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CEO reputation and stock-based compensation☆

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Abstract

I develop a theory of stock-based compensation contracts for the chief executive officers (CEOs) of firms and confront the theoretical predictions with recent CEO compensation data. The model characterizes the optimal contract for a CEO whose reputation evolves as signals of the executive's ability are observed by shareholders. Using various proxies for CEO reputation, I show a positive and economically meaningful relationship between stock-based pay-sensitivities and CEO reputation. The findings are robust to controls for CEO age, firm size, the dollar variability of the stock returns, and industry effects.

JEL classificaion: D8; G3; J3

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1. Introduction

The question of efficiency underlying the compensation packages awarded to the chief executive officers (CEOs) of publicly traded firms is one that has received great

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attention over the years. Much of this literature owes its origin to the seminal work of Jensen and Murphy (1990). They were among the first to examine the agency-theoretic prediction that CEOs are only motivated to act in their shareholders' best interest if they are offered incentive contracts that "pay for performance." Using a large sample of compensation contracts, Jensen and Murphy show a statistically positive, but small, *average* relationship between CEO compensation and firm performance. They find that the average CEO's firm-related wealth changes only \$3.25 for every \$1,000 change in shareholder wealth.

Hall and Liebman (1998) construct a highly comprehensive sample of more recent CEO pay packages, including executive shareholdings and stock option grants. With these data, they show an average pay-for-performance sensitivity of \$25.11 for every \$1,000 change in shareholder wealth, an average nearly eight times greater than that of Jensen and Murphy (1990). Arguably more important is their evidence of enormous cross-sectional variation in individual pay-for-performance sensitivities underlying this higher average sensitivity. What could explain this incredible richness in the cross-section of CEO compensation contracts? In particular, what empirical control variables would help explain this heterogeneity?

In this paper, I attempt to add to our understanding of the heterogeneity in *stock-based* compensation contracts by developing a theory of CEO compensation and bringing its prediction to the data. Naturally, this work is partially motivated by Jensen and Murphy (1990). However, I specifically focus, both theoretically and empirically, on the cross-sectional variation in CEO pay-for-performance sensitivities when shareholders can *only* write performance contracts on the firm's stock price. While other performance measures might also be important, attempts to understand the findings of Jensen and Murphy (1990) and Hall and Liebman (1998) are necessarily tied to stock-based compensation. Furthermore, by focussing solely on the sensitivity of compensation to the firm's stock price, I can address the question of what makes a firm's stock price a more effective contracting tool in one environment over another.

In my model, the effectiveness of stock-based pay depends directly on its *informativeness* of the CEO's contributions, which is affected in equilibrium by his perceived ability, or reputation. Therefore, the optimal stock-based contract depends on the CEO's reputation at the time of contracting, which I find to be strongly supported by the data using a host of empirical proxies for CEO reputation. Yet, in both the theoretical and empirical environment, a CEO's true underlying ability is unobservable. Thus, market participants form beliefs over CEO ability and update them according to Bayes rule as new information is observed. I define a CEO's reputation as this Bayesian assessment of ability.

The model I develop is one in which shareholders initially have a CEO of unknown ability managing their firm. The firm generates a single, noisy, terminal cash flow that depends on who is the CEO in place at the *end of the game*. The model characterizes the optimal (second-best) compensation contract offered to the incumbent CEO. Critical to the model is the feature that the firm has an opportunity to replace the incumbent CEO before the end of the game, and this has direct implications for the optimal contract.

In the model, the stock price is realized after the contract is offered to the CEO, but before the date at which the firm will make its retention/dismissal decision. Given the fact that the stock price represents the expected cash flow that will be earned in the future, the possibility that the CEO will be fired and replaced with a randomly drawn CEO from the labor pool affects the stock price. The reason is that the firm's terminal cash flow depends on the ability of the firm's CEO in place at the end of the game. Therefore, the stock price naturally reflects the probability that the incumbent CEO will be fired and replaced in the future. This is where perceptions of CEO ability (interpreted as a CEO's reputation) play an important role. The likelihood that the CEO will be retained in the future is increasing in the assessment of his ability at the time the compensation contract is offered. For higher estimates of CEO ability, there is a greater likelihood that the CEO will be retained until the end of the game. The stock price reflects this fact and thereby offers a more informative contracting mechanism. On the other hand, if the initial assessment of the incumbent CEO's ability is quite low, the likelihood of ultimately being retained in the future is also low. The stock price again reflects this fact and consequently puts more weight on the expected contribution to be made by the *replacement* CEO, as opposed to the incumbent CEO. This reduces the relative informativeness of stock price as a measure of the incumbent's contribution.

The model therefore predicts that the optimal stock-based pay sensitivity is increasing in the a priori reputational assessment of the CEO. As the assessment of the incumbent's ability increases, the relative weight that the stock price puts on the incumbent CEO's contribution increases and the optimal contract can be made more sensitive to the firm's stock price. Analogously, as the incumbent CEO's reputation falls, the stock price more heavily weights the value of a potential replacement, thereby minimizing its sensitivity to the incumbent CEO's effort choices. Given this lack of responsiveness, the reliance on stock-based compensation is optimally smaller for CEOs with lower reputations.

I confront this prediction with CEO compensation data drawn from Compustat's ExecuComp for the years 1993 to 1998. Similar to Jensen and Murphy (1990), I estimate stock-based pay sensitivities by the empirical relationship between changes in a CEO's firm-related wealth and changes in his shareholders' wealth. The change in a CEO's firm-related wealth includes yearly compensation flows (salary, bonus, stock option grants, and so on), as well as the change in the value of the stock and stock options held by the CEO during the year. Changes in shareholder wealth are estimated as the dollar return to shareholders each year. One way in which the methodology employed in this paper differs from that of Jensen and Murphy (1990) is that I rely on median regressions in place of ordinary least squares to minimize the effects of outliers. I also include a variety of executive- and firm-specific controls including CEO age, firm size, the variability of shareholder dollar returns, and industry effects. The empirical findings on the positive relationship between CEO reputation and pay sensitivities are robust to all of these controls.

To examine the model's claim that the heterogeneity in empirically observed, stock-based pay sensitivities can be (at least partially) explained by a CEO's reputation at the time compensation contracts are set, I collect several empirical

proxies of CEO reputation. In line with the model, the proxies are observable to the market and include:

(i) CEO tenure,
(ii) the number of business-related articles containing the CEO's name as returned by a search of the Dow Jones New Retrieval Service,
(iii) being appointed CEO from outside of the firm, and
(iv) industry-adjusted firm performance during the CEO's tenure.

I argue that each of these is positively related to the market's perception of the CEO's ability. For instance, a longer CEO tenure implies that the firm's board has historically been inclined to retain this executive.[1] More reputable CEOs should also find their names in the business press more often than those of lower perceived abilities. The third proxy relies on the idea that the perceived hurdle for becoming a CEO as an outsider is higher than for an insider who already possesses potentially valuable firm-specific knowledge. Lastly, generating favorable performance (relative to the firm's industry) while at the CEO helm should be associated with a higher reputation. A full discussion of the economic motivation underlying the choice of each of these proxies is given in Section 3.

I find that the data strongly support the model's prediction. The empirical proxies for CEO reputation are all positively associated with stock-based pay sensitivities in both a statistically and economically significant manner. For example, if CEO reputation is proxied by CEO tenure and the number of business articles in which the CEO's name appears, the range of pay sensitivities *not* explained by CEO age, firm size, or industry effects is \$9.03 per \$1, 000 change in shareholder wealth. To put this estimate in economic perspective, firm size alone explains a range of pay sensitivities of approximately \$20. The estimates underlying this range are as follows. For a median-aged CEO in a median-sized firm with the shortest CEO tenure and the fewest number of name-appearing articles, a compensation contract awards \$8.76 per \$1,000 change in shareholder wealth. However, if this same size firm employed a similar-aged CEO with the longest tenure and the most name-appearing business publications, the contract awards \$17.79 per \$1,000 change in shareholder wealth.[2]

Completely analogous results are shown when the other measures of reputation are included. Thus, given these empirical results, I conclude that CEO reputation (as proxied by several, observable control variables) is an important determinant in explaining the heterogeneity of observed stock-based pay sensitivities awarded to CEOs.

The remainder of the paper is organized as follows. Section 2 develops the theoretical model and characterizes the optimal stock-based compensation contract. Section 3 describes the data employed in this paper, including the proxies for CEO reputation, and outlines the empirical methodology. Section 4 shows the empirical findings on the link between pay sensitivities and CEO reputation. Section 5

[1] Corporate founders have been removed from the sample.

[2] As seen in Section 4, the range of the effect of CEO reputation on pay sensitivities is not affected by the choice of CEO age or firm size. The choice of *any* CEO age or firm size simply allows for an estimate of the overall pay sensitivities awarded CEOs with different reputations holding age and firm size fixed.

concludes. The appendix includes detailed discussions on parts of the data collection process.

2. The model

This is a model of the compensation design problem between a firm's shareholders and its CEO. Shareholders have the responsibility of hiring the firm's CEO, designing a compensation plan for the position, and potentially firing and replacing the CEO if performance is subpar. There is also an active financial market in which the claim on the firm's cash flow is priced. The model characterizes how the optimal stock-based contract changes as a function of the CEO's reputation and its relationship to the overall informativeness of the stock price.

2.1. Sequence of events

The model solves for a single-period compensation contract. However, there are several stages to the game. Each of these is described in detail and motivated below, but to fix ideas, the sequence of events can be summarized as follows:

1. At the start of the game, the firm has a CEO of unknown ability in place. The estimate of the incumbent CEO's ability is given by η_1, where $\eta_1 \sim N(\bar{\eta}_1, \sigma^2_{\eta_1})$. No one, including the CEO, knows this ability.
2. Shareholders offer a compensation contract to the CEO that is linear in the firm's stock price. Contracts take the form $W=S+bP$, where S represents the fixed salary, $b \in [0, 1]$ is the pay-for-performance sensitivity, and P is the firm's stock price for its one outstanding share.
3. The CEO decides whether to accept the wage contract, and if he does, privately chooses an effort level $e \in [0, \infty)$.
4. Stock market participants observe an informative, yet noncontractible signal about the incumbent CEO's effort choice. A stock price obtains that represents the expected terminal cash flow for the firm based on this signal and a rational conjecture regarding the retention of the incumbent CEO.
5. Shareholders observe a signal of the incumbent CEO's ability, given by $s=\eta_I+v$, where η_I is the incumbent's true ability and $v \sim N(0, \sigma^2_v)$. The CEO is fired if the posterior assessment of his ability, conditional on the signal s (where the posterior is denoted η_2), falls below a cutoff η^C. If the incumbent CEO is dismissed, a replacement CEO is chosen at random, and the prior over his ability is $\eta_0 \sim N(\bar{\eta}_0, \sigma^2_{\eta_0})$. For simplicity, let $\bar{\eta}_0 \equiv 0$.[3]
6. The terminal cash flow of the firm is realized and the game ends.

[3] The subscript 1 denotes an incumbent CEO at the start of the game. I use 1 since shareholders may have observed some information over his ability. I let the subscript 2 denote the fact that at this stage more information (s) has been observed about the incumbent's ability. Lastly, I denote a randomly drawn replacement CEO, for whom there is less information, with a subscript 0.

2.2. Agents and preferences

Risk-neutral shareholders own the firm. While these shareholders are interested in the firm's terminal cash flow, I assume that they act such that the stock price reflects its expected value at all points in time. A natural way to motivate this is to assume that a fraction of shareholders are forced to sell their claims for exogenous liquidity reasons. Henceforth, assume that shareholders maximize the expected value of their shares in their compensation design decision.

All CEOs are risk averse. Each has negative exponential utility given by

$$U(W,e) = -\exp\left\{-r\left[W - \frac{k}{2}e^2\right]\right\}, \tag{1}$$

where W is the CEO's total wage, e is the CEO's effort choice, r is the coefficient of risk aversion, and $k>0$ is a constant reflecting the CEO's aversion to effort.

Reservation wages are not specified as I am not characterizing the total wage contract, only the optimal sharing rule. The model, however, is directly amenable to such an exercise. What is implicit in the model is that firms prefer a more talented CEO to a less talented one. This necessitates that the contribution to firm value from an increase in CEO ability is greater than the commensurate increase in the CEO's reservation wage.

2.3. Signals, beliefs and retention policy

As noted in the sequence of events, shareholders observe a signal about the quality of the incumbent CEO before the end of the game, offering the shareholders an opportunity to fire and replace him. This signal, denoted s, is observed *after* the market price of the firm is realized. The signal is noncontractible and given by $s = \eta_I + v$, where η_I is the incumbent's true ability and $v \sim \mathrm{N}(0, \sigma_v^2)$. Conditional on observing s, the updated estimate of the incumbent CEO's ability is given by

$$\mathrm{E}(\eta|s,\eta_1) \equiv \eta_2, \tag{2}$$

where $\eta_2 \sim \mathrm{N}([\sigma_v^2\bar{\eta}_1 + \sigma_{\eta_1}^2 s]/[\sigma_{\eta_1}^2 + \sigma_v^2], [\sigma_v^2/[\sigma_{\eta_1}^2 + \sigma_v^2]]\sigma_{\eta_1}^2)$. Let $\bar{\eta}_2$ denote the mean of the posterior estimate of the incumbent CEO's ability. Observe that $Var(\eta_2) < Var(\eta_1)$. That is, the variance of the estimate of a CEO's ability diminishes over time. This relates to the Gibbons and Murphy (1992) tenure effect. As a CEO spends time on the job, the market learns about his ability and hence the variance of his estimated ability falls. The distinction between the role of tenure in reducing the variance of the estimate of ability and its role as a proxy for reputation is discussed later.

After shareholders observe the signal

$$s = \eta_\mathrm{I} + v \tag{3}$$

and update their beliefs surrounding the ability of the incumbent CEO, the CEO is fired and replaced with a random draw from the labor pool of CEOs if this estimate

falls below a critical level. I denote this termination cutoff as η^C. This cutoff can be derived in a number of ways, and I do not restrict the firm to any specific firing policy. Naturally, shareholders should adopt a firing policy to maximize their wealth and this would imply that they consider firing the CEO whenever his estimated ability fell below the average ability of the labor pool (that is, when $\eta_2 < \bar{\eta}_0 \equiv 0$). However, there may be costs associated with firing a CEO. Moreover, the inside shareholders (or the board) can have other implicit ties to the CEO and be reluctant to dismiss him.[4] To allow for a variety of dismissal policies, I simply specify that the CEO is fired if η_2 (the CEO's perceived ability conditional on the signal s) falls below η^C, where $\eta^C \in \Re^1$.

The efforts of the incumbent CEO are lost completely upon his dismissal, and I assume that a newly appointed CEO doesn't contribute effort. Therefore, a replacement's contribution to the firm's cash flow stems solely from his ability. Since the focus of this paper is on the design of the optimal contract for an incumbent CEO, I treat the replacement CEO exogenously. This assumption is innocuous. What is necessary for the results is that there is *some* part of the stock price that reflects the contributions of the replacement CEO, rather than the incumbent. These contributions could obviously include the replacement's effort choice, but need not for my purposes.

Although the retention/dismissal decision is made on the basis of the signal s, the wage contract is written prior to its realization. Hence, when shareholders design the CEO's compensation, they must assess the expected probability that the CEO will be fired in the future. Let $1 - \Gamma(\eta_1)$ be defined as the expected probability (as of the start of the game) that a CEO with perceived ability of η_1 (reputation) *will* have an assessed ability after the signal s is observed that falls below the cutofor retention. That is, let

$$1 - \Gamma(\eta_1) \equiv \mathrm{E}[\Pr(\eta_2 < \eta^C | \eta_1)]. \tag{4}$$

Hence, $\Gamma(\eta_1)$ represents the likelihood that a CEO that initially has a perceived ability of η_1 will be retained until the end of the game. Since the signal is normally distributed, $\Gamma(\eta_1)$ is monotonic in η_1. Therefore, the probability that a CEO is retained is strictly increasing in the CEO's reputation at the start of the game. That is, $\Gamma(\eta_1)$ is strictly increasing in the CEO's perceived ability η_1.

2.4. Cash flows and stock price

Given the firm's retention policy, there is a chance that either the incumbent CEO will survive until the end of the game, or that he will be replaced before the end. If

[4] Hermalin and Weisbach (1998) provide a theory of the bargaining game between a board of directors and the incumbent CEO. In their work, an important determinant to the board's firing rule is its perceived independence from the CEO (who may have appointed many of its members). Their result could certainly impact the cutoff η^C. The firing threshold can also be time-varying. Berkovitch, Israel, and Spiegel (2000) show that the threshold below which an incumbent CEO would be fired is increasing over his tenure. The intuition is that over time, a CEO loses his "option value" and thus his expected ability must be sufficiently high to outweigh the option value on an untried, yet riskier replacement.

the CEO is retained until the end of the game, the firm's terminal cash flow is

$$X_{\mathrm{I}} = e + \eta_{\mathrm{I}} + \varepsilon, \tag{5}$$

where e is the incumbent CEO's effort choice, η_I is the value of his true ability, and $\varepsilon \sim \mathrm{N}(0, \sigma_\varepsilon^2)$ is noise. On the other hand, if the CEO is fired and replaced, the terminal cash flow is $X_{\mathrm{R}} = \eta_{\mathrm{R}} + \varepsilon$, where η_{R} denotes the true ability of the replacement CEO and ε remains noise.

The financial market consists of competitive risk-neutral traders that set the price for the firm after observing a noncontractible signal of the incumbent CEO's effort choice. That is, the signal is a noisy estimate of $X_{\mathrm{I}} - \eta_{\mathrm{I}}$, given by $Y = [e + \varepsilon] + \omega$, where $\omega \sim \mathrm{N}(0, \sigma_\omega^2)$ and is independent of ε. With the different potential cash flow realizations that one could obtain, market participants compare the likelihood that the incumbent CEO will be retained until the end of the game to the chance that the CEO will be fired and replaced. The expected likelihood that the CEO will be retained is $\Gamma(\eta_1)$. When he is retained (occurring when $\eta_2 \geqslant \eta^{\mathrm{C}}$), price is equal to the conditional expected cash flow of the incumbent given the observed signal of the incumbent's effort choice, Y. This expectation takes account of the fact that only a CEO with an ability of $\eta_2 \geqslant \eta^{\mathrm{C}}$ is retained. When the CEO is fired (occurring when $\eta_2 < \eta^{\mathrm{C}}$), the expected value of the firm is simply the expected contribution of the replacement CEO who is randomly drawn from the CEO population. This value is given by $\bar{\eta}_0 \equiv 0$. Lastly, to insure that the effects of this mixing can't be perfectly unwound, I assume that there is an independent noise term in the stock price, given by $\xi \sim \mathrm{N}(0, \sigma_\xi^2)$ Uncertainty over the firing cutoff level of η^{C} would serve the same purpose.

Ignoring the CEO's wage, price can then be written as

$$P = \begin{bmatrix} \Pr(\text{CEO Retained}|\eta_1) \times \mathrm{E}[X_{\mathrm{I}}|Y, \eta_1] \\ +\Pr(\text{CEO Fired}|\eta_1) \times \mathrm{E}[X_{\mathrm{R}}] \end{bmatrix} + \xi, \tag{6}$$

where $\mathrm{E}[X_{\mathrm{R}}] = \bar{\eta}_0 \equiv 0$. The expected value of the incumbent's contribution is

$$\begin{aligned} \mathrm{E}[X_{\mathrm{I}}|Y, \eta_1] &= [[1-\beta]\mathrm{E}[X_{\mathrm{I}} - \eta_{\mathrm{I}}] + \beta Y] + E[\eta|\eta_2 > \eta^{\mathrm{C}}] \\ &= [[1-\beta][e] + \beta[e + \varepsilon + \omega]] + \left[\bar{\eta}_1 + \sigma_{\eta_1} \frac{\phi(\alpha)}{1 - \Phi(\alpha)}\right], \end{aligned} \tag{7}$$

where
$\beta = Cov(e + \varepsilon, Y)/Var(Y) = \sigma_\varepsilon^2/[\sigma_\varepsilon^2 + \sigma_\omega^2])$, $\alpha = [\eta^C - \bar{\eta}_1]/\sigma_{\eta_1},$; $Y = e + \varepsilon + \omega$ is the signal observed by traders, and $\phi(\cdot)$ and $\Phi(\cdot)$ are the density and distribution functions of the standard normal distribution, respectively. Collecting these pieces, the stock price is

$$P = \Gamma(\eta_1)\left\{[[1-\beta][e] + \beta[e + \varepsilon + \omega]] + \left[\bar{\eta}_1 + \sigma_{\eta_1} \frac{\phi(\alpha)}{1 - \Phi(\alpha)}\right]\right\} + \xi, \tag{8}$$

and its variance is

$$var(P) = [\Gamma(\eta_1)]^2\beta^2\left[\sigma_\varepsilon^2 + \sigma_\omega^2\right] + \sigma_\xi^2. \tag{9}$$

2.5. CEO's compensation contract

In characterizing the optimal contract, I begin with the CEO's maximization program. The CEO receives a stock-based wage contract of the form $W = S + bP$, where P is given by equation (8). Given normality and the CEO's negative exponential utility, the CEO will choose his effort to maximize the following:

$$\max_{e\in[0,\infty)} b\Gamma(\eta_1)e - \frac{k}{2}e^2 - \frac{r}{2}b^2 Var(P). \tag{10}$$

The maximand reflects the manager's certainty equivalent from choosing effort level e. The first order condition yields the manager's choice of effort,

$$e^* = \frac{b\Gamma(\eta_1)}{k}. \tag{11}$$

The CEO's equilibrium effort choice is naturally increasing in his share of the stock price, b. However, his equilibrium effort choice is also increasing in the likelihood that he will be retained until the end of the game. This is intuitive. If it is highly unlikely that the CEO will be retained, the stock price is not very responsive to the CEO's efforts since these are lost when he is fired. Thus, given that the CEO finds effort costly, he exerts less effort when his compensation is less responsive to it.

2.5.1. Optimal pay-for-performance sensitivity

With the CEO's first-order condition in hand, the shareholders will choose the desired effort level and the performance-sensitivity of the contract, b, to maximize the price of the firm. The shareholders' maximization program is

$$\begin{aligned} &\max_{\langle e\in[0,\infty),b\in[0,1]\rangle} && \Gamma(\eta_1)e - \frac{k}{2}e^2 - \frac{r}{2}b^2 Var(P) \\ &s.t. && e^* = \frac{b\Gamma(\eta_1)}{k}. \end{aligned} \tag{12}$$

Observe the absence of the participation constraint in the maximization program. Given the CEO's utility function, this constraint does not affect the optimal sharing rule b. This solution relies on the first-order approach, which owes its origins to Holmstrom (1979), Rogerson (1985), and Jewitt (1988). The solution to the program yields the following:

$$e^* = \frac{\Gamma(\eta_1)}{k[1 + rkVar(P)/[\Gamma(\eta_1)]^2]} \tag{13}$$

$$b^* = \frac{1}{[1 + rkVar(P)/[\Gamma(\eta_1)]^2]}. \tag{14}$$

2.5.2. Theorem

Theorem 1. The optimal pay-for-performance sensitivity, b^*, is increasing in the reputational assessment of the CEO at the time the contract is written, given by η_1.

The derivation of Theorem 1 is straightforward. As we can see from Eq. (14), the pay-for-performance sensitivity of the wage contract is strictly increasing in the probability that the CEO is retained until the end of the game, $\Gamma(\eta_1)$. Naturally, the likelihood of being retained is strictly increasing in the perceived ability of the incumbent CEO when the contract is written (η_1). Interpreting this perception of ability as the CEO's reputation, we have the result that b^* is increasing in the CEO's reputation at the time of contracting. The intuition is as follows. As the likelihood that the CEO will be in place to the end of the game increases, the *forward-looking* stock price more heavily weights information related to the incumbent CEO. As this weight increases, stock price informativeness with respect to the incumbent CEO's actions goes up, increasing the weight the stock price receives in the optimal contract. Thus, the model shows that involuntary CEO turnover affects the optimal contract in a novel way.

The result of Theorem 1 can be neatly distinguished from the pure tenure effect of Gibbons and Murphy (1992). They show that the pay-for-performance sensitivity is increasing in the CEO's tenure since the variance in the estimate of the CEO's ability declines over time. Their result would hold here as well. Observe from equation (9) that the variance of price is strictly decreasing in the variance of the incumbent CEO's estimated ability. In a repeated version of my model, the variance surrounding ability would be less for an incumbent CEO than a randomly drawn CEO. To see this, recall that within my model $Var(\eta_2) < Var(\eta_1)$. Therefore, since the optimal pay-for-performance sensitivity b^* is decreasing in the variance of price, it is also decreasing in the variance of the CEO's ability. The variance over ability is reduced over the life of a CEO, and thus the performance sensitivity of the optimal contract would be increasing in the CEO's tenure as well. However, what Theorem 1 says is that, holding tenure fixed, a CEO with a greater η_1 will have a greater b^*. That is, it is not just tenure that matters, but it is also the CEO's reputation and how that impacts the probabilistic assessment that he will be retained in the future. While a longer tenure can imply that there is less uncertainty over his estimated ability, if the assessment of his ability has dropped, the CEO is more likely to be dismissed. Consuquently, this CEO will have a lower pay-for-performance sensitivity.

3. Data description and empirical methodology

In this section, I summarize the data and empirical methods employed to bring the prediction of Theorem 1 that stock-based pay sensitivities are strictly increasing in CEO reputation to the data. The necessary data include CEO compensation data, stockholder return data for the employing firms of these CEOs, and empirical proxies for CEO reputation at the time the terms of the compensation contract are

set. The collection process for each of these is detailed below, followed by a description of the empirical methodology employed.

3.1. CEO compensation data

The CEO compensation data are collected from Compustat's ExecuComp, spanning the years 1993 to 1998. These data include explicit calculations of executive compensation flows, as well as information related to changes in the value of an executive's stock and stock option holdings. Given that the theory is explicitly developed for CEO compensation, the first step is to glean only CEOs from this database that covers (up to) the top five executives of firms that are either in the Standard and Poor's (S&P) 500, the S&P MidCap Index, or the S&P SmallCap Index. ExecuComp provides an indicator field of whether the executive appearing in the database was in fact CEO of that firm *during* the fiscal year. However, this delineator is frequently at odds with the dates given for when that executive became CEO and importantly, when he left office. To most accurately retain true CEOs in the sample, I rely on three ExecuComp and Compustat fields including Became CEO, Left Office, and Month of Fiscal year-end for the firm. In the case of CEOs who left their offices midyear, these executives are keyed as CEOs in that corporate year only if they remained CEOs for at least six months. Similarly, for those executives who became CEOs during a year, they are only keyed as the CEO if they were in office at least six months of the fiscal year.

To focus the empirical analysis on the most direct principal–agent relationship, all corporate founders are removed. Unlike the *Forbes* annual compensation surveys, ExecuComp does not include a field denoting whether the CEO is the corporate founder. However, using S&P's Net Advantage, I identify 65 corporate founders, and these founding CEOs comprise 3.89% of the original sample. See the Appendix for a detailed discussion of the S&P's Net Advantage, a web-based, searchable database, and how it was employed to identify founders in the ExecuComp sample. Note that none of the empirical results in this paper are sensitive to this restriction to a non-founder sample.

With the list of CEOs in hand, I define flow compensation as the sum of a CEO's yearly salary, bonus, other annual (short-term) compensation, payouts from long-term incentive plans, the value of restricted stock granted, the Black–Scholes value of stock options granted, and all other (long-term) compensation. The first row of Table 1 summarizes the flow compensation for CEOs in the years 1993 to 1998. Yearly flow compensation awarded to CEOs ranges from \$0 to \$202.2 million, with an average value of \$3.3 million and median value of \$1.7 million. The right skewness of these data is quite evident here, and attempts to minimize the effects of severe outliers are outlined later.

While compensation flows certainly reflect significant dollar amounts, it is the change in the value of a CEO's stock and stock option portfolio over the year that constitutes the overwhelming majority of the heterogeneity in empirically estimated pay-sensitivities (see Murphy, 1999). In contrast to yearly compensation flows, estimating the change in the value of previously granted stock options is less direct

Table 1
Summary statistics on compensation and firm characteristics
The compensation data are from Compustat's ExcecuComp database covering the years 1993 through 1998 and firm stock data are drawn from Center for Research in Security Prices (CRSP). Flow compensation is the sum of a CEO's yearly salary, bonus, other annual (short-term) compensation, payouts from long-term incentive plans, the value of restricted stock granted, the Black-Scholes value of stock options granted and all other (long-term) compensation. Value of old ITM (in-the-money) options represents the Black-Scholes value of previously granted stock options. This is estimated by the sum of two items reported in ExecuComp: INMONEX and INMONUN. These are the value of exercisable in-the-money options and the value of unexercisable in-the-money options, respectively, and represent the values the CEO would have realized at year end if he had exercised all of his vested options that had an exercise price below the market price. Percent of stock held by CEO represents the percentage of total shares outstanding held by the CEO at year end. One-year % stock return is the percentage return for the firm over its fiscal year. The standard deviations of % stock returns are calculated using monthly returns over the five years preceding the year in which the firm is observed in the ExecuComp sample. Market value of equity is the firm's market capitalization (in millions of dollars) at the end of the firm's fiscal year. Sample consists of 5,924 executive-year/firm-year observations, except in the case of standard deviation of percentage returns which could be estimated for 5,492 observations. All CEOs identified as corporate founders are removed. Shareholder dollar return is calculated as the percentage stock return times the market capitalization of equity as of the beginning of the year.

	Mean	Min	Median	Max	Std. Dev.
Flow compensation ($K)	3,273.3	0	1,708.1	202,185.1	10,378.9
Value of old ITM options ($K)	9,387.5	0	2,006.3	659,493	28,624.6
Percent of stock held by CEO (%)	2.23	0	0.24	50.1	5.07
One-year % stock return (%)	31.47	−98.9	13.86	7,150	809.172
Standard deviation of % returns (σ_{jt})	30.3	7.3	26.8	177.3	14.6
Market value of equity ($M)	5,221.3	6.73	1,363.3	333,672.2	14,536.5
Shareholder dollar return ($M)	983.3	−16,692.9	113.5	108,812.5	4,801.5

when using the Execucomp database. Execucomp provides the values of *exercisable in-the-money* options and the value of *unexercisable in-the-money* options. For any given CEO, these represent the dollar values he would have realized at year end if he had exercised all of his vested and unvested options, respectively, that had an exercise price below the market price. Thus, the year-end value of previously issued stock options is estimated as the sum of these two ExecuComp items (INMONEX and INMONUN), and the summary statistics are contained in the second row of Table 1. Their average and median values are $9.4 million and $2.0 million, respectively. Again, the range in values is enormous, spanning from $0 to $659 million.

Changes in the value of CEO stock holdings are directly calculated using the percentage of total shares outstanding held by each CEO at year end (summarized in row 3 of Table 1). Bringing all of the compensation components together, for every CEO in the sample, I estimate changes in total firm-related wealth as the sum of the CEO's flow compensation for the firm's fiscal year and the changes in the market values of the CEO's holdings of stock and stock options in his company (relative to the beginning of the year) as outlined above.

3.2. Stockholder return data

In order to empirically estimate the sensitivity of compensation to changes in shareholder wealth, I match the firms in the ExecuComp database to fiscal-year stockholder performance data from CRSP. The fourth and fifth rows of Table 1 summarize each firm's annual percentage stock return in its current fiscal year and its standard deviation of returns, which is calculated using monthly return data from the previous five years' returns. Annual stock returns average 31.47% (median return is 13.86%) across firms in this time period, and the five-year standard deviation of monthly stock returns averages 30.3% (median standard deviation is 26.8%). The market capitalization of equity is calculated at year end and has an average value of \$5,221.3 million (median value was \$1,363.3 million), as seen in row 6. Lastly, row 7 summarizes the changes in shareholder wealth (i.e., the dollar return to shareholders), calculated as the percentage stock return for the current fiscal year times the beginning of period market capitalization of equity. The average dollar shareholder return is \$983.3 million, and the median is \$113.5 million.

3.3. Empirical measures of CEO reputation

The theoretical model developed in this paper offers a clear message. The perceived ability of the CEO at the time of contracting (defined in the model as η_1) plays a key role in determining the stock-based pay-sensitivity of the optimal contract. A CEO's reputation is essentially the market's assessment of his ability. However, a direct empirical measure for CEO reputation is less obvious. Ultimately, I would like to identify an observable measure (or set of measures) that captures the capital market's assessment of the CEO's ability. This reputational assessment is realistically multi-dimensional and in this spirit I consider four empirical proxies, including CEO tenure, whether the CEO is appointed from inside or outside of the firm, the number of business-related articles returned by Dow Jones Retrieval Service in which the CEO's name appears, and industry-adjusted stockholder returns while the CEO has been at the firm (estimated separately over one-year, three-year, and five-year time intervals). Below, I first define and discuss the three proxies for CEO reputation that are not explicitly tied to a firm's stock performance. I then turn to the fourth measure, industry-adjusted stockholder returns, which is explicitly based on firm (stockholder) performance. Summary statistics for each measure are contained in Table 2, Panel A.

The first proxy for reputation is CEO tenure, defined as the number of years the executive has been CEO at this firm as of the compensation year in ExecuComp. The economic interpretation is that the longer is the CEO's tenure, the greater are the board of directors' assessments of his ability given that this CEO has survived previous retention/dismissal decisions. While the market can't observe the board's full information set, it can learn from past retention decisions. As seen in the first row of the table, average and median CEO tenure are 8.50 and 6.46 years, respectively. It is important to note that while the theory above distinguishes between a CEO-tenure effect (as in Gibbons and Murphy, 1992) and a reputation

Table 2
Summary statistics of reputation proxies and business article quality
This panel contains the summary statistics for the CEO reputation proxies estimated in this paper. CEO Tenure is defined as the number of years the executive has been CEO with this firm as of the company's fiscal year-end. Outsider takes the value of 0 for the CEO in every year he appears in the sample if he joined the company at a date prior to becoming CEO. It takes the value of 1 for the CEO in every year he appears if the executive became CEO at the same time he joined the company. If the field for when the CEO joined the company is empty, it is left as "no observation." DJ Hits represents the total number of articles found by the Dow Jones Retrieval Service that mention the CEO's name at least once over the five-year period preceding the data year. Ind-adj. Perf 1 Year is calculated as the difference between the firm's average monthly stock returns and its industry's (defined by two-digit SIC code) average monthly return over one year, scaled by the standard deviation of industry returns. Similarly, Ind-adj. Perf 3 Year and Ind-adj. Perf 5 Year are calculated using the firm's previous three-year and five-year performance relative to its industry's average stock return and return volatility over the same time period. These calculations are only carried out if the CEO was actually the CEO in place during these time periods. Hence, the number of observations falls as the window over which historical firm performance is measured increases. The column denoted *N* contains the number of observations available for each proxy.

Panel A: Repuation proxies

	N	Mean	Min	Median	Max	Std. Dev.
CEO tenure	5,924	8.50	0.91	6.46	48.08	6.95
Outsider ($\in\{0,1\}$)	3,535	0.23	0	0	1	0.42
DJ Hits	5,924	124.3	0	55	7,502	308.3
Ind-adj Perf 1 Year	5,840	−0.06	−6.03	−0.07	12.72	0.61
Ind-adj Perf 3 Year	4,498	−0.02	−1.30	−0.03	2.92	0.29
Ind-adj Perf 5 Year	3,120	−0.03	−1.01	−0.04	0.85	0.19

This panel contains a summary of the underlying quality of the Dow Jones (DJ) Hits for a randomly selected sample of 50 CEOs in each data year between 1993 to 1998. For each CEO-year, up to 20 articles containing the CEO's name in the year prior to the data year were read in their entirety and quality was classified as either (i) strictly favorable, (ii) neutral to favorable, or (iii) strictly negative. Below, the percentages of articles read that were strictly favorable and strictly nonnegative (not (iii)) are given.

Panel B. Business article quality

		Year						
		1993–1998	1993	1994	1995	1996	1997	1998
% Strictly	mean	20.5%	13.8%	7.6%	24.5%	33.6%	28.1%	15.3%
Favorable	median	15%	9.1%	10%	19.1%	31.7%	25.0%	14.6%
% Nonnegative	mean	90%	87.7%	86.6%	87.6%	92.0%	91.1%	92.4%
	median	100%	95%	97.5%	97.5%	100%	100%	100%

effect, I empirically posit that greater CEO tenure would be associated with greater CEO reputation.

A second proxy I employ is whether the CEO was appointed from within or outside of the firm, where outside appointments are associated with having a higher reputation. Himmelberg and Hubbard (2000) also consider this measure in their analysis of the relative performance evaluation (RPE) puzzle. The intuition is that the perceived ability level necessary to become CEO as an outsider over an inside

candidate with better knowledge of the firm's inner workings is greater. I let an indicator variable, denoted *outsider*, take the value of zero if the CEO joined the company at a date *prior* to becoming CEO. *Outsider* takes the value of one if the date the CEO joined the company is the same as the date at which he became CEO. The second row of Table 2, Panel A highlights that 23% of the sample of CEOs are outside appointments. Two points are noteworthy. First, once a CEO is identified as an outside appointment, the executive carries the *outsider* = 1 field in every year the CEO appears in the sample while employed by the same firm. Second, there are many CEOs for which the date at which they joined the company is unavailable in ExecuComp. These CEOs are not assigned any value for *outsider*. Thus, the sample size drops by nearly one-third whenever I proxy for CEO reputation with *outsider*.

The third measure of CEO reputation is the total *number* of articles returned by the Dow Jones News Retrieval Service in which the executive's name appears at least once over a time period of five years prior to the ExecuComp data-year. Only selected business publications are searched, and these include newswires, business periodicals, and major newspapers. Full details of the search methodology are outlined in the Appendix. The idea is that a CEO who appears in selected business publications more often than others has a higher reputation. For instance, an executive perceived to be the industry expert would be interviewed and cited more often. Again, an executive's prominence in the financial press would be observable by the market and a potentially reliable guide to the aggregate assessment of his ability. The article count is denoted *DJ Hits*, and this rolling five-year window is updated each time the CEO appears in the sample. As seen in the third row of Table 2, Panel A, article hits per CEO average 124.3 articles, ranging from zero to 7,502. The median number of articles is 55.

Naturally, not all press is necessarily "good" press. However, it seems reasonable that publicity and reputation are on the whole positively related. In fact, Panel B of Table 2 shows that for a subsample of these Execucomp CEOs, very few negative articles appear in print. This subsample is collected as follows. Fifty CEOs are randomly selected in *each* of the years between 1993 and 1998. The Dow Jones News Retrieval Service is searched for all articles (up to a maximum of 20) containing the CEO's name in the year prior to the data year. Each article is read and then classified as being either (i) strictly favorable, (ii) neutral to favorable, or (iii) strictly negative with respect to the CEO.

Based on these classifications, Panel B of Table 2 summarizes the percentage of total articles read that are strictly favorable, and the percentage that are strictly nonnegative (i.e., those that were either strictly favorable or neutral to favorable). Column 1 shows that on average, 20.5% (median value of 15%) of the articles associated with these 50 CEOs are strictly favorable, and 90% of articles on average (median value of 100%) are strictly nonnegative. The remaining columns display the same percentages for each year in the sample, where values are qualitatively similar. While such classifications of the data were not carried out for the full sample owing to the sheer number of articles, the subsample statistics certainly support the idea that prominence in the business publications is associated with favorable assessments on average. Consequently, screening the article counts to contain only nonnegative

references essentially wouldn't change this measure in a material way. It seems reasonable that to the extent that some CEOs do receive negative press on occassion, those CEOs are less likely to survive to future periods. Thus, conditional on surviving as CEO suggests that historical press coverage was most likely nonnegative.

The last proxy for CEO reputation that I employ is explicitly performance-based, and is the industry-adjusted stock price performance while the CEO has been at the helm of the firm. Over a variety of time intervals, I calculate a relative performance measure within the industry in which the firm operates based on its two-digit SIC code. This approach accounts for the fact that the market would not necessarily devalue a CEO's reputation based on poor performance if the entire industry exhibited such performance. Under this industry-adjusted measure, the reputation of the CEO of firm j, which operates in industry I, is proxied by

$$\text{Ind-adj Perf } T \text{ Year}_j = [\bar{R}_j - \bar{R}_I]/\sigma_I, \tag{15}$$

where $\bar{R}_j$ is the average monthly return on the firm's equity over the performance period, $\bar{R}_{\mathrm{I}}$ is the average monthly return on an equally weighted portfolio for firm j's two-digit SIC industry over the performance period, σ_I is the standard deviation of the average monthly industry returns over the period, and $T \in \{1, 3, 5\}$ is the number of years over which the industry-adjusted performance is measured. I use an equally weighted industry portfolio since it is difficult for a CEO of a firm that represents a large fraction of the industry to ever outperform the industry average.

This metric is estimated for each CEO over performance periods of one, three, and five years prior to the ExecuComp data year. As I turn to the empirical tests involving this proxy, only CEOs whose tenures as of the beginning of the data period are at least as long as the estimated performance period are retained in the subsample. Thus, the sample size falls when I replace one-year industry-adjusted returns with three-year industry-adjusted returns as a proxy for CEO reputation, and falls further when a five-year window is used. The fourth, fifth, and sixth rows of Panel A of Table 2 contain the summary statistics over the three different performance windows. As can be seen there, the average and median industry-adjusted returns are slightly negative. Not surprisingly, the standard deviations of these measures significantly decline as the performance window increases.

3.3.1. *Relationship among reputation measures*

With the reputation proxies in hand, a natural question is whether these are jointly independent signals of a CEO's reputation, or in the worst case, simply noise. To examine the issue of independence, Table 3 summarizes the Pearson correlations between each of the CEO reputation proxies (CEO tenure, Outsider, Dow Jones Hits, Industry-Adjusted Performance over one, three, and five years) along with the CEO's age. Correlations among the non-performance-based reputation proxies are quite small, although not surprisingly, CEO age and tenure are significantly correlated (38.4%). CEO age is also significantly correlated with all of the other proxies, but no correlation exceeds 11.1% in absolute value. *CEO tenure* has a correlation of 8.3% with the CEO being hired as an outsider, and a correlation of

Table 3
Correlations among reputation proxies
This table contains the correlations among the CEO reputation proxies estimated in this paper. CEO Tenure is defined as the number of years the executive has been CEO with this firm as of the company's fiscal year-end. CEO Age is the CEO's age in the data year. Outsider takes the value of 0 for the CEO in every year he appears in the sample if he joined the company at a date prior to becoming CEO. It takes the value of 1 for the CEO in every year he appears if the executive became CEO at the same time he joined the company. If the field for when the CEO joined the company is empty, it is left as "no observation". DJ Hits represents the total number of articles found by the Dow Jones Retrieval Service that mention the CEO's name at least once over the five-year period preceding the data year. Ind-adj. Perf 1 Yr is calculated as the difference between the firm's average monthly stock returns and its industry's (defined by two-digit SIC code) average monthly return over one year, scaled by the standard deviation of industry returns. Similarly, Ind-adj. Perf 3 Yr and Ind-adj. Perf 5 Yr are calculated using the firm's previous three-year and five-year performance relative to its industry's average stock return and return volatility over the same time period. These calculations are only carried out if the CEO was actually the CEO in place during these time periods. Hence, the number of observations falls as the window over which historical firm performance is measured increases. The number of observations over which each of these correlations are estimated is in parentheses below it. Note: * denotes that the significance for the test that the two proxies are independent at the 1% level, ** denotes the same significance at the 5% level, and *** denotes the same significance at the 10% level.

	CEO Tenure	CEO Age	Outsider	DJ Hits	Ind-adj Perf 1 Yr	Ind-adj Perf 3 Yr	Ind-adj Perf 5 Yr
CEO Tenure	1.0 (5,924)						
CEO Age	0.384* (5,924)	1.0 (5,924)					
Outsider	0.083* (3,535)	−0.058* (3,535)	1.0 (3,535)				
DJ Hits	0.047* (5,924)	0.082* (5,924)	0.030*** (3,535)	1.0 (5,924)			
Ind-adj Perf 1 Yr	−0.023*** (5,840)	−0.044* (5,840)	0.009 (3,500)	0.020 (5,840)	1.0 (5,840)		
Ind-adj Perf 3 Yr	−0.053* (4,498)	−0.073* (4,498)	0.012 (2,799)	0.030*** (4,498)	0.558* (4,495)	1.0 (4,498)	
Ind-adj Perf 5 Yr	−0.065* (3,120)	−0.111* (3,120)	0.009 (2,034)	0.044** (3,120)	0.488* (3,118)	0.650* (3,120)	1.0 (3,120)

4.7% with *DJ Hits*. Moreover, being an *outsider* is (weakly) significantly correlated with *DJ Hits* at 3.0%.

In summary, these proxies are essentially orthogonal to one another as even the correlation between *CEO tenure* and being an *outsider* of 8.3% implies that being an *outsider* explains only 0.69% of *CEO tenure* ($R^2 = \rho^2 = 0.083^2$). Therefore, it appears that these non-performance-based proxies are in fact picking up different facets of CEO reputation. The least charitable interpretation of these low

correlations is that the measures are simply picking up noise. However, as shown later, not only are all of these measures statistically and economically significant explanatory variables for observed stock-based pay sensitivities, they all work in the same direction. Thus, it appears less plausible that these proxies are just noise.

Turning to the performance-based proxies across different time windows, these are highly correlated with each other. Industry-adjusted performance over one year has correlations of 53.8% and 48.8% with industry-adjusted performance over three and five years, respectively, and industry-adjusted performance over three years has a correlation of 65.0% with the performance over five years. Empirically, these high correlations are not problematic as only one industry-adjusted measure at a time will be included as a proxy for CEO reputation in the analysis. Correlations between the industry-adjusted and the non-performance-based measures are never larger than 7.3% in absolute value. Moreover, as in the case of *CEO tenure*, *outsider*, and *DJ Hits*, these proxies also turn out to be positively and significantly related to CEO pay sensitivities.

3.3.2. Reputation measures and future job retention

While the low correlations among the reputation measures are consistent with the idea that CEO reputation is multi-dimensional, the theory I develop dictates that higher values of these measures should be associated with a greater likelihood of being retained in future periods. This is an important issue, but a difficult one to address empirically. Ideally, I would construct an entire career path for each executive and use his eventual tenure to test the theory directly. However, given that my sample period only spans seven years, I cannot accurately determine how long CEOs stay, and instead proxy for the market's expectation of future tenure with my four measures. That said, it can still be instructive to determine if my reputation measures are related to the limited data on actual turnover using a multinomial logit model, even though we know from Warner, Watts, and Wruck (1988) that these models perform quite poorly in predicting turnover.

Table 4 provides a summary of the estimated coefficients from multinomial logit regressions of whether the incumbent CEO remains in office in the year following the data year as a function of my reputation measures. To maximize sample size, I estimate four separate specifications that always include *CEO Tenure* and *DJ Hits*, and for robustness, a variety of standard controls, including CEO age, firm size, the percentage of CEO share ownership, and the firm's one-year stock return. Column II adds the proxy *outsider* to the specification, and Columns III and IV add the one-year and five-year industry-adjusted performance measures, respectively. As seen in the table, the coefficients on CEO age, CEO ownership, and firm performance reveal that these controls perform in the standard way. Older CEOs are less likely to be retained in the next period, while those with greater share ownership and stock-price performance are more likely to be retained. Estimated coefficients on the reputation measures reveal (at worst) weakly supportive results. Both the coefficients on *CEO Tenure* and *outsider* are insignificantly different from zero. However, observe that both *DJ Hits* and the performance-based reputation measures perform quite well. The estimated coefficient on *DJ Hits* is positive and significant in three out of four

Table 4
CEO reputation and future job retention
This table contains logit regressions of whether the incumbent CEO remains in once in the year after the data year as a function of the reputation proxies given in Table 2 and other relevant controls. Note that "cdf" signifies that the empirical cumulative density function is estimated for the relevant variable. CEO Tenure is defined as the number of years the executive has been CEO with this firm as of the company's fiscal year-end. DJ Hits represents the total number of articles found by the Dow Jones Retrieval Service that mention the CEO's name at least once over the five-year period preceding the data year. CEO Age is the CEO's age in the data year. Outsider takes the value of for the CEO in every year he appears in the sample if he joined the company at a date prior to becoming CEO. It takes the value of 1 for the CEO in every year he appears if the executive became CEO at the same time he joined the company. If the field for when the CEO joined the company is empty, it is left as "no observation." Ind-adj. Perf 1 Yr is calculated as the difference between the firm's average monthly stock returns and its industry's (defined by two-digit SIC code) average monthly return over one year, scaled by the standard deviation of industry returns. Similarly, Ind-adj. Perf 5 Yr is calculated using the firm's previous five-year performance relative to its industry's average stock return and return volatility over the same time period. Size is the firm's size, given by the firm's market capitalization of equity (in millions of dollars) at the end of the firm's fiscal year. % Share Ownership represents the percentage of total shares outstanding held by the CEO at year end. One-year % stock return is the percentage return for the firm over its fiscal year. Estimated coefficients for the constants in each model are suppressed. Standard errors are in parentheses below the estimated coefficients. * denotes significance at the 1% level, ** at the 5% level, and *** at the 10% level.

CEO in office next year	I	II	III	IV
cdf(CEO tenure)	−0.045	−0.139	−0.055	0.329
	(0.166)	(0.214)	(0.167)	(0.205)
cdf(DJ Hits)	0.334**	−0.020	0.316**	0.475**
	(0.145)	(0.129)	(0.147)	(0.195)
cdf(CEO Age)	−1.216*	−1.081*	−1.221*	−1.483*
	(0.157)	(0.202)	(0.157)	(0.215)
outsider		−0.196		
		(0.129)		
cdf(Ind-adj. Perf 1 Yr)			0.455*	
			(0.149)	
cdf(Ind-adj. Perf 5 Yr)				0.358***
				(0.206)
cdf(size)	−0.154	0.346	−0.067	−0.318
	(0.176)	(0.243)	(0.176)	(0.242)
cdf(% Share Ownership)	0.273	0.547**	0.265	0.534**
	(0.178)	(0.232)	(0.180)	(0.245)
cdf(1-Year % Stock Return)	0.582*	0.220		
	(0.155)	(0.195)		
Sample size	4,769	2,913	4,695	2,485
Likelihood Ratio Chi-Squared	94.40*	39.92*	86.70*	73.72*

specifications. In fact, the magnitude of its coefficient is roughly as large as those of firm size and past stock performance. The industry-adjusted performance measures over one- and five-year windows are also both positively and significantly related to retention.

While the estimated coefficient on *outsider* is insignificant, it is the one proxy for which I can say something about eventual tenure. Since this variable, unlike the other proxies, is defined as of the CEO's start date, the summary statistics on tenure conditional on the value of outsider are informative. For the sample of 2,738 CEO-firm years for which the CEO is an insider, CEO tenure is on average 8.49 years (median of 6.66). On the other hand, for the sample of 797 CEO-firm years for which the CEO is in fact an outside appointment, average tenure is 9.87 years (median of 7.08). Thus, it doesn't appear that the average outside appointment is more often hired as a short-term, turn-around specialist.

In summary, given the poor predictive power of such logit specifications in general, and the neutral to positive relationship shown between my measures and actual turnover in Table 4, I suggest that it is reasonable to conclude that my reputation measures capture something material with respect to eventual tenure.

3.4. Empirical methodology

The empirical analysis employed in this paper to estimate stock-based pay sensitivities is rooted in the method of Jensen and Murphy (1990). I estimate changes in a CEO's firm-related wealth in year t as a function of the dollar return earned by the employing firms' shareholders (change in shareholder wealth) in year t by the following linear specification:

$$w_{jt} = \beta_0 + \beta_1 DR_{jt} + \sum_{t=93}^{98} Y_t + \varepsilon_{jt}. \tag{16}$$

Here, w_{jt} is the change in the CEO's firm-related wealth while employed by firm j in year t, DR_{jt} is the dollar return to shareholders in firm j in year t, $\sum_{t=93}^{98} Y_t$ are indicator variables for each year 1993 to 1998, and ε_{jt} is the error term. Year effects are included to capture any changes in pay levels across time. Moreover, given the extreme right skewness in changes in CEO firm-related wealth (as in its underlying components in Table 1), I estimate median regressions (as in Hall and Liebman, 1998) which minimize the sum of the absolute residuals rather than the sum of the squares of the residuals as in ordinary least squares regressions. Thus, the influence of outliers on the empirically estimated results is greatly reduced.

Estimating the specification in Eq. (16) does not speak to the heterogeneity in stock-based pay sensitivities as the estimated coefficient β_1 offers only the *median* pay sensitivity observed in CEO compensation. The theory developed above predicts that the cross-sectional variation in CEO reputation is positively associated with the cross-sectional heterogeneity in stock-based pay sensitivities. In order to test the

model's prediction, I adapt the methodology of Aggarwal and Samwick (1999) that utilizes the cumulative density functions (CDFs) of the empirical control variables. That is, any variable upon which the pay-sensitivity estimates are conditioned is first normalized according to its empirical CDF, and then interacted with shareholder dollar returns. For example, to estimate the effects of CEO reputation as proxied by the number of Dow Jones article counts, the specification in equation (16) is amended to:

$$w_{jt} = \beta_0 + \beta_1 DR_{jt} + \beta_2 F(DJ\ \ Hits_{jt}) DR_{jt} + \beta_3 F(DJ\ \ Hits_{jt}) + \sum_{t=93}^{98} Y_t + \varepsilon_{jt}, \quad (17)$$

where $F(DJ\ Hits_{jt})$ is the CDF of the number of Dow Jones article counts for the CEO of firm j as of year t.

The motivation for this specification is twofold. First, by normalizing *DJ Hits* to the unit interval, the importance of extreme outliers in this empirical proxy for CEO reputation is diminished. Second, the estimated coefficients β_1 and β_2 can readily be interpreted in an economically meaningful way for the manner in which CEO reputation, as proxied in this example by *DJ Hits*, affects the stock-based pay sensitivities at any level of reputation. The estimated pay sensitivity is given by $\beta_1 + \beta_2 F(DJ\ Hits_{jt})$ for a CEO of firm j in year t with a given number of article counts $DJ\ Hits_{jt}$. The range of pay sensitivities is given by β_1 for a CEO with the lowest number of *DJ Hits*, $\beta_1 + \frac{1}{2}\beta_2$ for a CEO with the median number of *DJ Hits*, and $\beta_1 + \beta_2$ for a CEO with the largest number of *DJ Hits*. Other proxies for CEO reputation, as well as other any other control variables that might affect estimated pay sensitivities, can be incorporated directly into equation (17) and interpreted in an additive manner. Observe that there are no qualitative differences in the results I show in the next section if I simply use the raw empirical proxies for CEO reputation in a median regression. That is, one can readily replace the CDF of proxies such as *DJ Hits* with the raw number of articles and interact this number with dollar returns to obtain the same interpretation. The only drawback to this approach is the lack of an immediate economic interpretation of the estimated coefficients.

In the regressions that follow, I also control for four other empirically relevant variables including CEO age, firm size, the variability of dollar returns, and the firm's two-digit industry. CEO age is shown to be significantly related to pay sensitivities in Gibbons and Murphy (1992). Baker and Hall (2000) point out that it is necessary to control for the interaction of firm size and dollar returns in regression specifications such as equation (16) because of the simple fact that it is difficult for a CEO to acquire a large percentage of shares (either directly or through stock options) in a larger firm. Aggarwal and Samwick (1999) show that the variability of dollar returns plays a key role in explaining some of the heterogeneity in stock-based pay sensitivities. Lastly, many studies show the presence of industry effects (see Murphy, 1999).

The effects of these four controls are estimated in Table 5 to highlight their continued relevance in this ExecuComp sample, and as an example of how to

interpret the estimated coefficients from the median regressions relying on the CDF normalization. As a benchmark, Column I estimates a median Jensen and Murphy (1990) regression of the changes in CEO firm-related wealth (in $ thousands) on shareholder dollar returns (in $ millions), with the inclusion of year effects. The estimated pay sensitivity reveals that the median CEO receives $3.52 per $1,000 shareholder return.

Column II summarizes the estimated coefficients upon controlling for CEO age and firm size, under the specification:

$$w_{jt} = \beta_0 + \beta_1 DR_{jt} + \beta_2 F(Age_{jt}) DR_{jt} + \beta_3 F(MV_{jt}) DR_{jt} + \beta_4 F(Age_{jt}) + \beta_5 F(MV_{jt}) + \sum_{t=93}^{98} Y_t + \sum_{j=1}^{99} SIC_{jt} + \varepsilon_{jt}, \tag{18}$$

where Age_{jt} is the CEO of firm j's age, MV_{jt} is firm j's market value of equity (proxy for size), and $\sum_{j=1}^{99} SIC_{jt}$ are industry indicator variables based on two-digit SIC codes. The estimated pay sensitivity is

$$\begin{aligned} &\beta_1 + \beta_2 F(Age_{jt}) + \beta_3 F(MV_{jt}) \\ &= \$25.44 - \$1.89 \times F(Age_{jt}) - \$22.30 \times F(MV_{jt}). \end{aligned} \tag{19}$$

Therefore, for the smallest firm with the youngest CEO in the sample, the CEO's pay sensitivity is $\$25.44 - \$1.89 \times 0 - \$22.30 \times 0 = \$25.44$, and in the largest firm it is $\$25.44 - \$1.89 \times 1 - \$26.21 \times 1 = \$1.35$.[5]

Column III estimates a similar specification, but replaces firm size with the variability of dollar returns (σ_{jt}). As seen in the table, it behaves similarly to firm size. Lastly, Column IV estimates a linear specification controlling for CEO age, firm size, and the variability of dollar returns. CEO age and firm size behave as before, but the variability of stock returns has an insignificant effect on pay sensitivities. In summary, CEO age, firm size, and to a lesser extent, dollar return variability remain important controls in explaining pay sensitivities in this data sample, and thereby are included (jointly and separately) for robustness in the tests of reputation as an explanatory variable of some of the remaining heterogeneity in CEO pay sensitivities. Results are qualitatively unchanged if industry controls are omitted.

4. Empirical results on CEO reputation

In this section, I take the model's prediction for the effects of CEO reputation on optimal pay sensitivities to the compensation data using the empirical method

[5] Note that in the summary tables, the pay sensitivities are estimated with CEO age and firm size moving in perfect sync. This is done simply for convenience as these two effects are in fact completely separable in their interpretation. For instance, the smallest firm with the oldest CEO offers a contract with a pay sensitivity of $\$25.44 - \$89 \times 1 - \$22.20 \times 0 = \$23.55$. Thus, the model is amenable to any variable combination, and this separability remains as the reputation proxies are added to the estimation procedure.

Table 5
CEO pay sensitivities and basic controls
Column I of this table contains a median regression of changes in CEO firm-related wealth regressed on shareholder dollar returns (SH $ Returns) and year effects. Column II contains a median regression of changes in CEO firm-related wealth regressed on shareholder dollar returns, the interaction of shareholder dollar returns and the cumulative density function (cdf) of the CEO's age (cdf(age)), the cdf of the CEO's age, the interaction of shareholder dollar returns and the cdf of the market equity (cdf(size)), the cdf of the market equity, two-digit SIC code indicator variables, and year effects. Column III contains a median regression of changes in CEO firm-related wealth regressed on shareholder dollar returns, the interaction of shareholder dollar returns and the cumulative density function (cdf) of the CEO's age (cdf(age)), the cdf of the CEO's age, the interaction of shareholder dollar returns and the cdf of the dollar variance of shareholder returns (cdf(variance)), the cdf of the dollar variance of shareholder returns, two-digit SIC code indicator variables, and year effects. Column IV contains a median regression of changes in CEO firm-related wealth regressed on shareholder dollar returns, the interaction of shareholder dollar returns and the cumulative density function (cdf) of the CEO's age (cdf(age)), the cdf of the CEO's age, the interaction of shareholder dollar returns and the cumulative density function (cdf) of the market equity (cdf(size)), the interaction of shareholder dollar returns and the cdf of the dollar variance of shareholder returns, the cdf of the market equity, the cdf of the dollar variance of shareholder returns, two-digit SIC code indicator variables, and year effects. The change in CEO firm-related wealth, measured in thousands of dollars, is the sum of the CEO's flow compensation for the firm's fiscal year and the change in the market value of the CEO's holdings of stock and stock options in his company (as of the beginning of the year). Shareholder dollar returns are measured in millions of dollars. A summary of the estimated pay-for-performance sensitivities is contained at the bottom of the table. Estimated coefficients for the intercept, two-digit SIC code indicator variables, year effects, and the cdf variables that are not interacted with shareholder dollar returns are suppressed. Standard errors are in parentheses below the estimated coefficients. * denotes significance at the 1% level.

	I	II	III	IV
SH $ Returns	3.52*	25.44*	22.71*	23.86*
	(0.015)	(0.327)	(0.276)	(0.473)
SH $ Returns × cdf(age)		−1.89*	−2.00*	−1.48*
		(0.049)	(0.037)	(0.049)
SH $ Returns × cdf(size)		−22.20*		−21.79*
		(0.330)		(0.699)
SH $ Returns × cdf(variance)			−19.51*	0.80
			(0.279)	(0.728)
Sample Size	5,924	5,924	5,559	5,229
Psuedo-R^2	0.078	0.117	0.111	0.115
Estimated pay sensitivities				
Minimum CEO age, size, and/or variance		$25.44	$22.71	$23.86
Median CEO age, size, and/or variance		$13.40	$11.96	$12.23
Maximum CEO age, size, and/or variance		$1.35	$1.20	$0.59

and the various empirical proxies described above. Of the four empirical proxies for CEO reputation, I focus initially on the non-performance- based measures of *CEO tenure*, *DJ Hits*, and *outsider*. The model predicts that pay sensitivities are increasing in CEO reputation. To test this using an augmented specification of equation (17), I calculate the CDF of *CEO Tenure* and *DJ Hits* and interact each of these with shareholder dollar returns. *Outsider* is already normalized to the unit interval, and so shareholder dollar returns are interacted with *outsider* directly.

Table 6 contains the results of the first test of the model's prediction using non-performance-based proxies. To maximize the sample size, I begin with *CEO Tenure* and *DJ Hits* as the only empirical proxies for CEO reputation since nearly one-third of the sample couldn't be classified as either an outside or inside CEO appointment owing to empty "Joined Company" fields for many CEOs. The empirical test, controlling for CEO age, firm size, and industry effects, is to estimate the following:

$$\begin{aligned} w_{jt} = {} & \beta_0 + \beta_1 DR_{jt} + \beta_2 F(CEO\ \ Tenure_{jt}) DR_{jt} + \beta_3 F(DJ\ \ Hits_{jt}) DR_{jt} \\ & + \beta_4 F(Age_{jt}) DR_{jt} + \beta_5 F(MV_{jt}) DR_{jt} + \beta_6 F(CEO\ \ Tenure_{jt}) \\ & + \beta_7 F(DJ\ \ Hits_{jt}) \\ & + \beta_8 F(Age_{jt}) + \beta_9 F(MV_{jt}) \\ & + \sum_{t=93}^{98} Y_t + \sum_{j=1}^{99} SIC_{jt} + \varepsilon_{jt}. \end{aligned} \tag{20}$$

Estimating positive coefficients for both β_2 and β_3 would be consistent with the model's prediction that higher CEO reputation leads to greater stock-based pay sensitivity.

Column I of Table 6 highlights that both coefficients are significantly positive at the 1% level. Moreover, both reputation coefficients are economically meaningful as well. For instance, in the case of CEO tenure, the interpretation of the β_2 coefficient is that as a CEO moves from having the shortest tenure to the longest one, the executive is awarded an increased pay sensitivity of \$7.82 per \$1,000 shareholder return. Similarly, in the case of DJ article counts, a move from having the fewest to the most implies an increased pay sensitivity of \$1.21 per \$1,000 shareholder return. At the bottom of Column I, the estimated pay sensitivity is summarized for both reputation effects jointly. Holding CEO age and firm size to their median sample values, stock-based pay sensitivities range from \$8.76 to \$13.28 to \$17.79 as a CEO moves from the lowest to the median to the highest (joint *CEO Tenure/DJ Hits*) reputation, respectively. Therefore, these data are strongly consistent with the prediction of Theorem 1 that CEO reputation (as proxied by tenure and article count) positively affects the stock-based pay sensitivities of CEOs.

The results of this first test are robust to other specifications. Columns II and III provide alternative tests of Eq. (20), where in Column II firm size is replaced by the variance of dollar returns, and Column III includes both the firm size and dollar-return variability controls in addition to CEO age and industry effects. In both cases, the estimated coefficients for the reputation proxies are positive, statistically

Table 6
CEO pay sensitivities and reputation
Column I contains a median regression of changes in CEO firm-related wealth regressed on shareholder dollar returns (SH $ Returns), the interaction of shareholder dollar returns and the cumulative density function (cdf) of CEO tenure (cdf(CEO tenure)), the cdf of CEO tenure, the interaction of shareholder dollar returns and the cdf of DJ Hits (cdf(DJ Hits)), the cdf of DJ Hits, the interaction of shareholder dollar returns and the cdf of the CEO's age (cdf(age)), the cdf of the CEO's age, the interaction of shareholder dollar returns and the cdf of the market equity (cdf(size)), the cdf of the market equity, two-digit SIC code indicator variables, and year effects. Column II contains a median regression that mirrors that of Column I, but replaces the two size controls with the interaction of shareholder dollar returns and the cdf of the dollar variance of shareholder returns (cdf(variance)), and the cdf of the dollar variance of shareholder returns. Column III contains a median regression that controls for both size and dollar variance of returns. Column IV contains a median regression that mirrors Column I, but also includes the interaction of shareholder dollar returns and the outsider indicator variable, and the outsider indicator variable. Column V mirrors Column IV, but also controls for dollar return variability. The change in CEO firm-related wealth, measured in thousands of dollars, is the sum of the CEO's flow compensation for the firm's fiscal year and the change in the market value of the CEO's holdings of stock and stock options in his company (as of the beginning of the year). Shareholder dollar returns are measured in millions of dollars. A summary of the estimated pay-for-performance sensitivities is contained at the bottom of the table. Estimated coefficients for the intercept, two-digit SIC code indicator variables, year effects, and the cdf variables that are not interacted with shareholder dollar returns are suppressed. Standard errors are in parentheses below the estimated coefficients. * denotes significance at the 1% level, and ** at the 5% level.

	I	II	III	IV	V
SH $ Returns	22.05*	19.17*	19.97*	15.53*	13.37*
	(0.270)	(0.250)	(0.392)	(0.306)	(0.351)
SH $ Returns × cdf(CEO tenure)	7.82*	8.87	7.97*	8.57*	8.56*
	(0.045)	(0.038)	(0.046)	(0.057)	(0.049)
SH $ Returns × cdf(DJ Hits)	1.21*	1.57*	1.49*	0.90*	1.14*
	(0.038)	(0.032)	(0.039)	(0.044)	(0.037)
SH $ Returns × outsider				2.59*	2.71*
				(0.054)	(0.047)
SH $ Returns × cdf(age)	−6.73*	−7.27*	−6.28*	−6.92*	−6.06*
	(0.044)	(0.037)	(0.045)	(0.050)	(0.044)
SH $ Returns × cdf(size)	−19.85*		−16.00*	−13.66*	−14.53*
	(0.272)		(0.580)	(0.309)	(0.544)
SH $ Returns × cdf(variance)		−17.29*	−2.36*		2.34*
		(0.254)	(0.604)		(0.547)
Sample Size	5,924	5,229	5,229	3,535	3,212
Psuedo-R^2	0.134	0.131	0.134	0.135	0.130
Estimated Pay Sensitivities Assuming Median CEO AGE, Firm Size, and Variance					
Minimum reputation	$8.76	$6.89	$7.65	$5.24	$4.25
Median reputation	$13.28	$12.11	$12.38	$11.27	$10.45
Maximum reputation	$17.79	$17.33	$17.11	$17.30	$16.66

significant, and economically meaningful as the estimated joint effects of reputation exceed a spread of $9.[6]

Broadening the set of reputation proxies, Column IV reports the estimated coefficients when the third non-performance-based proxy *outsider* is included.[7] Again, each estimated coefficient on the reputation proxies is positive and statistically significant at the 1% level. Moreover, the economic importance of these reputation proxies remains quite large, both jointly and independently. Holding CEO age and firm size fixed at the median levels, pay sensitivities range here from $5.24 to $11.27 to $17.30 as a CEO moves from the lowest to the median and then from the median to the highest joint (*CEO tenure*/*DJ Hits*/*outsider*) reputation, respectively. The estimated coefficients in Column V show that this result is robust to controls for the dollar variability of shareholder returns in addition to CEO age and firm size.

The lesson from Table 6 is straightforward, using a variety of proxies for CEO reputation, pay sensitivities offered to CEOs in practice are strictly increasing in CEO reputation. This is strong empirical evidence in support of the theory that predicts just such a relationship.

Table 7 summarizes the estimated effects of CEO reputation on pay sensitivities using industry-adjusted firm performance in addition to the non-performance-based proxies. I estimate the model using industry-adjusted performance over one year, three years, and five years. Since sample size is reduced as the performance window increases, I estimate the model with and without the *outsider* proxy to maximize the number of observations in the samples whenever possible. In all cases, the estimated coefficients for the reputation proxies are positive and significantly different from zero. Column I estimates coefficients for the model where CEO reputation is proxied by CEO tenure, DJ Hits, and the one-year industry-adjusted performance of the firm's stock. Observe that the coefficients on CEO tenure and DJ Hits are only marginally affected (in an upward manner), and that the coefficient on *Ind-adj Perf 1 Year* is $2.57. Thus, to the extent that a CEO's reputation is positively affected by how well his firm did relative to the industry while he was CEO, an increase in this measure also results in a higher pay sensitivity.

A very similar picture emerges when the *outsider* reputation proxy is added (Column II), and in addition, when the industry-adjusted performance measure is estimated over longer time periods (Columns III to VI). In all, the empirical controls of CEO tenure, DJ Hits, outsider, and industry-adjusted stock return performance

[6] The sample size reported in Columns II and III falls (relative to Column I) from 5,924 observations to 5,229 owing to the data restriction imposed that five years of monthly stock returns are used to estimate the variance of returns. Note that every time the sample size changes, every variable is renormalized to the unit interval according to its empirical CDF.

[7] Sample size also varies as different reputation proxies are included. It is maximized when only CEO tenure and the number of referencing business articles are included. Roughly one-third of the sample is lost when the insider-outsider proxy is included. When reputation is proxied by past performance, the sample size is further affected by the length of the time interval over which firm performance is measured relative to the industry as the CEO must have a tenure with this firm at least as long for the proxy to be meaningful.

Table 7
CEO pay sensitivities, reputation, and past performance
Column I contains a median regression of changes in CEO firm-related wealth regressed on shareholder dollar returns (SH $ Returns), the interaction of shareholder dollar returns and the cumulative density function (cdf) of CEO tenure (cdf(CEO tenure)), the cdf of CEO tenure, the interaction of shareholder dollar returns and the cdf of DJ Hits (cdf(DJ Hits)), the cdf of DJ Hits, the interaction of shareholder dollar returns and the cdf of one-year, industry-adjusted performance of the firm under the CEO's control, the cdf of one-year, industry-adjusted performance, the interaction of shareholder dollar returns and the cdf of the CEO's age (cdf(age)), the cdf of the CEO's age, the interaction of shareholder dollar returns and the cdf of the market equity (cdf(size)), the cdf of the market equity, two-digit SIC code indicator variables, and year effects. Column II contains a median regression that mirrors Column I, but also includes the interaction of shareholder dollar returns and the outsider indicator variable, and the outsider indicator variable. Columns III and IV contain median regressions that mirror Columns I and II, but replace the one-year, industry-adjusted performance controls with three-year, industry-adjusted controls. Columns V and VI contain median regressions that mirror Columns I and II, but replace the one-year, industry-adjusted performance controls with five-year, industry-adjusted controls. The change in CEO firm-related wealth, measured in thousands of dollars, is the sum of the CEO's flow compensation for the firm's fiscal year and the change in the market value of the CEO's holdings of stock and stock options in his company (as of the beginning of the year). Shareholder dollar returns are measured in millions of dollars. A summary of the estimated pay-for-performance sensitivities is contained at the bottom of the table. Estimated coefficients for the intercept, two-digit SIC code indicator variables, year effects, and the cdf variables that are not interacted with shareholder dollar returns are suppressed. Standard errors are in parentheses below the estimated coefficients. * denotes significance at the 1% level.

	I	II	III	IV	V	IV
SH $ Returns	17.56*	12.29*	22.37*	13.90*	21.94*	11.08*
	(0.361)	(0.407)	(0.422)	(0.382)	(0.604)	(0.320)
SH $ Returns × cdf(CEO tenure)	8.03*	8.71*	9.43*	9.82*	12.95*	10.91*
	(0.045)	(0.054)	(0.063)	(0.057)	(0.080)	(0.049)
SH $ Returns × cdf(DJ Hits)	1.84*	1.75*	2.02*	2.41*	2.21*	2.40*
	(0.038)	(0.041)	(0.054)	(0.046)	(0.070)	(0.041)
SH $ Returns × outsider		2.65*		4.12*		10.90*
		(0.052)		(0.059)		(0.089)
SH $ Returns × cdf(Ind-adj. Perf 1 Yr)	2.57*	2.92*				
	(0.075)	(0.083)				
SH $ Returns × cdf(Ind-adj. Perf 3 Yr)			6.47*	6.05*		
			(0.107)	(0.095)		
SH $ Returns × cdf(Ind-adj. Perf 5 Yr)					8.83*	6.35*
					(0.131)	(0.066)
SH $ Returns × cdf(age)	−6.68*	−7.40*	−8.42*	−7.44*	−12.78*	−9.09*
	(0.045)	(0.048)	(0.063)	(0.055)	(0.092)	(0.051)
SH $ Returns × cdf(size)	−17.71*	−12.70*	−24.75*	−17.40*	−23.86*	−13.05*
	(0.375)	(0.423)	(0.441)	(0.399)	(0.625)	(0.327)
Sample Size	5,840	3,500	4,498	2,799	3,120	2,034

Table 7 (*continued*)

	I	II	III	IV	V	IV
Psuedo-R^2	0.137	0.138	0.144	0.140	0.141	0.138
Estimated Pay Sensitivities Assuming Median CEO Age, and size						
Minimum reputation	\$5.37	\$2.24	\$5.79	\$1.48	\$3.62	\$0.01
Median reputation	\$11.59	\$10.26	\$14.75	\$12.68	\$15.62	\$15.29
Maximum reputation	\$17.81	\$18.27	\$23.71	\$23.88	\$27.61	\$30.57

have a positive and meaningful impact on estimated pay sensitivities, as predicted by the model.

5. Conclusion

Stock prices are the obvious and central measure of CEO performance. However, they are flawed in that they reflect forces outside of the CEO's control. Market-wide shocks represent an obvious example. I argue that an equally important source stems from the fact that firms are in principle infinitely lived, while CEOs only serve over a finite horizon. Informationally efficient stock prices therefore include expected performance well beyond a given CEO's tenure. The empirically testable prediction of the model is that stock-based pay sensitivities are strictly increasing in a CEO's reputation. Utilizing compensation data and a host of empirical measures of reputation, I provide strong supporting evidence for this prediction. My model can be viewed as a step towards a full principal-agent model in which the structure of stock prices (and therefore its contracting value) is directly modelled. Clearly other factors outside of the CEO's control affect a firm's stock price, and to the extent that we can model and empirically estimate them, further insights into executive pay design could be uncovered.

Appendix A. Data construction

A.1. Classifying founders

Since Standard and Poor's (S&P's) ExecuComp does not include a field for which CEOs are founders of their firms, I employ the S&P Corporation Records database. This is contained as part of the S&P Net Advantage database and provides financial information on over 12,000 publicly held corporations in the US and Canada.[8]

[8] See http://www.netadvantage.standardpoor.com/

As a menu-driven, web-based database, large searches are tedious. However, the whole sample need not be checked as part of the sample of CEOs is most likely disqualified if these executives had joined the company prior to becoming CEO. I eliminate those for further search when the *Joined Company* date precedes the *Became CEO* date in ExecuComp (i.e., those CEOs initially identified as insider appointments and *outsider* $\equiv 0$). The subsample of CEOs who certainly qualify as potential founders consists of those CEOs for which the *Became CEO* field matches the *Joined Company* field. Recall that these are the CEOs initially defined as outside appointments to the CEO post and *outsider* $\equiv 1$.

I then search the Corporation Records database for all firms employing CEOs for which *outsider* $\equiv 1$ for their *Incorporation Year*. If the year these executives became CEO matches the incorporation year, I identify them as founders and let *founder* $\equiv$ 1. Every other CEO is then assigned *founder* $\equiv 0$. This yields 65 corporate founders. One additional founder was identified upon a simple examination of CEO tenure. The CEO with the longest tenure, Charles H. Kaman of Kaman Corporation, also became CEO in the year in which the company was incorporated. This was not the case for the next 10 CEOs that topped the tenure list.

A.2. Identifying Dow Jones Article Counts

In any executive year, the reputation proxy *DJ Hits* represents the total number of articles returned by the Dow Jones Retrieval Service that mention the CEO's name at least once over the preceding five-year period.[9] That is, if the executive data year is 1993, *DJ Hits* is the total number of articles in which the CEO's name appears over the January 1988 to December 1992 time period. To be clear, only the total number of articles that are identified by the Dow Jones search are recorded in the full sample, and these articles are not individually read to insure that the correct CEO has always been identified.[10] To minimize some potential errors in the identification process, only the "Dow Jones—Selected Publications" list was searched. This list includes:

- Major News and Business Publications (112 International Publications)
- Top 50 US Newspapers (several, such as *The New York Times*, are already included in the first group)
- Wires: Press Release Wires (six newswires)

Invariably, article counts for executives could be understated. For example, there exists possible misspellings in ExecuComp's name fields, shortened names (e.g., Bill for William), and so on, which would return an empty or lower count. Or the count could be overstated due to very common names (e.g., Johnson), names combined with Jr. or III, and so on which would return a higher count. However, there seems no obvious direction that this bias would occur across the large sample of CEOs. In

[9] See http://www.djinteractive.com/

[10] See Table 2, Panel B for a summary of articles that were read and classified according to their "tone" for a subsample of CEOs.

addition, the empirical methods employed in the tests of model's hypotheses, including the use of median regressions and the normalization of the reputation proxies to the unit interval, should alleviate much of the concern for outliers.[11]

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