074 (1.58)	0.0475*** (5.91)	0.0500*** (6.19)	0.0477*** (3.44)	0.0457*** (3.30)
% Outside board members	0.0018 (0.04)	−0.0023 (−0.06)	−0.0006 (−0.01)	0.0261 (0.37)	0.1618* (1.66)	0.1444 (1.49)
% Institutional ownership	0.0333 (1.17)	0.0305 (1.06)	0.0796 (1.56)	0.0764 (1.28)	−0.05705 (−0.67)	−0.0612 (−0.72)
% Block ownership	0.0157 (0.57)	0.0176 (0.64)	−0.0856* (−1.84)	−0.0820* (−1.74)	0.0746 (0.95)	0.0810 (1.04)
% CEO stock ownership	−0.0504 (−0.38)	−0.0494 (−0.38)	−1.4449*** (−3.47)	−0.7130*** (−3.53)	−1.3559*** (−2.04)	−1.3918*** (−2.10)
Founding family (0/1)	−0.0178 (−0.99)	−0.01312 (−0.73)	0.0305 (0.99)	0.0270 (0.91)	−0.1420*** (−2.28)	−0.1303*** (−2.09)
Log (1 + cash flow volatility)	−0.1308*** (−3.62)	−0.1285*** (−3.53)	0.1104*** (2.61)	0.1121*** (2.59)	−0.0850 (−1.02)	−0.0744 (−0.89)
Leverage ratio	0.0091 (0.60)	0.0093 (0.62)	−0.0441* (−1.76)	−0.0466* (−1.85)	−0.0050 (−0.12)	−0.0037 (−0.09)
Convertible debt ratio	−0.2065*** (−2.06)	−0.2058* (−1.94)	0.4849*** (2.83)	0.4609*** (2.84)	−0.1367 (−0.56)	−0.1341 (−0.55)
Dual CEO/board chair (0/1)	−0.0035 (−0.27)	−0.0010 (−0.08)	−0.0364 (−1.63)	−0.0348 (−1.55)	0.4419 (1.19)	0.0478 (1.29)
Model χ^2	61.06***	121.03***	203.82***	189.64***	83.86***	87.55***

Compensation is classified as cash bonus, restricted stock or stock options (and stock appreciation rights) as a fraction of total pay. Capital expenditures/assets, R&D/assets, and market-to-book assets (market value of equity + book value of debt ÷ book value of assets) measure investment opportunity, and log (total assets) represents firm size. The % outside board members (the percentage of non-affiliated members), the % blockholder ownership (total fraction of shares held by 5% owners) and the % institutional ownership measure firm monitoring, and the % CEO stock ownership measures incentive alignment. Cash flow volatility is the coefficient of variation trend-adjusted operating cash flows. The debt-to-equity (convertible debt) ratio is the book value of long-term debt (convertible debt) over the market value of equity. Dual CEO/Board Chair equals 1 if CEO chairs the board and zero if not. *T*-statistics are in parentheses.^a

^aHeteroscedastic standard errors are modeled as $\sigma_i = \sigma_e^{\alpha'w_i}$ where $w_i = (\text{R\&D, CEO Tenure, \% Outside Board members, \% Block Ownership, Cash Flow Volatility})$ for cash bonus and $w_i = (\text{Capital Expenditures, Market-to-Book Assets, \% Outside Board Members, \% CEO Stock Ownership})$ for stock options. A Likelihood ratio test fails to reject the null hypothesis of homoscedastic disturbance terms for restricted stock.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

This relation suggests that firms with long-term and risky investment opportunities use less cash bonus, which is tied to short-term performance metrics. Age is positively related with cash bonus and Age² is negatively related (both at the 5% level), indicating that firms use less cash bonus for younger managers and for older managers consistent with managerial horizon hypothesis. As expected cash flow volatility is negatively related to cash bonus (significant at 1%). This result supports Holmstrom and Milgrom (1987), who argue that incentive compensation should not be based on noisy performance metrics. Although we made no specific predictions for these variables, we also find a positive relation with firm size (significant at the 10% level in the linear age regression only) and a negative relation with convertible debt (significant at the 5% and 10% levels, respectively). No other variables are significantly related to cash bonus.

When the percentage of stock options in the CEO's compensation is the dependent variable, we find a positive relation with all of our investment opportunity proxies as expected. The relation with R&D is significant at the 1% level and the relations with capital expenditures and market-to-book assets are significant at the 5% level. Inconsistent with the managerial horizon hypothesis, but consistent with previous empirical evidence (e.g., Bryan et al., 2000), we find a negative relation between stock options and the CEOs age (significant at the 1% level). We do not find any evidence of a curvilinear relation. CEO tenure is negatively related with stock options at the 10% significance level. This finding is inconsistent with an entrenchment argument, but consistent with our premise that CEOs with long tenures have accumulated more stock and therefore require less equity-based pay than newer CEOs.¹⁵

Among the monitoring proxies, outside block ownership is negatively related to stock option compensation (significant at the 10% level), suggesting a substitute relation. CEO stock ownership is negative and significant at the 1% level, consistent with the proposition that CEO's with high stock ownership require less equity-based compensation to align their interests with shareholders. We do not find any relation between founding family involvement and stock option compensation. We had expected a negative relation.¹⁶

¹⁵ To further examine this premise, we divide our sample into CEOs at or above the median tenure of seven years and CEOs below the median tenure. Consistent with our premise, long-tenured CEOs own 3.1% of their firms' stock on average vs. 0.9% for newer CEOs ($T = 7.01$). In dollar terms, the seasoned CEOs have almost US\$62 million in stock on average vs. nearly US\$16 million for their less experienced counterparts ($T = 2.42$).

¹⁶ We note that members of founding family do own significantly more stock than CEOs who are not members of the founding family. The average stock holdings of CEOs who are members of the founding family is 5.3% of the firm's outstanding shares (US\$149.8 million) while non-founding family CEOs hold 1.3% of the firm's shares (US\$14.8 million). These results are statistically different at the 1% (5%) level.

Monitoring difficulties do appear to exert a significant influence on the use of stock options, however. As the volatility of operating cash flows increases, it becomes more difficult to distinguish normal operating volatility from the outcomes of managerial decisions, suggesting a greater need for equity-based compensation. Consistent with this prediction, the volatility of operating cash flow is positively related to the use of stock options at the 1% significance level. We also document a positive relation between the use of stock options and firm size, but no significant relation between CEO/chair duality and incentive compensation.

Finally, our evidence suggests that the agency costs of debt are a significant determinant of the compensation structure. As predicted by John and John (1993), the use of stock options is negatively related to the leverage ratio (significant at the 10% level) but positively related to the convertible debt (significant at the 1% level). These findings suggest that firms use their compensation policies as pre-commitment devices to ameliorate costly equity-debt agency conflicts, and that convertible debt also serves to lessen these agency costs. As an additional test, we compare the use of stock options and the leverage ratios for firms that have convertible debt ($n = 152$) and those that do not ($n = 943$). Consistent with the debt agency cost hypothesis, the mean (median) percent of option compensation for firms with convertible debt is 42% (42%) vs. 32% (29%) for firms without convertible debt. Both means and medians are significantly different at the 1% level. Additionally, the mean (median) debt-to-equity ratio for firms with convertible debt is 0.39 (0.21) vs. 0.24 (0.10) for firms without convertible debt. Both means and medians are significantly different at the 1% level.

In the last pair of regressions, we examine the use of restricted stock in incentive compensation schemes. Restricted stock is negatively related to R&D intensity, consistent with the premise that managers underinvest in risky investment opportunities if they bear too much residual risk. We find a negative relation with CEO stock ownership consistent with the notion that stock ownership reduces the need for equity-based compensation. Similarly, we find a negative relation with founding family membership, significant at the 5% level. This relation is in contrast to that for options. A possible explanation for this difference between options and restricted stock is that founding family CEOs make conservative decisions to protect their wealth. In fact, we find that founding family CEOs have significantly more wealth at stake than other managers. The stock ownership of founding family CEOs is valued at US\$150 million on average while non-founding family CEOs' holdings are worth only US\$15 million on average (significantly different at the 5% level). We conjecture that board compensation committees pay founders or founding family members an average amount of stock options to encourage risk-taking, but significantly less restricted stock to avoid exacerbating their downside risk.

We also find that restricted stock, like stock options, is positively related to firm size. Consistent with Mehran (1995) but inconsistent with a substitution hypothesis, we find a positive relation between the percentage of outside board

members and restricted stock (significant at the 10% level in the non-linear age regression only). Contrary to our expectations, we find a concave relation between restricted stock and age. This relation suggests that firms pay the youngest and the oldest CEOs with less restricted stock, the opposite of our managerial horizon prediction.

In summary, our findings are consistent with the premise that firm- and manager-specific characteristics are significant cross-sectional determinants of incentive compensation structure. Consistent with an increased need for monitoring and overcoming managerial risk-aversion, we find that stock options are positively related to investment opportunity, and cash-flow volatility. Both cash bonus and restricted stock are negatively related to R&D intensity and cash flow volatility, although the latter result is only statistically significant for cash bonus. As suggested by the need to balance the agency costs of debt, options are negatively related to leverage but positively related to the use of convertible debt. While stock ownership is identified as a strong substitute for equity-based compensation, we find only limited support for external monitoring substitutes. Finally, consistent with horizon problems among young CEOs who want to build their reputations and older CEOs facing retirement, we find a concave relation between cash bonus and CEO age. Contrary to the CEO horizon hypothesis, however, compensation from stock options is negatively related to CEO age and restricted stock awards exhibit a concave relation. These findings will be further explored in the next section.¹⁷

4.2. CEO age, stock compensation, investment opportunity, and industry

A possible explanation for the counterintuitive results between equity-based compensation and CEO age might lie in industry differences. For instance, younger CEOs might be more prevalent in industries with high (and/or risky) growth opportunities. To explore this possibility, we divided our sample into CEOs above and below the median age (57) and compared our vector of firm- and manager-specific characteristics for these two groups. Consistent with our speculation, younger CEOs are in firms with greater R&D intensity (4.7% vs. 2.8%, $T = 3.73$). Furthermore, younger CEOs are more prevalent in the computer industry (5.1% vs. 2.3%, $T = 2.43$) and the software industry (8.3% vs. 1.9%, $T = 4.77$), while older CEOs are in light manufacturing (32.6% vs. 17.7%,

¹⁷ We further analyze these investment horizon and uncertainty aspects using a relative ratio of investment intensity equal to the log (1 + R&D intensity) divided by log (1 + capital expenditure intensity) instead of the individual expenditure variables. The relation between stock options and relative investment intensity is positive and significant, consistent with our premise that firms with relatively riskier project portfolios use more options for incentive alignment. The results for the other variables are essentially the same as in Table 4.

Table 5

Analysis of the interaction between CEO age, investment opportunity, and industry in Tobit regressions of CEO equity-based compensation for 1095 firms in 1997 on measures of investment opportunity, CEO horizon, firm size, ownership characteristics, leverage characteristics, founding family affiliation, and dual CEO/Chairman of the Board designation

Panel A: Analysis of interaction between CEO age and investment opportunity

	Age * $D_{\text{HIGH GROWTH}}$	Age ² * $D_{\text{HIGH GROWTH}}$	Age * $D_{\text{LOW GROWTH}}$	Age ² * $D_{\text{LOW GROWTH}}$
Stock options	−0.0065*** (−3.92)		−0.0067*** (−4.10)	
	0.0026 (0.83)	−0.0000 (−0.75)	−0.0106 (−0.80)	0.0000 (0.36)
Restricted stock	0.0017 (0.56)		0.0013 (0.43)	
	0.0104* (1.70)	−0.0002* (−1.67)	0.0624** (2.05)	−0.0005** (−1.91)

Panel B: Analysis of interaction between CEO age and industry

	Age * D_{MFG}	Age ² * D_{MFG}	Age * D_{COMP}	Age ² * D_{COMP}	Age * D_{OTHER}	Age ² * D_{OTHER}
Stock options	−0.0057*** (−3.01)		−0.0010 (−1.03)		−0.0051*** (−2.69)	
	−0.0042 (−0.28)	−0.0000 (−0.24)	−0.0061 (−0.90)	0.0001 (0.80)	−0.0008 (−0.05)	−0.0001 (−0.54)
Restricted stock	0.0026 (0.70)		−0.0010 (−0.51)		0.0017 (0.46)	
	0.0804** (2.10)	−0.0009* (−1.88)	−0.0213 (−1.23)	0.0004 (1.16)	0.0805** (2.11)	−0.0009* (−1.95)

Only age and interactive terms are presented. $D_{\text{HIGH GROWTH}}$ is one if the firm is above the sample R&D intensity ratio and zero if not. $D_{\text{LOW GROWTH}}$ is one if the firm is at or below the sample R&D intensity ratio and zero if not. D_{MFG} is one if the company is a manufacturing firm (excluding computer-related manufacturing) and zero if not. D_{COMP} is one if the firm is involved in computer or software related activities or services and zero if not. D_{OTHER} is a dummy variable that is one if the firm is in any other industry and zero otherwise. *T*-statistics, corrected for heteroscedasticity, are in parentheses.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

$T = 5.75$) and heavy manufacturing (7.4% vs. 4.9%, $T = 1.74$).¹⁸ If investment opportunity or industry differences explain the relation between equity-based compensation and age reported above, we expect to observe an interactive effect between age and investment opportunity or industry. These tests are presented in Table 5.

In the regressions presented in Panel A, we include interaction between CEO Age and a dummy variable for high (low) growth. High (low) growth firms have R&D intensity above (below) the sample median. The relations between age and options (negative linear) and restricted stock (concave) are significantly independent of the growth opportunities of the firm. The negative relation for stock options is significant at the 1% level in both cases, and the curvilinear relation with restricted stock is significant at the 1% level for low growth firms and the 10% level for high growth firms. Thus, despite differences in investment opportunities facing old and young managers, interaction between age and investment opportunity does not explain the counterintuitive relations between age and equity-based compensation components.

In Panel B, we include interaction terms to control for broad industry classifications. We include dummy variables for manufacturing (heavy and light combined) computer related industries (computer and software), and all other industries. For CEOs working in the computer industry, age is not a statistically significant factor for any of the incentive components. However, options and restricted stock are significantly negative and concave for both the manufacturing and all other sub-samples, respectively. Thus, industry classification provides only a partial explanation, at best, of the relations between CEO age and equity-based compensation.

5. Conclusion

Economic theory suggests that since managers have the incentives and the opportunity to deviate from policies that maximize shareholder wealth, firms should tie executive compensation to changes in stock price. Moreover, the structure of these compensation plans should differ based on the types of agency problems prevalent in the firm, the presence of other incentive alignment mechanisms, and the ability to monitor a manager's actions. In this paper, we analyze the

¹⁸ We test for differences in heavy manufacturing (SIC = 3400 to 3570), light manufacturing (SIC = 2000 to 3400), biotechnology and pharmaceutical (SIC = 2830 to 2840), light manufacturing excluding biotechnology and pharmaceutical, computer (SIC = 3570 to 3580), high technology (SIC = 3600 to 3700), software (SIC = 7370 to 7380), and all other industries as a group. We also analyzed the ownership structures of the two groups. Surprisingly, given our findings for CEO tenure and the positive correlation between tenure and age, we find no differences in CEO stock ownership between old and young CEOs.

influence of firm- and manager-specific characteristics on the structure of incentive compensation for CEOs. Consistent with agency theory, we find that the incentive compensation structure varies systematically with specific attributes of the firms and their managers.

Supporting the notion that managers who are more difficult to monitor should have their compensation more closely tied to shareholder value we document a positive relation between the use of stock options and the firm's investment opportunity. We find, however, that managerial risk aversion and the nature of a firm's investment opportunity influences the type of equity-based awards that are offered. Specifically, we document a negative relation between restricted stock grants and R&D intensity. These findings suggest that firms facing more uncertain investment opportunities attempt to encourage risk-averse managers to invest in risky projects by providing upside potential and minimizing downside risk.

We also document a negative relation between cash bonus, which depends on short-term results and the volatility of operating cash flows, but a positive relation between stock options and cash flow volatility. High cash flow variability makes it difficult to monitor the CEO and at the same time exposes him to greater risk since results, even if they are not related to the manager's decisions, may be attributed to the manager. In this case, the manager has the incentive to minimize the risk to his human capital, potentially to the detriment of shareholders, by avoiding risky investments. Our findings suggest that firms with high cash flow volatility avoid tying compensation to this noisy performance metric, but instead use more options to overcome monitoring problems and offset a manager's risk aversion.

Additionally, we find a negative relation between both types of equity awards and the CEO stock ownership, and between stock options and blockholder ownership. The negative relations with CEO stock ownership suggest that the incentives of managers who own large amounts of stock are already aligned with shareholders and that these managers require less alignment via incentive compensation. The negative relation with outside blockholders supports the notion that there is a tradeoff between incentive alignment and external monitoring.

Our results also shed light on the relation between capital structure and incentive compensation structure. Consistent with the notion that compensation policy is used as a pre-commitment device to minimize the agency costs of debt (John and John, 1993), we document a negative relation between stock options and firm leverage, but a positive relation between options and convertible debt. These results contribute to our understanding of the role of capital structure and the agency costs of debt in determining compensation policy and also provide evidence on the role of convertible debt in mitigating debt-equity agency conflicts.

Finally, we provide some new evidence on the relation between managerial horizon and executive compensation. Previous researchers have argued that managers have the incentives to adopt short-term strategies as they approach retirement. We suggest, however, that younger managers who need to build their

reputations also have the incentives to focus on short-term outcomes. Supporting our premise, we find a concave relation between cash bonus and age, suggesting that firms pay the youngest and oldest managers less short-term bonus. Consistent with previous researchers, however, we find a negative linear relation between options and age. Furthermore, we find a concave relation between restricted stock and age. On the surface, these two relations seem counterintuitive since firms appear to be reinforcing short-term tendencies of older CEOs in the case of options and both older and younger CEOs in the case of restricted stock. Alternatively, these results suggest the need for researchers to develop a more complete understanding of the influence of a manager's horizon on decision-making.

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References

- Baber, W., Janakiraman, S., Kang, S., 1996. Investment opportunities and the structure of executive compensation. *Journal of Accounting and Economics* 21, 297–318.
- Bange, M., DeBondt, W., 1998. R&D budgets and corporate earnings targets. *Journal of Corporate Finance* 4, 153–184.
- Bhagat, S., Welch, L., 1995. Corporate research and development investments: international comparisons. *Journal of Accounting and Economics* 19, 443–470.
- Bizjak, J., Brickley, J., Coles, J., 1993. Stock-based incentive compensation and investment behavior. *Journal of Accounting and Economics* 16, 349–372.
- Brickley, J., Coles, J., Jarrell, G., 1997. Leadership structure: separating the CEO and chairman of the board. *Journal of Corporate Finance* 3, 189–220.
- Bryan, S., Hwang, L., Lilien, S., 2000. CEO stock-based compensation: An empirical analysis of incentive-intensity, relative mix, and economic determinants. *Journal of Business* 73, 661–693.
- Clinch, G., 1991. Employee compensation and firms' research and development activity. *Journal of Accounting Research* 29, 59–78.
- Dechow, P., Sloan, R., 1991. Executive incentives and the horizon problem. *Journal of Accounting and Economics* 14, 51–89.
- DeFusco, R., Johnson, R., Zorn, T., 1990. The effect of executive stock option plans on stockholders and bondholders. *Journal of Finance* 45, 617–627.
- Demsetz, H., Lehn, K., 1985. The structure of corporate ownership: causes and consequences. *Journal of Political Economy* 93, 1155–1177.
- Fama, E., 1980. Agency problems and the theory of the firm. *Journal of Political Economy* 88, 288–325.
- Gaver, J., Gaver, K., 1993. Additional evidence on the association between the investment opportunity set and corporate financing, dividend, and compensation policies. *Journal of Accounting and Economics* 16, 125–160.

- Gaver, J., Gaver, K., 1995. Compensation policy and the investment opportunity set. *Financial Management* 24 (1), 19–32.
- Gibbons, R., Murphy, K., 1993. Does executive compensation affect investment? *Journal of Applied Corporate Finance*, 99–109.
- Gilson, S., Vetsuypens, M., 1993. CEO compensation in financially distressed firms: an empirical analysis. *Journal of Finance* 48, 425–458.
- Green, W., 1990. *Econometric Analysis*. MacMillan, New York, NY.
- Hirshleifer, D., 1993. Managerial reputation and corporate investment decisions. *Financial Management* 22, 145–160.
- Holmstrom, B., 1979. Moral hazard and observability. *Bell Journal of Economics* 10, 74–91.
- Holmstrom, B., Milgrom, P., 1987. Aggregation and linearity in the provision of intertemporal incentives. *Econometrica* 55, 303–328.
- Holmstrom, B., Ricart i Costa, J., 1986. Managerial incentives and capital investment. *The Quarterly Journal of Economics* 101, 835–860.
- Jensen, M., Meckling, W., 1976. Theory of the firm: managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* 3, 305–360.
- Jensen, M., Murphy, K., 1990a. Performance pay and top management incentives. *Journal of Political Economy* 98, 225–264.
- Jensen, M., Murphy, K., 1990b. CEO incentives—it's not how much you pay, but how. *Harvard Business Review* (May–June 1990), pp. 138–153.
- John, K., John, T., 1993. Top-management compensation and capital structure. *Journal of Finance* 48, 949–974.
- Kole, S., 1997. The complexity of compensation contracts. *Journal of Financial Economics* 43, 79–104.
- Lambert, R., 1986. Executive effort and selection of risky projects. *Rand Journal of Economics* 17, 77–88.
- Lewellen, W., Loderer, C., Martin, K., 1987. Executive compensation contracts and executive incentive problems: an empirical analysis. *Journal of Accounting and Economics* 10, 287–310.
- Mehran, H., 1995. Executive compensation structure, ownership, and firm performance. *Journal of Financial Economics* 38, 163–184.
- Meulbroek, L., 2000. The efficiency of equity-linked compensation: understanding the full cost of awarding executive stock options, Harvard Business School working paper.
- Narayanan, M., 1985a. Observability and the payback criterion. *Journal of Business* 58, 293–315.
- Narayanan, M., 1985b. Managerial incentives for short-term results. *Journal of Finance* 40, 1469–1484.
- Pi, L., Timme, S., 1993. Corporate control and bank efficiency. *Journal of Banking and Finance* 17, 515–530.
- Pisano, G., 1989. Using equity participation to support change: evidence from the biotechnology industry. *Journal of Law, Economics, and Organization* 5, 109–126.
- Shavell, S., 1979. Risk sharing and incentives in the principle and agent relation. *Bell Journal of Economics* 10, 55–73.
- Smith, M., 1996. Shareholder activism by institutional investors: evidence from CalPERS. *Journal of Finance* 51, 227–252.
- Smith, C., Watts, R., 1992. The investment opportunity set and corporate financing, dividend and compensation policies. *Journal of Financial Economics* 31, 263–292.
- Vancil, R., 1987. *Passing the Baton: Managing the Process of CEO Succession*. Harvard Business School Press, Boston.
- Yermack, D., 1995. Do corporations award CEO stock options effectively? *Journal of Financial Economics* 39, 237–269.