Strategic Flexibility and the Optimality of Pay for Sector Performance

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Abstract

While standard contract theory suggests that a CEO should be paid relative to a benchmark that removes the effects of sector performance, there is evidence that CEO pay is strongly and positively related to such sector performance. Many have coined this relationship as pay for luck. In this paper, we offer an explanation. We model a CEO charged with selecting the firm's strategy which determines the firm's exposure to sector performance. To incentivize the CEO to choose optimally, pay contracts will be positively and sometimes asymmetrically related to sector performance. Consistent with our predictions, our empirical analysis indicates that the observed sensitivity of pay to sector performance is almost fully confined to multi-segment firms and is greater in firms that offer greater strategic flexibility to alter sector exposure, for more talented CEOs, and for CEOs as compared to their subordinate executives. Our evidence is robust to alternate explanations such as CEO entrenchment. (*JEL* G30, J33)

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1 Introduction

One of the basic tenets of compensation theory is that optimal incentive-based pay should depend on variables under the manager's control and not on those over which the manager has no control. If the performance of the firm's sector is outside the manager's control, then this would imply that the optimal incentive contract should be based on the firm's performance relative to the sector performance (this is known as Relative Performance Evaluation (RPE)).[1] This prediction has been extensively tested on CEO pay data with firm performance measured relative to the performance of either the firm's sector or the overall stock market. Such studies typically find very little evidence of RPE for the average CEO.[2] On the contrary, there is strong evidence of a positive relationship between CEO pay and the performance of the firm's operating sector, although this varies in the cross-section. The lack of RPE for the average CEO has been recently spun under the auspice that CEOs receive compensation contracts that exhibit "pay for luck," rather than true "pay for performance" (Bertrand and Mullainathan (2001)). This has become the crux of the managerial power hypothesis, most prominently put forth by Bebchuk and Fried (2003), who argue that the pay process has been captured and unduly influenced by the CEOs.[3] Our paper sheds light on both the lack of RPE and also speaks to the popular managerial power hypothesis.

We return to the basic premise of Holmstrom (1979) and ask a fairly simple question. Even if sector performance is outside the manager's control, can the manager influence how sector performance affects firm performance? That is, is the empirically-identified portion of firm performance due to sector performance really something over which the executive has no control? We argue that the answer to this question is a resounding no. While there are clearly market forces at work that are beyond the executive's control, our basic argument is that the CEO typically has at least some discretion over the firm's exposure to such forces through the choice of the firm's strategy.

Holmstrom (2005) makes a similar point: "if John Browne's (then CEO of British Petroleum) incentive pay were insulated from oil price shocks, it would affect the way he thinks about ex-

[1] RPE is analogous to benchmarking or indexation. In all cases, some element of performance attributed to an exogenous factor is pulled out of the ultimate measure of an agent's performance. See Weisbach (2007) for a summary and Holmstrom (1982) for its origins.

[2] Aggarwal and Samwick (1999a, 1999b), Antle and Smith (1986), Janakiraman, Lambert and Larcker (1992), and Garvey and Milbourn (2003) offer studies that jointly span the 1980's through early 2000's.

[3] The more appropriate term for this observed phenomenon is "pay for firm performance due to luck." Given the literature's familiarity with the more elegant phrase, "pay for luck," we use it in our discussions as well. To fix terminology, by "luck" we refer to the sector performance over which the CEO has no control, and by "pay for luck" we refer to pay for the component of firm performance due to luck.

ploration and how he reacts to price shocks once they occur. Even comparisons with other oil companies or the overall stock market could influence his risk choices." Here, we propose a simple model to formalize optimal incentive contracts when a firm's exposure to sector movements is the CEO's strategic choice. Our model shows that the optimal incentive contract should not remove such sector forces from the CEO's pay. We derive a number of predictions about how the sensitivity of CEO pay to firm performance due to sector movements will vary in the cross-section and find significant empirical support for these predictions.

Our view in this paper is that to understand CEO pay we should first specify what CEOs actually do in that role. The longstanding modeling choice in the literature considers a standard agency setup, wherein expected firm performance is assumed to *directly* depend on the CEO's (personally) costly effort and some random factors over which the CEO has no control. The optimal contract incentivizes the CEO to exert effort to maximize firm value. If the sector performance only affects the random portion of firm performance, then such models predict the optimality of RPE. Our contention is that the Board of Directors is not primarily concerned with how hard the CEO is actually working, but whether she has the vision to choose the right *strategy* for deploying the firm's assets. In doing so, the CEO concerns herself with the firm's strategic direction in lieu of its surrounding market environment: Where is the industry going and how does the firm fit into it? What type of exposure to the industry is optimal for the firm? Such a situation forms the basis of our analysis to model the CEO's job as one of choosing the firm's strategy, which in turn affects the firm's exposure to sector movements. It is important to note that sector or industry benchmarks are just a special case of the general theory we have in mind. The CEO could choose an exposure to anything relevant for her firm, but industry returns happen to be something we can observe empirically as we test our theory.[4]

The rapidly growing literature on leadership models CEOs as visionaries whose main role is to set the strategy for the firm (see, for example, Rotemberg and Saloner (2000), and Van den Steen (2005)). However, to the best of our knowledge, such a CEO role has not been integrated into a formal analysis in the compensation literature. In fact, Bolton, Brunnermeier and Veldkamp (2008) argue that "the principal-agent approach to the firm makes no room for leadership, ... no room for any significant role for management... more often than not shareholders are in reality looking for guidance by the manager... when a firm appoints a new CEO it [the board] may define in broad

[4] Our results are robust to using broader market returns as well.

terms the CEO's compensation package, but otherwise gives *carte blanche* to the CEO in defining and implementing the firm's strategy..." Our paper takes an early step at modeling such an active role for the CEO and highlights its effect on the optimal incentive contract. Such an approach yields several new predictions and also sheds light on existing puzzles.

There is significant anecdotal support for our assumption that the CEO actively influences firm strategy. McKinsey & Company surveyed 586 global corporate directors and these respondents reported that 24% of board time was spent on the development and analysis of strategy.[5] Bennedsen, Pérez-González and Wolfenzon (2008) demonstrate the impact of CEOs on firm value using a natural experiment involving CEO-family deaths. Their findings suggest that the CEO is not an otherwise passive agent, but adds value through the host of actions and decisions she makes vis-à-vis the firm's strategic course. It is in this manner that we model the CEO's role in the firm. Our model is also in the spirit of the recent work of Frydman (2007) and Murphy and Zábojník (2007) that suggest that over time, CEOs have become more highly valued for their general management skills, rather than for their firm-specific knowledge. This is akin to a world where CEO ability is linked explicitly to navigating the firm within the broad market.

In our model, a CEO is charged with choosing the firm's strategy as she faces uncertainty regarding future sector movements. She has the ability to put forth (personally) costly effort to generate an informative signal about future sector returns. The optimal contract rewards the CEO for firm performance induced by sector movements so as to provide her incentives to exert effort to forecast the sector movements and choose the firm's optimal exposure to them.[6] As our model shows, benchmarking the CEO's performance against her sector is the same as *not* offering her pay for sector performance and will make firm investment decisions *insensitive* to sector movements. This practice is suboptimal if sector performance affects firm performance. Our model also helps pin down situations in which the sensitivity of pay to sector performance is more likely to be present. We find that multi-segment firms, especially those in which the sector performances of the different segments are less positively correlated, will offer pay contracts that are more sensitive to sector performance as compared to single segment firms. This is because such firms provide greater opportunity to the CEO to actively shift resources towards sectors that are likely to outperform. We also find that the sensitivity of pay to sector performance will be greater in any firm that

[5] See Chen, Osofsky and Stephenson (2008).

[6] For brevity, in our subsequent discussions we refer to the sensitivity of CEO pay to the component of firm performance due to sector performance as the sensitivity of pay to sector performance.

offers greater strategic flexibility to the CEO to alter firm exposure to sector movements and for more talented CEOs. Another contribution of our model is to show that the optimal contract rewards a risk-averse CEO more when sector performance is good than punishes her when sector performance is bad; that is, the optimal contract is asymmetrically sensitive to good and bad sector performance.[7]

Oyer (2004) suggests that executive pay should be sensitive to market movements to avoid losing them to other firms because the value of their outside opportunities likely rise and fall with market levels. While probably part of the story, it doesn't tell us whether and how the sensitivity of CEO pay to sector forces will vary in the cross-section. Our analysis uncovers significant cross-sectional variation of this sort. Furthermore, Oyer's story does not explain the asymmetry in sector-pay sensitivity as documented by Garvey and Milbourn (2006). Our model can explain the asymmetric sensitivity of CEO pay to sector performance in an optimal contracting setting.

We take the theory's empirically-testable predictions to CEO compensation data spanning 1992 through 2006 and find strong empirical support for the model. Using industry returns to proxy for sector performance, we confirm previous studies and document the dependence of CEO compensation on sector performance. Also, as CEOs are likely to have a greater role in setting firm strategy, we expect CEO pay to be more sensitive to sector performance as compared to pay of other executives. Our empirical results support this conjecture. Moreover, consistent with our model, we find that CEO pay is more sensitive to sector performance for multi-segment firms – those that report positive sales and assets in more than one three-digit SIC code industry – as compared to single segment firms. We further find that the sensitivity of CEO pay to sector performance in multi-segment firms is greater when the sector performances of the different segments are less positively correlated. Our results are also robust to controlling for the quality of firm-level corporate governance using the Bebchuk, Cohen and Ferrell (2009) entrenchment index.

To test whether the observed pay for sector performance is greater in firms that offer more strategic flexibility to the CEO, we introduce two proxies *at the industry level* meant to capture the extent of strategic flexibility. Our first proxy is industry market-to-book ratio. Industries with high market-to-book ratios are likely to have greater investment and growth options and thereby offer CEOs greater strategic flexibility in timing the exercise of those options. Our second proxy relies on the level of R&D expenditures in an industry. The idea is that firms in industries with

[7]One can think of this asymmetric loading as one of differential sharing rules in good and bad times.

higher levels of R&D expenditures are likely to provide their CEOs with greater strategic flexibility. In these industries, the CEO has more latitude to scale up or down such expenditures and thereby change the firm's exposure to market conditions. When we divide our sample into firms in industries with high and low market-to-book ratios, we find that pay for sector performance is in fact greater for the subsample of firms in industries with high market-to-book ratios. Similar results hold when we measure strategic flexibility using industry R&D expenditures.

If pay for sector performance provides incentives for the CEO to exploit the available strategic flexibility, then we should expect firms with greater pay for sector performance to show some evidence of CEOs exploiting their strategic flexibility to a greater extent *at the firm level*. To test this prediction, we classify firms with positive industry-adjusted R&D expenditures and asset-growth rates as exploiting their strategic flexibility to a greater extent. Consistent with our conjecture, we find that CEO pay is more sensitive to sector performance in firms that have positive industry-adjusted R&D expenditures the following year and positive industry-adjusted asset-growth rates during the sample period. This additional test offers some further support to our theory.

Apart from compensation, firms can also provide incentives to the CEO through their retention decision. In a recent working paper, Jenter and Kanaan (2008) show that a decline in the industry component of firm performance significantly increases the likelihood of a disciplinary CEO turnover. If disciplinary turnovers provide incentives for the CEO to choose the right sector exposure, then our model would predict that the likelihood of a disciplinary CEO turnover should be sensitive to sector performance, with a greater sensitivity in firms that offer greater strategic flexibility to the CEO. To test this prediction, we follow the procedure in Parrino (1997) and identify all disciplinary CEO turnovers that occur during our sample period. We identify 275 instances of disciplinary CEO turnover in our sample. We find that consistent with our conjecture the likelihood of a disciplinary CEO turnover is sensitive to sector performance only in firms from industries with high market-to-book ratios and high R&D expenditures.

Next, to test our model prediction of greater pay for sector performance for more talented CEOs, we use three proxies for CEO talent, two of which have been used in Milbourn (2003). Our first proxy for CEO talent is the firm's stock return under the CEO's watch. We classify CEOs with performance above the median industry-adjusted stock return during the previous year as talented. Our second proxy is based on the classification of CEOs as internal or external to the firm. We identify external CEOs as more talented than CEOs promoted from within. Hiring an external CEO indicates that the board is willing to go with a candidate with less firm-specific knowledge probably due to expectations of superior talent. Our third proxy further differentiates among external CEOs and classifies external CEOs hired from firms with better stock performance as more talented. Consistent with our theory, we find evidence of greater pay for sector performance for more talented CEOs as identified by all three proxies.

Finally, consistent with Garvey and Milbourn (2006), we find evidence of asymmetric pay for sector performance in our sample as well. In line with our model, we find that the asymmetry in pay for sector performance is present in multi-segment firms, in firms that offer greater strategic flexibility to their CEOs (as identified by our two proxies for strategic flexibility) and for more talented CEOs (as identified by our three proxies for talent).

Overall, our empirical analysis provides significant support for our model and highlights important cross-sectional patterns in the extent of the sensitivity of pay to sector performance. This shows that at least for certain firms, the observed correlation between pay and sector movements may be designed to provide appropriate strategic incentives to the CEO. Our contribution in this paper is to offer an optimal contracting explanation for the observed phenomenon. In doing so, we highlight an alternative way to model a CEO's role in a firm as one of choosing a firm's exposure to sector movements. We certainly concede that there may exist some poorly governed firms in which CEOs control their own pay process, but we believe that the widespread presence of the sensitivity of pay to sector performance and its persistence over time highlight that it may not be all about inefficient rent extraction. The phenomenon may simply be part of an optimal incentive contract in a richer environment where the role of the CEO is to select a firm's strategy by managing its exposure to external factors relevant to its performance.

The remainder of the paper is organized as follows. In Section 2, we delineate the primitives of our model and derive the optimal compensation contract in a world where CEOs choose the firm's strategy by altering its exposure to sector movements. Section 3 contains a description of our data and empirical strategy along with our tests of the model's predictions. Section 4 concludes. All proofs are relegated to the Appendix.

2 The Model

We analyze a simple model and characterize the optimal incentive contract when a CEO directly determines her firm's exposure to sector performance through her choice of firm strategy. The model delivers several empirically-testable predictions that we take to the data in the next section.

2.1 Agents and economic environment

Consider a two-date ($t = 0$ and 1) economy in which an all-equity firm is owned by risk-neutral investors and managed by a risk-averse Chief Executive Officer (CEO). The CEO chooses a one-period project to be implemented at $t = 0$. This project is a manifestation of the firm's strategy, and henceforth we refer to this choice as such. The CEO can choose between two alternative strategies: a high-risk strategy denoted by subscript H, and a low-risk strategy denoted by subscript L. The realized return at $t = 1$ from implementing either strategy, R_i with $i \in \{H, L\}$, is $\beta_i R_s + \varepsilon$, where β_i is a measure of the riskiness of strategy i and R_s is the realized sector return.[8] We naturally assume that $\beta_H > \beta_L \geq 0$. The loading β_i can alternatively be interpreted as a measure of firm scale, with β_H representing a larger scale than β_L. The scale interpretation of β_i is convenient when we extend our model to multi-segment firms in Section 2.3. In the recent CEO compensation literature, R_s is referred to as "luck" and $\beta_i R_s$ is referred to as the component of firm performance due to luck (Bertrand and Mullainathan (2001)). The key assumption in our model is that by the choice of her strategy, the CEO directly affects the firm's exposure β_i to sector performance, so $\beta_i R_s$ is not totally driven by exogenous forces. Throughout the rest of our analysis, we refer to $\beta_i R_s$ as sector performance to capture the clumsier phrase of sector-driven firm performance. Lastly, the term ε represents the idiosyncratic component of firm performance. It is assumed to be common to both strategies and is independently distributed with respect to R_s on support $(-\infty, \infty)$, with $\mathbf{E}(\varepsilon) = 0$ and $\mathbf{Var}(\varepsilon) = \sigma^2$.

It is useful to pause here and highlight the main difference between our approach and that used in the extant literature. This will also serve to provide some early intuition for why the optimal contract has pay sensitive to sector performance in our setting. The extant literature has typically modeled firm performance R_i as, $R_i = \alpha(e) + \beta R_s + \varepsilon$, where e denotes CEO effort. Here, the realized firm performance consists of three components: CEO effort, $\alpha(e)$, sector performance,

[8] We allow firm performance to depend on multiple sectors when we analyze multi-segment firms in Section 2.3.

βR_s, and noise, ε. Since CEO effort does not influence sector performance in this specification, it is obvious that βR_s should be filtered out from firm performance in an optimal incentive scheme and pay for sector performance is not needed to induce CEO effort. The main innovation in our paper is to recognize that at least for some firms, the realized sector exposure depends on CEO effort. Thus, we model firm performance as, $R_i = \alpha(e) + \beta(e)R_s + \varepsilon$, which makes a firm's realized exposure to the sector performance, $\beta(e)$, dependent on CEO effort. Given this specification, our model highlights the optimality of making pay sensitive to sector performance (i.e., $\beta(e)R_s$ should *not* be filtered out) and shows how it varies with firm and CEO characteristics.[9] Since our main objective is to study the optimality of pay for sector performance and its cross-sectional variation, for simplicity we suppress the term $\alpha(e)$ in specifying firm performance. We now lay out the rest of our model.

The sector performance, R_s, can be specified as $R_s = \bar{r} + \widetilde{r}_s$, where $\bar{r}$ is the expected value of R_s and $\widetilde{r}_s$ is the variable component that can take two possible values with equal probabily: $r_s > 0$ (akin to a sector boom) and $-r_s < 0$ (akin to a sector bust). We assume $r_s > \bar{r}$, so the realized sector return during a sector bust is negative. To maximize firm value, naturally it is optimal to choose the high-risk strategy (β_H) if the expectation is for a sector upturn and the low-risk strategy (β_L) if the expectation is for a sector downturn. At $t = 0$, the CEO can exert effort to generate a private signal, Θ, about the sector return. The signal is fully revealing and can take two possible values, $\Theta \in \{\theta_+, \theta_-\}$, where

$$\Pr(\Theta = \theta_+ | R_s = \bar{r} + r_s) = \Pr(\Theta = \theta_- | R_s = \bar{r} - r_s) = 1.$$

The probability that the CEO generates Θ is the effort supplied by her, $e \in [0, 1]$, at a personal cost of $\delta e^2/4$. With probability $1 - e$, the CEO fails to generate Θ, in which case her information set contains only the prior belief. Note that in our model the CEO has two choice variables, namely the amount of effort to generate a signal about sector performance and the firm's strategy. While the CEO's effort choice lies continuously in the unit interval, $[0, 1]$, we limit her strategy choice to two candidates, $\{\beta_H, \beta_L\}$. We believe our model can be extended, at the expense of considerable

[9]Our model of CEO is somewhat analogous to that of a mutual fund manager who actively engages in market timing by increasing the fund's market exposure in anticipation of market upturns and reducing the exposure in anticipation of market downturns (see Mamayski, Spiegel and Zhang (2008)). Similar to our setup, in the absence of market timing the mutual fund manager should only be compensated for the fund's α, whereas with market timing the compensation should also include the systematic portion of fund performance due to market movement. We thank Sheridan Titman for pointing out this analogy.

complexity, to include more strategy choices. The presence of two choice variables in our model also distinguishes it from the standard effort-choice models. In those models, CEOs typically choose effort which then *directly* affects firm performance. In equilibrium investors are aware of the CEO's effort choice. In our model, the CEO's effort choice affects the appropriateness of her strategy choice to the firm's sector, and thus *indirectly* affects firm performance. Furthermore, unlike in the standard effort-choice models, even ex post investors are uninformed about one dimension of the CEO's action space, namely her strategy choice.[10]

At $t = 1$, both the CEO and investors observe and can verify the firm's realized return, R_i, and the realized sector performance, R_s, whereas investors do not observe the CEO's effort choice (e), the chosen strategy (β_i) or ε.[11] The problem confronting the investors is to appropriately design a compensation contract to incentivize the CEO to both exert effort to uncover the impending sector performance and choose the optimal strategy accordingly. Since investors only observe R_i and R_s, an incentive contract can only be contingent on these two variables. We initially assume a linear contract of the form $W = w_0 + wR_i$, where w_0 represents fixed pay and w is the sensitivity of pay to the firm's return. For now, we assume a contract that is independent of R_s, but we relax this assumption subsequently in Section 2.4. In our model, firm performance is predominantly driven by sector performance, $\beta_i R_s$, therefore any loading of pay on firm performance also loads on $\beta_i R_s$. An important question in the context of our model is whether it is optimal for investors to remove the effect of expected sector performance (i.e., $\bar{r}$, which is commonly known) in designing the incentive contract. Interestingly, in our setting it is not possible for investors to do so. To see this clearly, note that $R_i = \beta_i R_s + \varepsilon = \beta_i \bar{r} + \beta_i \widetilde{r}_s + \varepsilon$. Thus, $\bar{r}$ affects R_i through the chosen strategy, β_i. Since investors do not observe β_i even ex post, they cannot design a contract that depends on R_i and also fully removes the effect of $\bar{r}$ on compensation.

We now formally define the term "sensitivity of pay to sector performance" that we will use in our subsequent discussions:

Definition 1: *CEO pay is sensitive to sector performance if it is sensitive to the sector-driven component of firm performance, $\beta_i R_s$.*

Thus, in the context of our model, $w > 0$ indicates that pay is sensitive to sector performance. The

[10]The CEO's equilibrium effort choice is also known to investors in our model, because the compensation contract prescribes how much effort the CEO *should* exert through the CEO's incentive-compatibility constraint.

[11]The CEO does not observe ε either. But since the CEO knows the strategy, she can back out ε from R_i.

CEO's utility is given by $V_{CEO}(W) - \delta e^2/4$, where $V_{CEO}(\cdot)$ is an increasing and concave function, with $V'_{CEO} > 0$ and $V''_{CEO} < 0$. The CEO's reservation utility is given by a constant $\bar{V}_{CEO}$.

2.2 Optimal sensitivity of pay to sector performance

Suppose the CEO exerts an effort e, then with probability e she generates the signal Θ. Conditional on generating the signal, she optimally chooses the high-risk strategy (β_H) if $\Theta = \theta_+$ and the low-risk strategy (β_L) if $\Theta = \theta_-$. With probability $1 - e$ she fails to generate Θ, in which case she may unconditionally choose either the high-risk or the low-risk strategy. We assume that the CEO will always choose the low-risk strategy whenever she fails to obtain a signal. This can be justified as follows. Following the interpretation of the choice of β_i as a choice of firm scale – with β_H representing a larger scale than β_L – in the absence of the informative signal Θ, investing in the sector is equivalent to a zero-NPV investment.[12] Hence, we assume that whenever the CEO fails to obtain a signal, she chooses β_L and minimizes the investment in the sector.

Without loss of generality and to simplify our analysis, we normalize $\beta_L = 0$ and denote $\beta_H \equiv \beta > 0$ subsequently. Hence, the CEO's expected utility, given any compensation contract denoted by (w_0, w), can be written as:

$$V_{CEO}(w_0, w) = e\left[\frac{\mathbf{E}\big(V_{CEO}(w_0 + w[\beta\bar{r} + \beta r_s + \varepsilon]) + V_{CEO}(w_0 + w\varepsilon)\big)}{2}\right] + [1-e]\left[\frac{\mathbf{E}\big(V_{CEO}(w_0 + w\varepsilon) + V_{CEO}(w_0 + w\varepsilon)\big)}{2}\right] - \frac{\delta e^2}{4}.$$

The term in the first set of square brackets represent the CEO's payoff when she generates the signal. This equals the sum of her payoff when $\Theta = \theta_+$ (which occurs with probability 1/2) and she optimally chooses the high-risk strategy, and her payoff when $\Theta = \theta_-$ (which also occurs with probability 1/2) and she optimally chooses the low-risk strategy. The term in the second set of square brackets represent the CEO's expected payoff when she fails to generate Θ and chooses the low-risk strategy. The last term is the CEO's personal cost of effort provision.

[12]The implicit assumption is that $\bar{r}$, the expected return from investing in the sector without Θ, is a fair compensation for the risk involved in investing in the sector. Thus in the absence of Θ, the risk-adjusted excess return from investing in the sector is zero.

The investors' corresponding expected payoff, denoted as $V_I(w_0, w)$, is:

$$V_I(w_0, w) = [1 - w][e]\left[\frac{\beta\bar{r} + \beta r_s}{2}\right] - w_0.$$

The investors' problem at $t = 0$ is to design a contract, (w_0, w), to maximize their expected payoff, $V_I(w_0, w)$, by providing the CEO the right incentives to choose an appropriate effort level to find out the sector performance. The investor's problem can be formally stated as:

$$\max_{\{w_0, w\}} \; V_I(w_0, w), \tag{1}$$

$$\text{s.t.} \quad V_{CEO}(w_0, w) \geq \bar{V}_{CEO}, \tag{2}$$

$$\text{and} \quad e = \arg\max_{e \in [0,1]} V_{CEO}(w_0, w). \tag{3}$$

In the above problem, the incentive-compatibility constraint in equation (3) stipulates that the chosen effort level maximizes the CEO's expected utility given the contract (w_0, w). The CEO's participation constraint is given by the weak inequality (2).

We term the CEO's ability to change the firm's exposure in response to sector performance as the extent of strategic flexibility. In our model, this can be measured by the distance between the betas, i.e., $\beta_H - \beta_L = \beta$. Note that in the trivial case when $\beta = 0$, there is no flexibility for the CEO to alter firm exposure in response to the sector movements. The CEO of a firm with greater strategic flexibility (larger β) has more latitude in choosing the firm's exposure to the sector performance. We now provide our first result on the structure of the optimal incentive contract. To obtain closed-form solution, we make specific assumption about the CEO's utility function. Specifically, we assume that the CEO's utility function can be represented by a modified mean-variance utility of the form: $\mathbf{E}\big(V_{CEO}(w_0, w)\big) = w_0 + w[\beta_i R_s] - [\lambda/2][w^2\sigma^2] - [\lambda/2]\{w[\beta_i R_s]\}$, where $R_s \in \{\bar{r} + r_s, \bar{r} - r_s\}$ and the constant λ is the CEO's risk-aversion parameter.[13]

Proposition 1. *The optimal incentive contract, denoted as (w_0^*, w^*), exhibits pay for sector performance, i.e., $w^* > 0$. Moreover, w^* is strictly increasing in the extent of strategic flexibility, β, and the level of sector abnormal performance, r_s, and decreasing in the effort disutility parameter, δ.*

[13]The CEO faces two sources of uncertainty: the first is due to the idiosyncratic shock, ε, and the second is due to the sector return, R_s. The term $-[\lambda/2][w^2\sigma^2]$ represents her risk aversion towards ε, and her risk aversion towards R_s is captured (with the minimum mathematical complexity) by the term $-[\lambda/2]\{w[\beta_i R_s]\}$. Note that with this formulation, we need $\lambda < 2$ to ensure that the CEO's expected utility is increasing in her pay.

The intuition for this result is as follows. The CEO's compensation is intentionally left sensitive to the *sector's* return R_s to ensure that she has sufficient incentives to exert effort to uncover sector performance and choose the optimal strategy accordingly. Absence of pay for sector performance (i.e., $w^* = 0$) will result in the CEO shirking and choosing the low-risk strategy unconditionally, and hence the firm's exposure is unlikely to be correctly matched to sector performance. To see why pay for sector performance w^* is increasing in β, note that the marginal benefit of CEO effort to investors is increasing in β since the benefit of correctly matching the firm's exposure to sector performance increases with β. Thus, as β becomes larger, investors increase the sensitivity of pay to sector performance to induce more effort from the CEO.[14] A similar intuition applies for why w^* is increasing in r_s. Finally, w^* is decreasing in the effort disutility parameter δ. In our empirical analysis, we equate δ to the cross-sectional variation in CEO talent, with a more talented CEO having a lower δ.

2.3 Multi-segment firm

We now extend our analysis to a setting where multiple sectors affect firm performance and examine how the sensitivity of pay to sector performance may differ between multi-segment and single segment firms. To fix ideas, consider a firm that operates in two sectors, denoted sector 1 and 2. The $t = 1$ return for sector $k \in \{1, 2\}$, R_{sk}, can be either $\bar{r} + r_s > 0$ or $\bar{r} - r_s < 0$, which are *a priori* equiprobable. The returns of the two sectors are correlated via the following conditional probabilities:

$$\Pr(R_{sk'} = \bar{r} + r_s | R_{sk} = \bar{r} + r_s) = \Pr(R_{sk'} = \bar{r} - r_s | R_{sk} = \bar{r} - r_s) = \eta \in [0, 1], \ \forall k, k' \in \{1, 2\}.$$

Note that $\eta = 0$ corresponds to the case where the two sector returns are perfectly negatively correlated, whereas $\eta = 1$ corresponds to the case where the returns are perfectly positively correlated. At $t = 1$, the firm's return is $\beta_1 R_{s1} + \beta_2 R_{s2} + \varepsilon$, where $\beta_1, \beta_2 \in \{\beta, 0\}$. In line with our interpretation of β as a measure of the firm's sector-investment scale, and in the spirit of resource constraint within a multi-segment firm (also to simplify the analysis), we assume that at most one

[14] Although for a fixed $w^* > 0$, an increase in β itself induces the CEO to exert more effort, that additional effort alone is typically not sufficient from the investors' perspective. This is because the CEO only enjoys a fraction of the gain from the increase in strategic flexibility and the ability to correctly match exposures to sector performance. Hence, notwithstanding the greater effort resulting from an increase in β, investors increase w^* to induce greater effort.

among β_1 and β_2 can be positive, i.e., $\beta_1+\beta_2 \leq \beta$. Thus, if the CEO allocates capital to sector 1 by choosing the high-risk strategy for that sector ($\beta_1 = \beta$), she will have to reduce capital allocation to sector 2 by choosing the low-risk strategy with $\beta_2 = 0$, and vice versa. The CEO's private signal Θ perfectly reveals the returns for both sectors. The rest of the setup is the same as that in Section 2.1. We denote the optimal incentive contract for the multi-segment firm as (w^*_{0m}, w^*_m), where w^*_m is the sensitivity of CEO pay to firm performance and consequently to sector performance.

The following proposition compares the optimal incentive contracts between multi-segment and single segment firms.

Proposition 2. *The multi-segment firm ceteris paribus exhibits greater sensitivity of pay to sector performance than the single segment firm, i.e.,* $w^*_m > w^*$. *Moreover,* w^*_m *is decreasing in the degree of sector-return correlation,* η.

The key to understanding this proposition is to note that investors benefit from CEO effort if she can identify a sector that is expected to outperform and direct resources to that outperforming sector. Since the performances of the two sectors are not perfectly correlated, the likelihood that the CEO of a multi-segment firm can identify one sector that will outperform and direct resources to that sector is greater than that of a single segment firm's CEO. To see this more clearly, note that even if a single segment firm's CEO can also observe the returns for both sectors, she may not easily be able to direct resources to the outperforming sector if her firm does not currently operate in that sector – unless of course she decides to diversify into that sector. Hence, CEO pay in multi-segment firms is more sensitive to sector performance. This also explains why pay for sector performance is decreasing in the sector correlation, η, within a multi-segment firm. The lower is the sector correlation, the greater is the likelihood that at least one sector will outperform and resources can be directed to that sector.

2.4 Asymmetric sensitivity of pay to sector performance

We now relax our original assumption on the contractual form and analyze a more general one that allows the loading on firm performance to depend on sector performance. To succinctly convey the main message in this section, we perform the analysis in a single segment setting, but the conclusions here are robust to an extension to a multi-segment setting. More specifically, we assume that investors offer the CEO a piecewise linear contract with $W = w_0 + \bar{w}R_i$ when $R_s = \bar{r} + r_s$, and $W = w_0 + \underline{w}R_i$ when $R_s = \bar{r} - r_s$, where $\bar{w}$ is the loading on firm performance when the sector performance is good and $\underline{w}$ is the loading on firm performance when the sector performance is bad. How do investors implement such an incentive contract? Since the contract we specify is piecewise linear, it can be implemented using a fixed wage (to the extent of w_0) plus stock grants. The amount of stock grants may vary with the sector performance, with the amount during sector upturns and downturns being given by $\bar{w}$ and $\underline{w}$, respectively. Analyzing this general contract helps us explore any potential asymmetry in the optimal incentive contract. Let us proceed by first defining asymmetric sensitivity of pay to sector performance in the context of our model:

Definition 2: *The incentive contract exhibits asymmetric sensitivity of pay to sector performance if the sensitivity of CEO pay to sector performance during sector upturns, $\bar{w}$, is greater than the sensitivity during sector downturns, $\underline{w}$.*

The following proposition delineates the result from the analysis of the general contract.

Proposition 3. *The optimal compensation contract, denoted as $(w_0^*, \underline{w}^*, \bar{w}^*)$, has the following properties:*

1. *it loads positively on sector performance both when sector performance is good and when it is bad, i.e., $\underline{w}^* > 0$ and $\bar{w}^* > 0$;*
2. *it exhibits asymmetric sensitivity of pay to sector performance, i.e., $\bar{w}^* > \underline{w}^*$, whenever $\bar{r} \leq 0$; for a given $\bar{r} > 0$, there exists a cutoff value of CEO risk aversion such that for all values of risk aversion greater than the cutoff, the contract exhibits asymmetric sensitivity to sector performance;*
3. *the extent of asymmetric sensitivity of pay to sector performance is increasing in the extent of strategy flexibility, i.e., $\bar{w}^* - \underline{w}^*$ is increasing in β.*

The intuition for this proposition is as follows. Observe first that the result of a positive sensitivity of pay to sector performance obtains with the general contract as well. As explained before, the CEO's compensation is contingent on the sector performance (i.e., $\underline{w}^* > 0$ and $\bar{w}^* > 0$) to ensure that she has sufficient incentives to exert effort to uncover the sector performance and choose the optimal strategy accordingly. The two loadings, $\underline{w}^*$ and $\bar{w}^*$, however, serve two slightly different incentive purposes. The loading when the sector performance is bad, $\underline{w}^* > 0$, ensures that the CEO does not shirk and unconditionally choose the high-risk strategy (β_H), whereas the loading when the sector performance is good, $\bar{w}^* > 0$, ensures that the CEO does not shirk and unconditionally choose the low-risk strategy (β_L). To see this, note that when $\underline{w}^* > 0$, the CEO suffers a loss if she under-supplies effort and chooses β_H whenever she fails to generate Θ and the low sector return, $R_s = \bar{r} - r_s$, is realized. Similarly, when $\bar{w}^* > 0$, the CEO forgoes a compensational gain if she under-supplies effort and chooses β_L whenever she fails to generate Θ and the sector boom, $R_s = \bar{r} + r_s$, occurs. Given risk aversion, the CEO's incentive to avoid the loss when $R_s = \bar{r} - r_s$ is *ceteris paribus* stronger than her incentive to avoid forgoing her compensational gain when $R_s = \bar{r} + r_s$. Hence, all other things being equal, investors rely to a lesser extent on the compensation contract to provide incentives to the CEO to not shirk and choose the high-risk strategy unconditionally. Such reliance on the contract is further reduced if the expected sector return is non-positive, i.e., $\bar{r} \leq 0$, in which case the CEO is *ceteris paribus* less likely to choose β_H whenever she fails to obtain a signal.[15] Thus, when $\bar{r} \leq 0$, the optimal incentive contract for a risk-averse CEO exhibits asymmetry in the sensitivity of pay to sector performance. When $\bar{r} > 0$, the CEO is *ceteris paribus* more likely to choose β_H unconditionally whenever she fails to obtain a signal. This factor alone would induce investors to choose a higher $\underline{w}^*$ than $\bar{w}^*$ in the compensation contract. Note that risk aversion diminishes the CEO's preference for β_H. Thus, in order to have $\bar{w}^* > \underline{w}^*$ in this case, the CEO needs to be sufficiently risk averse, which reduces the contract's reliance on $\underline{w}^*$ to incentivize the CEO to not shirk and choose β_H unconditionally.

Moreover, as the firm's strategic flexibility increases (i.e., β becomes larger), in order to provide incentives to the CEO to exert more effort, both the loadings ($\bar{w}^*$ and $\underline{w}^*$) increase. Given CEO risk aversion, each unit increase in the loading when the sector performance is bad ($\underline{w}^*$) *ceteris paribus* produces a stronger incentive effect than each unit increase in the loading when the sector performance is good ($\bar{w}^*$). Thus, to provide appropriate incentives, $\bar{w}^*$ increases more than $\underline{w}^*$. That is, the asymmetry in pay for sector performance, $\bar{w}^* - \underline{w}^*$, is increasing in the firm's strategic flexibility.

[15] To see this more clearly, note that in this case whenever the CEO fails to generate Θ, the expected return from investing in the sector is negative (since $\bar{r} \leq 0$), and hence all other things being equal (i.e., for any compensation contract without asymmetry, $\bar{w} = \underline{w}$) the CEO is strictly worse off by choosing β_H.

2.5 Empirical predictions

In this section, we list the main empirical predictions of our model. From *Proposition 1*, we know that the optimal incentive contract rewards the CEO for firm performance resulting from sector movements. That is, the optimal incentive scheme does not remove the sector performance. Our first prediction states:

Prediction 1: *Optimal incentive contracts will reward CEOs for sector performance.*

Support for this prediction can be found in Bertrand and Mullainathan (2001) and Garvey and Milbourn (2006), although it was cast in a different light. One important aspect of testing *Prediction 1* relative to these two papers is that our model is quite specific about the nature of what those authors call "luck." It is reasonable to argue that CEOs, through their choice of strategy, will affect the extent of the firm's exposure to its industry movements. One way to think about this is that the CEO uses capital budgeting to decide on the amount of incremental capital investment in the firm's industry. Instead of investing more, the CEO can decide to either keep the money as cash holdings, return to shareholders or invest in another industry. The decision is likely to depend on the CEO's view on the future prospects of the firm's industry. Thus, according to our model, the luck that matters for CEO compensation should be industry performance. Hence, we repeat the tests of Bertrand and Mullainathan (2001) and Garvey and Milbourn (2006) for our extended sample period to test this prediction using industry returns.

Proposition 2 generates the second prediction of our model regarding the sensitivity of pay to sector performance in multi-segment firms:

Prediction 2: *The sensitivity of pay to sector performance will be greater for CEOs in multi-segment firms than those in single segment firms. The sensitivity of pay to sector performance in a multi-segment firm will decrease in the degree of correlation between the performances of the firm's different segments.*

Next, we know from *Proposition 1* that the sensitivity of pay to sector performance will be greater for CEOs managing firms that offer them greater strategic flexibility. To test this prediction, we identify two proxies for the extent of *ex ante* strategic flexibility offered to the CEO. To be consistent with our model, we take care to ensure that the proxies are the ones that a CEO cannot readily influence through her decisions. We do this by identifying *industry-level* variables that are not easily altered. For example, industries with higher market-to-book ratios are likely to have greater investment and growth opportunities and hence offer CEOs greater strategic flexibility. The idea is that CEOs can change the sensitivity of firm performance to sector movements by timing the exercise of those growth options. Hence, we expect the sensitivity of pay to sector performance to be greater in industries with higher levels of market-to-book ratio. Similarly, industries with higher levels of R&D expenditures may offer a greater potential for CEOs to vary the firm's sector exposure. The idea is that CEOs can alter the sensitivity of firm performance to sector movements by scaling up or down the level of R&D expenditures. Consistent with this, Bennedsen, Pérez-González and Wolfenzen (2008) find that CEOs have a greater impact on firm performance in industries with higher levels of R&D expenditures. Thus, we expect the sensitivity of pay to sector performance to be greater in industries with higher levels of R&D expenditures. Summarizing, our third prediction is:

Prediction 3: *The sensitivity of pay to sector performance will be greater for CEOs in firms that offer greater strategic flexibility, that is, for CEOs in firms: in industries with higher levels of market-to-book ratio and higher levels of R&D expenditures.*

We also know from *Proposition 1* that the sensitivity of pay to sector performance will be greater for more talented CEOs, as captured by the decreasing disutility of effort of more talented executives. We construct three proxies for CEO talent to test this prediction. Our first proxy for CEO talent, drawn from Milbourn (2003), is the industry-adjusted stock return during the previous year. The idea is that firms managed by more talented CEOs will exhibit higher industry-adjusted performance. Our second proxy is whether the CEO is an internal hire or an external hire. We identify CEOs appointed from outside the firm as being more talented than inside CEOs, since these executives overcome their relative lack of firm-specific knowledge to get hired anyway. Our third proxy for talent further differentiates among externally-hired CEOs. It is based on the stock performance of the external CEO's previous firm. Thus, our next prediction is:

Prediction 4: *The sensitivity of pay to sector performance will be greater for more talented CEOs, that is, for CEOs in firms with above median industry-adjusted stock returns, for externally-hired CEOs, and for external CEOs hired from firms with better stock performance.*

From *Proposition 3*, we know that in the optimal contract we have $\bar{w}^* > \underline{w}^*$. This implies that the optimal contract rewards the CEO more for firm performance resulting from good sector returns ($R_s = \bar{r}+r_s$) than punishes her for declines in firm performance due to bad sector outcomes ($R_s = \bar{r} - r_s$), i.e., the optimal incentive contract is asymmetric in the pay sensitivity to sector performance. Our prediction is thus in line with the results of Garvey and Milbourn (2006). Interestingly, apart from the asymmetry built in the optimal contract, the CEO's ability to change firm exposure to sector performance implies that empirical tests that ignore this fact may be biased towards finding asymmetry in the sensitivity of pay to sector performance. The reason for this is as follows. In estimating the sector component of firm performance, these tests typically estimate one average β for every firm, say $\bar{\beta}$. However, if a CEO actively changes her firm's exposure to sector performance by increasing the risk of the firm's projects during sector upturns and reducing the risk during sector downturns, then such tests are likely to underestimate the actual β during sector upturns and overestimate the actual β during sector downturns. This in turn is likely to bias the estimates towards finding asymmetry in the sensitivity of pay to sector performance. To see this more clearly, note that in the context of our model, in equilibrium (whenever the CEO generates a signal) $\beta_H \times [\bar{r} + r_s]$ and $\beta_L \times [\bar{r} - r_s]$ represent the sector-driven component of firm performance during sector upturns and downturns, respectively, and $\bar{w}^*$ and $\underline{w}^*$ are the loadings on these two components. However, the empirically-estimated sector-driven component of firm performance during upturns and downturns will be, respectively, $\bar{\beta} \times [\bar{r} + r_s]$ and $\bar{\beta} \times [\bar{r} - r_s]$. Let w^+ and w^- represent the empirically-estimated loadings on these two components. It is easy to show that we will have $w^+ = \bar{w}^* \beta_H / \bar{\beta}$ and $w^- = \underline{w}^* \beta_L / \bar{\beta}$. Thus, even if $\bar{w}^* = \underline{w}^*$, we are likely to have $w^+ > w^-$ because $\beta_H > \bar{\beta} > \beta_L$. Thus, empirically we will observe asymmetry in the compensation contracts if we ignore the fact that CEOs can change the firm's risk exposure.

Moreover, similar to *Predictions 2 – 4*, our model also predicts that we should observe asymmetry between pay for good and bad sector outcomes in incentive contracts for CEOs in multi-segment firms, in firms that offer greater strategic flexibility, and for more talented CEOs. Note that strictly speaking, *Proposition 3* predicts greater asymmetry in the sensitivity of pay to sector performance for firms that offer more strategic flexibility. Our ability to test this prediction is compromised by a couple of issues. The first one is the above noted bias in estimating the extent of asymmetry. Second, when we estimate pay for good and bad sector outcomes for the subsample of firms (i.e., firms with more versus less strategic flexibility), the pay for either good or bad sector realizations is insignificant in a number of cases. This makes comparison of the difference in coefficients across the two subsamples difficult. Given these issues, we confine our tests to establishing the presence of asymmetric sensitivity of pay for sector performance in our full sample, and for multi-segment firms, firms that offer more strategic flexibility to the CEO, and for more talented CEOs. Summarizing, our fifth prediction yields the following:

Prediction 5: *CEO pay will be more sensitive to sector performance when it is good than when it is bad. This asymmetric sensitivity will be present for CEOs in multi-segment firms, in firms that offer greater strategic flexibility (that is, for firms: in industries with higher market-to-book ratios and higher levels of R&D expenditures), and for more talented CEOs (that is, for CEOs in firms with better industry-adjusted stock performance, for externally-hired CEOs, and for external CEOs hired from firms with better stock performance).*

With these predictions in hand, we turn now to our empirical analysis.

3 Empirical Analysis

In this section, we describe our data, lay out our empirical methodology, and provide the main results stemming from the tests of our model's predictions.

3.1 Data and descriptive statistics

The data for testing our predictions are drawn from two standard sources. Stock returns come from the Center for Research in Security Prices (CRSP), and compensation data are from Standard and Poor's ExecuComp. Our sample period covers the years 1992-2006. The compensation data are for each firm's executive identified by ExecuComp as the CEO. To obtain a sample suitable for testing, we modify this overall sample in the following ways. First, we drop firms with fiscal years ending in any month other than December. We do this to ensure that the period we use to measure firm performance coincides with the period used to measure industry performance, which we use as the benchmark. Second, to ensure that we have a full year's compensation data, we drop firm-years in which the CEO changed. In Section 3.3, we compare the overall ExecuComp sample to our sample to ensure that the selection does not bias our conclusions. For robustness, we repeat all our tests with the full sample and obtain results similar to the ones reported.

3.2 Empirical specification and key variables

In testing our predictions, we are broadly interested in examining how CEO compensation is related to the component of firm performance due to sector movements. To do this, we follow the approach used in Bertrand and Mullainathan (2001) and Garvey and Milbourn (2006) and break the test into two stages. In the first stage, we calculate the sector and firm-specific components of the firm's dollar return. We achieve this using the following specification:

$$y_{it} = \beta \mathrm{X}_s + \mu_t \mathrm{T} + \epsilon_{it}, \tag{4}$$

where the subscript i indicates the firm, s indicates the sector, t refers to time in years and the term T refers to a set of time dummies. The dependent variable y is the annual stock return and X represents the return on a set of sector indices. We convert both the firm's stock return and sector return into dollar returns by multiplying them with the firm's market capitalization at the beginning of the year. In the baseline specification, the sector indices include the equal- and value-weighted industry returns, where industry is identified at the level of the two-digit SIC code. We remove the firm's return while calculating the industry returns. As discussed earlier, industry returns are most relevant for testing our model implications. For robustness, we repeat our tests by including equal- and value-weighted portfolio returns of all NYSE/AMEX/NASDAQ stocks, the return on the S&P 500 index and the return on the firm's size-decile portfolio. Since many of these indices are highly correlated with industry returns, not surprisingly we obtain similar results with these as well. Furthermore, since all of these are imperfect measures of the sector return that is likely to be relevant for choosing a firm's strategy, we may misclassify some sector and firm-specific portions of performance.

Because our tests are based on how CEO pay is related to the sector component of firm performance in the cross-section, measurement error is unlikely to bias our conclusions. Note also that even our tests are likely to be biased towards finding asymmetry in pay for sector performance because we only estimate one average loading (β) for a firm. Due to the noise in short-term return measures and the lack of sufficient observations, we are unable to estimate time-varying loadings for a firm. As mentioned earlier, taking into account the potential bias, we confine our tests to establishing the presence of asymmetric pay for sector performance consistent with our predictions. Based on the estimation of the above equation, we calculate the sector component of firm performance as:

$$\text{Sector}_{it} = \widehat{\beta}\text{X}_s + \widehat{\mu}_t\text{T}, \tag{5}$$

where $\widehat{\beta}$ and $\widehat{\mu}_t$ represent the coefficient estimates from (4). The difference between firm stock return and its sector component is referred to as the firm-specific component.

Having estimated the sector and firm-specific components of firm performance, in the next stage we estimate how CEO compensation varies with these two. To do this, we follow the approach of Aggarwal and Samwick (1999a) and Garvey and Milbourn (2006) on the pay for performance relationship and estimate the following model:

$$z_{it} = \alpha_1 \times \text{Sector}_{it} + \alpha_2 \times \text{Firm specific}_{it} + \gamma\text{X}_{it} + \mu_e\text{E} + \mu_t\text{T}, \tag{6}$$

where the dependent variable z is the level of compensation. We use three alternative measures of CEO compensation. Our first measure is the executive's total direct compensation, *Total compensation*, which is a sum of the CEO's yearly salary, bonus, other annual compensation, long-term incentive payouts, other cash payouts, the value of restricted stock and the Black and Scholes value of stock option awards in the year. The other two measures of compensation are *Bonus*, which is a measure of the CEO's bonus for the year, and *Option grants*, which is the Black and Scholes value of option grants during a year.

Following Garvey and Milbourn (2006), we do not fix the sensitivity of pay to either *Sector* or *Firm Specific* to be the same for all firms. Instead, we let the loadings vary with the riskiness of the two components of firm performance by including interaction terms between *Sector* and *Firm Specific* and the cumulative distribution function (CDF) of their own respective variances. We also include the level of the CDF as an additional control. Thus, our set of controls X_{it} include interaction terms between *Sector* and *Firm specific* and the CDF of their variances (i.e., *Sector* $\times$ *CDF of var of sector*, and *Firm specific* $\times$ *CDF of var of firm specific*), the level of the CDF of the two variances and the tenure of the CEO. We calculate the tenure for a CEO in any year as the difference in years between the fiscal year end of that year and the date when the executive became CEO. Jensen and Murphy (1990) find that firm size matters for pay for performance sensitivity. To control for this, we include a dummy variable *Large* that identifies firms with above sample median firm size as measured by the natural logarithm of the book value of total assets.[16] We also control for executive fixed effects (E) and for time fixed effects (T). Our predictions are about how α_1 varies in the cross-section of CEOs. In the tests designed to measure asymmetry in pay for sector performance, we augment the above model by replacing *Sector* with two interaction terms. These are $Sector \times (+ve\ Sector)$ and $Sector \times (-ve\ Sector)$, where $+ve\ Sector$ ($-ve\ Sector$) is a dummy variable that takes the value one when *Sector* is positive (negative) and zero otherwise. We now present our empirical results, starting with the summary statistics.

3.3 Summary statistics

In Panels A and B of Table 1, we compare the summary statistics for compensation and firm-specific variables for executives identified as the CEO (given by the CEOANN field in ExecuComp) for the full ExecuComp sample (Panel A), and our subsample that excludes firms with fiscal years ending in any month other than December and firm-years in which the CEO changed (Panel B). These summary statistics show that our subsample is comparable to the full sample in terms of average market value and CEO pay. Focusing on Panel B, the average salary and bonus for a CEO in our sample are approximately $653,207 and $723,793, respectively, while option grants in the year average about $2.0 million. The standard deviation of stock returns are the volatilities provided in the Execucomp database that are used to calculate the Black and Scholes value of options. The more important feature of both the full sample and the subsample is the significant right skewness in the data. For instance, the maximum value of option grants is about $290 million in our subsample, and the median value is approximately one-fourth of the mean. To reduce the effects of such outliers, our variables of empirical interest are all winsorized at the 1% level and we estimate robust standard errors throughout our analyses.

[Table 1 goes here]

Critical to our ability to test the hypothesis that CEOs change firm exposures to sector returns is the fact that the benchmark can take both positive and negative values. Table 2 summarizes the percentage of the observations for each benchmark that are positive, as given in the column

[16] We do not include an interaction term between *Sector* and firm size as measured by either *Large* or the natural logarithm of the book value of total assets, because the correlation between this interaction term and *Sector* is more than 90%. Our results are robust to controlling for the book value of total assets instead of the dummy variable *Large*.

denoted as percent positive. Not surprisingly for our sample period, a large proportion of our sample contains positive benchmark returns.

[Table 2 goes here]

3.4 Empirical results

With the data and empirical strategy in hand, we now proceed to test our model's predictions.

3.4.1 Pay for sector performance

We begin our empirical analysis by testing *Prediction 1* to see if there is evidence of pay for sector performance in our sample. These tests are similar to those in Bertrand and Mullainathan (2001) except that our sample period is longer than theirs. We repeat the tests to ensure that the results hold in our sample as well. The results are reported in Table 3. In Column (1), the dependent variable is *Total compensation*. The statistically significant positive coefficient on *Sector* confirms pay for sector performance. In Columns (2) and (3), we repeat the estimation with *Bonus* and *Option grants* as measures of compensation, respectively, and find evidence of reward for sector performance for bonus payments, whereas there is no statistically significant pay for sector performance for option grants (the coefficient estimate on *Sector* in Column (3) is positive, though). Our point estimates are consistent with earlier papers. The point estimates imply that for a CEO of a firm with median risk, an additional $1,000 increase in firm value arising from sector movements (i.e., luck in Bertrand and Mullainathan (2001)) increases the CEO's total compensation by approximately $1.2, bonus payouts by 27 cents, and new option grants by 21 cents.

It is reasonable to expect that within a firm the CEO has a greater control in setting the firm's strategy and hence its sector exposure as compared to other executives. If, according to our model, pay for sector performance is aimed at providing incentives for the executive to find out the sector movements and choose the right sector exposure, then we should expect greater pay for sector performance for the CEO as compared to other executives within a firm. We test this prediction in Columns (4) – (6) of Table 3 by expanding our sample to include both CEOs and non-CEO executives from ExecuComp. We include all executives who appear for more than three years in the database. We re-estimate model (6) after including three additional terms: a dummy variable *CEO* to identify CEOs, and two interaction terms *Sector* × *CEO* and *Firm Specific* × *CEO*. Note that in Columns (4) – (6) the coefficient estimates on *CEO* and *Sector* × *CEO* are all positive and statistically significant, regardless how we measure compensation. This shows that pay for sector performance is indeed greater for CEOs than non-CEO executives, which is consistent with our conjecture. Interestingly, we do not find a similar pattern in pay for firm-specific performance. This additional test offers some further support for our theory.

[Table 3 goes here]

Since pay for sector performance is statistically insignificant for *Option grants* (see Columns (3) and (6)), in the subsequent analysis we drop *Option grants* as a measure of compensation.

3.4.2 Pay for sector performance in multi-segment firms

One main advantage of our theory is that it identifies specific situations in which pay for sector performance should be more prevalent. From *Prediction 2* we expect greater pay for sector performance for multi-segment firms as compared to single segment firms. To test this prediction, we classify the firms in our sample into multi-segment and single segment firms and repeat our analysis for the two subsamples. We identify a firm as a multi-segment firm if it reports positive sales and assets in more than one three-digit SIC code industry. In measuring *Sector* for multi-segment firms, we use the sector performance of the firm's largest segment. In unreported robustness tests, we repeat our estimation using the weighted average sector performance of all the segments in the firm to measure *Sector* and obtain consistent results.

The results in Panel A of Table 4 show that when CEO pay is measured using *Total compensation*, there is pay for sector performance only for multi-segment firms.[17] We also find that the coefficient estimates on *Sector* across the two subsamples are significantly different from each other. When pay is measured using *Bonus*, we also find that pay for sector performance is significantly greater for multi-segment firms as compared to single segment firms. These results offer strong support for our theory. Since ex ante it is not apparent that CEOs of multi-segment firms are more talented than CEOs of single segment firms, our results here also help distinguish our model from

[17] We run separate tests in the sub-sample of single segment and multi-segment firms to allow for different coefficients on the control variables across the two sub-samples.

that of Oyer (2004) who predicts greater pay for sector performance for more talented CEOs with higher reservation utility.

Prior research shows that firms may endogenously choose to be multi-divisional (Campa and Kedia (2002)) and hence it may not be appropriate to compare the valuations of multi-segment and single segment firms. While a similar critic may be leveled against our tests as well, there are two mitigating arguments. First, it is not obvious why the differences across multi-segment and single segment firms should reflect in greater pay for sector performance in multi-segment firms. One possible reason could be that multi-segment firms may have worse governance structures as compared to single segment firms and pay for sector performance may be a manifestation of CEO power. To partly control for this, in unreported tests, we repeat our analysis after controlling for the Bebchuk, Cohen and Ferrell entrenchment index and find that our results are robust. Second, in all our specifications we employ executive fixed effects. To the extent that CEOs remain with the same firm, these fixed effects are likely to control for time-invariant differences across multi-segment and single segment firms. In additional robustness checks, we repeat our analysis with firm fixed effects instead of executive fixed effects and obtain consistent results (see Campa and Kedia (2002)).

In Panel B, we test the second part of *Prediction 2* which states that the sensitivity of pay to sector performance within a multi-segment firm should be decreasing in the degree of correlation between the performances of the segments. We measure the correlation between segment performances using the correlation between the industry performance of a multi-segment firm's main segment (by total assets) and the weighted average industry performance of all other (non-main) segments. We use the industry performance as opposed to the actual segment performance to avoid spurious correlations. We use the book value of total assets of the non-main segments as the weights to calculate the weighted industry performance. We then construct a dummy variable, *Low corr*, which takes the value one if the correlation is less than the sample median and zero otherwise. Then, we re-estimate (6), including both *Low corr* and an interaction term between *Low corr* and *Sector*. These tests are confined to firms that we identify as multi-segment firms.[18] In Columns (1) and (3), we display the estimation results from Panel A for comparison. The results in Column (2) show that when pay is measured using *Total compensation*, there is evidence of greater pay for sector performance in multi-segment firms where the correlation between the industry perfor-

[18]We do not estimate separately for conglomerates with low and high-correlations because of the limited sample size.

mance of the main segment and all other segments is low. When pay is measured using *Bonus*, we find that the coefficient estimate on the interaction term, *Sector* $\times$ *Low corr*, is also positive but not statistically significant (see Column (4)). These results offer support for our theory and show that at least for some firms, pay for sector performance may be optimal and aimed at providing incentives for the CEO to choose the appropriate strategy.

[Table 4 goes here]

3.4.3 Strategic flexibility and pay for sector performance

We now test *Prediction 3*, which predicts greater pay for sector performance in firms that offer greater strategic flexibility to the CEO. To test this prediction, we use two alternate proxies to identify firms that offer greater strategic flexibility. First, we use the market-to-book ratio of a firm's industry as a proxy for strategic flexibility. We define a firm's industry at the level of two-digit SIC code and measure the industry market-to-book ratio as the median market-to-book ratio of all firms in that industry. We classify industries with market-to-book ratios above the 60^{th} percentile as offering greater strategic flexibility to the CEO.[19] We then repeat our estimates of pay for sector performance in subsample of firms with high and low industry market-to-book. The evidence in Columns (1) and (2) of Table 5 shows that when pay is measured using *Total compensation*, there is evidence of greater pay for sector performance for firms in industries with high market-to-book ratios. We also find that the coefficient estimates on *Sector* for the two subsamples (high and low market-to-book) are significantly different from each other. In Columns (3) and (4) we repeat our estimation with *Bonus* as our measure of compensation. While pay for sector performance is marginally greater for firms in industries with low market-to-book ratios, we find that the coefficients in the two subsamples are not statistically different from each other.

In subsequent columns, we use the level of R&D expenditures in an industry to identify flexible industries. Here again, we define a firm's industry at the level of two-digit SIC code and measure the industry R&D expenditures as the median ratio of R&D expenditures to total assets of all firms in the industry. We classify industries with R&D expenditures above the 70^{th} percentile as offering greater strategic flexibility to the CEO. The idea is that by scaling up or down R&D

[19]The cutoff to identify high and low market-to-book industries is chosen to make the two sub-samples approximately equal in size. Same criterion is used to divide the sample for our second proxy of strategic flexibility: industry R&D expenditures.

expenditures, CEOs can alter the speed of new product introduction and hence the sensitivity of firm performance to sector movements. As can be seen from Columns (5) and (6) of Table 5, pay for sector performance is greater for firms in industries with higher levels of R&D expenditures. These results offer further support for our theory. In Columns (7) and (8), we repeat our estimation with *Bonus* as our measure of CEO compensation but find that pay for sector performance is actually higher for firms in industries with low R&D expenditures.

[Table 5 goes here]

3.4.4 Pay for sector performance, R&D expenditures and asset growth

Our results so far indicate that pay for sector performance is greater in firms in industries that offer the CEO greater strategic flexibility. If, according to our model, pay for sector performance provides incentives for the CEO to exploit the available strategic flexibility, then it can be argued that we should expect firms with greater pay for sector performance to show some evidence of the CEOs exploiting their strategic flexibility to a greater extent *at the firm level*. To test this prediction, we use actual firm R&D expenditures and asset-growth rates to identify firms that show evidence of CEOs exploiting their strategic flexibility. Results are reported in Table 6. In Columns (1) and (2), every year we classify firms with positive industry-adjusted R&D expenditures as firms in which the CEO exploits her strategic flexibility. We then form two subsamples of firms with positive and negative industry-adjusted R&D expenditures in the following year (Column (1) and Column (2), respectively). We then re-estimate (6) in the two subsamples. A larger coefficient estimate on *Sector* in the subsample of firms with positive industry-adjusted R&D expenditures as compared to firms with negative R&D expenditures in the following year would indicate greater pay for sector performance in firms that show evidence of exploiting their strategic flexibility the next year. The evidence in Column (1) and (2) shows that pay for sector performance is indeed greater in firms that have higher industry-adjusted R&D expenditures in the following year. Although the coefficient on *Sector* in Column (1) is about twice the one in Column (2), we find that the coefficient estimates are not significantly different from each other. Next, we classify firms into subsamples based on whether they have positive or negative industry-adjusted asset-growth rates during the sample period and re-estimate (6) in the two subsamples. Consistent with our conjecture, the results in Columns (3) and (4) indicate that pay for sector performance is greater in firms that have positive industry-adjusted asset-growth rates. This additional test offers some further support to our theory.

[Table 6 goes here]

3.4.5 Strategic flexibility and CEO turnover

Apart from compensation, firms can also provide incentives to the CEO through their retention decision. If CEOs suffer loss of utility when they are fired, then the threat of getting fired due to poor performance is likely to provide additional incentives to the CEO to find out the sector movements and choose appropriate sector exposures. In a recent working paper, Jenter and Kanaan (2008) show that a decline in the industry component of firm performance significantly increases the likelihood of a disciplinary CEO turnover. Several explanations are proposed in their paper, but none of them is fully supported by the data. Our theory offers a new angle to understand their finding. If disciplinary turnovers provide incentives to the CEO to choose the right sector exposure, then our model would predict that the likelihood of a disciplinary CEO turnover should be sensitive to sector performance. Furthermore, we should also observe greater sensitivity of disciplinary CEO turnover to sector performance in firms that offer greater strategic flexibility to the CEO, since in these firms sector performance is *ceteris paribus* more informative about the CEO's effort and talent in choosing the right sector exposure.[20] To test this prediction, we identify all disciplinary CEO turnovers that occur during our sample period. A turnover event is recognized for a firm in a given year if the CEO identification in the ExecuComp database changes. We then hand-collect media reports that announce the CEO turnover and classify a CEO turnover as disciplinary following the procedure in Parrino (1997). Specifically, a CEO turnover is classified as disciplinary if it is reported that the CEO is fired, forced to step down, or departs due to unspecified policy differences. For other cases, if the departing CEO is under the age of 65, and the news announcement reports that the CEO is retiring, but does not announce the retirement at least six months before the effective date, or if the announcement does not report the reason for the departure as related to death, poor health, or the acceptance of another position, then the CEO turnover is classified as a disciplinary turnover. We identify 275 instances of disciplinary CEO turnover in our sample. We then create a

[20]It is also reasonable to expect the sensitivity to be greater for multi-segment firms as compared to single segment firms. Since we have very few instances of disciplinary CEO turnovers for multi-segment firms, we do not test this prediction.

dummy variable *Fired* that takes the value one if a firm experiences a disciplinary CEO turnover and zero otherwise. We then estimate (6) with *Fired* as the dependent variable and present the results in Table 7.[21]

In Columns (1) and (2), we present the results in subsamples of firms with high and low industry market-to-book ratios. The evidence shows that, consistent with our conjecture, the likelihood of a disciplinary CEO turnover is more sensitive to *Sector* for firms in industries with high market-to-book ratios. Although the coefficient estimate for firms in high market-to-book industries is thrice the coefficient for firms in low market-to-book industries ($-.049$ in comparison to $-.016$), due to the noise in our estimation we find that the estimates are not statistically different from each other. We repeat our estimation in Columns (3) and (4) with industry R&D expenditures as a measure of strategic flexibility. Our results again show that the likelihood of a disciplinary CEO turnover is more sensitive to *Sector* in firms in industries with high R&D expenditures. Our results thus offer strong support for our theory.

[Table 7 goes here]

3.4.6 CEO talent and pay for sector performance

In Table 8, we test *Prediction 4*, which indicates greater pay for sector performance for more talented CEOs. We use three proxies for CEO talent. Our first proxy for talent is the industry-adjusted stock performance of the firm during the previous year. Our second proxy is a classification of the CEO as internal or external. Our third proxy measures the talent of external CEOs and is based on the stock performance of the firm from which the external CEO is hired. We provide the results with *Total compensation* as our measure of CEO compensation in Panel A and *Bonus* as the compensation measure in Panel B.

In Columns (1) and (2), we use the industry-adjusted stock performance during the previous year as our proxy for CEO talent.[22] The idea is that firms managed by more talented CEOs will exhibit better industry-adjusted stock performance. We measure the annual industry-adjusted performance as the average of $\frac{R_i - R_{ind}}{\sigma_i}$, where R_i is the monthly return on the firm i's stock, R_{ind} is

[21] We do not employ the Logit or the Probit models due to the incidental parameters problem that is likely in non-linear models with a large number of variables (Woolridge (2001)).

[22] Since we measure performance over one year period, we do not use a performance measure such as the Carhart (1997) four-factor α whose accurate estimation may require more data.

the monthly equal-weighted industry return and σ_i is the standard deviation of monthly return of all firms in the same industry as firm i. To test for greater pay for sector performance for more talented CEOs, we divide our sample into two subsamples: CEOs of firms with above and below median industry-adjusted performance during the previous year. We then repeat the estimation in both the subsamples. The results reported in Columns (1) and (2) of Panel A show that there is strong evidence of pay for sector performance for more talented CEOs. Specifically, *Total compensation* loads significantly more on *Sector* for CEOs with above median industry-adjusted performance. This offers support for our theory.

In Columns (3) and (4), we classify CEOs as internal or external depending on whether the CEO was recruited from inside or outside the firm. We classify a CEO as external if she becomes the CEO within two years of joining the firm. Following Milbourn (2003), we identify external CEOs as being more talented than internal CEOs and repeat our tests in the two subsamples. The results reported in Columns (3) and (4) show that when pay is measured using *Total compensation*, there is evidence of greater pay for sector performance for external CEOs as compared to internal CEOs.

In Columns (5) and (6), we look at the subsample of external CEOs to try to further differentiate between talented and untalented ones. To achieve that, we identify the previous firm from which an external CEO was hired and measure the stock performance of that firm during the tenure of the executive. We use the Carhart (1997) four-factor α during the executive's tenure as a measure of firm performance.[23]. We then identify external CEOs hired from firms with positive four-factor α's as more talented than those hired from firms with negative α's. We then re-estimate (6) in the two subsamples of external CEOs with positive and negative α's. Our results in Columns (5) and (6) do provide evidence of greater pay for sector performance for external CEOs hired from firms with positive four-factor α's.

In Panel B, we repeat our estimation with *Bonus* as our measure of compensation and obtain consistent results. With *Bonus* we find that both CEOs with better industry-adjusted performance and external CEOs have greater pay for sector performance, although only the estimates for external versus internal CEOs are different across the subsamples. We do not find any evidence of greater pay for sector performance for external CEOs hired from firms with positive four-factor α's when

[23]We have sufficient data to estimate the four-factor α's as our performance measure because we use the full tenure of the executive to measure the stock performance.

pay is measured by bonus.

[Table 8 goes here]

3.4.7 Asymmetric pay for sector performance

In this section, we test *Prediction 5*, which predicts asymmetry in the optimal pay for sector performance relationship. In Panel A of Table 9, we test whether there is evidence of asymmetry in the overall pay for sector performance relationship. The tests in this subsection are similar to those in Garvey and Milbourn (2006) except that our sample period is longer than theirs. To test for asymmetry, we repeat the estimation of (6) after replacing *Sector* with two interaction terms, namely *Sector* × (*+ve Sector*) and *Sector* × (*−ve Sector*). Recall that *+ve Sector* (*−ve Sector*) is a dummy variable that takes the value one when *Sector* is positive (negative) and zero otherwise. The results in Panel A show that there is significantly greater reward for good sector performance than for bad sector performance, regardless of whether pay is measured by *Total compensation* or *Bonus*. These results are consistent with Garvey and Milbourn (2006) and also in line with our model's predictions.

In Panels B of Table 9, we repeat our estimation to see if pay for sector performance asymmetry is present in multi-segment firms. Although our objective is only to establish pay for sector performance asymmetry in these firms, to provide a complete picture, we repeat the estimation in both subsamples of multi-segment and single segment firms. Consistent with our prediction, we do find asymmetry in the pay for sector performance relationship in the subsample of multi-segment firms when we measure compensation using *Total compensation*. We do not find significant pay for sector performance asymmetry when we use *Bonus* as our measure of compensation.

In Panel C, we repeat our estimation to see if the asymmetry in pay for sector performance is present for firms that offer greater strategic flexibility to the CEO. In Columns (1) and (2), we measure strategic flexibility using industry market-to-book ratio. As mentioned earlier, industries with higher market-to-book ratios are likely to offer greater strategic flexibility to the CEO. Consistent with our prediction, we do find asymmetry in the pay for sector performance relationship in the subsample with high market-to-book ratios. In Columns (3) and (4), we repeat our estimates with *Bonus* as our measure of compensation and find evidence of pay for sector performance asymmetry in firms in high market-to-book industries. We next use industry R&D expenditures as a measure of strategic flexibility in Columns (5) – (8). Here again, consistent with our model, we find pay for sector performance asymmetry in firms in high R&D industries.

In Panel D, we test to see if pay for sector performance asymmetry is present for more talented CEOs. As before we use three proxies for CEO talent. In Columns (1) – (4), we use the industry-adjusted stock performance during the previous year as a measure of CEO talent and find that pay for sector performance asymmetry is present for CEOs in firms with higher industry-adjusted stock performance during the previous year. In Columns (5) – (8), we classify CEOs as internal or external and find that pay for sector performance asymmetry is present for externally-hired CEOs, who are likely to be more talented. Finally, in Columns (9) – (12), we classify external CEOs based on the stock performance of the firms they are hired from and find that pay for sector performance asymmetry is present for external CEOs hired from firms with positive Carhart four-factor α's. Overall, these results offer strong support for our theory.

[Table 9 goes here]

4 Conclusion

Optimal contracting prescribes that any portion of a firm's performance that is truly outside of the CEO's control should be filtered out of her pay, but empirically, neither sector nor market movements are filtered out in CEO pay packages. Many interpret this as a failure of corporate governance, arguing that CEOs have taken control over their own corporate boards and set pay in their own interests. Our paper suggests that the observed relationship between CEO pay and sector performance is consistent with optimal contracting if one takes an alternative perspective on the genesis of the portion of the firm's performance recently referred to as luck. In this paper, we provide a simple model of firms employing CEOs to select and implement the firm's strategy, and that this strategy choice manifests itself in realized exposures to sector returns. Ultimately, we attribute at least a portion of the firm's returns that correlate with sector returns to the CEO's decision to have just such an exposure. Optimal compensation necessarily evolves in such a setting, and predicts the positive relationship uncovered empirically between CEO pay and sector performance. In fact, our analysis suggests that filtering out the portion of a firm's performance that is attributable to sector or broad market forces would actually distort CEO incentives. Our analysis also suggests that the positive reward for sector performance should be more prominent in multi-segment firms and in firms for which the CEO has greater flexibility to change the firm's strategy by altering its exposures. Using a novel set of proxies for strategic flexibility, we uncover strong empirical support for this prediction. In future work, we hope to move beyond our current empirical focus on industry returns and explore the implications of modeling a CEO's action space more broadly as an active agent leading her firm.

Appendix A: Proofs of propositions

Proof of Proposition 1: Note that under the specific assumption for the CEO's utility function, we have $\mathbf{E}\big(V_{CEO}(w_0 + w[\beta_i \bar{r} \pm \beta_i r_s + \varepsilon])\big) = w_0 + w[\beta_i \bar{r} \pm \beta_i r_s] - [\lambda/2][w^2\sigma^2] - [\lambda/2]\{w[\beta_i \bar{r} \pm \beta_i r_s]\}$, $i \in \{H, L\}$, where $\lambda \in (0, 2)$. The CEO's incentive-compatibility constraint, (3), can be written as:

$$e = \frac{[w\beta][\bar{r} + r_s][2 - \lambda]}{2\delta}, \tag{A1}$$

and her participation constraint, (2), can then be written as:

$$\begin{aligned} 2\bar{V}_{CEO} &= \mathbf{E}\big(V_{CEO}(w_0 + w\varepsilon) + V_{CEO}(w_0 + w\varepsilon)\big) + \frac{\delta e^2}{2} \\ &= 2w_0 - \lambda w^2\sigma^2 + \frac{[w^2\beta^2][\bar{r} + r_s]^2[2 - \lambda]^2}{8\delta}. \end{aligned} \tag{A2}$$

Substituting both (A1) and (A2) into the investors' objective function (1), we can rewrite the investors' optimization problem as:

$$\max_{\{w\}} \frac{w[1 - w][\beta^2][\bar{r} + r_s]^2[2 - \lambda]}{4\delta} + \frac{[w^2\beta^2][\bar{r} + r_s]^2[2 - \lambda]^2}{16\delta} - \frac{\lambda w^2\sigma^2}{2} - \bar{V}_{CEO}. \tag{A3}$$

Denote the solution as w^*, we have:

$$w^* = \frac{4 - 2\lambda}{4 - \lambda^2 + \frac{8\lambda\delta\sigma^2}{\beta^2[\bar{r} + r_s]^2}}. \tag{A4}$$

It is clear from (A4) that w^* is increasing in β and r_s and decreasing in δ. □

Proof of Proposition 2: Note that w^* is given by (A4). We now analyze the multi-segment firm. Given the contract (w_{0m}, w_m), the CEO's expected utility is:

$$\begin{aligned} V_{CEO}(w_{0m}, w_m) = [e\eta] &\left[\frac{\mathbf{E}\big(V_{CEO}(w_{0m} + w_m[\beta\bar{r} + \beta r_s + \varepsilon]) + V_{CEO}(w_{0m} + w_m\varepsilon)\big)}{2}\right] \\ &+ [e][1 - \eta]\mathbf{E}\big(V_{CEO}(w_{0m} + w_m[\beta\bar{r} + \beta r_s + \varepsilon])\big) \\ &+ [1 - e]\mathbf{E}\big(V_{CEO}(w_{0m} + w_m\varepsilon)\big) - \frac{\delta e^2}{4}. \end{aligned} \tag{A5}$$

To understand (A5), first suppose the CEO generates the signal. With probability η the two sectors realize the same return, in which case with probability 1/2 both sectors realize $\bar{r} + r_s > 0$ but the CEO can only choose the high-risk strategy for one sector, resulting the firm return to be $[\beta][\bar{r}+r_s]+[0][\bar{r}+r_s]+\varepsilon = \beta\bar{r}+\beta r_s$, and with probability 1/2 both sectors realize $\bar{r} - r_s < 0$ and the CEO chooses the low-risk strategy for both, resulting the firm return to be ε. This corresponds to the first term in (A5). With probability $1 - \eta$ the two sectors realize different returns. The CEO chooses the high-risk strategy for the outperforming sector (with return of $\bar{r}+r_s$) and the low-risk strategy for the underperforming sector (with return of $\bar{r}-r_s$), resulting the firm return to be $[\beta][\bar{r}+r_s]+[0][\bar{r}-r_s]+\varepsilon=\beta\bar{r}+\beta r_s$, regardless which sector outperforms. This corresponds to the second term in (A5). Finally, if the CEO fails to generate the signal, she chooses $\beta_L=0$ for the two sectors, resulting firm return to be $[0][R_{s1}+R_{s2}]+\varepsilon=\varepsilon$, regardless of the realized values of R_{s1} and R_{s2}.

The CEO's incentive-compatibility constraint can be written as:

$$e=\frac{[w_m\beta][\bar{r}+r_s][2-\lambda][2-\eta]}{2\delta}. \tag{A6}$$

The investors' expected payoff is:

$$V_I(w_{0m},w_m)=[1-w_m][e]\left\{[\eta]\left[\frac{\beta\bar{r}+\beta r_s}{2}\right]+[1-\eta][\beta\bar{r}+\beta r_s]\right\}-w_{01}. \tag{A7}$$

The investors' contracting problem can be solved in the same way as that in the proof of Proposition 1 for the single segment firm, which yields:

$$w_m^*=\frac{4-2\lambda}{4-\lambda^2+\frac{8\lambda\delta\sigma^2}{\beta^2[\bar{r}+r_s]^2[2-\eta]^2}}, \tag{A8}$$

which is larger than w^*. It is also clear that $\partial w_m^*/\partial\eta<0$, and $w_m^*\downarrow w^*$ when $\eta\uparrow 1$. □

Proof of Proposition 3: If the CEO always chooses the high-risk strategy ($\beta_H=\beta$) when she fails to generate the private signal Θ, then the CEO's incentive-compatibility constraint, (3), can be written as:

$$\mathbf{E}\big(V_{CEO}(w_0+\underline{w}\varepsilon)-V_{CEO}(w_0+\underline{w}[\beta\bar{r}-\beta r_s+\varepsilon])\big)=\delta e. \tag{A9}$$

On the other hand, if the CEO always chooses the low-risk strategy ($\beta_L=0$) when she fails to generate Θ, then we have:

$$\mathbf{E}\big(V_{CEO}(w_0+\bar{w}[\beta\bar{r}+\beta r_s+\varepsilon])-V_{CEO}(w_0+\bar{w}\varepsilon)\big)=\delta e. \tag{A10}$$

Thus, in equilibrium under the optimal contract we have:

$$\begin{aligned}\delta e&=\mathbf{E}\big(V_{CEO}(w_0^*+\underline{w}^*\varepsilon)-V_{CEO}(w_0^*+\underline{w}^*[\beta\bar{r}-\beta r_s+\varepsilon])\big)\\&=\mathbf{E}\big(V_{CEO}(w_0^*+\bar{w}^*[\beta\bar{r}+\beta r_s+\varepsilon])-V_{CEO}(w_0^*+\bar{w}^*\varepsilon)\big)\\&>0.\end{aligned} \tag{A11}$$

First, note that we must have $\bar{w}^* > 0$ and $\underline{w}^* > 0$ in order for (A11) to hold. The reason is as follows. If $\bar{w}^* = 0$, then $\mathbf{E}\big(V_{CEO}(w_0^* + \bar{w}^*[\beta\bar{r} + \beta r_s + \varepsilon]) - V_{CEO}(w_0^* + \bar{w}^*\varepsilon)\big) = 0$; similarly, if $\underline{w}^* = 0$, then $\mathbf{E}\big(V_{CEO}(w_0^* + \underline{w}^*\varepsilon) - V_{CEO}(w_0^* + \underline{w}^*[\beta\bar{r} - \beta r_s + \varepsilon])\big) = 0$. Second, note that, for any realized value of ε, $\{w_0^* + \bar{w}^*[\beta\bar{r} + \beta r_s + \varepsilon]\} > \{w_0^* + \bar{w}^*\varepsilon\} > \{w_0^* + \underline{w}^*[\beta\bar{r} - \beta r_s + \varepsilon]\}$. Thus, we must have $\{w_0^* + \bar{w}^*[\beta\bar{r} + \beta r_s + \varepsilon]\} - \{w_0^* + \bar{w}^*\varepsilon\} > \{w_0^* + \underline{w}^*\varepsilon\} - \{w_0^* + \underline{w}^*[\beta\bar{r} - \beta r_s + \varepsilon]\}$, i.e.,

$$\bar{w}^*[\bar{r} + r_s] > \underline{w}^*[r_s - \bar{r}], \tag{A12}$$

in order for (A11) to hold, because $V_{CEO}(\cdot)$ is concave. If $\bar{r} \leq 0$, (A12) clearly implies that $\bar{w}^* > \underline{w}^*$. If $\bar{r} > 0$, in order to have $\bar{w}^* > \underline{w}^*$, $\bar{w}^*[\bar{r} + r_s]$ must be sufficiently larger than $\underline{w}^*[r_s - \bar{r}]$, i.e., $V_{CEO}(\cdot)$ must be sufficiently concave and the CEO be sufficiently risk averse.

To show $\bar{w}^* - \underline{w}^*$ is increasing in β, note that $\{w_0^* + \bar{w}^*[\beta\bar{r} + \beta r_s + \varepsilon]\} - \{w_0^* + \bar{w}^*\varepsilon\} = \bar{w}^*\beta[\bar{r} + r_s]$, and $\{w_0^* + \underline{w}^*\varepsilon\} - \{w_0^* + \underline{w}^*[\beta\bar{r} - \beta r_s + \varepsilon]\} = \underline{w}^*\beta[\bar{r} - r_s]$. As β increases, say by $\Delta\beta$, there are four possibilities for the changes of $\bar{w}^*$ and $\underline{w}^*$ under the new optimal contract. First, both $\bar{w}^*$ and $\underline{w}^*$ increase. Suppose $\bar{w}^*$ increases by $\Delta\bar{w}^*$ and $\underline{w}^*$ increases by $\Delta\underline{w}^*$ under the new optimal contract. If the CEO is sufficiently risk averse (i.e., $V_{CEO}(\cdot)$ is sufficiently concave), $\Delta\bar{w}^*\Delta\beta[\bar{r} + r_s]$ must be much larger than $\Delta\underline{w}^*\Delta\beta[\bar{r} - r_s]$ in order for the incentive-compatibility constraint (A11) to hold under the new optimal contract; this is because $V_{CEO}(\cdot)$ is concave. That is, $\Delta\bar{w}^* > \Delta\underline{w}^*$, and $\bar{w}^* - \underline{w}^*$ is increasing in β. Second, $\bar{w}^*$ increases, whereas $\underline{w}^*$ decreases. In this case, it is trivially true that $\bar{w}^* - \underline{w}^*$ increases. Third, both $\bar{w}^*$ and $\underline{w}^*$ decrease. Suppose $\bar{w}^*$ decreases by $\Delta\bar{w}^*$ and $\underline{w}^*$ decreases by $\Delta\underline{w}^*$ under the new optimal contract. We must have $\Delta\bar{w}^*\Delta\beta[\bar{r} + r_s] < \Delta\underline{w}^*\Delta\beta[\bar{r} - r_s]$, and hence $\Delta\bar{w}^* < \Delta\underline{w}^*$, in order for the incentive-compatibility constraint (A11) to hold under the new optimal contract; this is again because $V_{CEO}(\cdot)$ is concave. That is, $\bar{w}^* - \underline{w}^*$ is again increasing in β in this case. Finally, $\bar{w}^*$ decreases, whereas $\underline{w}^*$ increases. This is, however, not possible, since the incentive-compatibility constraint (A11) will not hold under the new contract in this case. □

Appendix B: Empirical variable definitions

The variables used in the empirical analysis are defined as follows:

- *Salary* is the CEO's yearly salary value.
- *Bonus* is the CEO's yearly bonus value.
- *Option grants* represents the Black and Scholes value of the options granted to the CEO in the year.

- *Total compensation* is the sum of salary, bonus, other annual compensation, long-term incentive payouts, other cash payouts, and the value of restricted stock and stock option awards.
- *Tenure* for any year is calculated as the difference between the fiscal year-end of that year and the date at which the CEO became CEO as given by the BecameCEO field in ExecuComp.
- *Age* is the CEO's age in the data year.
- *Stock return* is the one-year percentage return for the firm over its fiscal year.
- *Volatility* is the stock return volatility provided in ExecuComp that is used to calculate the Black-Scholes value of the stock options.
- *Market value* is the firm's equity market capitalization at the end of the firm's fiscal year.
- *Log(assets)* is the natural logarithm of the book value of total assets.
- *Sector* is the sector component of firm performance estimated using the equal- and value-weighted industry returns, where industry is defined at the two-digit SIC code level.
- *+ve Sector (−ve Sector)* is a dummy variable that takes the value one when the sector performance is positive (negative) and zero otherwise.
- *Firm specific* is the residual firm performance and is estimated as the difference between firm return and *Sector*.
- *CDF of var of sector* (*Firm specific*) is the cumulative distribution function of the variance of *Sector* (*Firm specific*).
- *CEO* is a dummy variable that takes the value one if the executive is a CEO and zero otherwise.
- *Large* is a dummy variable that equals to one if the firm size, as measured by the natural logarithm of the book value of total assets, is above the sample median.
- *Low corr* is a dummy variable that takes the value one for multi-segment firms in which the correlation between the industry performance of the main segment and the weighted average industry performance of the other (non-main) segments is less than the sample median.
- *Fired* is a dummy variable that takes the value one for a disciplinary CEO turnover. We classify a CEO turnover as disciplinary following the procedure in Parrino (1997). Specifically CEO turnovers are classified as disciplinary if it is reported that the CEO is fired, forced to step down, or departs due to unspecified policy differences. For other cases, if the departing CEO is under the age of 65, and the news announcement reports that the CEO is retiring, but does not announce the retirement at least six months before the effective date, or if the announcement does not report the reason for the departure as related to death, poor health, or the acceptance of another position, then the turnover is classified as disciplinary.

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Table 1: Summary statistics

Descriptive statistics of Chief Executive Officers (CEOs) and firms. The data are collected for every CEO in ExecuComp for the period 1992-2006. Panel A summarizes the full ExecuComp sample, and Panel B summarizes the subsample that only includes firms with fiscal year ending in December and excludes the firm-years with CEO transition. Details on the definition of the variables reported in this table are provided in Appendix B. Compensation data are in thousands, and market values are in millions of yearly dollars.

Panel A: Summary statistics for full ExecuComp sample

Variable	N	Mean	Min	Median	Max	Std. Dev.
Salary ($ thousand)	22966	620.021	0	561	5806.651	346.664
Bonus ($ thousand)	22966	696.959	0	324.909	102015.2	1625.406
Option grants ($ thousand)	21809	2174.368	0	526.351	600347	8804
Total compensation ($ thousand)	22754	4573.603	0	2081.918	2256186	18494
Tenure (years)	17377	7.460	0	5.170	46.027	7.051
Age (years)	21424	55.602	28	56	91	7.601
Stock return (%)	21984	18.936	-97.842	11.101	2619.417	63.690
Volatility	19966	0.424	0.102	0.363	4.211	0.245
Market value ($ million)	22685	6292.372	0.190	1338.287	507216.7	20819.3
Log(assets)	22946	7.437	0.644	7.276	14.449	1.779

Panel B: Summary statistics for our subsample

Variable	N	Mean	Min	Median	Max	Std. Dev.
Salary ($ thousand)	14507	653.207	0	600	5806.651	360.342
Bonus ($ thousand)	14507	723.793	-0.001	346	102015.2	1713.297
Option grants ($ thousand)	13363	2000.138	0	534.573	290594.8	6675.643
Total compensation ($ thousand)	14436	4607.190	0	2194.180	2256186	20497.180
Tenure (years)	13272	7.997	1	5.986	46.027	6.800
Age (years)	13496	56.007	29	56	91	7.325
Stock return (%)	13736	19.050	-97.842	11.843	1494.336	59.777
Volatility	13968	0.407	0.102	0.341	4.211	0.260
Market value ($ million)	13872	6270	5.102	1460	506000	19900
Log(assets)	14468	7.695	1.233	7.582	14.449	1.837

Table 2: Market indices

This table reports the summary statistics of the two market indices that we use in our baseline specification to estimate the sector and firm-specific components of firm performance: equal-weighted industry return and value-weighted industry return. We define the firm's industry at the level of the two-digit SIC code. The data are collected for every firm in which a Chief Executive Officer (CEO) in ExecuComp is identified as defined by the CEOANN field for each year 1992-2006. The percent positive (negative) represents the proportion of the sample for which the relative benchmark return is positive (negative).

Variable	Percent positive	Percent negative	Min	Median	Max	Std. Dev.
Equal-weighted industry return	74.9%	25.1%	-50%	13.9%	126%	31.3%
Value-weighted industry return	73%	27%	-51.8%	12.9%	83.4%	24.3%

Table 3: Pay for sector performance

This table reports the results of the regression relating CEO compensation to the sector and firm-specific components of firm performance. Specifically, we estimate the panel corrected OLS regression: $z_{it} = \alpha_1 \times \text{Sector}_{it} + \alpha_2 \times \text{Firm specific}_{it} + \gamma \text{X}_{it} + \mu_e \text{E} + \mu_t \text{T}$, where z is *Total compensation* in Columns (1) and (4), *Bonus* in Columns (2) and (5) and *Option grants* in Columns (3) and (6). The compensation data are from ExecuComp, and stock returns are from CRSP. Details on the definition of the variables in this table are provided in Appendix B. The sample includes all CEO-firm year data from ExecuComp after excluding CEO transition years and firms with fiscal year ending other than December for the years 1992-2006. Robust standard errors are reported in parentheses, and the coefficients on the intercept, the CDF of the dollar variance return, and the year and executive fixed effects are suppressed for convenience. The standard errors are clustered at individual executive level. Asterisks denote statistical significance at the 1% (∗∗∗), 5% (∗∗) and 10% (∗) levels.

	Total compensation	Bonus	Option grants	Total compensation	Bonus	Option grants
	(1)	(2)	(3)	(4)	(5)	(6)
Sector	1.195	.268	.210	.790	.203	.014
	(.311)***	(.055)***	(.222)	(.319)**	(.060)***	(.223)
Firm specific	.684	.353	-.085	.767	.289	.031
	(.197)***	(.036)***	(.130)	(.205)***	(.037)***	(.132)
Sector × CEO				.522	.077	.230
				(.121)***	(.028)***	(.078)***
Firm specific × CEO				-.160	.025	-.153
				(.115)	(.021)	(.076)**
CEO ($\times 10^8$)				4.450	1.310	4.200
				(0.877)***	(0.148)***	(0.551)***
Large ($\times 10^8$)	11.508	0.992	7.156	8.349	0.897	5.442
	(1.99)***	(0.314)***	(1.359)***	(1.822)***	(0.265)***	(1.207)***
Sector × CDF of var of sector	-1.156	-.253	-.239	-1.244	-.252	-.267
	(.350)***	(.062)***	(.254)	(.336)***	(.060)***	(.237)
Firm specific × CDF of var of firm specific	-.526	-.312	.098	-.422	-.264	.153
	(.240)**	(.044)***	(.161)	(.223)*	(.041)***	(.146)
Obs.	12654	12723	11692	14947	15179	13991
R^2	.727	.724	.615	.697	.692	.58

Table 4: Pay for sector performance in multi-segment firms

Panel A of this table reports the results of the regression relating CEO compensation to the sector and firm-specific components of firm performance for the subsamples of multi-segment firms (which are firms that report positive assets and sales in more than one three-digit SIC code industry) and single segment firms. Specifically, we estimate the panel corrected OLS regression: $z_{it} = \alpha_1 \times \text{Sector}_{it} + \alpha_2 \times \text{Firm specific}_{it} + \gamma \text{X}_{it} + \mu_e \text{E} + \mu_t \text{T}$ for each subsample, where z is *Total compensation* in Columns (1) and (2) and *Bonus* in Columns (3) and (4). Columns (1) and (3) report the estimation results for multi-segment firms, and the results for single segment firms are in Columns (2) and (4). Δ*Coeff* is the difference between the coefficient estimates on *Sector* for the multi-segment firms and the single segment firms. Panel B reports the results of the regression relating CEO compensation to the sector and firm-specific components of firm performance for multi-segment firms. The empirical specification and variables are similar to the ones in Panel A. The compensation data are from ExecuComp, and stock returns are from CRSP. Details on the definition of the variables in this table are provided in Appendix B. The sample includes all CEO-firm year data from ExecuComp after excluding CEO transition years and firms with fiscal year ending other than December for the years 1992-2006. Robust standard errors are reported in parentheses, and the coefficients on the intercept, the CDF of the dollar variance return, and the year and executive fixed effects are suppressed for convenience. The standard errors are clustered at individual executive level. Asterisks denote statistical significance at the 1% ($***$), 5% ($**$) and 10% ($*$) levels.

Panel A: Pay for sector performance – multi-segment firms versus single segment firms

	Total compensation		Bonus	
	Multi-segment	Single segment	Multi-segment	Single segment
	(1)	(2)	(3)	(4)
Sector	1.937 (.471)***	.459 (.604)	.377 (.105)***	.151 (.092)*
Firm specific	1.163 (.288)***	.588 (.384)	.414 (.069)***	.297 (.058)***
Large ($\times 10^8$)	7.133 (2.913)**	16.039 (3.424)***	0.771 (0.581)	1.962 (0.516)***
Sector × CDF of var of sector	-1.973 (.519)***	-.346 (.690)	-.367 (.116)***	-.128 (.105)
Firm specific × CDF of var of firm specific	-1.016 (.343)***	-.403 (.465)	-.391 (.083)***	-.240 (.067)***
Obs.	4263	4193	4280	4218
R^2	.772	.706	.719	.709
ΔCoeff	1.478 (.77)*		.226 (.139)*	

Panel B: Pay for sector performance within multi-segment firms

	Total compensation		Bonus	
	(1)	(2)	(3)	(4)
Sector	1.937	1.906	.377	.379
	(.471)***	(.482)***	(.105)***	(.108)***
Sector × Low corr		.241		.035
		(.118)**		(.025)
Low corr ($\times 10^8$)		9.076		6.972
		(13.372)		(7.616)
Firm specific	1.163	1.162	.414	.396
	(.288)***	(.301)***	(.069)***	(.073)***
Large ($\times 10^8$)	7.133	4.792	0.771	0.587
	(2.913)**	(2.907)	(0.581)	(0.646)
Sector × CDF of var of sector	-1.973	-2.046	-.367	-.381
	(.519)***	(.537)***	(.116)***	(.122)***
Firm specific × CDF of var of firm specific	-1.016	-1.011	-.391	-.375
	(.343)***	(.356)***	(.083)***	(.087)***
Obs.	4263	3820	4280	3835
R^2	.772	.775	.719	.717

Table 5: Strategic flexibility and pay for sector performance

This table reports the results of the regression relating CEO compensation to the sector and firm-specific components of firm performance. The specification is the same as that in Table 3. In Columns (1) and (3) (Columns (2) and (4)) we report the results for the subsample of firms in industries with market-to-book ratio above (below) the 60^{th} percentile, and in Columns (5) and (7) (Columns (6) and (8)) we report the results for the subsample of firms in industries with R&D expenditures above (below) the 70^{th} percentile. The cutoffs to identify the subsamples are determined so as to obtain approximately equal-sized subsamples. Δ *Coeff* is the difference between the coefficient estimates on *Sector* for the subsamples. The compensation data are from ExecuComp, and stock returns are from CRSP. Details on the definition of the variables are provided in Appendix B. The sample includes all CEO-firm year data from ExecuComp after excluding CEO transition years and firms with fiscal year ending other than December for the years 1992-2006. Robust standard errors are reported in parentheses, and the coefficients on the intercept, the CDF of the dollar variance return, and the year and executive fixed effects are suppressed for convenience. The standard errors are clustered at individual executive level. Asterisks denote statistical significance at the 1% (∗∗∗), 5% (∗∗) and 10% (∗) levels.

	Total compensation		Bonus		Total compensation		Bonus	
	High MTB	Low MTB	High MTB	Low MTB	High R&D	Low R&D	High R&D	Low R&D
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sector	1.716	.532	.191	.281	1.500	.991	.119	.367
	(.471)***	(.453)	(.079)**	(.084)***	(.520)***	(.406)**	(.083)	(.077)***
Firm specific	.560	.914	.331	.322	.319	.959	.314	.379
	(.258)**	(.314)***	(.044)***	(.064)***	(.273)	(.292)***	(.046)***	(.059)***
Large ($\times 10^8$)	13.011	8.261	1.291	.281	13.917	10.559	1.424	.774
	(2.705)***	(2.921)***	(.382)***	(.534)	(3.175)***	(2.606)***	(.425)***	(.470)*
Sector × CDF of var of sector	-1.657	-.536	-.165	-.286	-1.401	-.988	-.061	-.378
	(.519)***	(.510)	(.090)*	(.094)***	(.575)**	(.461)**	(.093)	(.086)***
Firm specific × CDF of var of firm specific	-.403	-.775	-.310	-.237	-.103	-.827	-.277	-.330
	(.311)	(.393)**	(.052)***	(.081)***	(.325)	(.365)**	(.054)***	(.075)***
Obs.	6953	5701	6994	5729	5957	6697	5992	6731
R^2	.736	.766	.746	.757	.719	.759	.754	.726
ΔCoeff	1.184		-.090		.509		-.248	
	(.65)*		(.12)		(.66)		(.113)**	

Table 6: Pay for sector Performance, firm R&D expenditures and asset growth

This table reports the results of the regression relating CEO compensation to the sector and firm-specific components of firm performance. The specification is the same as that in Table 3. In Columns (1) and (2) we report results for subsamples of firms with positive and negative industry-adjusted R&D expenditures in the following year, respectively, and in Columns (3) and (4) we report results for firms with positive and negative industry adjusted asset-growth rates during the sample period, respectively. $\Delta\,Coeff$ is the difference between the coefficient estimates on *Sector* for the subsamples. The compensation data are from ExecuComp, and stock returns are from CRSP. Details on the definition of the variables in this table are provided in Appendix B. The sample includes all CEO-firm year data from ExecuComp after excluding CEO transition years and firms with fiscal year ending other than December for the years 1992-2006. Robust standard errors are reported in parentheses, and the coefficients on the intercept, the CDF of the dollar variance return, and the year and executive fixed effects are suppressed for convenience. The standard errors are clustered at individual executive level. Asterisks denote statistical significance at the 1% ($***$), 5% ($**$) and 10% ($*$) levels.

	High R&D	Low R&D	High growth	Low growth
	(1)	(2)	(3)	(4)
Sector	2.249	1.023	1.457	1.114
	(1.079)**	(.345)***	(.539)***	(.362)***
Firm specific	.253	.621	.610	.667
	(.497)	(.235)***	(.306)**	(.251)***
Large ($\times 10^8$)	23.543	9.302	11.739	10.933
	(6.739)***	(2.133)***	(3.144)***	(2.141)***
Sector × CDF of var of sector	-2.221	-1.014	-1.351	-1.163
	(1.165)*	(.390)***	(.610)**	(.405)***
Firm specific × CDF of var of firm specific	-.156	-.439	-.429	-.527
	(.550)	(.285)	(.369)	(.307)*
Obs.	2052	9639	5571	7083
R^2	.71	.739	.727	.732
ΔCoeff	1.226		.343	
	(1.13)		(.649)	

Table 7: Strategic flexibility and CEO turnover

This table reports the results of the regression relating the probability of a CEO getting fired to the sector and firm-specific components of firm performance. Specifically, we estimate the panel corrected OLS regression: $\text{Fired}_{it} = \alpha_1 \times \text{Sector}_{it} + \alpha_2 \times \text{Firm specific}_{it} + \gamma \text{X}_{it} + \mu_e \text{E} + \mu_t \text{T}$. In Columns (1) and (2) we report the results for the subsample of firms in industries with market-to-book ratio above and below the 60^{th} percentile, respectively, and in Columns (3) and (4) we report the results for the subsample of firms in industries with R&D expenditures above and below the 70^{th} percentile, respectively. The cutoffs to identify the subsamples are determined so as to obtain approximately equal-sized subsamples. Δ*Coeff* is the difference between the coefficient estimates on *Sector* for the subsamples. The CEO turnover data are from ExecuComp, and stock returns are from CRSP. Details on the definition of the variables in this table are provided in Appendix B. The sample includes all CEO-firm year data from ExecuComp after excluding CEO transition years and firms with fiscal year ending other than December for the years 1992-2006. Robust standard errors are reported in parentheses, and the coefficients on the intercept, the CDF of the dollar variance return, and the year and executive fixed effects are suppressed for convenience. The standard errors are clustered at individual executive level. Asterisks denote statistical significance at the 1% ($***$), 5% ($**$) and 10% ($*$) levels.

	Fired			
	High MTB	Low MTB	High R&D	Low R&D
	(1)	(2)	(3)	(4)
Sector ($ billion)	-.049 (.018)***	-.016 (.017)	-.063 (.023)***	-.022 (.014)
Firm specific ($ billion)	-.038 (.012)***	.0009 (.011)	-.046 (.014)***	.006 (.009)
Large	.007 (.007)	-.001 (.010)	-.008 (.008)	.002 (.009)
Sector × CDF of var of sector ($ billion)	.053 (.019)***	.013 (.019)	.070 (.025)***	.019 (.015)
Firm specific × CDF of var of firm specific ($ billion)	.041 (.014)***	-.007 (.013)	.050 (.017)***	-.011 (.011)
Obs.	6994	5729	5992	6731
R^2	.432	.464	.38	.442
ΔCoeff	-.033 (.024)		-.041 (.027)	

Table 8: CEO talent and pay for sector performance

Panel A of this table reports the results of the regression relating CEO compensation to the sector and firm-specific components of firm performance. The specification is the same as that in Table 3. In Columns (1) and (2) we report results for the subsamples of CEOs of firms with above and below industry-adjusted performance during the previous year, in Columns (3) and (4) we report results for the subsamples of internal and external CEOs, and in Columns (5) and (6) we report results for the subsamples of external CEOs who have positive and negative Carhart (1997) four-Factor α's in their previous firms. Δ*Coeff* is the difference between the coefficient estimates on *Sector* for the subsamples. Panel B repeats the estimations in Panel A, with *Bonus* as the measure of CEO compensation. The compensation data are from ExecuComp, and stock returns are from CRSP. Details on the definition of the variables in this table are provided in Appendix B. The sample includes all CEO-firm year data from ExecuComp after excluding CEO transition years and firms with fiscal year ending other than December for the years 1992-2006. Robust standard errors are reported in parentheses, and the coefficients on the intercept, the CDF of the dollar variance return, and the year and executive fixed effects are suppressed for convenience. The standard errors are clustered at individual executive level. Asterisks denote statistical significance at the 1% ($***$), 5% ($**$) and 10% ($*$) levels.

Panel A: CEO talent and pay for sector performance (total compensation)

	Total compensation					
	High return	Low return	External	Internal	External	
					Prev +ve α	Prev $-$ve α
	(1)	(2)	(3)	(4)	(5)	(6)
Sector	1.436 (.484)***	.952 (.534)*	1.786 (.705)**	.997 (.337)***	3.773 (1.514)**	1.053 (1.264)
Firm specific	.385 (.291)	1.116 (.318)***	1.344 (.468)***	.455 (.208)**	.077 (.707)	1.315 (.886)
Large ($\times 10^8$)	14.150 (3.017)***	9.022 (2.722)***	16.372 (4.724)***	9.607 (1.905)***	19.254 (6.555)**	19.136 (9.775)**
Sector $\times$ CDF of var of sector	-1.495 (.546)***	-.811 (.609)	-1.791 (.791)**	-.954 (.382)**	-3.998 (1.861)**	-.766 (1.393)
Firm specific $\times$ CDF of var of firm specific	-.155 (.351)	-.949 (.389)**	-1.303 (.590)**	-.253 (.251)	.614 (.946)	-1.444 (1.088)
Obs.	6191	6308	3176	9478	1362	858
R^2	.775	.791	.678	.747	.605	.629
ΔCoeff	.484 (.721)		.789 (.781)		2.72 (1.97)	

Panel B: CEO talent and pay for sector performance (bonus)

	Bonus					
	High return	Low return	External	Internal	External	
					Prev +ve α	Prev $-$ve α
	(1)	(2)	(3)	(4)	(5)	(6)
Sector	.282	.279	.435	.208	.334	.537
	(.087)***	(.094)***	(.114)***	(.062)***	(.182)*	(.208)***
Firm specific	.354	.360	.471	.307	.385	.613
	(.050)***	(.060)***	(.069)***	(.041)***	(.101)***	(.152)***
Large ($\times 10^8$)	1.231	0.661	1.146	0.885	1.663	3.003
	(0.344)***	(0.434)	(0.701)	(0.329)***	(0.916)*	(0.885)***
Sector $\times$ CDF of var of sector	-.287	-.231	-.411	-.191	-.272	-.521
	(.099)***	(.105)**	(.129)***	(.071)***	(.224)	(.273)*
Firm specific $\times$ CDF of var of firm specific	-.326	-.281	-.439	-.259	-.336	-.587
	(.062)***	(.072)***	(.081)***	(.051)***	(.129)***	(.196)***
Obs.	6223	6342	3195	9528	1390	869
R^2	.784	.783	.707	.732	.616	.638
ΔCoeff	.003		.227		-.203	
	(.128)		(.129)*		(.276)	

Table 9: Asymmetric pay for sector performance

Panel A of this table reports the results of the regression relating CEO compensation to sector and firm-specific components of firm performance. Specifically, we estimate the panel corrected OLS regression: $z_{it} = \alpha_1 \times \text{Sector} \times (\text{+ve Sector})_{it} + \alpha_2 \times \text{Sector} \times (-\text{ve Sector})_{it} + \alpha_3 \times \text{Firm specific}_{it} + \gamma \text{X}_{it} + \mu_e \text{E} + \mu_t \text{T}$, where z is measured by *Total compensation* (Column (1)) and *Bonus* (Column (2)). *Sector* × (*+ve Sector*) − *Sector* × (−*ve Sector*) is the difference between the coefficient estimates on *Sector* × (*+ve Sector*) and *Sector* × (−*ve Sector*). Panel B repeats the estimations separately for multi-segment firms which are firms that report positive assets and sales in more than one three-digit SIC code industry (Columns (1) and (3)) and single segment firms (Columns (2) and (4)), Panel C repeats the estimations for firms that offer difference levels of strategy flexibility as measured by industry market-to-book ratio (Columns (1) – (4)) and R&D expenditures (Columns (5) – (8)), and Panel D repeats the estimations for talented and untalented CEOs, where talent is measured by industry-adjusted firm performance during pervious year (Columns (1) – (4)), whether the CEO is hired from inside or outside (Columns (5) – (8)), and the performance of the externally-hired CEO's previous employer as measured by Carhart (1997) four-factor α (Columns (9) – (12)). The compensation data are from ExecuComp, and stock returns are from CRSP. Details on the definition of the variables in this table are provided in Appendix B. The sample includes all CEO-firm year data from ExecuComp after excluding CEO transition years and firms with fiscal year ending other than December for the years 1992-2006. Robust standard errors are reported in parentheses, and the coefficients on the intercept, the CDF of the dollar variance return, and the year and executive fixed effects are suppressed for convenience. The standard errors are clustered at individual executive level. Asterisks denote statistical significance at the 1% ($***$), 5% ($**$) and 10% ($*$) levels.

Panel A: Asymmetric pay for sector performance

	Total compensation	Bonus
	(1)	(2)
Sector × (+ve Sector)	2.080	.343
	(.333)***	(.058)***
Sector × (−ve Sector)	.036	.170
	(.339)	(.058)***
Firm specific	.812	.364
	(.200)***	(.036)***
Sector × CDF of var of sector	-1.740	-.302
	(.359)***	(.063)***
Firm specific × CDF of var of firm specific	-.648	-.322
	(.243)***	(.044)***
Obs.	12654	12723
R^2	.729	.724
Sector × (+ve Sector) − Sector × (−ve Sector)	2.044	.173
	(.261)***	(.040)***

Panel B: Multi-segment firms and asymmetric pay for sector performance

	Total compensation		Bonus	
	Multi-segment	Single segment	Multi-segment	Single segment
	(1)	(2)	(3)	(4)
Sector × (+ve Sector)	2.649 (.491)***	1.345 (.636)**	.423 (.109)***	.241 (.099)**
Sector × (−ve Sector)	.884 (.527)*	-.772 (.633)	.314 (.114)***	.024 (.093)
Firm specific	1.270 (.293)***	.730 (.393)*	.421 (.068)***	.311 (.059)***
Sector × CDF of var of sector	-2.407 (.521)***	-.909 (.699)	-.395 (.117)***	-.185 (.107)*
Firm specific × CDF of var of firm specific	-1.114 (.348)***	-.537 (.476)	-.398 (.082)***	-.253 (.068)***
Obs.	4263	4193	4280	4218
R^2	.774	.706	.719	.708
Sector × (+ve Sector) − Sector × (−ve Sector)	1.765 (.416)***	2.117 (.416)***	.109 (.08)	.217 (.07)***

Panel C: Strategic flexibility and asymmetric pay for sector performance

	Total compensation		Bonus		Total compensation		Bonus	
	High MTB	Low MTB	High MTB	Low MTB	High R&D	Low R&D	High R&D	Low R&D
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sector × (+ve Sector)	2.481 (.495)***	1.385 (.494)***	.245 (.083)***	.348 (.093)***	2.342 (.565)***	1.696 (.431)***	.190 (.087)**	.422 (.081)***
Sector × (−ve Sector)	.183 (.536)	-.226 (.496)	.095 (.083)	.218 (.089)**	.631 (.557)	-.202 (.453)	.048 (.087)	.272 (.084)***
Firm specific	.713 (.263)***	1.000 (.315)***	.341 (.044)***	.330 (.063)***	.446 (.278)	1.037 (.294)***	.325 (.046)***	.385 (.058)***
Sector × CDF of var of sector	-2.114 (.526)***	-1.137 (.532)**	-.199 (.091)**	-.333 (.097)***	-2.040 (.603)***	-1.372 (.468)***	-.115 (.095)	-.408 (.087)***
Firm specific × CDF of var of firm specific	-.548 (.316)*	-.867 (.394)**	-.319 (.052)***	-.245 (.080)***	-.234 (.330)	-.892 (.367)**	-.288 (.054)***	-.335 (.074)***
Obs.	6953	5701	6994	5729	5957	6697	5992	6731
R^2	.737	.768	.746	.757	.719	.761	.753	.726
Sector × (+ve Sector) − Sector × (−ve Sector)	2.298 (.405)***	1.611 (.379)***	.150 (.056)***	.130 (.067)**	1.711 (.397)***	1.898 (.353)***	.142 (.054)***	.150 (.059)**

Panel D: CEO talent and asymmetric pay for sector performance

	Total compensation		Bonus		Total compensation		Bonus	
	High return	Low return	High return	Low return	External	Internal	External	Internal
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sector × (+ve Sector)	2.089	1.820	.365	.335	3.023	1.762	.524	.280
	(.527)***	(.550)***	(.090)***	(.098)***	(.769)***	(.356)***	(.117)***	(.066)***
Sector × (−ve Sector)	.574	-.517	.169	.187	.404	-.119	.338	.102
	(.529)	(.571)	(.096)*	(.099)*	(.766)	(.376)	(.124)***	(.066)
Firm specific	.448	1.234	.364	.367	1.529	.565	.484	.317
	(.295)	(.322)***	(.050)***	(.060)***	(.487)***	(.209)***	(.068)***	(.041)***
Sector × CDF of var of sector	-1.925	-1.321	-.341	-.265	-2.641	-1.436	-.473	-.237
	(.567)***	(.609)**	(.100)***	(.106)**	(.826)***	(.388)***	(.129)***	(.072)***
Firm specific × CDF of var of firm specific	-.218	-1.061	-.336	-.288	-1.486	-.355	-.452	-.269
	(.355)	(.394)***	(.061)***	(.072)***	(.610)**	(.252)	(.079)***	(.051)***
Obs.	6191	6308	6223	6342	3176	9478	3195	9528
R^2	.774	.795	.784	.783	.679	.749	.708	.733
Sector × (+ve Sector) − Sector × (−ve Sector)	1.515	2.337	.196	.148	2.619	1.881	.186	.178
	(.418)***	(.377)***	(.069)***	(.06)**	(.573)***	(.289)***	(.079)**	(.046)***

(continued)

Panel D – continued

	Total compensation		Bonus	
	External (prev +ve α)	External (prev −ve α)	External (prev +ve α)	External (prev −ve α)
	(9)	(10)	(11)	(12)
Sector × (+ve Sector)	5.413	2.194	.497	.635
	(1.577)***	(1.372)	(.188)***	(.203)***
Sector × (−ve Sector)	2.001	-.611	.158	.425
	(1.607)	(1.689)	(.204)	(.290)
Firm specific	.460	1.262	.422	.595
	(.734)	(.879)	(.100)***	(.149)***
Sector × CDF of var of sector	-5.093	-1.431	-.381	-.583
	(1.892)***	(1.436)	(.220)*	(.264)**
Firm specific × CDF of var of firm specific	.260	-1.377	-.370	-.568
	(.958)	(1.091)	(.125)***	(.194)***
Obs.	1362	858	1390	869
R^2	.609	.622	.617	.632
Sector × (+ve Sector) − Sector × (−ve Sector)	3.411	2.805	.339	.21
	(.842)***	(1.543)*	(.146)**	(.24)