

The Effects of Idiosyncratic Risks Borne by Managers on the Design of CEO Compensation Contracts

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The Effects of Idiosyncratic Risks Borne by Managers on the Design of CEO Compensation Contracts

We use proportional measures of CEO salary, bonuses, and option grants to analyze whether the design of managerial compensation contracts reduces idiosyncratic risks faced by managers. We use pooled cross-sectional data for a sample of 13,026 observations from 1,804 firms over the thirteen years from 1992 through 2004. We employ Tobit models with firm and year-specific fixed-effects in our econometric specifications. We test five hypotheses about the how the design of the compensation contracts are related to factors affecting the personal risks faced by the CEO's. In support of most of our hypotheses, the portion of salary granted seems to serve to balance out risks in CEO equity compensation and stock holdings. In many cases the portion of bonus compensation seems to have similar relationship with the elements of CEO idiosyncratic risk, but it is generally less sensitive to these risks than is the portion of salary compensation. As expected, the total level of CEO pay is positively related with the portion of salary compensation, and negatively correlated with option grants. On the other hand, salary compensation is positively correlated with the level of managerial stockholdings, while option grants are negatively related to the value of the portfolio. The case where our results are most at odds with the hypothesis is the effect of equity volatility on the structure of CEO pay, where the standard deviation of daily stock returns are negatively correlated with the portion of salary, and positively related to option grants. In our most unique findings, the deltas of the managers' equity portfolios have a U-shaped relationship with the portion of salary and an inverted U-shaped relationship with option grants. Bonus compensation is positively correlated with the delta. It is clear the option grants are the variable that is most sensitive to variations in the managers' portfolio deltas.

I. Introduction

In their seminal paper Lambert, Larcker and Verrecchia (1991) argue that managerial pay packages must be structured to mitigate important personal risks faced by managers. They hold that the salary component of compensation may be used to balance the effects of some of these risks.

We study the effect of four factors that contribute to the compensation risks faced by the manager. Our hypotheses are drawn (or are inferred) from the ideas in Lambert, Larcker and

Verrecchia. We predict that the portion of cash-based compensation should be negatively related to the total dollar value of annual compensation and the sensitivity (or delta) of the manager's equity portfolio, and that cash pay should be positively associated with the volatility of the shares and the total dollar value of managerial equity holdings. The opposite should hold for the relationship of the portion of stock-based compensation with the four variables.

A unique aspect of our approach is that we use proportional measures of the three major components of managerial compensation: straight-salary, bonuses, and option grants. Many prior studies have concentrated on levels and changes in the forms of compensation, which makes it difficult to see all of the subtlety in contract structure. Using the portion of each form of compensation is an integral part of our research design; the proportional measures capture the interactions among the components. A change in the proportional use of any one of the components affects the portions used of the other three. This interrelationship is important because a difference in macroeconomic or firm-specific factors can influence the manager's utility-function. One of the weaknesses of this approach is that it can create a "mechanical" relationship where an increase in one form of pay automatically causes a decline in the portions of the other forms. However, we feel that this feature actually embodies the character of CEO compensation, because contracts are constrained by the executive's next-best alternative. This should create a substitution effect between the forms of pay in the compensation contract. Some recent empirical studies have begun to use proportional measures of the components of compensation; notably Anderson, Banker and Ravindran (2000) and two papers by Ryan and Wiggins (2001, 2002).

We collect information on the compensation and equity holdings for a sample of 13,026 firm-year observations for 1,804 firms over thirteen years, from 1992 to 2004. The firms in the sample correspond roughly with the S&P 1500 over the period.

Due to the structure of our data, we combine two widely used econometric techniques. Because many of the managers receive no compensation in one of the forms we employ Tobit models as in earlier studies by Yermack (1995), Bryan, Hwang and Lilien (2000) and Ryan and Wiggins (2001). Also, following Murphy (1985), Himmelberg, Hubbard and Palia (1999), and Palia (2001) we add firm and year specific fixed-effects to the models.

Our results generally support the arguments implied by Lambert, Larcker and Verrecchia. As suggested by agency theory, we find that the portion of salary in compensation moderates much of the idiosyncratic risks faced by the managers.

As expected, the portion of salary paid to the manager are negatively correlated with the real dollar value of their annual compensation, and positively related to the real dollar value of their equity-holdings in the firm. The opposite is usually true for the portion of option grants.

While bonuses are often lumped with salary as “cash compensation,” we find that the relationships of the variables with bonuses conform to the hypotheses less often or clearly than for the salary component. This is not terribly surprising, as bonuses are quite different from straight-salary, and are a reward for firm performance.

In our most unique contribution to the existing literature, we empirically confirm Lambert, Larcker and Verrecchias’ assertion that the delta of the manager’s equity portfolio has a U-shaped relationship with the portion of straight-salary paid to the managers, and an inverted U-shaped relationship with option grants. There is also evidence of a positive relationship between the portion of bonus compensation and delta. The portion of option grants to the

manager is clearly more sensitive to the level of delta than the other two forms of compensation. These results imply that when the sensitivity of the manager's portfolio is low they are granted more equity, but if the delta is high they are given less stock, and there is evidence of a shift to bonuses.

The most glaring exception to the hypotheses of Lambert, Larcker and Verrecchia is that the risk of firm equity is positively correlated with the portion of option grants to the manager, and is negatively correlated with the portions of salary and bonuses. These results correspond more closely to the argument by Demsetz and Lehn (1985) that managers of more risky firms must be granted higher portions of equity to align their interests with those of shareholders. Our findings here conform to the observation that young, high-tech firms employ high levels of equity-based compensation.

The remainder of the paper is organized as follows. In the next section we outline the hypotheses concerning the portions of four widely used components of managerial compensation contracts. Next, we describe the sources for the data used in the study. Then, we describe our models and econometric methodologies. In the fifth section of the paper we discuss the empirical results. We summarize and draw conclusions in the final section.

II. Development of the Hypotheses

In developing testable hypotheses about managerial risk-bearing, it is important to be mindful that managers face a set of risks significantly different from those borne by the well-diversified outside shareholders. Fama (1980) and Amihud and Lev (1981) stress that the managers have invested their career (human capital) in the firm, and the failure of the enterprise could be ruinous for them. Therefore, trying to provide motivation to managers that will align their interests with the stockholders is no simple task.

Theoretical models by Lambert and Larcker (1987), Lambert, Larcker and Verrecchia (1991), Bushman and Indjejikian (1993), Lambert (2001), Datar, Kulp and Lambert (2001), and Hall and Murphy (2002) begin to address this issue of how a manager faced with excessive levels of idiosyncratic risk should be compensated. Not surprisingly, most of these models are based on standard microeconomic models of risk-averse behavior. We focus on the approach of Lambert, Larcker and Verrecchia, who assume that the principal and agent collectively design a compensation contract that clears the managers' reservation wage and that the participants consider efficient based on their *a priori* expectations of the risks and expected outcomes of the venture.

Using standard utility theory, we derive five hypotheses about the relative certainty equivalent risk premiums these managers must be paid. We examine how the proportion of the three major forms of CEO compensation, straight-salary, bonuses and option grants, are affected by four firm or manager-specific characteristics. These are, (1) the real dollar value of annual CEO compensation, (2) the risk of the firm's equity, (3) the real dollar value of CEO equity holdings, and (4) the delta or sensitivity of the managerial equity portfolio to a change in equity value.

At the outset it is necessary to say a few words about the relationship between the three forms of compensation. Salary and bonuses are usually categorized as "cash-compensation," which is normally contrasted with "stock-based compensation." But, bonuses are clearly not the same thing as straight-salary. They are usually rewards for firm performance, and are clearly more risky to managers than salary. In deriving our hypotheses we usually argue that the relationship between firm characteristics and "cash-based compensation" should be opposite those on "stock-based compensation." Here we will treat straight-salary and bonus as roughly

equivalent. But, we are more doubtful about these hypotheses as they concern bonuses rather than salary.

II.A Effect of Size of the Compensation Package on the Design of Compensation

First, consider the relationship between the portion of cash-based compensation the manager must be paid and the total dollar amount of annual pay. Assume the stocks of two firms are equally risky. Presume that the managers of the two firms have similar utility functions and are equally skilled. At this point, for simplicity, assume that these managers currently hold no equity. In an efficient market, both managers would need to receive annual compensation that would clear their reservation wage. Therefore, contracts would have to be offered that would provide both with equal total utility. For simplicity, assume that one of the managers is remunerated with a combination of cash and equity, while the other's entire pay package consists of firm stock. According to standard utility theory, the manager who receives the cash component in his compensation contract could be given a package with a lower expected value than the one who receives all risky stock compensation. That is, although the firms are equally risky, the relative weights assigned to the components of the compensation contract alter the risk faced by the manager.

Therefore, there should be a negative relationship between the portion of cash compensation in the pay package and the over all amount of pay. Of course, this implies a positive relationship between the portion of stock-based compensation and the amount of annual compensation. Thus, our first set of hypotheses in alternative form are:

- H1 The portions of straight-salary and bonuses (option grants) paid to the CEO are negatively (positively) related to the real total dollar value of annual managerial compensation.

II.B Effect of the Risk of Firm Equity on the Design of Compensation

We develop a parallel hypothesis for the relationship between the risk of the firm's stock and the portion of cash-based compensation that must be paid to the manager. In this case, assume two managers are paid the same total amount of annual compensation, but the mixture of ingredients in the package can be altered. According to the utility argument, the managers of the more risky firm would need to be granted a higher portion of the certainty equivalent cash to produce the same total utility as for the manager granted stock in the less risky firm. Again, within the framework of Lambert, Larcker and Verrecchia, the cash component of the compensation package is employed to moderate the risk faced by the manager. This implies a positive relationship between firm risk and the portion of cash-based compensation, and negative correlation between stock-based compensation and risk. Therefore, our second set of hypotheses in alternative form are:

H2 The portions of straight-salary and bonuses (option grants) paid to the CEO are positively (negatively) related to the risk of firm equity.

In earlier empirical studies, Beatty and Zajac (1994) and Zajac and Westphal (1994) found evidence of such a negative relationship between firm equity risk and option grants.

However, there is a widely held counter hypothesis, advanced most clearly by Demsetz and Lehn (1985), that it is necessary to grant the managers of more risky ventures a higher portion of stock-based compensation to properly align their incentives with those of the outside stockholders. According to this argument, more risky firms should use greater stock-based compensation and less cash-based components. Palia (2001) found some support for a positive relationship between the risk of firm equity and

option grants to the CEO. Recently, Aggarwal and Samwick (2003) also found that the CEO is generally exposed to higher firm-specific risk than lower level managers in firms.

Following the logic of Lambert, Larcker and Verrecchia (1991) we hypothesize a positive relationship between the portion of cash-based compensation and the risk of firm equity. But, the opposite result would not be surprising in light of the argument that managers of risky firms may require higher levels of equity-based compensation.

II.C Effect of CEO Equity Holdings on the Design of Compensation

The same line of utility-based logic can be used to develop hypotheses concerning the relationship between the real total dollar value of managerial equity holding and the mixture of annual compensation employed. These hypotheses are, again, based on minimizing agency conflicts between the manager and outside stockholders. The standard agency argument is that some form of stockholding is usually necessary to properly align managerial incentives with the shareholders. Therefore, managers with smaller equity holdings should be given a compensation contract containing a higher portion of stock based compensation, implying a negative relationship between stock-based compensation and total managerial equity holdings. Therefore, our third set of hypotheses in alternative form are:

- H3 The portions of straight-salary and bonuses (option grants) paid to the CEO are positively (negatively) related to the real total dollar value of managerial equity and option holdings.

Lambert and Larcker (1987), Smith and Watts (1992), and Klein (2002) all advance similar hypotheses about the relationship between the design of the compensation package and the value of managerial equity holdings.

II.D Effect of CEO Equity Portfolio Sensitivity on the Design of Compensation

Lambert, Larcker and Verrecchia (1991) also suggest that the sensitivity of the manager's portfolio of equity may have an important bearing on the design of the compensation package. As the portfolio becomes deeper-in-the-money, the manager is more exposed to the risk associated with changes in equity value. But, if the portfolio is not very sensitive to changes in stock value, the manager may be less concerned with the risk of the shares. One of the most unique elements of our study is to examine the issue of how sensitive a manager's holdings are to changes in firm value, we estimate the delta for CEO equity portfolios.

If the manager's portfolio consists entirely of stock (restricted or non-restricted) the portfolio delta would be equal to one. Meaning the value of the portfolio changes by exactly the same percentage as for outside shareholders. Options have a delta less than one, so they are less sensitive to movements in stock price than the shares themselves. The deeper in-the-money the options, the lower their delta (typically options at-the-money have a delta of about 0.60). Therefore, as a manager holds more options, particularly if they are not deep in-the-money, the delta of his portfolio will become less than one and the value of his portfolio will not rise nor fall one-for-one with stocks in the market.

Lambert, Larcker and Verrecchia suggest that if delta is low, the manager would value equity-based compensation more highly, and when delta is high, stock-based compensation would be valued less. This implies a concave downward (inverted U-shape) relationship between the delta of the manager's equity portfolio and the portions

of stock-based compensation granted, and a concave upward (U-shaped) relationship between delta and the portions of cash-based compensation. Therefore, our fourth and fifth hypotheses in alternative form are:

- H4 The portions of straight-salary and bonuses (option grants) paid to the CEO are negatively (positively) related to the delta of the manager's equity and option holdings.
- H5 The portions of straight-salary and bonuses (option grants) paid to the CEO are positively(negatively) related to the square of the delta of the manager's equity and option holdings.

III. Variable Definitions and Data Sources

The data for the study are collected from three sources. Information on managerial compensation and equity holdings are taken from the EXECUCOMP database, which contains reasonably comprehensive information for a sample corresponding roughly to the S&P1500. Other necessary data are culled from the COMPUSTAT and CRSP datasets. Data are available for thirteen years, from 1992 to 2004.

Total annual CEO compensation (CEOCOMP) is the sum of salary, bonus, payments from long-term incentive plans, the Black-Scholes value of option grants, restricted stock grants, and all other compensation taken from the EXECUCOMP database. These values are then deflated by the Consumer Price Index (CPI-U) for the end-of-fiscal-year month.¹

We compute the proportion of each form of CEO compensation by taking the ratio of the annual dollar value of that form of compensation to total annual CEO

¹ Consumer Price Index for all urban consumers, the year 1982-1984 is set to one.

compensation. For instance, the percentage of straight-salary paid to the CEO (SALRYPC) is the ratio of salary divided by the total compensation figure. The portions of bonus (BONUSPC), and option grants (OPTGRPC) are computed in a similar fashion.

Our proxy for firm risk is the annualized standard deviations of daily returns (SDS), which is estimated using daily stock returns taken from the CRSP database. We carefully match the daily stock returns to correspond to each firm's fiscal year for accounting purposes. All firms that are missing more than ten daily returns for a year are eliminated from the sample.

Core and Guay (2002) provide a widely used adaptation of the Black and Scholes (1973) model to estimate the delta of a manager's option portfolio, using the EXECUCOMP data. We use the end-of-fiscal-year share price as the market value. The strike price is estimated as the difference between the current share price and the ratio of the EXECUCOMP estimate of the intrinsic value of in-the-money options with the number of options held by the CEO. Following Core and Guay (2002), we presume that all unexercisable options have a time-to-exercise of nine-years, and exercisable options have a time-horizon of six-years. The annualized standard deviations of daily stock returns for the fiscal year, described above, are used as the estimate of volatility in the model. The yield on seven-year Treasury Bonds in the month of the fiscal-year end is used as the risk-free rate. Finally, we incorporate the dividend-payout-ratio (the ratio of dividends to end-of-year share price) for the fiscal year using Merton's (1973) extension of the Black-Scholes model.

To estimate the delta of the manager's entire equity portfolio, DELTA, we multiply the number of options held by the CEO by the option portfolio delta computed

above and add the total number of restricted and non-restricted shares held by the manager (which have a delta equal to one), and divide this total by the sum of options, restricted and non-restricted shares held. DELTA explains how much the CEO's portfolio changes in value for a one-dollar change in share price.

Because Lambert, Larcker and Verrecchia (1991) argue the compensation should be non-linear in delta, we also included the squared value of delta, DELTA2. This allows us to check if compensation plans differ for firms where the equity portfolio of the manager is very sensitive to changes in equity value than for firms where the compensation package is less sensitive.

The real total dollar value of CEO equity holdings (CEOEQ) is also culled from EXECUCOMP, it is the sum of the market value of all restricted and non-restricted stock holdings plus the Black-Scholes value of the executive's option holdings, estimated using the Core and Guay (2002) approximation described above. These values are also deflated by the CPI-U.

We also include five control variables in our models to account for factors that have important effects on the design of managerial compensation contracts.² These are (1) CEO Tenure, (2) the firm's Market-to-Book ratio, (3) firm size, (4) Return-on-Assets, and (5) annual stock return.

First, we obtain estimates of the tenure of CEO's in their position (TENURE) from EXECUCOMP. Dechow and Sloan (1991) and Gibbons and Murphy (1992) argue that CEO tenure should be negatively correlated with equity grants. Yermack (1995) and Ryan and Wiggins (2002) find such a negative relationship between tenure and the level

of stock-based compensation. Also, Palia (2001) finds that CEO tenure has vital explanatory power even in regression models that control for firm specific effects.

The Market-to-Book ratio of long-term capital (M/B) is our proxy for the level of unrecorded intangible assets or growth opportunities. This is estimated as the ratio of total assets minus the book value of equity plus the market value of equity (the product of shares and end-of-fiscal-year price), to total assets. Gaver and Gaver (1995), Mehran (1995), Himmelberg, Hubbard and Palia (1999), and Palia (2001) all find a positive relationship between measures of growth opportunities and the level of equity grants to managers.

Many argue that firm size should have important effects on managerial compensation and equity holdings (Smith and Watts, 1992; Baker and Hall, 1998; Himmelberg, Hubbard and Palia, 1999). Therefore, we include the logarithm of the market value of firm equity (LEQMARK) as a proxy in our models.

In the last several decades focus on better aligning managerial compensation with firm performance has been prevalent among practitioners, the popular press, and academic researchers. Therefore, we include controls for both accounting and stock-market performance.

Our measure of the level of normalized earnings (ROA) is earnings before extraordinary items divided by the value of total assets, taken from the COMPUSTAT annual industrial file. There is strong evidence that earnings are the primary determinant of bonus packages, so we expect to find a strong positive relationship between the portion

² We also included controls for the age of the firms and for cash and dividend constraints, as suggested by Core and Guay (1999). But, these variables were not statistically significant in any of the models containing controls for firm-specific fixed-effects.

of bonus compensation and ROA. There is little empirical evidence concerning the impact of earnings on option compensation.

Estimates of the level of annual stock returns (RET) are made using daily stock returns taken from the CRSP database. Healy (1985) and Murphy (1999) note that earnings are the primary determinant of bonuses, but stock returns are also often included in the calculation. Recently, Murphy (1985), Gibbons and Murphy (1990), Boschen and Smith (1995), Baber, Janakaraman and Kang (1996), Hall and Liebman (1998) and Anderson, Banker and Ravindran (2000) have all found a positive relationship between bonuses and stock returns. Evidence on the relationship between the firm performance measures and option grants has been mixed. In a seminal study Jensen and Murphy (1990) argued that the relationship was weak. Recently, Core, Guay and Larcker (2003) continue to argue that there is little clear evidence of a solid relationship between firm performance and managerial equity grants, On the other hand, Hall and Liebman (1998) and Aggarwal and Samwick (2003) present some evidence of a strong relationship.

Normally, it is assumed that the salary component of compensation is not dependent on firm performance, so little effort has been made to study this relationship. However, since we are using the proportional measures of compensation, the portion of salary should be negatively correlated with both measures of firm performance. Because anything that increases the portions of either bonuses or option grants should mechanically decrease the portion of salary compensation. This is an important element in the design of our study to test if the portion of salary compensation is systematically adjusted to help control the idiosyncratic risks faced by managers.

After, collecting all the data, we eliminate all observations for any firm-year that are missing values for any of the variables. As is common, we delete all observations from utilities and financial firms.³ Because of use of firm-specific fixed-effects we must eliminate all firms that do not have at least two years of observations. This aggregate sample contains 13,026 firm-year observations from 1,804 firms spread over thirteen years, from 1992 to 2004. The variable definitions and the symbols to represent them in the models are summarized in Table 1. Univariate summary statistics for the 13 variables for the sample are presented in Table 2.

IV. Models and Econometric Methodology

To test our hypotheses, we specify three models with each of the portions of the three major components of CEO compensation as the dependent variables. For instance, the model to explain the portion of straight-salary paid to the CEO as a percentage of total compensation is written as:

$$\begin{aligned} \text{SALRYPC} = & \alpha_0 + \alpha_1 \text{TENURE} + \alpha_2 \text{LEQMARK} + \alpha_3 \text{M/B} + \alpha_4 \text{ROA} + \alpha_5 \text{RET} + \\ & \beta_1 \text{CEOCOMP} + \beta_2 \text{SDS} + \beta_3 \text{CEOEQ} + \beta_4 \text{DELTA} + \beta_5 \text{DELTA2} + \\ & \sum_{i=1}^f F_i + \sum_{j=1}^y Y_j + e. \end{aligned}$$

The parameters values α_i are associated with the control variables, and the β_j with the variables proxying the idiosyncratic risk faced by the CEO. The e is an error term.

Descriptions of the variables in the equation are given in Table 1. Murphy (1985) found that it is very important to control for firm-specific fixed effects in studies of managerial compensation. More recently Himmelberg, Hubbard and Palia (1999) and Palia (2001)

³ SIC codes 4900 – 4999 and 6000 – 6999.

have reinforced the necessity of such controls. Also, because some of our independent variables are dollar amounts that vary widely from firm-to-firm, it is even more important to control for these fixed effects. Therefore, the F_i are one/zero dummy variables for each of the i firms in the sample. We also control for year-specific effects by including the Y_j that are one/zero dummies for each of the j years. Similar models are specified for the proportions of bonuses and option grants in annual CEO compensation (BONUSPC and OPTGRPC respectively).

As a preliminary step, we estimate each of the three models using OLS to identify any outliers that seriously bias parameter estimates. We eliminate all observations that have residuals with a Cook's D value higher than one, and/or an R-Student value with an absolute value greater than three. See Welsch (1980) for more details on these procedures. After purging the outliers, statistics for the three samples are: (1) in the model with SALRYPC as the dependent variable there are 12,831 observations drawn from 1,794 firms, (2) for BONUSPC, 12,910 observations from 1,803 firms, and (3) for OPTGRPC there are 12,982 observations for 1,802 firms.

After eliminating the outliers from each sample, we estimate the models again using OLS and conduct an F-test for the presence of fixed-effects in the data for each model advanced by Hausman (1978). All three test statistics are significant, suggesting the firm and year specific fixed effects specifications are reasonable. The F-test value for the specification with SALRYPC as the dependent variables is 5.54, that for BONUSPC is 4.45, and the value is 3.90 for the specification for OPTGRPC.

We also calculate the variance inflation factors (VIF) and Eigen values for each specification. Not surprisingly we find evidence of multicollinearity. But, the VIF

suggests that, to a great extent, this is associated with the inclusion of DELTA and DELTA2. We also checked the correlations between all of the regression variables (not shown). The correlation between DELTA and DELTA2 had a value of virtually one. While most of the other cross-correlations were statistically significant because of the large number of observations in the samples, the values did not seem excessive. For instance, the second highest level of correlation among the variables was between ROA and the standard deviation of daily stock returns (SDS), which had a value of only about -0.38 .

Finally, many CEOs have a zero percentage for the some of the forms of compensation (left-censored values). A smaller number of managers also receive 100% of their compensation as one of the forms (right-censored); straight-salary is clearly the most likely form of compensation to be the entire package. When many observations have a value of either zero or one, OLS results in biased estimates (Greene, 2003, pp. 761-780). Several earlier studies of executive compensation, such as Yermack (1995), Bryan, Hwang and Lilien (2000) and Ryan and Wiggins (2001) have employed Tobit models to eliminate these biases. Therefore, in presenting our final results, we estimate Tobit models for each of the three specifications.

V. Empirical Results

We have cast our five hypotheses concerning the effect of the personal risk faced by the manager on the design of the compensation package in terms of the arguments in Lambert, Larcker and Verrecchia (1991). In at least one case there is a convincing counter proposal.

The parameter estimates for the three Tobit specifications are presented in Table 3. This table contains summary statistics on the log-likelihood statistic for each model, the number of firm-year observations after eliminating the outliers, the number of left and right-censored observations, and the number of firm-specific cross-sections included. As is common for the fixed-effects models, we have not presented the coefficients for the numerous firm and year-specific dummy variables, but these are available from the authors upon request.

V.A Parameter Estimates on the Control Variables

First, consider the relationships of the five control variables with the portions of compensation granted to the CEO. These are CEO tenure (TENURE), the logarithm of the market value of equity (LEQMARK), the market-to-book ratio of firm assets (M/B), the Return-on-Assets (ROA) and the annual stock return for the firm (RET).

CEO tenure (TENURE) is positively and significantly correlated with the portion of straight-salary paid in compensation, and is significantly negatively related to the portion of option grants. The findings correspond to the hypotheses of Dechow and Sloan (1991) and Gibbons and Murphy (1992), and the empirical findings of Yermack (1995) and Ryan and Wiggins (2002).⁴ The relationship between tenure and bonus compensation is negative, but only at a 90% confidence level.

The logarithm of the market value of equity (LEQMARK) is a proxy for firm size. We find that larger firms pay their CEO a lower percentage of straight-salary, and higher portions of bonuses and option grants. In earlier studies Smith and Watts (1992),

Core and Guay (1999) and Ryan and Wiggins (2001, 2002), all found positive relationships between proxies of firm size and the portion of options grants to the CEO.⁵

The market-to-book ratio of firm assets (M/B) is often used as a proxy for the existence of growth opportunities, or the presence of asymmetrical information. In empirical studies Gaver and Gaver (1995), Mehran (1995), Himmelberg, Hubbard and Palia (1999), and Palia (2001) all find positive relationships between measures of firm growth opportunities and managerial equity compensation. However, in recent Tobit estimates of the relationship between option grants and the M/B ratio the results are somewhat mixed. Ryan and Wiggins (2001) find a positive correlation, while Yermack (1995) finds the opposite.

In our results the portions of straight-salary and options granted to the manager are positively and significantly related to the M/B ratio. The relationship between the portion of bonus compensation and M/B is negative, but only at the 90% confidence level. The lack of a strong relationship between the portion of bonus compensation and M/B might suggest that earnings-based performance measures are less widely used in compensation contracts for growth firms or those with high levels of intangibles.

As expected, we find a positive relationship between Return-on-Assets (ROA) the portion of bonuses granted to the CEO. This accords well with the findings of Healy (1985) and Murphy (1999) that earnings are the primary ingredient in most CEO bonus plans. We also find a significant negative relationship between ROA and the portion of

⁴ Ryan and Wiggins (2001) fail to find any evidence of a significant relationship. Bloom and Milkovich (1998) and Palia (2001) find a positive relationship between the variability of CEO compensation and tenure, which could be interpreted as contrary to our result.

⁵ Mehran (1995) finds no significant relationship. Palia (2001) finds evidence of a negative relationship between the variability of CEO compensation and firm size, which can be interpreted as opposite to our result.

salary compensation. We expected such a result because of our use of proportional measures; any factor that drives up the portion of bonus compensation must drive down the portion of the other measures. However, we find no evidence of a significant relationship between the portion of option grants and ROA.

Annual stock returns (RET) are also positively and significantly correlated the portion of bonuses granted to the CEO. In earlier studies Murphy (1985), Gibbons and Murphy (1990), Boschen and Smith (1995), Baber, Janakaraman and Kang (1996), Hall and Liebman (1998) and Anderson, Banker and Ravindran (2000) all found similar relationships. Both the portions of straight-salary and option grants to the CEO are significantly negatively correlated with stock returns. In the case of salary this can probably again be explained by a mechanical contrary relationship with the portion of bonuses. In the case of option grants interpreting the result is more problematic. Since the study by Jensen and Murphy (1990), the relationship between stock returns and option compensation has been problematic. Again, the negative relationship could simply be a mechanical counter relationship because of the positive relationship of stock returns and bonuses. But, it could also be an indication of the inefficient granting of option compensation as suggested in popular studies such as Gillian (2001) and Bebchuk, Fried and Walker (2002). Finally, researchers such as Boschen and Smith (1995) have noted that managerial compensation often depends on a series of performance measures; perhaps it is also necessary to include lagged values of the measures to gain clearer insight into their relationship with stock-based compensation.

V.B Hypotheses Tests: Effect of CEO Risk-Bearing on the Design of Compensation

We argue that the idiosyncratic risk faced by managers depends on four factors, their level of compensation, the value of their holdings of equity in the firm, the volatility of these holdings, and the delta of their equity portfolio. We use the seminal study by Lambert, Larcker and Verrecchia (1991), based on standard utility-theory arguments, to develop a set of hypotheses about how these four factors should influence the design of compensation contracts.

Lambert, Larcker and Verrecchia imply that the total level of managerial pay (CEOCOMP) should be negatively related with the portion of cash-based compensation, and positively with the stock-based portion. The estimates of β_1 in the three models provide convincing evidence in support of Hypotheses H1. The portions of straight-salary and bonuses are negatively and significantly correlated with CEOCOMP, while the portion of option grants is significantly positively related.

Our proxy for the risk of the firm's equity is the annualized standard deviation of daily stock returns (SDS). On one hand, the utility argument following from Lambert, Larcker and Verrecchia implies that equity risk should be positively related to the portion of cash-based compensation, and negatively with the stock-based portion. In earlier studies, Beatty and Zajac (1994) and Zajac and Westphal (1994) find such a negative relationship. On the other hand, Demsetz and Lehn (1985) argue that the riskier the firm, the greater the need for more stock-based compensation. Palia (2001) provides supporting evidence for this hypothesis.

Our empirical results strongly support the argument of Demsetz and Lehn, and are contrary to Hypotheses H2 based on the predictions of Lambert, Larcker and Verrecchia.⁶ The estimates of β_2 for the portions of both salary and bonuses paid to the manager are negatively correlated with the riskiness of the firms stock. The portion of option grants is positively related to equity risk.

Building on Lambert, Larcker and Verrecchia we hypothesize that the dollar amount of wealth held by the CEO in shares, restricted shares and options (CEOEQ) should be positively correlated with the cash-based components of compensation, and negatively with option grants. For the most part our results support Hypothesis H3. As expected, the portion of straight-salary paid to the CEO is significantly positively related with CEOEQ, and the relationship between CEOEQ and the portion of option grants is negative. However, there is no evidence of a significant relationship between the portion of bonus pay and CEO equity holdings.

We include an estimate of the delta of the manager's equity portfolio, DELTA, using a method developed by Core and Guay (2002), and also the square of this measure, DELTA2. Lambert, Larcker and Verrecchia suggest that when delta is low, managers should value stock-based compensation more highly, and when delta is high, further equity grants are less valuable. This implies a concave downward (inverted U-shape) relationship between delta and the portions of stock-based compensation granted, and a concave upward (U-shaped) relationship between delta and the straight-salary.

Our results generally support Hypotheses H4 and H5. For the portion of straight-salary paid to the managers, the parameter β_4 on DELTA is negative and β_5 on DELTA2

⁶ In a sensitivity test (results not shown) we follow Aggarwal and Samwick (1999) by including a cross-product term between annualized standard deviation of daily returns and annual stock returns, and these

is positive, the expected U-shaped relationship. The two parameters have the opposite signs ($\beta_4 > 0$ and $\beta_5 < 0$) in the model of the portion of option grants, the implied inverted U-shape. Clearly, the magnitudes of the parameters β_4 and β_5 are much greater in the model for the portion of option compensation, than those in the model for salary compensation. The parameter β_4 in the model for the portion of bonus compensation is not statistically significant, but β_5 on DELTA2 does have the anticipated positive sign. This at least supports the hypothesized positive relationship between this component of cash-based compensation and option portfolio sensitivity at very high levels of delta.

Figure 1 shows the relationship between the delta of the managers' equity portfolios and the proportional forms of management compensation at levels of delta between 0.50 and 1.00.⁷ Clearly, the portion of option compensation is the most sensitive to the delta (the magnitude of β_4 and β_5 are much larger in this specification). The inflection point in this inverted U-shaped relationship occurs at a value of delta of 0.79. This is a bit lower than the mean or median levels of delta in our samples, which are about 0.93 or 0.94 in Table 2. By comparison, the U-shaped relationship between the portion of salary compensation and delta is not nearly so pronounced. Because the curvature in the graph is slight, we have included an arrow showing the inflection point in this relationship, which occurs at a value of delta of 0.84. The portion of salary compensation is lowest when delta is very low. The relationship between delta and the portion of bonus compensation is positive and increasing (because only β_5 is statistically significant under this specification).

relationships between equity risk and the portions of the various forms of compensation still clearly held.

⁷ Only one observation in the aggregate sample (before the elimination of outliers) had a value of delta lower than 0.50.

V.C Sensitivity Test: the Idiosyncratic Risk of Total Compensation

Because we use data with time-series elements, the relationship between the real dollar value of total annual CEO compensation and the three types of compensation is an area where our proportional measures may cause an econometric difficulty. Studies such as Hall and Liebman (1998) document that over the last decade CEO compensation has risen dramatically, and much of this increase can be attributed to the growth in option grants. In Table 4 we present the median levels of real total compensation for each year in our sample. This table contains the total level of compensation, as well as the real dollar values of salary, bonuses and option grants each year, and our three proportional measures.

From 1993⁸ through 2001 option grants sky-rocket, and total compensation rises correspondingly. Salary and bonus compensation drift down slightly during the period. Then following the collapse of the dot.com bubble and the attendant accounting scandals following 2001, the levels of option grants fall precipitously, and total compensation falls in concert. There is some evidence of salary and bonuses coming back into fashion.

These figures suggest it is possible that the positive relationship we find between total real compensation and the portion of option grants, and the negative correlations of the portions of salary and bonuses with total compensation, may merely be vestiges of these time series relationship, and not actually capturing a trade-off in the utility of risk-bearing faced by the managers as we contend. To circumvent this difficulty we included

⁸ The EXECUCOMP data for 1992, and to some extent 1993, are a bit difficult to compare to the other years. Public statement of these items was not mandatory until fiscal years beginning after December 15, 1995. So for the first two years, a small sample of firms disclosed the information voluntarily. For the most part, these were very large firms.

the year-specific dummy variables in our models to control for such time-series effects. But, some further analysis may help to reinforce the support for Hypothesis H1.

One easy way to reconfirm the results is to simply eliminate the time-series elements from the analyses. To this end, we estimate Tobit models for each of the three relationships with data for each year in turn.⁹ Clearly, the firm and year-specific dummy variables cannot be employed in these specifications that use only one-year of data. Because the firm-level controls are not now present, we also estimate each model a second time, and include four more control variables. These are (1) a dummy variables set to one if the firm pays no dividends,¹⁰ (2) a dummy variable set to one if the firm pays high dividends,¹¹ (3) a measure of cash constraint,¹² and (4) firm age, proxied by the number of years since the firm was first listed on the CRSP tape. Core and Guay (1999) suggest the first three measures of cash and dividend constraints.

The results of the year-by-year regressions lend more support to our hypothesis concerning the relationships between the portions of the types of CEO compensation and real total pay. Here we do not show the results for all of these specifications. But, in the models for the portion of salary compensation the parameters on total real compensation are negative and significant (at the 99% confidence level) for all thirteen years. Similarly, for all the years the parameters in the models of the portion of option compensation are positive and significant.¹³ For the models of the portion of bonus compensation the

⁹ Again, we execute an initial OLS regression and eliminate outliers.

¹⁰ This includes share repurchases as well as common and preferred cash dividends.

¹¹ This dummy is set to one if common and preferred cash dividends (and/or share repurchases) are more than 50% of retained earnings.

¹² First, calculate the sum of common or preferred cash dividends, capital expenditures, and cash investment expenditures. Then subtract cash flows from operations. The sign of the difference indicates whether cash outflows are greater than cash inflows. Finally, the difference is scaled by total assets.

¹³ When the four extra control variables are included, the parameter in one year (2001) is no longer statistically significant at the 95% confidence level.

parameters are negative and significant in ten of the thirteen years (the exceptions are 1992, 1993 and 2001). These results give us added confidence in our Hypothesis H1.

VI. Summary and Discussion

We conduct an empirical study of the interrelationship of the major components of managerial compensation, straight-salary, bonuses, and option grants, with several firm-specific operating variables. We are primarily interested in how the personal risks faced by the manager influence the design of the compensation contract. We analyze four variables, the dollar value of total compensation, managerial equity holdings, firm equity risk, and the delta of the manager's equity portfolio.

We derive our hypotheses from the theoretical study by Lambert, Larcker and Verrecchia (1991), who employ a utility-based framework to explain the design of managerial compensation contracts. Their fundamental assertion is that the cash components included in a typical compensation contract are employed to moderate the personal risk faced by the poorly diversified manager.

We collect pooled, cross-sectional data from EXECUCOMP, COMPUSTAT and CRSP for a sample of CEO pay packages and the characteristics of their firms, for 13,026 firm-years, from 1,804 firms over thirteen years, from 1992 to 2004. The firms in the sample correspond roughly with the S&P 1500 over the period.

One of the unique contributions of our study is to test our hypotheses regarding the proportion of each of the four forms of compensation as a percentage of total pay against a series of firm-specific variables. Using the portions of the components of compensation is vital in our research design, as the proportional measures capture the interactions among the components. A change in the proportional use of any one of the

ingredients clearly affects those of the other three. This is consistent with how weights are assigned to the elements of compensation in a constrained maximization setting.

We combine two different econometric techniques to estimate each of the three models. First, similar to Yermack (1995), Bryan, Hwang and Lilien (2000) and Ryan and Wiggins (2001), we employ Tobit models because of the large number of censored values in the data. Second, following Murphy (1985), Himmelberg, Hubbard and Palia (1999), and Palia (2001) we add firm and year-specific fixed-effects to the models.

We find consistent evidence of a negative relationship between the components of cash-based compensation and the total level of compensation. The opposite is true for the relationship of the portion of option compensation and the size of the pay package. These results accord well with the view of Lambert, Larcker and Verrecchia who argue that compensation packages are, to some extent, designed to limit the personal risk faced by the CEO.

Our results concerning the relationships between the risk of firm equity (the standard deviation of daily stock returns throughout the fiscal year) and the elements of the compensation contract are one area where our results are fundamentally at odds with the contentions of Lambert, Larcker and Verrecchia. We find that the portion of option grants is positively correlated with equity risk, while the portions of straight-salary and bonuses are negative. These results are consistent with the argument by Demsetz and Lehn (1985) that managers of more risky firms must be granted a greater portion of stock-based compensation to provide proper motivation. It also coincides with anecdotal evidence that young, high-tech firms employ a large portion of managerial stock options.

The dollar value of equity held by the CEO is significantly and positively correlated with the portion of straight-salary and negatively correlated with the portion of option grants. These results support our hypothesis that if managers have limited equity holdings, they should be given more stock-based compensation to align their interests with those of shareholders.

One of the most unique elements of our study is our investigation of the effect of the manager's option portfolio delta on the design of the compensation contract. As expected, we observe that the delta has an inverted U-shaped relationship with the portion of option grants and a U-shaped relationship with the portion of salary compensation. We also find a positive relationship between the portion of bonus compensation and delta. The portion of option compensation is clearly the element of managerial compensation that is most sensitive to the value of delta. Our results support Lambert, Larcker and Verrecchia who argue that if the sensitivity of the manager's portfolio to changes in equity value is low, there is a strong incentive to increase it. But, when the sensitivity becomes too high, the desire is to decrease it.

Our results generally support the contention of Lambert, Larcker and Verrecchia (1991) who hold that cash-compensation may serve to balance out some of the risks associated with the equity compensation and holdings of the CEO. However, our findings on the effect of the risk of firm equity on the design of compensation contracts are most notably at odds with this line of reasoning.

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Table 1	
Variable Definitions and Symbols	
SALRYPC	Straight-Salary as a Percentage of Total Annual CEO Compensation
BONUSPC	Bonuses as a Percentage of Total Annual CEO Compensation
OPTGRPC	Option Grants as a Percentage of Total Annual CEO Compensation
TENURE	CEO Tenure (Years)
LEQMARK	Natural Logarithm of the Market Value of Equity
M/B	Market-to-Book Ratio of Firm Assets
ROA	Return on Assets (Ratio of Net Earnings to Total Assets)
RET	Annual Geometric Return on the Market Value of Equity
CEOCOMP	Real Total Annual CEO Compensation
SDS	Annualized Standard Deviation of Daily Stock Returns
CEOEQ	Real Value of Shares, Restricted Shares and the Estimated Real Black-Scholes Value of Options Held by the CEO
DELTA	Estimated Delta of the CEO's Equity Portfolio
DELTA2	DELTA Squared

Table 2**Univariate Sample Statistics**

13,026 Observations

<i>Variable</i>	<i>Median</i>	<i>Mean</i>	<i>Stand Dev</i>	<i>Minimum</i>	<i>Maximum</i>
SALRYPC	0.2737	0.3394	0.2479	0.0000	1.0000
BONUSPC	0.1591	0.1844	0.1688	0.0000	1.0000
OPTGRPC	0.3621	0.3621	0.2949	0.0000	1.0000
TENURE	5.0000	7.2524	7.3369	0.0000	54.0000
LEQMARK	0.1261	0.2799	1.6315	-5.9277	6.2311
M/B	1.6539	2.2142	2.0871	0.2983	78.5648
ROA	0.0512	0.0309	0.1672	-4.5831	0.6009
RET	0.1012	0.0647	0.4914	-3.8358	2.6419
CEOCOMP	1.9702	4.1386	12.6164	0.0005	694.3747
SDS	0.4022	0.4022	0.2271	0.0734	2.0728
CEOEQ	0.0167	0.1117	1.1480	0.0000	72.6243
DELTA	0.9432	0.9288	0.0642	0.0074	1.0000
DELTA2	0.8897	0.8668	0.1144	0.0001	1.0000

Table 3
Empirical Results

Parameter	SALRYPC			BONUSPC			OPTGRPC		
	Exp Sign	Parameter Estimate	Chi Square	Exp Sign	Parameter Estimate	Chi Square	Exp Sign	Parameter Estimate	Chi Square
TENURE α_1		0.00420	170.66***		-0.00053	3.00*		-0.00660	122.38***
LEQMARK α_2		-0.05641	328.03***		0.00724	5.69**		0.08503	243.35***
M/B α_3		0.00298	7.40***		-0.00223	3.64*		0.00563	8.62***
ROA α_4		-0.04703	16.18***		0.14530	119.20***		-0.01014	0.25
RET α_5		-0.01716	24.23***		0.06843	398.71***		-0.03062	24.56***
CEOCOMP β_1	-	-0.00491	585.67***	-	-0.00348	282.18***	+	0.00364	831.18***
SDS β_2	+(?)	-0.02843	4.41**	+(?)	-0.10556	63.21***	-(?)	0.12443	26.53***
CEOEQ β_3	+	0.00761	19.78***	+	0.00129	0.56	-	-0.01067	4.54**
DELTA β_4	-	-1.00543	11.25***	-	-0.38018	1.90	+	9.31537	102.03***
DELTA2 β_5	+	0.59741	12.02***	+	0.47094	8.80***	-	-5.90542	127.53***
Observations		12,831			12,911			12,982	
Cross-Sections		1,794			1,803				
Right Censored (100%)		175			0			20	
Left Censored (0%)		58			2,717			3,197	
Log Likelihood		5,976.73			3,981.21			-2,924.53	

Table 4**Median Amounts and Proportions of the
Components of Annual Compensation
1992-2004**

<i>Year</i>	<i>Real Total Comp.</i>	<i>Real Salary Comp.</i>	<i>Real Bonus Comp.</i>	<i>Real Option Comp.</i>	<i>Portion Salary Comp.</i>	<i>Portion Bonus Comp.</i>	<i>Portion Option Comp.</i>
1992	2,293	755	493	456	33.82%	19.71%	22.81%
1993	1,605	613	307	314	37.96%	19.32%	21.75%
1994	1,579	528	305	386	35.27%	19.31%	26.92%
1995	1,539	528	287	368	34.87%	18.49%	24.62%
1996	1,770	546	327	488	31.22%	17.56%	30.75%
1997	2,104	549	358	614	26.79%	17.42%	31.54%
1998	2,061	537	318	753	26.09%	14.66%	39.25%
1999	2,241	538	339	840	24.95%	14.72%	42.82%
2000	2,561	562	347	981	23.17%	13.13%	42.02%
2001	2,484	534	242	1,086	21.73%	8.94%	47.43%
2002	2,443	574	308	969	23.54%	13.43%	43.67%
2003	2,239	591	375	723	25.27%	16.30%	34.72%
2004	1,633	346	298	522	21.09%	18.00%	35.33%

Figure 1
Portions of the Forms of
Compensation and CEO Equity
Portfolio Delta

