The Relationship between Firm Performance and Executive Pay:
Dynamics, Asymmetries, and Alternative Performance Measures*

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Abstract

This study explores the dynamic structure of the pay-for-performance relationship in executive compensation and quantifies the effect of introducing a more complex model of financial performance on the estimated performance sensitivity of executive pay.

The results suggest that current compensation responds to past performance outcomes, but that the effect decays considerably within two years. This contrasts sharply with models of infinitely persistent performance effects implicitly assumed in much of the empirical compensation literature.

We find that both accounting and market performance measures influence compensation and that the salary and bonus component of pay as well as total compensation have become more sensitive to firm financial performance over the past decades.

There is no evidence that boards fail to penalize executives for poor financial performance or reward them disproportionately well for good performance. Finally, the data suggest that boards may discount extreme performance outcomes both－high and low－relative to performance that lies within some "normal" band in setting compensation.

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1. Introduction

The relationship between firm performance and executive pay has been one of the most widely studied questions in the executive compensation literature. A substantial theoretical literature develops optimal executive compensation contracts that link pay to variations in firm performance as a means of aligning the incentives of managers (the "agents") with the interests of shareholders. This theoretical literature has spawned numerous empirical tests of the presence, form and strength of the relationship between executive compensation and firm financial performance. The desirability of "incentive pay" based on firm performance has become so widely accepted that it was written into recent reforms in the corporate income tax code intended to reduce or limit overall executive pay.

As a theoretical matter, the precise form of the optimal compensation contract is complicated(Rosen, 1992). In general, it will depend on such factors as the preferences of managers toward risk, the sensitivity of managerial effort to compensation, and the information on true managerial performance provided by the measures of firm performance that are observable by boards of directors.[1]

This paper has two primary objectives. First, we examine how more complex measures of firm performance affect the estimated pay for performance relationship. In this analysis we allow firm performance to be measured by a vector of indicators that includes both market return and accounting return measures of financial performance, allows the sensitivity of pay to performance to change over time, and allows the performance sensitivity to depend on how good or bad the firm's financial performance has been. We believe that this richer specification of firm financial performance is essential given that traditional measures necessarily are noisy signals of underlying managerial performance. A broader set of measures is likely to provide a better signal of managerial performance than does a single unidimensional performance measure, and appears to accord more closely with institutional descriptions of the compensation process(Milgrom and Roberts, 1992).

Our second objective is to explore the dynamic structure of the pay-for performance relationship. A variety of different functional forms has been used in the literature, embodying quite different implicit assumptions about the

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[1] Gibbons and Murphy (1990) provide one of the few analyses that report results for different functional forms, but even their study focuses on choosing one form (using a minimum least squares based criterion), rather than on interpreting the differences in the results.

persistence of firm performance effects on executive pay.

At one extreme are specifications that assume no memory in the compensation process. Current compensation is influenced by current performance only; past financial performance has no impact. At the other extreme are specifications that assume complete persistence: current compensation is determined by current financial performance and all previous performance realizations, with all realizations weighted equally. Few authors have acknowledged the implication of these differing assumptions, and this paper, along with independent work by Boschen and Smith(1994) is among the first to test them explicitly.

2. Literature Review

Gibbons and Murphy (1990) provide one of the few analyses that report results for different functional forms, but even their study focuses on choosing one form (using a minimum least squares based criterion), rather than on interpreting the differences in the results.

Boschen and Smith (1994) use a vector autoregressive approach that relates the level of current compensation (in logs; either salary and bonus or total compensation) to current and past financial performance (measured by stock market rates of return I and lagged compensation, and the level of financial performance to current and past compensation and lagged financial performance. Their analysis uses three lags in both compensation and market rates of return. Their estimates, based on data for 16 firms over the 1948-1990 period, yield the same general conclusions as our results. Past performance appears to have a significant influence on current compensation, but the effect is not permanent. Their study also indicates changes in performance sensitivity of pay over the four decades spanned by their data, although the relatively small size of their cross section may somewhat limit the generalizations one can draw from this finding.

3. Empirical Models of the Pay-For-Performance Relationship

An extensive empirical literature investigates the sensitivity of top executive pay to variations in firm performance. Rosen(1992) provides an overview of many of these analyses; Sloan (1993) provides additional references to the accounting literature on this topic.

We have identified four dimensions along which empirical analyses tend to vary. These are:

ⅰ) The choice of performance measure (accounting-based, stock market-based, or both)

ⅱ) Whether performance sensitivities are restricted to be the same or are allowed to vary across firms

ⅲ) The functional form of the compensation-return specification

ⅳ) The use of absolute returns or returns relative to other firms in the same industry or overall market.

To the best of our knowledge, the literature is uniform in imposing constant performance coefficients over time and estimating a constant performance slope over the entire range of the chosen performance measure. We describe below each of these dimensions of the pay-for-performance specification and sketch its implications for our investigation.

1) Stock-market v. accounting performance:

In the economics and finance literatures, most studies of the pay-for-performance relationship focus on stock market-based measures of financial performance (e.g., Murphy, 1985; Jensen and Murphy, 1990; Gibbons and Murphy, 1990; Barro and Barro, 1990; and Hubbard and Palia, 1994). In contrast, studies in the accounting literature typically use either accounting-based measures of firm performance, or include both accounting and stock market measures of performance in their analysis (e.g., Antle and Smith, 1986; Lambert and Larcker, 1987; and Sloan, 1993)[2].

While the appropriate choice of performance measure is not obvious a priori, it seems reasonable to expect both accounting and market measures of firm financial performance to influence compensation. Boards must confront the task of extracting information about true managerial performance from noisy financial performance realizations. Both accounting and market returns are determined in

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2) Exceptions to this division by field are Kaplan (1994), who includes both market returns and a dummy variable for negative accounting earnings; and Joskow, Rose and Shepard (1993) and Rose and Shepard (1994), discussed below.

part by factors beyond the control or influence of the firm's managers. To the extent that they also are influenced by the quality of managerial inputs and actions, they may provide useful information on managerial performance. Given the imperfect correlation between these financial performance measures, the theoretical literature suggests that contracting on both may enhance the firm's ability to filter the signal of true managerial input (e.g., Holmstrom, 1979). Institutional factors support this conclusion, as firms appear in practice to use both measures. Compensation contracts most frequently link bonuses to accounting earnings (Sloan, 1993) while stock-based forms of compensation, particularly options grants, tie realized compensation to stock market returns.

We explore models that include both accounting and market-based measures in the specification of firm performance.

2) Changes in performance sensitivities over time:

Most studies of executive compensation estimate a single return coefficient for a panel of firms and executives over time. The primary exceptions are: accounting studies, which tend to estimate performance slopes on a firm-by-firm basis (e.g., Lambert and Larcker, 1987 and Sloan, 1993, who explore how the relative market and accounting performance sensitivities vary with their signal-to-noise ratios for each firm); Gibbons and Murphy (1992), who find evidence that the performance sensitivity of pay varies over a CEO's career; Schaefer (1993), who develops theoretical and empirical support for an inverse relation between performance sensitivity and firm size (measured by dollar changes in compensation on dollar changes in market value); and Boschen and Smith (1994), who analyze how the pay-for-performance relationship varies over 1948-1990 for their sample of 16 large companies.

In this study, we explore whether the sensitivity of executive pay to firm performance has been constant over time. The rhetoric of corporate proxy statements and business press discussions of executive compensation strongly suggest that incentive pay has become more visible and widespread over the last 10 years. Some empirical support for this view is provided by the compensation levels equations estimated by Joskow, Rose, and Shepard (hereafter, JRS, 1993)′ which suggest that performance sensitivities for unregulated industries increased steadily between 1970 and 1990.[3]

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3) JRS estimated separate slope coefficients over five-year intervals. While there appears to be some additional variation within decades, the 10-year splits reported in this paper capture much of the

To accommodate potential changes in the sensitivity of executive pay to firm performance, we estimate separate performance slopes for the early 2000s and late 2000s.

3) Asymmetries in performance sensitivities:

We examine a variety of potential asymmetries in the responsiveness of executive pay to variations in firm performance. Of particular interest is the claim that executive pay packages have "more upside than downside elasticity" (Crystal, 1992). This argument, which has attracted considerable popular attention, suggests that executive compensation is more sensitive to positive performance realizations than to negative performance realizations.

We test for potential asymmetries in performance sensitivities by investigating whether compensation is unusually sensitive to very poor financial performance (measured by accounting losses), whether compensation responds more to performance gains than to performance losses, and whether compensation responds differentially to performance changes that are within some "normal" range as opposed to outside that band.

4) Functional form and the temporal structure of pay-for-performance:

This is the dimension on which empirical studies exhibit the least consistency or consensus, even across different studies by the same author. Common specifications correspond to regressions of the log of compensation on the share price (e.g., Murphy, 1985), dollar compensation on the dollar market value of the firm (e.g., Jensen and Murphy, 1990); changes in the log of compensation on the market rate of return (e.g., Gibbons and Murphy, 1990); and the log of compensation on the rate of return (e.g., JRS, 1993). Compensation equations may be estimated in levels or first differences (changes in compensation)' in which case both compensation and performance are measured as changes in the described variables. Studies that use both accounting and market-based returns commonly model changes in the log of compensation as a function of the level of market return and the change in the accounting return.

These alternative specifications imply quite different dynamic models of the compensation process. For example, a model of changes in log compensation on the level of return implies complete persistence in the performance component of

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differences over time while preserving some parsimony in the length of the estimated parameter vector

executive compensation[4]. A one-time shock to the firm's "normal" return generates a permanent change in compensation, even as return recedes to its normal level in subsequent years. Alternatively, a model of changes in log compensation on changes in return implies that the relationship between compensation and performance is contemporaneous only. A one-time shock to return generates higher compensation only in the current period.

Most models that relate log compensation to returns can be nested within a simple dynamic model of the relation between compensation and firm performance over time:

$$\ln Compensation_{it} = \ln C_{0\,it} + \sum_{s=0}^{t} \beta_s Return_{i,\,t-s} + \epsilon_{it} \tag{1}$$

where $C_{0\,it}$ is the base (non-performance related) compensation for EXECUIVE i in year t and RETURN is the market return in each year of executive i's tenure (0 through t). An increase of x percentage points in RETURN in year (t-s) increases compensation in year t by β_s in this model.

$$
\begin{aligned}
\ln C_{it} - \ln C_{i,\,t-1} = {} & (\ln C_{0\,it} - \ln C_{0\,i,\,t-1}) + \beta_0 (Return_{it} - Return_{i,\,t-1}) \\
& + \beta_1 (Return_{i,\,t-1} - Return_{i,\,t-2}) + \cdots \\
& + \beta_{t-1} (Return_{i1} - Return_{i0}) \\
& + \beta_t Return_{i0} + (\epsilon_{it} - \epsilon_{i,\,t-1})
\end{aligned}
\tag{2}
$$

If all the return coefficients are equal ($\beta_0 = \beta_1 = \cdots \beta_t$), this model collapses to a specification that relates changes in log compensation to the current level of return:

$$(\ln C_{it} - \ln C_{i,\,t-1}) = (\ln C_{0\,it} - \ln C_{0\,i,\,t-1}) + \beta_0 Return_{it} + (\epsilon_{it} - \epsilon_{i,\,t-1}) \tag{3}$$

In this specification, an increase of × percentage points in RETURN in any year increases the EXECUIVE's compensation in that year and every subsequent year by xβ percent.
Alternatively, if current compensation is a function of contemporaneous financial performance only, then $\beta_0 = \beta_1 = \cdots \beta_t = 0$, and the general model collapses to

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[4] Models that specify compensation to be a function of market value or share price suggest that superior financial performance prior to the current executive's tenure increase his or her current compensation, all else equal.

a specification that relates changes in log compensation to the first difference in return:

$$(\ln C_{it} - \ln C_{i,\,t-1}) = (\ln C_{0\,it} - \ln C_{0\,i,\,t-1}) + \beta_0\,(Return_{i\,t} - Return_{i,\,t-1}) + (\epsilon_{it} - \epsilon_{i,\,t-1})$$

(4)

We explicitly test these extreme specifications by nesting them within the more general model of equation (2) and testing whether the restrictions implied by either (3) or (4) are satisfied by the data. Our approach allows us to determine whether the compensation process includes any "memory," in that previous financial performance affects current compensation levels, as well as whether this effect decays over time.

There is little reason to think that the compensation-performance relationship must be entirely contemporaneous or perfectly persistent, even though most studies in the literature implicitly have assumed one of the two extremes. If executive compensation depends on both past and current performance, but the compensation impact of past performance decays over time, we would expect to find that the estimated {βᵢ} are non-zero for some period, but decline as firm performance recedes further into the past. We assess the dynamics of the pay-for-performance relationship with a model that includes current, one- and two-year lags in both accounting and market returns.

5) Absolute v. relative performance measures:

A number of studies explore whether executive compensation responds to absolute measures of firm performance or to performance relative to that of some reference group of firms (e.g., Antle and Smith, 1985; Barro and Barro, 1990; Gibbons and Murphy, 1990; Janakiraman, Lambert and Larcker, 1992; and Sloan, 1993). Apart from Gibbons and Murphy, however, most studies conclude that relative performance evaluation (RPE) tends to play a minor role in determining executive compensation. That is, compensation responds primarily to a firm's own return rather than to its return relative to some benchmark group of firms. Moreover, it appears that RPE, if it operates at all, is strongest for quite broad reference groups, corresponding to 1-digit SIC code industries or perhaps the market as a whole. Finally, the slope of the pay for performance relationship seems to be quite robust to the inclusion or exclusion of returns for

alternative reference groups (see Gibbons and Murphy, 1990). In light of these previous results, and to limit the dimension of the performance parameter vector we estimate, we adopt a specification that implicitly measures return and compensation relative to the overall market (by including individual year effects in the regression model), but do not investigate the RPE hypothesis any further [5].

4. Data and Empirical Methodology

We model executive compensation as a function of firm scale, firm financial performance, executive characteristics, and industry and market-wide norms in executive pay. The data used to measure these variables are described below. We next sketch the basic regression model, which is similar to models used by JRS(1993) to investigate compensation differentials across regulated and unregulated industries and by Rose and Shepard(1994) to explore the effects of firm diversification on compensation. We finally summarize our tests of the key restrictions on the performance sensitivity parameters of executive pay that are implicit in this model.

1) Data

Our data base is developed from three primary sources. Information on executive compensation and executive characteristics were obtained from KRX and annual executive compensation over 2002-2010. Information on firm characteristics, accounting profitability, and fiscal year stock market returns are from FnGuide(DataGuide) data. To reduce non-comparability across firms we exclude those in industries subject to economic regulation and those in financial services, using KRX's SIC code assignment to determine industry affiliation. Because some of the specifications that we present include first differences in compensation and up to two-period lags in performance variables, we work with a basic sample of executive-years for which we observe at least one prior year

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5) We also include aggregated 2-digit SIC industry fixed effects, which implicitly control for industry average performance over the entire sample period (see JRS for a description). The dimension of the performance parameter space (K) for our chosen specification suggests the prudence of suppressing an explicit investigation of RPE parameters, which would increase the parameter vector to 2K. In our simpler specifications, K=10; this increases quickly to K=20 or K=30 as we relax various restrictions.

of compensation and three prior years of performance data. These criteria yield a panel data set of 3285 observations on 361 executives in 90 firms(top 200 companies, excluding financial firms). Descriptive statistics for this sample are reported in Table 1. Variables are described below.

ⅰ) Compensation Measures: We report results for two measures of compensation.

The first, SALARY, includes current and deferred salary and bonus. This generally is the least inclusive measure of compensation reported by KRX, and its definition is relatively consistent over the entire sample period we analyze. Real SALARY, in 2010 constant won, grew at an average annual rate of 4.5% for our sample, and averaged ₩782,045 overall. Despite this growth, SALARY accounts for a decreasing share of overall compensation over time.

The second measure of compensation, TOTAL, is the most inclusive compensation measure reported by KRX. TOTAL includes salary and bonus, contingent compensation excluded from SALARY, the cash value of company-provided benefits (such as company-paid life insurance, private automobiles, and drivers), and realized net gains from the exercise of stock options, stock appreciation rights, and stock accrual rights. TOTAL compensation in 2010 constant won averaged ₩3,025 million for our sample, and at an average annual rate of 5.4% between 2002 and 2010. While TOTAL compensation we have, its treatment of stock options, appreciation rights, and accrual rights prevent it from accurately measuring overall current compensation [6].

ⅱ) Firm Scale: The relationship between CEO compensation and firm size is one of the most consistent empirical results in the compensation literature, with most studies reporting a compensation elasticity with respect to firm revenues(SALES) of about 0.25(Rosen, 1992). We have experimented with a variety of scale measures, including SALES, book assets, and employees. The firms in our sample are large on all three dimensions. They average ₩12,893

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[6] As noted in JRS (1993), an ideal measure of total compensation would include the ex ante value of options grants (or similar instruments) in the year they are awarded and the ex post change in the value of previously awarded (as yet unexercised and unexpired) options each year. It seems impossible to construct these exact measures, and difficult to construct even close approximations to them, from 1970 through 1990 proxy statements. SEC reporting requirements in place for 1 993 and subsequent years' proxy statements should make these calculations more feasible in the future.

million in 2010 constant sales, ₩4,288 million in constant 2010 assets, and 123,000 employees. Because the estimated pay-for-performance relationship appears to be reasonably robust to alternative definitions of firm scale, we report results only for specifications that use SALES, the dominant measure of firm scale in the compensation literature.

ⅲ) Firm Financial Performance: The basic constructs that we use to measure firm performance are stock market rates of return and accounting rates of return. The market return(MKTROR) is the annual rate of return to common equity shareholders during the firm's reported fiscal year, and is constructed from market interest rate. The accounting rate of return(ACCROE) is defined as reported earnings excluding extraordinary items divided by total common equity (book value), and is constructed from FnGuide & KRX data[7]. Although the means of these two return measures are roughly comparable, stock market returns exhibit much greater variance: MEDIAN-MKTROR and MEDIAN-ACCROE are variables that denote the annual median change in market and accounting returns, respectively, for the full JRS dataset of unregulated, nonfinancial companies. We use these variables to separate our sample observations into companies that have close to median performance changes in a given year and those whose performance change is substantially above or below the median. This allows us to test whether performance sensitivities are dampened at the high or low extremes of performance.

ⅳ) Executive Characteristics: The levels equations model log compensation as a function of executive characteristics as well as the variables described above. These characteristics include the executive's tenure in the executive position(TENURE), his/her age at appointment to the executive position(AGE), an indicator variable for whether the executive was an appointment from outside the firm as opposed to an internal promotion(OUTSIDE), and an indicator variable for whether the executive was the founder of the firm(FOUNDER). These variables and their empirical effects on compensation are described in considerable detail in JRS(1993).

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7) This definition poses a problem when a firm's chronic accounting losses drive the book value of its common equity through zero. We define ACCROE to be missing if the book value of equity is negative and therefore exclude these observations from the basic dataset.

1) A regression model of executive compensation

The basic econometric specification of the compensation equation follows from our earlier work(JRS), but is expanded to investigate a richer specification of the performance variables that may influence a executive′s compensation. The basic compensation equation is specified as:

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\begin{aligned}
\ln(EXECUTIVE\ COMPENSATION_{ijkt}) =\ & \beta_1 \ln(SALES_{jt}) + \beta_2 \ln PERFORMANCE_{ijt} \\
& + \beta_3 CEOTEN_{ijt} + \beta_4 AGE_{ij} \\
& + \beta_5 OUTSIDE_{ij} + \beta_6 FOUNDER_{ij} \\
& + \alpha_k + \delta_t + \epsilon_{ijkt}
\end{aligned}
$$

$$(5)$$

where ′i′ denotes the executive, ′j′ denotes the firm, ′k′ denotes the primary industry identification, and ′t′ denotes the year. Industry effects, α_k are measured at an aggregated two-digit SIC code level. These incorporate the impact of industry-level variables, including industry-wide compensation norms, on executive pay. Year effects, δ_t, accommodate nonlinear(and non-monotonic) economy-wide trends in real executive compensation over the sample period. The error term, ϵ_{ijkt}, may include executive specific effects. Any endogeneity between these and the independent variables in the model can be treated by estimating the model in first-differences rather than levels, and we investigate both specifications in the results reported below.

ⅰ) Performance Specification: The influence of firm performance on executive pay is represented in this equation by the term β_2′PERFORMANCE, where PERFORMANCE is a vector of financial performance variables and β_2′ is the vector of associated parameters. We begin with a highly restricted model, similar to that estimated in many previous compensation studies, in which RETURN is a single variable, MKTROR, and β_2 is a scalar parameter. We next relax the assumption of a single performance parameter as we introduce progressively more flexibility into the estimated pay-for-performance relationship. We expand the dimension of the RETURN vector to include current accounting returns(ACCROE), relax the restriction on constant performance sensitivities over time, explore the role of memory in the pay-for-performance

relationship, and finally test for asymmetries in performance sensitivities.

5. Empirical Results

Table 2 presents results from compensation level equations that use In(Salary & Bonus) as the dependent variable. To keep the size of the tables manageable, we suppress all coefficients except those for firm size and the performance measures. Column 1 displays results for the simplest model, which includes current stock market return as the sole performance measure and restricts the performance semi-elasticity to be the same for all observations. The coefficient on market return implies that a 10 percentage point increase in the market return[8] increases salary and bonus by roughly 1.2% (standard error, 0.2%). This is broadly similar to results from previous empirical studies(see Rosen, 1992). Column 2, which substitutes the accounting rate of return as the single performance measure, implies that a 10 percentage point(average) increase in accounting return.

The results in column 3 include both accounting and market returns, and suggest that both measures are important determinants of executive pay. In this specification, the pay sensitivity to a 10 percentage point movement in return is 0.8%(0.2%) for market returns and 6.9%(0.5%) for accounting returns. Thus, even when both return measures are included in the regression, the semi-elasticity of pay is an order of magnitude larger for accounting returns than for market returns. This pattern is consistent with results from previous studies that have included accounting rates of return and with the observation that compensation contracts are much more likely to base bonuses on explicit accounting performance targets than on market-based targets. Given the economic and statistical significance of both accounting and market returns in determining executive pay, we focus our remaining attention on specifications that include both measures.

Columns 4 through 6 repeat the first three specifications, but allow the performance slopes to differ between the 2002-2005 and 2006-2009. The data clearly reject the restriction of constant slopes over time. In column 6, which allows both market and accounting return parameters to differ over time, the performance slopes increase by one-third to one-half between the early 2000s

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8) about one-quarter of the sample standard deviation of MKTROR

and late 2000s. This suggests that the increasing emphasis on incentive pay over the sample period carries through to salary and bonus decisions and is not solely a function of increased use of stock options in compensation packages.

Finally, column 7 estimates the more general dynamic performance specification, based on equation (1). This column reports results that include current and two lags for each return measure. The results from this model of compensation level strongly reject both of the simple models of pay-for-performance dynamics: past performance has an influence on current compensation, but that influence is not perfectly persistent over time.

The dynamic pattern of performance effects on compensation differs considerably between accounting and market performance measures. The estimated overall impact of accounting return on pay is roughly constant between the contemporaneous-only (column 6) and general dynamic(column 7) specifications, but including lagged accounting returns shifts about 20% of the estimated weight to the previous years' return measures. The results suggest that a 10 percentage point increase in accounting returns during the 2006-2009 generates an average cumulative increase in salary and bonus equivalent to 7% of one year's compensation.

In contrast, the estimated impact of market returns on executive pay is substantially higher in the unrestricted dynamic model, relative to the contemporaneous-only model of column 6. The effect of current market return on current pay is slightly higher in column 7 than in column 6(though within one standard error), and the lagged market return terms more than double that impact.

We explore the intertemporal structure of the pay-for-performance relationship in further detail in table 3, using first-difference models of compensation. These regressions model changes in In(SALARY) as a function of changes in In(SALES), year and industry effects, and alternative specifications of the performance measures. To limit the size of the table, we use changes in accounting return in all specifications that include an accounting measure of performance. We vary the specifications to examine both levels of market return and changes in market return.

Columns 1, 2, and 3 in table 3 model changes in In(SALARY) as a function of changes in market returns. These correspond to simple first-difference estimates of the specifications reported in columns 1, 2, and 6 of table 2. These

restricted models, based on equation (3), implicitly assume no "memory" in the compensation process: a one-time shock to return generates a one-time shock to compensation. The estimated coefficients are considerably smaller than those reported in table 2, suggesting that positive correlations between unobserved executive-specific effects and firm performance may overstate the performance sensitivity of pay in compensation levels equations.

Columns 4 and 5 of table 3 model changes in ln (SALARY) as a function of the *level* of market return. These correspond to the restricted model of equation (4), which assumes that performance effects are perfectly (and infinitely) persistent: a one-time shock to the firm's market return triggers a permanent increase in current and future compensation. These results imply much greater sensitivity of executive pay to market returns than do the column 1-3 results.

These estimates are comparable to those reported by Gibbons and Murphy(1990) for a somewhat different *Forbes* sample and slightly modified, but similar, compensation equations[9].

The choice of functional form makes a significant difference to the fit of these restricted equations. A minimum least squared errors test would prefer the restricted model of equation (4) to the restrictions imposed by equation (3) (compare the SSR of columns 1 and 4 or of columns 3 and 5). If one is forced to choose between one of these two highly simplified specifications, assuming that performance effects are perfectly persistent appears to better satisfy the data. As in the levels equations, however, this specification is strongly rejected in favor of the more general dynamic model of equations (1) and (2).

Column 6 of table 3 reports results for the general dynamic performance structure. This model corresponds to first-difference estimates of the specification reported in column 7 of table 2, and is based on the first-difference equation (2). These estimates decisively reject both the restriction that performance effects are contemporaneous only and the restriction that the performance coefficients are constant over time. The pattern of coefficients highlights the reasons these restrictions are rejected.

Finally, we note that the market return estimates from the general dynamic first difference model in column 6, table 3, are quite similar to those of the

9) The Gibbons and Murphy sample covers a shorter time period (1974-1986) but larger sample of CEO-years than does ours (due partially to our exclusion of financial sector and regulated firms and the elimination of the first three years of each CEO's tenure due to the data requirements of our lagged return structure tests) Gibbons and Murphy do not include sales and do include various industry return measures as variables in their compensation equations.

levels model in column 7 of table 2. This may suggest that the differences between these two estimation methods for the contemporaneous-only model are due more to mis-specification of the pay-for-performance relationship than to correlation between returns and a executive-specific component of the error term.

For completeness, we report in column 7 of table 3 estimates from a first difference model that uses the level of market return and its lags rather than first differences in market return. This is similar to the model that assumes completely persistent market performance effects in compensation(e.g., column 5 of table 3). If this assumption is correct, the coefficients on the lagged market return terms should be zero. As expected from the results in column 6, which nest this model as a special case, the data reject this restriction. For the 2006-2009, the previous year's market return has a slightly larger impact on current compensation than does the current year's return.

Given the superiority of the general dynamic specification in both the levels and first-difference equations, we focus our attention on variants of this model in the remaining analysis.

Table 4 replicates the analysis of Tables 2 and 3 using total compensation (TOTAL) rather than salary and bonus as the measure of executive pay. Column 1 reports the simplest performance specification (market return only, with slopes split by decade) for comparability with table 2 and previous studies. Columns 2 and 3 report results from the "full dynamic" specification, estimated in levels (2) and first differences (3). Total compensation is, not surprisingly, more responsive to market performance variations than is salary and bonus, and the sensitivity increased markedly during the 2006-2009. As in the salary and bonus results, past performance influences current compensation but the effect decays after the first lag. This is more than twice the cumulative market return effect on salary and bonus (column 6, table 3).

As our final step in modelling the pay-for-performance relationship, we explore potential asymmetries in the impact of performance on executive compensation. We consider three types of possible asymmetries. First, is compensation unusually responsive (or non-responsive) to accounting losses? Second, does compensation respond differently to performance gains than to performance losses? Third, does compensation respond differently to unusually large changes in performance than to changes within some "normal" range?

Table 5 reports results of these tests for salary and bonus; table 6 repeats the analysis for total compensation. Both tables use the first difference specification of In(compensation) with the general dynamic return structure(as in column 7, table 3, and column 3, table 4). To simplify the exposition, we report coefficients only for the contemporaneous return measures; the patterns of coefficients on the lagged performance terms tend to be similar but noisier.

In column 1 of tables 5 and 6 we modify our basic specification to include a separate control for negative accounting earnings. To test whether accounting losses shift the level of compensation beyond that predicted by the slope coefficient on Δaccounting return, we estimate these first difference models using the change in an indicator variable that equals one in years with reported accounting losses.

The results suggest that accounting losses reduce compensation beyond their direct effect through the accounting return variable.

Finally, we explore whether compensation responds differentially to unusually large changes in performance. The definition of an "unusually large change inperformance" is fairly arbitrary. We operationalize it as follows. For each firm-year we compare the change in each return measure to the median change in that return measure across all firms in the JRS dataset. We then divide the observations into three classes: those in which the change in return was "substantially" below the median change, those within a band around the median change, and those "substantially" above the median change. We have experimented with several numerical thresholds for "substantial." The results reported in the paper use thresholds of more than 20 percentage points above or below the median change in market return, and more than 2 percentage points above or below the median change in accounting return. The distribution of observations using these thresholds is given in table 7. Forty-two percent of the observations fall within the median band for Δmarket return and 52 percent of the observations fall within the median band for Δaccounting return under these definitions.

The results are reported in the last columns of tables 5 and 6. For parsimony and because the data generally do not reject the restriction of common slope coefficients for observations above and below the median band, we report a single coefficient for these observations (denoted as "outside the median band"). For accounting returns, compensation may be much more responsive to changes

within the median band than to changes outside the median band. The accounting return coefficients differ by roughly a factor of two or more for both salary and bonus and total compensation, although the point estimates are sufficiently noisy that the restriction of common slopes across the return range cannot be rejected. This pattern would be consistent with some smoothing by boards of directors when accounting earnings experience unusually large movements from one year to the next. For market returns, the results suggest roughly constant performance sensitivity across the entire range: the point estimates generally are quite close and well within the statistical margin of error from each other. These results suggest no evidence of compensation smoothing in response to even quite large fluctuations in market returns.

6. Conclusions

The results of this study suggest that the pay-for-performance relationship is considerably richer than the models typically incorporated into most previous studies.

Compensation is sensitive to both accounting and market measures of firm performance, and the sensitivity of executive pay to firm performance has increased considerably during the 2000s. This increased performance sensitivity is due to more than increased used of stock options in compensation packages, as it carries through to salary and bonus decisions as well.

We find that the dynamic structure of the pay for performance relationship is more complex than implied by the specifications used in earlier compensation analyses. Past financial performance has an effect on current compensation, but the effect appears to decay substantially over two to three years. For market returns, current compensation is influenced as much or more by the previous year's market return(relative to current market returns), but returns more distant than this have a relatively small compensation impact. For accounting returns, the compensation impact decays almost proportionally over time. Our results suggest that failure to model the full dynamic structure of the pay-for-performance relationship may have important consequences for both the magnitude and interpretation of estimated performance sensitivities.

Finally, we find no evidence for the popular view that boards of directors tend

to reward good performance and ignore poor performance in setting compensation. Indeed, the strongest evidence of asymmetry in the pay-for-performance relationship is an additional compensation penalty for exceptionally poor accounting performance.

While our estimates of performance sensitivities do not alter the general conclusion that changes in managerial compensation resulting from superior financial performance of the firm are small in comparison to changes in total shareholder wealth, the compensation effects are nonetheless economically important.

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Table 1: Descriptive Statistics of Performance Sample

(3285 executive-years)

Variable	Mean	Standard Deviation	Minimum	Maximum
Salary & Bonus, thousands of 2010 won	799.17	580.05	93.37	15207.36
Total Comp., thousands of 2010 won	1251.41	2184.58	132.83	67780.39
Sales, millions of 2010 won	5332.90	10496.23	22.24	158263.50
Book Assets, millions of 2010 won	4288.14	9581.64	26.00	180432.00
Employees, thousands	38.04	59.14	0.07	13.66
Stock Market Rate of Return	0.12	0.39	−0.74	6.13
Median ΔMarket Return	−0.010	0.247	−0.358	0.641
Accounting Rate of Return on Book Equity	0.132	0.103	−1.193	1.440
Median ΔAccounting Return	0.001	0.010	−0.106	0.103
Negative Earnings Dummy	0.36			
Tenure as executive	6.42	4.33	2	46
Age at appointment	55.12	7.10	41	68
Outside Hire	0.250			
Company Founder	0.508			
Number of Firms	90			
Number of executives	361			

Table 2: Determinants of ln (Salary & Bonus)

(N= 3285)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln(Sales)	0.253 (0.006)	0.255 (0.006)	0.256 (0.006)	0.254 (0.006)	0.254 (0.006)	0.255 (0.006)	0.258 (0.006)
Market Return, (2002-2005)	0.122 (0.015)		0.080 (0.020)	0.092 (0.022)		0.068 (0.023)	0.074 (0.024)
Market Return, (2006-2009)				0.146 (0.020)		0.090 (0.020)	0.107 (0.021)
Accounting Return, (2002-2005)		0.755 (0.052)	0.704 (0.052)		0.560 (0.114)	0.471 (0.118)	0.371 (0.151)
Accounting Return, (2006-2009)					0.803 (0.057)	0.745 (0.059)	0.570 (0.073)
Market Return, t-1 , (2002-2005)							0.053 (0.024)
Market Return, t-1, (2006-2009)							0.096 (0.019)
Market Return, t-2, (2002-2005)							0.018 (0.023)
Market Return, t-2, (2006-2009)							0.042 (0.018)
Accounting Return, t-1, (2002-2005)							0.081 (0.175)
Accounting Returns, t-1, (2006-2009)							0.119 (0.084)
Accounting Returns, t-2, (2002-2005)							−0.040 (0.166)
Accounting Returns, t-2, (2006-2009)							0.027 (0.080)
Adjusted R^2	0.472	0.488	0.491	0.472	0.488	0.491	0.496
SSR	585.68	567.92	564.76	585.29	567.47	564.03	558.75

※ Standard errors are in parentheses.

All regressions include controls for executive characteristics, year effects, and industry fixed effects

Table 3: Determinants of Δln (Salary & Bonus)

(N= 3285)

Market Return	(1) Δlevel	(2) --	(3) Δlevel	(4) level	(5) level	(6) Δlevel	(7) level
ln(Sales)	0.261 (0.023)	0.189 (0.023)	0.197 (0.023)	0.212 (0.023)	0.162 (0.023)	0.170 (0.023)	0.156 (0.023)
Market Return, (2002-2005)	0.035 (0.006)		0.025 (0.010)	0.097 (0.009)	0.056 (0.013)	0.040 (0.011)	0.051 (0.014)
Market Return, (2006-2009)			0.020 (0.008)		0.093 (0.010)	0.078 (0.010)	0.082 (0.012)
ΔAccounting Return, (2002-2005)		0.518 (0.034)	0.358 (0.076)		0.313 (0.078)	0.385 (0.082)	0.369 (0.084)
ΔAccounting Return, (2006-2009)			0.532 (0.038)		0.497 (0.038)	0.573 (0.041)	0.584 (0.042)
Market Return, t-1 , (2002-2005)						0.028 (0.012)	-0.0003 (0.014)
Market Return, t-1, (2006-2009)						0.095 (0.011)	0.023 (0.011)
Market Return, t-2, (2002-2005)						0.009 (0.008)	-0.008 (0.013)
Market Return, t-2, (2006-2009)						0.042 (0.009)	-0.049 (0.010)
ΔAccounting Return, t-1, (2002-2005)						0.178 (0.087)	0.147 (0.090)
ΔAccounting Returns, t-1, (2006-2009)						0.222 (0.045)	0.229 (0.046)
ΔAccounting Returns, t-2, (2002-2005)						0.127 (0.087)	0.098 (0.090)
ΔAccounting Returns, t-2, (2006-2009)						0.082 (0.043)	0.089 (0.044)
Adjusted R^2	0.073	0.112	0.115	0.091	0.127	0.141	0.130
SSR	195.75	187.70	187.04	192.10	184.38	181.44	181.90

※ Standard errors are in parentheses.

All regressions include year and industry fixed effects.

Market returns are in levels or differences as specified in the column header.

Table 4: Determinants of ln (Total Compensation)

Dependent Variable	ln(Total Compensation)		Δln (Total Comp.)
Market Return	level	level	Δlevel
ln(Sales)	0.282 (0.009)	0.295 (0.009)	0.245 (0.054)
Market Return, (2002-2005)	0.157 (0.034)	0.122 (0.036)	0.049 (0.027)
Market Return, (2006-2009)	0.232 (0.030)	0.186 (0.030)	0.133 (0.023)
Accounting Return, (2002-2005)		0.790 (0.203)	0.725 (0.195)
Accounting Return, (2006-2009)		0.794 (0.107)	0.682 (0.098)
Market Return, t-1, (2002-2005)		0.084 (0.035)	0.022 (0.029)
Market Return, t-1, (2006-2009)		0.255 (0.027)	0.230 (0.025)
Market Return, t-2, (2002-2005)		0.053 (0.034)	0.006 (0.018)
Market Return, t-2, (2006-2009)		0.136 (0.027)	0.114 (0.022)
Accounting Return, t-1, (2002-2005)		0.138 (0.258)	0.482 (0.209)
Accounting Return, t-1, (2006-2009)		0.187 (0.123)	0.262 (0.107)
Accounting Returns, t-2, (2002-2005)		−0.015 (0.245)	0.122 (0.214)
Accounting Returns, t-2, (2006-2009)		0.231 (0.117)	0.227 (0.103)
Adjusted R^2	0.411	0.456	0.075
SSR	1295.48	1196.22	1021.28
Number of Observations	4677	4677	4657

※ Standard errors are in parentheses. Levels regressions include controls for executive characteristics, year effects, and industry fixed effects. Change regressions are specified as first difference equations and include controls for year and industry fixed effects. Market returns mayor may not be differenced, as specified in the column header under the change regressions.

Table 5: Asymmetries in Pay-for-Performance, Δln(Salary & Bonus)

ΔReturn coefficient differs by:	(1) Single coefficient	(2) Negative Δreturn	(2) Positive Δreturn	(3) Inside median band	(3) Outside median band
ΔMarket return, (2002–2005)	0.041 (0.011)	0.062 (0.021)	0.047 (0.015)	0.019 (0.030)	0.035 (0.011)
ΔMarket return, (2006–2009)	0.079 (0.009)	0.066 (0.016)	0.096 (0.015)	0.101 (0.033)	0.077 (0.010)
ΔAccounting return, (2002–2005)	0.327 (0.091)	0.790 (0.144)	0.063 (0.118)	1.464 (0.534)	0.379 (0.082)
ΔAccounting return, (2006–2009)	0.423 (0.047)	0.575 (0.056)	0.556 (0.073)	1.311 (0.440)	0.572 (0.041)
ΔNegative Earnings dummy, (2002–2005)	0.052 (0.035)				
ΔNegative Earnings dummy, (2006–2009)	−0.121 (0.018)				
Adjusted R^2	0.150	0.147		0.13	
SSR	179.64	180.31		179.69	
Number of Observations	4697	4697		4677	

※ Standard errors are in parentheses. All regressions include additional lagged first differences in returns, first differences in sales, and year and industry fixed effects. See text for additional description of this table.

Table 6: Asymmetries in Pay-for-Performance, Δln (Total Compensation)

ΔReturn coefficient differs by:	(1) Single coefficient	(2) Negative Δreturn	(2) Positive Δreturn	(3) Inside median band	(3) Outside median band
ΔMarket return, (2002-2005)	0.048 (0.027)	0.014 (0.052)	0.089 (0.037)	0.005 (0.073)	0.049 (0.027)
ΔMarket return, (2006-2009)	0.134 (0.023)	0.165 (0.038)	0.113 (0.035)	0.143 (0.078)	0.133 (0.023)
ΔAccounting return, (2002-2005)	0.754 (0.220)	0.998 (0.347)	0.543 (0.283)	1.381 (1.283)	0.715 (0.196)
ΔAccounting return, (2006-2009)	0.511 (0.112)	0.684 (0.135)	0.661 (0.174)	1.421 (1.050)	0.676 (0.099)
ΔNegative Earnings dummy, (2002-2005)	0.019 (0.085)				
ΔNegative Earnings dummy, (2006-2009)	0.019 (0.085)				
Adjusted R^2	0.077	0.076		0.066	
SSR	1019.00	1019.85		1018.34	
Number of Observations	321	321		321	

※ Standard errors are in parentheses.
All regressions include additional lagged first differences in returns, first differences in sales, and year and industry fixed effects.
See text for additional description of this table.

Table 7: Distribution of Observations Below, Within, and Above Median Band of ΔReturn

Category	Mean Δreturn	Number of observations
Market Returns:		
ΔMarket return more than 0.20 below median Δmkt return	−0.528	110
ΔMarket return within 0.20 of median Δmkt return	−0.027	152
ΔMarket return more than 0.20 above median Δmkt return	0.482	98
Accounting returns:		
ΔAccounting return more than 0.02 below median Δacc return	−0.092	91
ΔAccounting return within 0.02 of median Δacc return	0.002	189
ΔAccounting return more than 0.02 above median Δacc return	0.084	81

※ The median Δreturn is defined for each year over the full set of firms in the JRS dataset.
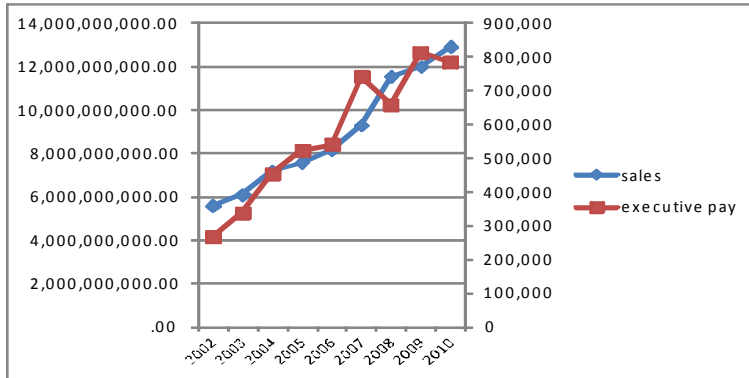
Figure 1: sales-executive pay

Figure 2: return-executive pay