An Analysis of the Relation Between the Stewardship and Valuation Roles of Earnings

Robert Bushman
Kenan-Flagler Business School
University of North Carolina - Chapel Hill
McColl Building
Chapel Hill, NC 27599

Ellen Engel
Jennifer Milliron
Abbie Smith
Graduate School of Business
The University of Chicago
1101 East 58th Street
Chicago, IL 60637

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* Corresponding author. Email address:  ellen.engel@gsb.uchicago.edu;  Phone (773)834-0966
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Abstract

We analytically and empirically investigate the association between the weights on earnings in executive compensation contracts (CERCs) and in stock price formation (ERCs). Our analyses are driven by the notion that the marginal product of current period managerial action is a key driver of a link between the weights on earnings in these two roles. We support this conjecture with two theoretical models that show a positive association between these weights. Our empirical analyses provide evidence of a positive link between changes in CERCs and ERCs, persistence and other agency-based determinants of CERCs from the first half to the second half of our 1971-1995 sample period. We also conduct an empirical investigation of the existence of shifts in CERCs and in the importance of earnings relative to other information in explaining CEO cash compensation over the sample period. In contrast to recent studies documenting declining trends in ERCs, we find no significant shift in CERCs. We find, however, a decline in the importance of earnings in explaining cash compensation relative to information reflected in stock returns.

JEL Classification: J33, M41
Key Words: Executive compensation, Pay-performance sensitivities
1. Introduction

Published financial accounting information is supplied to meet heterogeneous information demand in the economy. Two of the many potential uses of accounting information are valuation of the firm and evaluation of a firm’s managers. While reported earnings appear to play a fundamental role in both determining stock prices, and in evaluating and compensating executives, the relation between the stewardship and valuation uses of earnings is not well understood. Gjesdal (1981) illustrates the subtlety of this issue by demonstrating that the ranking of information systems for valuation purposes may not coincide with the ranking of information systems for control purposes. The main purpose of this paper is to theoretically and empirically investigate potential linkages between the weights placed on accounting earnings in executive compensation contracts and in stock price formation. We conjecture that the marginal product of current period managerial actions reflected in current earnings is such a link and formally illustrate how this linkage could come about. We empirically document a robust, positive correlation between the two weights and between measures of earnings persistence and the compensation weight on earnings. We also document secular trends over the 1971-1995 time period in the importance of earnings information, in general and relative to other information in explaining CEO cash compensation.

The main idea underlying our conjecture is quite simple. Holding all else constant, a principal desires a manager to take higher effort as the marginal product of such effort increases. Thus, the compensation weight on earnings in an optimal contract will generally increase in the marginal product of effort. On the other hand, efficient markets imply that a firm’s stock price capitalizes the full valuation implications of reported earnings. Thus, the coefficient on earnings in stock price may capture an element of the market’s assessment of the marginal product of

1 This latter role has commonly been termed the stewardship role of accounting information. For example, Gjesdal (1981) defines the stewardship role as the demand by investors for information about managers’ actions “for the purposes of controlling them” [p. 208].
effort not reflected in current earnings. To the extent that it does, we expect a positive correlation between CERCs and ERCs.

Despite its intuitive appeal, formalizing our conjecture presents certain challenges. The relation between firm value, often expressed as the sum of discounted future expected dividends, and accounting information has been the subject of a long and ongoing debate. As might be expected, the way in which the accounting/value relation is modeled directly impacts conclusions about connections between stewardship and valuation roles of accounting information. For example, using the standard LEN framework, Paul (1992) finds that the weight placed on a performance measure for valuation purposes is independent of the marginal product of effort. This occurs because the valuation role of earnings is to infer stochastic elements of value that are assumed unrelated to managerial effort. However, before accepting this conclusion as fact, it is important to explore other plausible valuation roles for earnings beyond simply inferring stochastic elements of value unrelated to effort. In this spirit, we present two reasonable alternative models that support our conjecture that the marginal product of current period managerial actions provides a connection between the weights placed on earnings in the two uses.

In the first formulation, current earnings are modeled as parameterizing a stochastic process used to compute expectations of future earnings and assess firm value. We adapt the classic valuation framework and linear information dynamic analyzed in Ohlson (1995) to include moral hazard. This well known formulation uses the clean surplus relation to express firm value in terms of discounted future abnormal accounting earnings. In contrast to Paul (1992), the

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2 For example, see the extensive discussions of this debate in Beaver (1998), Ohlson (1995) and Ohlson (1990).
3 The LEN framework invokes linear compensation contracts, negative exponential utility functions, and normally distributed random variables. In these models, it is typical that the marginal product of effort and the sensitivity of performance measures to effort are deterministic with values that are common knowledge to all players. The independence of valuation weights and marginal products of effort in the LEN framework was first noted by Paul (1992). See also Bushman and Indjejikian (1993), Feltham and Xie (1994), Datar, Kulp and Lambert (2001) and Lambert (2001) for additional analyses and discussion of this point.
4 A similar approach is used by Govinderaj and Ramakrishnan (1999) to connect moral hazard and valuation.
valuation role of current earnings in our first setting is to predict future abnormal earnings. Thus, the valuation weight on earnings captures discounted, all-in effects of the manager’s current effort on all future periods, and is a component of the marginal product of current period effort not captured by current period earnings. In our second formulation, we alter the standard LEN framework to allow for the possibility that marginal product of effort is a random variable. In this setting, the contracting role of earnings is to motivate actions consistent with the true marginal product of effort, while its valuation role is to infer true marginal product. Both formulations lead to the marginal product of effort linking the compensation and valuation weights on earnings in intuitive ways. In the first setting, the link between the weights is driven by the multiperiod nature of managerial effort while the link in our second setting derives from the stochastic nature of marginal product of effort.

The inferences concerning the link between the valuation and compensation weights on earnings in our two settings differ from those in the LEN framework. Whether there is an economically meaningful relation between the valuation and compensation weights on earnings is ultimately an empirical question. We empirically investigate links between CERCs and ERCs using CEO annual cash compensation from Forbes annual compensation surveys over the period 1971-1995. Our primary tests examine the cross-sectional relation between changes in industry-specific CERCs from the first half (1971-1983) to the second half (1984-1995) of our sample period with corresponding changes in industry-specific ERCs and a number of control variables.

We aggregate sample firms by industry in estimating changes in CERCs and ERCs because we expect more homogeneity within industries than across a pooled sample in the determinants of CERCs and ERCs. Also, our focus on shifts between periods in model variables in the empirical tests controls for omitted variables such as managers' attitudes toward effort and risk, under the assumption that these unobservable characteristics are stable within an industry over time.

We find that average industry changes in CERCs are positively associated with changes in ERCs, after controlling for changes in growth opportunities, proxies for changes in noise in
both earnings and other performance information, and regulation. Further, we find that changes in CERCs are associated with changes in both ERCs and persistence in the multivariate regression. The correlation of CERCs with persistence captures the idea that current effort reflected in earnings has a multi-period impact which is consistent with the classic valuation framework in our first model formulation. However, the fact that the association between ERCs and CERCs is significant even after controlling for persistence suggests perhaps factors beyond those considered in our basic frameworks also play a role in the extent of the link between compensation and valuation weights on earnings.

Our cross-sectional analysis is most closely related to Lambert and Larcker (1987), Sloan (1993), and Baber et al. (1998). Lambert and Larcker (1987) and Sloan (1993) examine how the compensation weight on earnings cross-sectionally varies with the correlation between earnings and stock returns (i.e., R²) with mixed results. Baber et al. (1998) document a positive relation between the compensation weight on earnings and earnings persistence. Our analysis focuses specifically on the relation between the weights placed on earnings in valuation and stewardship settings.

Finally, we also investigate the existence of secular trends over the 1971-1995 sample period in CERCs and in the importance of accounting information relative to other information in explaining CEO cash compensation. While recent research documents substantial use of non-financial performance measures in determining CEO cash compensation (see Bushman, Indjejikian and Smith (1996) and Ittner, Larcker and Rajan (1997)), the extent to which the relative importance of accounting information in annual CEO compensation has shifted over time is unknown. We document a general decline over the 25-year sample period in the importance of earnings in explaining cash compensation relative to other information reflected in stock returns.

5 See Bushman and Smith (2001) for an in-depth discussion of research on the cross-sectional determinants of compensation weights on earnings.
The remainder of the paper is organized as follows. Section 2 presents our model of the determinants of pay-earnings and price-earnings sensitivities. Section 3 describes our sample and data. Section 4 presents our main empirical analysis, section 5 discusses sensitivity analyses performed, and section 6 concludes.

2. Theoretical Development

In this section we theoretically explore potential links between the weights on earnings in determining compensation and in stock price formulation. We first illustrate the economic disconnect between the contracting and valuation uses of earnings in the classic LEN framework. We then present two alternative formulations, clearly delineating what it is in each model that drives the relationship of the weights across uses. We use the simplest model possible in each setting. We abstract away from issues of multiple performance measures and multiple dimensions of managerial actions, focusing on single action settings where earnings is the only performance measure and contracts are written only on earnings. While these assumptions sacrifice generality, we believe the clarity of the results offers some offsetting compensation.

Our approach involves comparing two endogenous variables, an incentive weight chosen by the principal in designing an optimal contract (\(CERC\)) and a valuation weight chosen by the market in capitalizing earnings into stock price (\(ERC\)). This exercise immediately highlights a difference in the governance and valuation processes: optimal incentive contract design is ex-ante in nature in that the principal offers the contract prior to earning releases, while price formation is by nature ex-post in that the market responds to actual realizations of earnings. As a result, it is unlikely that the two weights would in general be identical. This raises the question of how to measure the degree of connection between endogenous choice variables. Unless one variable is a direct function of the other, a comparison must rely on how comparative static analysis of the two variables with respect to the underlying parameters defining the environment align. This is problematic in that there may be directional agreement with respect to some parameters but not
with respect to others. However, while recognizing these issues, we believe it is a valuable exercise to isolate potential links between the two weights.

**Standard LEN Framework**

Consider a principal-agent setting with a risk neutral principal and a single risk averse agent who chooses unobservable effort, \( e \). The agent has a negative exponential utility function with risk aversion parameter \( r \). The opportunity cost of managerial effort is given by \( \frac{1}{2}C_e^2 \).

Firm value, which is unobservable, is given by \( V = v \cdot e + \varepsilon_v \), and accounting earnings are given by \( EARN = ae + \varepsilon_v + \varepsilon_E \), with \( \varepsilon_i \sim N(0, \sigma_i^2) \), \( i = V, E \), and \( \text{Cov}(\varepsilon_v, \varepsilon_E) = 0 \). Here, \( v \) is the marginal product of the agent’s effort and \( a \) is the sensitivity of earnings to the agent’s effort. The wage contracts is given by \( EARNC = \beta_0 + CERC \cdot EARN \), and stock price as \( E[V|EARN, \hat{e}] \), where \( \hat{e} \) represents the market’s conjecture about the action that the manager will take.

In this model, market participants have adequate information about the production environment and the manager’s preferences to correctly conjecture the actions the agent will select. In equilibrium, the action the agent selects will equal the action conjectured by the market. Price is thus given by \( E[V|EARN, \hat{e}] = v\hat{e} + E[\varepsilon_v | EARN, \hat{e}] = v\hat{e} + ERC \cdot (EARN - a\hat{e}) \).

Standard solution techniques lead to the following weights on earnings in contracting with managers and in valuation, respectively:

\[
CERC = \frac{va}{a^2 + rC(\sigma_E^2 + \sigma_Y^2)} \quad \text{and} \quad ERC = \frac{\text{Cov}(V, EARN)}{\text{Var}(EARN)} = \frac{\sigma_v^2}{\sigma_E^2 + \sigma_Y^2} = \frac{1}{1 + \frac{\sigma_E^2}{\sigma_Y^2}}.
\]

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6 The assumption that value is unobservable is common in the recent agency literature (e.g., Holmstrom and Milgrom (1991), Baker (1992), Bushman and Indjejikian (1993), Feltham and Xie (1994)). The unobservability (non-contractibility) of value can be motivated by the notion that actual impact of actions on firm value will only be known with certainty in the future, beyond the managers’ time horizon. See Gibbons (1998) for a useful perspective on the import and realism of dropping the assumption that value is observed and contractible.
Equation (1) captures the Paul (1992) insight that ERCs are fundamentally unrelated to the contracting problem. Marginal product of effort, \( \nu \), appears in the numerator of \( \text{CERC} \), but appears in the intercept term in stock price, not in \( \text{ERC} \). Because the market directly conjectures managerial action and knows the marginal product of effort, the valuation role for earnings is limited to assessing the random component of value, \( \varepsilon_{\nu} \), which is unrelated to the marginal product of effort. The fundamental difference between the two weights is clearly seen by noting that while \( \sigma_{\nu}^2 \) is noise from the standpoint of evaluating managerial effort and reduces \( \text{CERC} \), \( \text{ERC} \) increases in \( \sigma_{\nu}^2 \) as the market uses \( \text{Cov}(V, \text{EARN}) = \sigma_{\nu}^2 \) to infer realizations of \( \varepsilon_{\nu} \).

The main point of this setting is that the valuation role of earnings is inherently unrelated to managerial actions. In the next setting, we alter the valuation framework and allow the manager’s effort, as a component of earnings, to be directly incorporated into the market’s assessment of value.

**Classic valuation framework with Ohlson’s linear information dynamic**

The key difference in this first formulation concerns the nature of the inference process used for valuation. Current earnings will now parameterize a stochastic process that is used to compute expectations of future earnings and determine price. As in Ohlson (1995), we express firm value in terms of accounting numbers as

\[
V_t = b v_t + \sum_{k=1}^{\infty} R^{-k} E_t \left[ \text{EARN}^{i+k}_t \right],
\]

where \( b v_t \) = net book value at date \( t \).

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7 See Lambert (2001) for an in-depth discussion of this result.
8 Note that a marginal product connection can be arbitrarily introduced into this framework. Keeping all else constant, let the value function now be given by \( V = \nu \cdot \text{EARN} \). In this case, \( \text{CERC} \) will remain the same as in (1), but now \( \text{ERC} \) is given by \( \text{ERC} = \frac{\text{Cov}(V, \text{EARN})}{\text{Var}(\text{EARN})} = \nu \cdot \frac{\text{Cov}(\text{EARN}, \text{EARN})}{\text{Var}(\text{EARN})} = \nu \). By arbitrarily reformulating the value function as a linear function of \( \text{EARN} \), a marginal product link is created between \( \text{ERC} \) and \( \text{CERC} \). That is, the valuation role of earnings is still to make inferences about stochastic variables completely unrelated to effort.
\[ R = \text{the discount rate.} \]
\[ E_t[\cdot] = \text{the expected value operator conditioned on the date} \ t \ \text{information set.} \]
\[ EARN_t = \text{earnings for the period ended at date} \ t. \]
\[ EARN^*_t \equiv EARN_t - (R - 1)b_{vt} = \text{residual income for the period ended at date} \ t. \]

In contrast to the standard LEN framework in which the value function is exogenously assumed, the assumption of efficient markets in this framework implies that there is no distinction between the value function (2) and price if the expectations are taken with respect to the market’s information set.

To evaluate the expectations in equation (2), we adapt the linear dynamic of Ohlson (1995) to include managerial effort. We assume that the sequence \( EARN^*_t \) follows the stochastic process

\[ EARN^*_t = \omega EARN^*_{t-1} + ae_t + \tilde{\varepsilon}, \quad (3) \]

where \( \omega \) reflects the persistence of earnings, \( a \) is the sensitivity of earnings to effort, \( e_t \) is the manager's effort in the period ended at date \( t \), \( Var(e_t) = \sigma^2_t \), and \( Cov(e_t, e_k) = 0 \) for all periods \( t \neq k \). The realization of earnings, which includes current period effort, parameterize the stochastic process over future earnings and drive the market’s assessment of expected future earnings. Note that \( e_t \) impacts current earnings directly, and future period earnings through the stochastic process. This differs from the standard LEN framework in which the effort component of earnings plays no role in the market’s inference process. The notion that current period effort may impact the trajectory of future earnings seems quite plausible.

Using equation (3) to evaluate the expectations in equation (2), firm value is given by (see appendix for the derivation)

\[ V_t = bv_t + ERC \cdot EARN^*_t + F(\hat{e}), \quad (4) \]
where \( ERC = \frac{\omega}{R - \omega} \) and \( F(\hat{e}) = \sum_{t=1}^{\infty} R^{-t} [(1 + ERC) \cdot a\hat{e}_{t+k}] \). The term \( F(\hat{e}) \) captures the valuation impact of conjectured actions to be taken by the manager in all future periods after \( t \). \( ERC \) captures the discounted, all-in effect of the manager’s current effort on all future periods, and is thus a component of the marginal product of current period effort not captured by current period earnings. All information about current effort is captured in the current period realization \( EARN_t^a \). That is, even though period \( t \)'s effort impacts the future, no new information is made available in the future concerning these actions over and above what is already contained in \( EARN_t^a \) (i.e., future impacts of current period effort are fully anticipated via equation (4)).

Turning to the contracting problem, we assume that the agent’s utility function exhibits inter-temporally constant absolute risk aversion with risk aversion parameter \( r \) (i.e., negative exponential utility over the sum of consumption over the manager’s tenure). Given this utility specification and the stochastic independence of all periods, it has been shown that there are no gains to writing long-term contracts. This allows us to analyze the contracting problem as a single period problem with the principal choosing the wage contract in period \( t \) to maximize the expected value of \( V_t - w_t \) subject to the standard constraints. Solving for the optimal period \( t \) contract, \( w_t = \beta_0 + CERC \cdot EARN_t^a \), yields

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9 Note that equation (4) can be rewritten easily in terms of earnings, rather than abnormal earnings. In this case, the total impact of \( EARN \) on value is \((1+ERC)\) due to the presence of book value in (2).
10 That is, the impact of effort on future abnormal earnings is deterministically defined by the stochastic process in equation (3), and the discounted value of this multi-period impact is fully captured in equation (2) by \( ERC \).
11 See for example, Fellingham, Newman and Suh (1985) and Chiappori, et. al. (1994) for an analysis of this issue. With these preferences, there is no need to use the contract to spread risk across periods and contracts exhibit no memory.
12 The term \( F(\hat{e}) \) in equation (4) will have no impact on the current period contracting problem as these represent the market’s conjectures of future period effort and are not chosen by the manager.
\[ CERC = \frac{ERC \cdot a^2}{a^2 + rC\sigma_i^2}. \]  

The incentive weight on earnings is strictly increasing in the ERC. A natural interpretation is that managerial actions have multi-period effects that are not fully captured in the current earnings number, and so the ERC is included in the incentive coefficient to motivate the manager to internalize the discounted all-in value impact of current period action. This, of course, differs substantially from the implications of the LEN framework.

*The case of stochastic marginal product and sensitivity of earnings to effort*

In a significant departure from the standard LEN framework, our second alternative formulation models the marginal product of effort and the sensitivity of earnings to the manager’s actions as random variables whose distributions are common knowledge. This also differs from the Ohlson framework in our first setting which allows for effort to have multi-period impacts, and focuses instead on the stochastic nature of marginal product of effort as a driver of the link between earnings weights in valuation and compensation. In this formulation, we depart from a pure moral hazard setting and allow the manager to have pre-decision private information. Following Baker (1992) and Bushman, Indjejikian and Penno (2000), we present a simple agency model where a risk neutral owner hires a risk neutral agent who receives private information after signing the contract but prior to taking actions.\(^\text{13}\)

Let the unobservable value of the firm be given by \( V = \tilde{\epsilon}_v e \), and earnings by 

\[ EARN = \tilde{\epsilon}_v e. \] 

The marginal product of effort is given by \( \tilde{\epsilon}_v \sim N(\mu_v, \sigma_v^2) \), the sensitivity of

\(^{13}\) The assumption that the manager is risk neutral greatly simplifies the analysis. This assumption is also utilized in Baker (1992), and Bushman et al. (2000) who also analyze the risk averse case. The unobservability of \( V \) implies that the firm cannot be sold to the manager. With risk aversion, the agent’s risk aversion parameter would impact the CERC.
earnings to effort by $\bar{\varepsilon}_E \sim N(\mu, \sigma^2_E)$, and let $Cov(\varepsilon_F, \varepsilon_E) > 0$ \footnote{The fact that the means are assumed equal is without loss of generality and is done primarily for notational simplicity. If they were not equal, a simple rescaling could make them equal. See Baker (1992) for more on this.} As before, the principal offers a linear contract $w = \beta_0 + CERC \ast EARN$. The manager is directly concerned with realizations of $\varepsilon_E$ as compensation is dictated by $EARN$, while the principal is most directly concerned with $\varepsilon_Y$, the true marginal product of effort. To complete the specification, we assume that the manager observes the realization of $\varepsilon_E$ after signing the wage contract, but before choosing effort, while no one observes the realization of $\varepsilon_Y$. \footnote{The model could allow the manager to observe a signal $y$ that is imperfectly correlated with $\varepsilon_E$ and $\varepsilon_Y$, but at the cost of mathematical complexity that is beyond the scope of this paper.} The principal thus chooses $CERC$ to maximize $E[V - w] = E[\bar{\varepsilon}_F \cdot e - \beta_0 - CERC \ast EARN]$, subject to

\begin{align*}
IR & \quad E[\beta_0 + CERC \ast EARN - \frac{1}{2} C \cdot (e^*)^2] = U \\
IC & \quad \text{For all } \varepsilon_E, e^* \text{ maximizes } E[\beta_0 + CERC \ast EARN \mid \varepsilon_E] - \frac{1}{2} C \cdot e^2.
\end{align*}

A few comments on this formulation are in order here. First the incentive compatibility constraint, $IC$, must be met for each realization of $\varepsilon_E$ as the manager observes this realization before choosing effort, $e$. Solving $IC$ yields effort selection $e^* = \frac{CERC \ast \varepsilon_E}{C}$, implying that effort is a random variable depending on realizations of $\varepsilon_E$. Secondly, when contracts are signed, the principal and manager have common priors about the state of the world. Thus, the agent’s participation constraint, $IR$, must be met in expectation, and not state by state for each realization of $\varepsilon_E$. Following Bushman, et al. (2000), the compensation weight on earnings is given by

\[ CERC = \frac{\mu^2 + Cov(\varepsilon_F, \varepsilon_E)}{\mu^2 + \sigma^2_E}. \] (6)
The intuition behind equation (6) is that the principal increases incentive weight on earnings as the correlation between the manager’s private information, $\epsilon_E$, and the true marginal product of effort, $\epsilon_V$, increases. Because firm value is driven by the true marginal product of effort, not $\epsilon_E$, the principal increases incentive power as the statistical linkage between $\epsilon_E$ and $\epsilon_V$ increases.

Turning to valuation, we again assume risk neutral pricing with price given by $E[V \mid EARN; e(\epsilon_E)] = E[\bar{e}_V e \mid EARN = \epsilon_e e; e(\epsilon_E) = \frac{CERC}{C} \cdot \epsilon_E]$. This notation captures the idea that market participants correctly conjecture the effort function, $e(\epsilon_E) = \frac{CERC}{C} \cdot \epsilon_E$, rather than effort level as in the standard LEN framework. In general, this expectation is difficult to assess. From the market’s perspective, effort is a random variable and so the conditioning variable, $EARN$, is the product of two random variables, $\epsilon_e e$, while $V$ is also the product of random variables, $\epsilon_V e$. To simplify this calculation, we make the additional assumption that effort level, $e$, is observed by the market but is non-contractible. A similar assumption is utilized in Baiman and Verrecchia (1995). This suppresses inference issues associated with stochastic effort. The weaker assumption that the sign of $\epsilon_e$ is observable would actually be sufficient here.

If the market knows the sign of $\epsilon_e$, observing $EARN$ is informationally equivalent to observing $\sqrt{\frac{\epsilon_e e \cdot C}{CERC}} = \sqrt{\epsilon_E^2} = \epsilon_E$. Given either assumption, price is given by $E[\bar{e}_V e \mid \epsilon_E, e] = E[\bar{e}_V e \mid \epsilon_E] = \mu e(1-ERC) + ERC \cdot EARN$,

where $ERC = \frac{Cov(\epsilon_V, \epsilon_E)}{\sigma_{\epsilon_E}^2}$. 

16 For example, if we assume that all variables are lognormal rather than normal, the statistical calculations become tractable, though messy. A full analysis of this, or other distributional assumptions, is beyond the scope of this paper. Thanks to Raffi Indjejikian for pointing out the tractability of using the lognormal.
A comparison of equations (6) and (7) completes the analysis. Recall from equation (1) that in the LEN model, \( ERC \) increases in \( \text{Cov}(V, EARN) = \sigma^2 \), while \( CERC \) decreases. However, from equations (6) and (7), both weights increase in \( \text{Cov}(\epsilon_V, \epsilon_E) \). The connection between the two weights in our setting is the marginal product of effort. For contracting, \( \text{Cov}(\epsilon_V, \epsilon_E) \) impacts incentive power by capturing the relationship between the manager’s objective and marginal product of effort, while for valuation the market uses \( EARN \) to make inferences about marginal product, \( \epsilon_V \).

While Paul (1992) and others conclude that valuation weights are unrelated to the contracting problem, this conclusion depends on assuming a specific valuation role for earnings: inferring stochastic elements of value that are independent of effort. By altering the valuation role of earnings in reasonable ways, we illustrate that marginal product of effort can be a connecting link between the two weights. First, extending a classical valuation framework to embed moral hazard, we find that \( ERC \) impounds multi-period aspects of current effort not reflected in current earnings, and thus captures a component of marginal product. Second, we allow marginal product to be stochastic. Here, the contracting role of earnings is to motivate actions consistent with the true marginal product of effort, while its valuation role is to infer true marginal product. Given the various alternative modeling approaches, whether the weights on earnings in valuation and in determining compensation are associated as we conjecture is ultimately an empirical question to which we now turn.

3. **Sample and Data**

The sample for our empirical analysis is drawn from the firm-years for which CEO cash compensation data are available from annual Forbes surveys during 1970-1995. We exclude firm-years in which a CEO change occurs. Firms are excluded from the sample if earnings and stock return data are not available on Compustat and CRSP, respectively. Our primary analyses examine
changes in average industry shifts in \( CERCs \) and \( ERCs \) between subperiods of the sample period. We, therefore, require each sample industry, defined on the basis of the 2-digit SIC code, to have at least 50 useable observations in each of the first and second halves of the period 1971-1995. The sample includes 10,195 firm-years, representing 919 different firms, with an average of 11 observations per firm. Table 1 describes the industry membership of sample firms. The sample includes 20 different industries, ranging from 127 to 2,095 firm-years per industry.

Our CEO compensation measure is annual cash compensation, defined as salary plus annual bonus payments. We focus on the annual cash component of CEO compensation because it is the component of CEO compensation that is most directly linked with accounting performance measures, particularly earnings.\(^{17}\) Since our interest is in the link between the use of earnings in valuation and in management compensation plans, it is appropriate to focus on the component of compensation that has been documented to be most directly associated with accounting earnings. Our measure of compensation does not include the value of grants of stock-based compensation based on lack of evidence in existing studies of an association between accounting earnings and granting of stock-based compensation by firms.\(^{18}\)

We focus our analyses on annual compensation of CEOs to allow us to directly examine the link between the use of earnings as a performance measure in valuation and stewardship settings.

Our analysis of trends in the use of earnings in CEO cash compensation over the sample period in section 5 provides new evidence to complement recent studies which document that the


\(^{18}\) Several studies explore the determinants of granting of stock-based compensation by firms (e.g., Yermack (1995), Baber, Kang and Kumar (1996), Core and Guay (1999), and Bryan, Hwang and Lilien (2000)) and provide evidence that granting of options and stock are associated with CEO existing holdings, liquidity, extent of CEO horizon problem, tax status and firm stock performance, among other factors. The analyses of granting strategies of firms generally acknowledge that firms use grants of stock-based compensation as both a reward for past performance and an incentive for future performance. We are aware of no evidence that directly links granting of stock-based compensation to the earnings performance of the firm.
overall sensitivity of CEO pay to changes in performance has shifted to become dominated by the CEOs’ portfolio of stock and options (see Murphy (1998) and Hall and Liebman (1998)). These studies show that only a small amount of the sensitivity to overall firm performance derives from the cash compensation portion of the contract. Given that the compensation use of accounting numbers is most prevalent in annual bonus plans, the trend documented by Murphy may suggest that the direct use of accounting numbers in CEO compensation has potentially become less important to CEO incentives. The extent to which the cash component of CEO compensation has shifted away from accounting information towards alternative performance measures over time, however, is unknown. We examine trends in the use of earnings as a performance measure in the component of compensation mostly directly linked with accounting performance to specifically address how the role of accounting earnings in CEO compensation has changed over time.

4. Test of the Association Between Pay-Earnings and Price-Earnings Sensitivities

In this section we explore whether there is a link between compensation-earnings sensitivities, $CERC_s$, and price-earnings sensitivities, $ERC_s$, by examining the relation between changes in industry-specific $CERC_s$ and $ERC_s$ from the first half to the second half of the 25-year sample period, 1971-95. We examine the correlation between changes in $CERC_s$ and $ERC_s$ (section 4.1) and then conduct multivariate analyses that also consider other agency theoretic determinants of $CERC_s$ (section 4.2).

Our setting differs from that in existing studies in three key ways. First, our analyses consider the impact of price-earnings sensitivity ($ERC$) as a potential additional agency-based determinant of pay-earnings sensitivity. Second, our analyses focus on the association between shifts in pay-earnings sensitivities over time and their agency-based determinants rather than the level of pay-earnings sensitivities in cross-sectional analyses. Our focus on shifts over time allow us to assess whether changes in the factors hypothesized to impact compensation weights on earnings trigger corresponding changes in the compensation weights. Further, a focus on shifts in
weights may provide a control for firm or manager-specific factors found to impact optimal pay-performance sensitivities in our model and other agency models.

Finally, while prior studies generally examine agency theory-based determinants of relative pay-earnings sensitivities, this study examines agency theory-based factors as hypothesized determinants of absolute weights on earnings in compensation contracts. Examining the absolute weight on earnings to allow us to focus explicitly on the use of earnings in its stewardship and valuation settings. Examination of absolute weights may also allow us to overcome certain econometric concerns that results from using the ratio of estimated weights in our analyses.

4.1 Analysis of Correlation between CERCs and ERCs

We begin with the estimation of proxies for CERCs and ERCs described in the models in section 2. We proxy for ERC using a measure of the sensitivity of stock prices to earnings changes. This sensitivity measure is commonly referred to as the "earnings response coefficient" in existing capital markets literature. Similarly, we develop an implicit estimate of the compensation weight on earnings using a measure of the sensitivity of annual cash compensation to earnings changes, controlling for other performance information. We aggregate sample firms by industry in estimating CERCs and ERCs because we expect more homogeneity within industries than across a pooled sample in the determinants of CERCs and ERCs. Prior research suggests that earnings coefficients are unlikely to be a cross-sectional constant in either stewardship or valuation settings. Collins and Kothari (1989), Easton and Zmijewski (1989), and Ahmed (1994) examine factors, such as discount rates, product market competition and cost structure, that affect the sensitivity of stock returns to earnings (i.e., ERCs). Agency models suggest that a firm’s optimal compensation

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19 As Lambert and Larcker (1987) note, several econometric concerns arise when using the ratio of coefficients which are computed from estimates of the individual weights. The potential disadvantages include a distribution of the ratio that may possess undesirable properties, effects of scale differences among the measures, and the imposition of constraints on the signs of the individual weights in computing the ratio.

20 For reasons discussed in this section, we adopt an industry pooled approach for our primary analyses rather than estimation of coefficients from either firm-specific or annual cross-sectional regressions. We test the sensitivity of our results to these alternative specifications in section 5.
contract is influenced by its production, operating and management environments which are likely
to be similar within industries.\textsuperscript{21}

We compute changes in industry-specific ERCs from the first half to the second half of the
sample period by allowing the slope on $\Delta EARN$ to differ between the two subperiods in a regression
model of changes in stock returns on changes in earnings. Specifically, we estimate the following
model for each industry:

$$XRET_{i,t} = \sum_{t=1}^{95} \gamma_{0,t} + \gamma_{1} \Delta EARN_{i,t} + \gamma_{2} \Delta EARN^{2}_{i,t} + \epsilon_{i,t}$$

(8)

where $XRET_{i,t}$ = the cumulative, market-adjusted return for firm $i$ over the 12 month period of the
firm's fiscal year $t$;

$\Delta EARN_{i,t} =$ the change in earnings before extraordinary items and discontinued operations
for firm $i$ between year $t$ and year $t-1$, deflated by the market value of equity at the
beginning of year $t$ and

$\Delta EARN^{2}_{i,t} = \begin{cases} 
\Delta EARN_{i,t} & \text{if } t \geq 1984 \\
0 & \text{otherwise}
\end{cases}$

We include fixed year-effects in the models to allow the intercept to vary by common factors
influencing stock returns during specific years.

We similarly compute changes in industry-specific CERCs from the first half to the second
half of the sample period by allowing the slope on $\Delta EARN$ to differ between the two subperiods in a
regression model of changes in compensation on changes in earnings and stock market returns. We

\textsuperscript{21} Examples of production, operating and management factors documented to influence the structure of
incentive contracts include the form of the production function, the extent of the agency problem, manager
disutility for effort and manager opportunity cost. Ely (1991) provides empirical support for significant
inter-industry differences in the weights placed on various performance measures in compensation
contracts.

\textsuperscript{22} We divide our sample period into two roughly equal subperiods for each industry for these analyses
(1971-1983 and 1984-1995). We are not suggesting a shock occurred at the midpoint of the sample period
(or any other point) for each industry. Rather we expect any shift over the sample period to be more
gradual. We test the sensitivity of all reported results to alternative cutoff points to determine subperiods,
ranging from 1980 to 1986 (i.e., three years on either side of the midpoint). The results of these analyses
are statistically similar to those reported in the accompanying tables.
include stock returns in this model to proxy for other performance information that is used by Boards of Directors in developing compensation contracts.\(^{23}\) We estimate the following model:

\[
COMP_{i,t} = \delta_1 \Delta EARN_{i,t} + \delta_2 \Delta EARN2_{i,t} + \delta_3 RET_{i,t} + \delta_4 RET2_{i,t} + \epsilon_{i,t}
\]  

(9)

where \(COMP_{i,t}\) = the percentage change in the CEO’s cash compensation for firm \(i\) in year \(t\); \(RET_{i,t}\) = the cumulative stock market return for firm \(i\) over the 12 month period of the firm’s fiscal year \(t\) and \(\Delta EARN_{i,t}\) and \(\Delta EARN2_{i,t}\) are as defined in equation (8).\(^{24}\)

We estimate equations (8) and (9) separately for the 20 sample industries. For each industry, \(\gamma_1 (\delta_1)\) reflects the ERC (CERC) in the first subperiod, while \(\gamma_1 + \gamma_2 (\delta_1 + \delta_2)\) reflects the ERC (CERC) in the second subperiod, and \(\gamma_2 (\delta_2)\) reflects the change in the ERC (CERC) from the first subperiod to the second subperiod. This specification allows an assessment of the relation between the changes in CERCs and ERCs between two roughly equal subperiods, 1971-1983 and 1984-1995.

We compute the correlation between \(\Delta ERC\) (i.e., \(\gamma_2\)) and \(\Delta CERC\) (i.e., \(\delta_2\)) across the 20 industries as a test of the association between inter-temporal shifts in CERCs and ERCs from the first to the second subperiod. The Pearson (Spearman rank) correlation between the shifts in the

\(^{23}\) In our model, we do not assume that stock prices are directly used in the compensation contract, but rather that contracts reflect other available performance information. We proxy for other available information using stock market returns which capture the value impact of publicly available information. It is also important to include stock returns in our empirical model because if the true compensation model involved stock returns, omission of stock returns in the regression would result in a mechanistic relation between CERCs and ERCs (we thank Raffi Indjejikian and an anonymous referee for bringing this to our attention). We replicate all empirical tests involving CERCs with CERCs estimated from a model of changes in compensation on changes in earnings alone (rather than the multivariate model) and find similar qualitative results.

\(^{24}\) Our model measures accounting performance using the change in earnings deflated by beginning market value of equity for consistency with earnings measure in the traditional market returns model in equation (8). Percentage change in compensation (or log of the change in compensation) is often used as the dependent variable in estimations of the compensation/performance relation. We also conduct estimations with the change in compensation deflated by beginning market value of equity. Our results with the alternative compensation measure produce similar inferences as those in sections 4 and 5 – the estimations document significant positive correlation between changes in CERCs and ERCs, as in section 4.1, show significant positive association between changes in ERCs and CERCs in the multivariate analyses in section 4.2 and similar inferences on shifts in CERCs over the sample period as those in section 5.
The inter-industry Spearman correlation between the level of \( CERC \) and \( ERC \) is positive and significant each subperiod, but declines from 0.76 within the first subperiod to 0.41 (significant at the .07 level) within the second subperiod. A possible explanation for this decline in the inter-industry correlation between subperiod \( CERCs \) and \( ERCs \) is an increase in special items within reported earnings in the second subperiod. This would occur if the sensitivities of stock returns and compensation to special items are different. Pearson correlation of changes in \( CERCs \) and \( ERCs \) computed using earnings before special items (0.60) is comparable to that above.\(^{25}\) Overall, our analysis of the univariate correlation of changes in industry shifts in \( CERCs \) and \( ERCs \) across subperiods is consistent with a positive association in the use of earnings information in valuation and stewardship settings.

4.2 Cross-Sectional Regressions of the Determinants of \( CERCs \)

While our main empirical objective is to investigate the existence of a link between \( CERCs \) and \( ERCs \), prior literature has documented a number of potential factors as determinants of \( CERCs \). We next extend our cross-sectional analysis of the relation between industry-specific changes in \( CERCs \) and \( ERCs \) by considering additional determinants of \( CERCs \). The determinants we consider include the importance of growth opportunities, noise in earnings and in other performance information and the presence of regulation. We also consider the role of earnings persistence – a hypothesized determinant of \( ERCs \). Although prior literature also shows that \( CERCs \) are impacted by managers' attitudes toward effort and risk, we do not directly test these predictions due to the lack of empirical proxies for these factors. The focus on shifts between periods in model variables in the empirical tests, however, controls for these omitted variables under the plausible assumption that managerial attitudes toward effort and risk are stable within an industry over time. The

\(^{25}\) We also re-estimate the prior analyses using a measure of ‘bottom-line’ earnings (i.e., after extraordinary items and discontinued items). We find significant correlation (0.67) between changes in \( ERCs \) and \( CERCs \) using bottom-line earnings.
remainder of this section describes our empirical proxies for these potential determinants of pay-earnings sensitivities.

Importance of Growth Opportunities Relative to Assets in Place. Strategic activities are arguably important within firms with significant growth opportunities. Prior research provides some evidence of a decline in the relative weight placed on earnings in cash compensation with an increase in the importance of growth opportunities (e.g., Lambert and Larcker (1987), Bushman, Indjejikian, and Smith (1996), Ittner, Larcker, and Rajan (1997) and Smith and Watts (1992)).

We use two proxies for industry-based changes in the importance of strategic activities relative to assets in place from the first to the second subperiod. First, we compute the change between subperiods in median industry market-to-book values of equity across firm-years within the subperiod (ΔMTB). Second, we compute the change in median industry sales growth between subperiods (ΔSALES_GROW). We compute the annual sales growth for each firm as one plus the percentage change in sales level from year \( t-1 \) to year \( t \). The median industry sales growth for each subperiod is based on all firm-years in the industry within the subperiod. Recognizing that a single metric is unlikely to precisely capture growth opportunities, we aggregate the two proxies for growth opportunities to allow for a determination of their principal components. We use a principal components analysis in an attempt to reduce both potential multicollinearity between the proxies and potential measurement error with which the proxies capture growth opportunities relative to assets in place. The principal components analysis for changes in growth opportunities produces a first principal component that explains a large proportion of the variance of the data (70%) and has an eigenvalue greater than one. We use the first principal component as our measure for the change in growth opportunities, \( ΔGRO_OP \), in our estimation of the cross-sectional model for pay-earnings sensitivities.

26 In our use of principal components analyses for independent variables in this study, we adopt the latent root criterion method which selects principal components with eigenvalues greater than one. In each instance in our study, the first principal component for a construct explains a large proportion of the
**Performance measure noise.** We use three proxies to measure the change in the noise in earnings with respect to managers' actions. The first proxy, $\sigma^2_{EARN}$, is based on the time-series variance of annual changes in earnings before extraordinary items and discontinued operations computed for each firm that has at least 10 observations in each subperiod. We compute $\sigma^2_{EARN}$ as the change in the median industry time-series variance between the two subperiods where the median industry time-series variance for each subperiod is based on all firms in the industry within the subperiod.

Since theory considers noise to reflect those factors outside managers’ control (the random or uncontrollable component), the second proxy involves separating earnings into components reflecting market-wide activity (i.e., random) and firm-specific (i.e., manager controlled) aspects. Specifically, we decompose earnings changes using firm-specific time-series regressions by subperiod of changes in earnings before extraordinary items and discontinued items on annual market value-weighted averages of earnings changes of Compustat firms. The proxy, $\sigma^2_{SYS\_EARN}$, is computed as the change between the subperiods in the median industry variance of the systematic or market-wide component of earnings changes.

Finally, our third proxy is based on the time-series volatility of 'one-time items' included in net income. One-time items impacting earnings may have different information content for compensation and incentive purposes and therefore, may be used differently by compensation committees than other components of earnings. We compute the absolute value of the ratio of changes in one-time items (i.e., extraordinary items, discontinued operations and special items, net of tax) to changes in earnings before one-time items for each year for each firm. We compute our third noise proxy, $\sigma^2_{ABS\_ONETIME}$, as the median industry change in the ratio between the two subperiods. As with $\Delta GRO\_OP$, the three proxies for changes in the noise in earnings between the subperiods are then grouped to conduct a principal component analysis. The first principal variance and is the sole component with an eigenvalue great than one. See Johnson and Wichern (1992) for further discussion of the use of principal components analyses.
component, which explains 63% of the variation, is used as $\Delta NOISE\_EARN$, our measure of the change in the noise in earnings in our cross-sectional models of pay-earnings sensitivities.

We also consider proxies for the noise in other performance information with respect to managers actions. The first proxy, $\sigma^2 RET$, captures changes in the total time-series variance of annual returns across the subperiods and is computed as the median industry change in the time-series variance of raw stock returns (computed on a firm-specific basis) between the two subperiods. Analogous to the second proxy for the noise in earnings, the second proxy for the noise in other performance information, $\sigma^2 SYS\_RET$, attempts to capture changes in the variance of the systematic component of returns on the basis of firm-specific time-series regressions of returns on annual market value-weighted averages of returns of CRSP firms. $\sigma^2 SYS\_RET$ is computed as the median industry change in the variance of the market or “systematic” component of the returns between the two subperiods. The two measures for the change in the noise in returns are grouped to allow for a determination of their principal components. The first principal component of the two noise proxies explains 90% of the variation in the data and is used as our measure of change in the noise in other performance information, $\Delta NOISE\_RET$, in the cross-sectional analyses of pay-earnings sensitivities.

**Regulatory Environment** We also consider the importance of changes in the regulatory environment on changes in pay-earnings sensitivities. Executives in highly regulated industries arguably have less potential influence over shareholder value, leading to the prediction that the impact of earnings on executive pay is lower in heavily regulated industries.\(^{27}\) We operationalize changes in the regulatory environment by a dummy variable for deregulation of the banking, telecommunication, airline, and utility industries in the second subperiod ($\Delta REG$). We expect a

\(^{27}\) Joskow, Rose and Shepard (1993) document lower levels of pay and less incentive pay (controlling for size, performance and CEO characteristics) in regulated firms than in unregulated firms with more dramatic differences when regulations are tighter. Hubbard and Palia (1995) and Crawford, Ezzell and Miles (1994) provide evidence that deregulation activities in the banking industry positively impact the extent of use of incentive pay.
positive relation between changes in the compensation weight on earnings and our dummy variable proxying for deregulation.

Earnings persistence In addition to examining the association between CERCs and ERCs, we directly assess whether persistence is an important driver of the link between ERCs and CERCs. We expect that changes in the weights on earnings in the compensation function (CERCs) in the managers’ contract are positively associated with proxies for changes in earnings persistence. We also examine the incremental role of other determinants of ERCs on CERCs by including both ERCs and a measure of persistence in our model.

Prior empirical studies in the capital market setting that have explored the underlying determinants of ERCs document the significant positive relation between ERCs and earnings persistence (e.g., Easton and Zmijewski (1989) and Collins and Kothari (1989), among others). Using 1992 and 1993 data from a sample of firms responding to a survey, Baber, Kang and Kumar (BKK, 1998) provide evidence from cross-sectional analyses that compensation weights on earnings changes increase with a measure of earnings persistence derived from an IMA(1,1) process. BKK conjecture that boards consider the persistence of earnings in contracting in an effort to address or mitigate a myopic decision focus by the CEO. It is not clear, however, how this idea fits into a formal economic framework. Our empirical analysis is motivated by the modeling framework in section 2 and allows for a reinterpretation of their results. While the existence of multi-period effects can be framed as a myopia problem, it seems more natural to view it as an issue of properly measuring marginal product of current period actions that impact current and future earnings. The multi-period impact of actions is simply factored into the definition of marginal product through the valuation weight on earnings.

28 Baber, Kang and Kumar conduct sensitivity analyses of their main results using alternative proxies for earnings persistence, including earnings response coefficients. ERCs are chosen due to their documented positive association with persistence in prior studies although BKK acknowledge that ERCs are affected by factors other than earnings persistence. In contrast, our model suggests that CERCs are positively related to ERCs per se, not simply persistence.
Our empirical design differs from that in BKK in that our estimations also consider the role of other factors found to influence optimal performance measure weights in agency models. We address these 'other factors' in several ways. First, we include proxies for certain relevant properties of performance measures discussed in the agency literature (e.g., performance measure noise and sensitivity). We also explicitly consider the association of ERCs with CERCs, conditional on a proxy for persistence. Further, we allow compensation weights to vary by industry in an attempt to control for aspects of firms' production, operating and management environments that may impact optimal contract weights. Finally, we adopt a changes format by examining shifts across subperiods of our sample to control for factors, such as manager risk and effort aversion, that are likely constant within an industry over time.

We capture the persistence of earnings with three proxies. Our first proxy measures the extent of persistence in the time series of changes in earnings before extraordinary items and discontinued operations using an ARIMA (2,1,0) model which is consistent with the structure of our multi-period model of earnings in section 2. We estimate rolling annual firm-specific regressions over the period 1971 to 1994 for all firms for which ten consecutive years of data are available for each estimation. We aggregate across all firms and years to compute the industry median persistence for each subperiod. We then compute changes in persistence for each industry as the change in the median persistence in earnings for each industry from period 1 to period 2 ($\Delta PERS_{TSI}$).

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29 BKK acknowledge firm characteristics as potential correlated omitted variables in their parsimonious model and conduct sensitivity analyses with several firm characteristics. They do not consider, however, the impact on compensation weights of performance measure properties addressed in the agency literature. For example, it is plausible that the positive coefficient associated with persistence in the BKK estimation is capturing the effects of the noise in earnings since we observe significant negative correlation between our proxies for the noise in earnings and the BKK earnings persistence measure over our sample period.

30 Specifically, we estimate $\Delta EARN_i = a_0 + b_1 \Delta EARN_{i-1} + b_2 \Delta EARN_{i-2} + \epsilon_i$ annually for each firm with 10 years of complete data. An annual persistence proxy is then computed for each firm using Kormendi and Lipe's (1987) PVR measure capturing the sum of the present value of expected future earnings assuming a 10% discount rate.
Our second measures of earnings persistence, also derives from estimating a time series model of changes in earnings. Following Baber, et al., we estimate rolling annual firm-specific IMA(1,1) models over the sample period for all firms for which ten consecutive years of data are available for each estimation. As with \( PERS_{TS1} \), we compute median persistence by industry for each subperiod. The change in median persistence for each industry from period 1 to period 2 is our second measure of persistence, \( PERS_{TS2} \).

Our third measure of earnings persistence is the difference between long and short window earnings response coefficients. A number of papers (for example, Beaver, Lambert and Morse (1980) and Beaver, Lambert, and Ryan (1987)) find that stock prices lead accounting earnings. Kothari and Sloan (1992) provide evidence that returns measured over three leading years contain information about an annual earnings change, and conjecture that this effect relates to the persistence, or permanence, of earnings. We estimate short window \( ERCs \) from industry-specific regressions of annual market-adjusted returns on contemporaneous annual earnings before extraordinary items and discontinued items. We allow the slope on earnings to differ between the first and second subperiods in each regression. We estimate long window \( ERCs \) in an analogous fashion, using a three-year return window (current and two lagged years) regressed against annual earnings. Our proxy for changes in earnings persistence, \( \Delta LW_{SW} \), is the change from subperiod 1 to subperiod 2 in the difference between long and short window \( ERCs \).

The three measures of changes in earnings persistence are then grouped to allow for a determination of their principal components. The first principal component has an eigenvalue greater than two and explains 77% of the variation in the data. We use the first principal component as our measure for the change in the persistence of earnings, \( \Delta PERSIST \), in our estimations of the cross-sectional model for pay-earnings sensitivities.

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[31] See Baber, et al. (1998) for further discussion of the IMA(1,1) model. As in Baber, et al., our measure of persistence is computed as \( 1 - \Theta \), where \( \Theta \) is the IMA(1,1) parameter.
### 4.2.1 Empirical model of CERC determinants and results of analyses

Table 2 presents descriptive statistics for the explanatory variables used in the cross-sectional models for changes in pay-earnings sensitivities for the 20 sample industries. While we have no specific expectations about the significance and direction of any shift in the level of the proxies from the first to second subperiod, we note that all proxies with the exception of the persistence proxy $\Delta LW\_SW$ experience a significant shift in median based on a paired t-test or the Wilcoxon sign rank test.

We first estimate the following regression model that considers the factors discussed above that are hypothesized to influence absolute pay-earnings sensitivities:

$$
\Delta CERC_j = \beta_0 + \beta_1 * \Delta ERC_j + \beta_2 * \Delta GRO\_OP_j + \beta_3 * \Delta NOISE\_EARN_j + \beta_4 * \Delta NOISE\_RET_j + \beta_5 * \Delta REG_j + \nu_j
$$

(10)

where $\Delta CERC_j$ = Estimated change in the compensation earnings response coefficient from period 1 to period 2 for industry $j$ (i.e., $\hat{\delta}$ from equation (9));

$\Delta ERC_j$ = Estimated change in the earnings response coefficient from subperiod 1 to subperiod 2 for industry $j$ (i.e., $\hat{\gamma}$ from equation (8));

$\Delta GRO\_OP_j$ = First principal component of $\Delta MTB$ and $\Delta SALES\_GROW$ for industry $j$;

$\Delta NOISE\_EARN_j$ = First principal component of $\sigma^2 EARN$, $\sigma^2 SYS\_EARN$ and $\sigma^2 ABS\_ONETIME$ for industry $j$;

$\Delta NOISE\_RET_j$ = First principal component of $\sigma^2 RET$ and $\sigma^2 SYS\_RET$ for industry $j$ and;

$\Delta REG_j$ = 1 if industry is airlines, banking, telecommunications or utility and 0 otherwise.

The sign of the predicted relation with $CERCs$ is noted below each variable in equation (10) above.

The results for the cross-sectional estimations of the changes in compensation weights on earnings ($CERCs$) in equation (10) both with and without the $\Delta PERSIST$ proxy are reported in columns 1 through 3 of Table 3. The results in column 1 indicate that consistent with our earlier

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32 Murphy and Topel (1985) propose an adjustment to standard error estimates to eliminate potential bias in settings where regressors are estimated in a first-stage estimation as is the $ERC$ in equation (10). Pagan (1984), however, illustrates that standard error estimates are consistent in settings with a null hypothesis of a zero coefficient. We conduct White’s tests for heteroscedasticity which do not reject the null hypothesis of homoscedasticity for each model.
documented position correlation, the coefficient on the ΔERC is positive and significant (t=2.89).
In addition, the coefficient on our proxy for the importance of growth opportunities relative to
assets in place (ΔGRO_OP) is negative and significant, as predicted. The coefficients on the
proxies for the noise in earnings (ΔNOISE_EARN) and the noise in other performance information
(ΔNOISE_RET) are negative and positive, respectively, as predicted (with ΔNOISE_RET significant
at the 5% level). Finally, the coefficient on the proxy for deregulation is opposite of that predicted,
but is insignificant at the 5% level. Overall, the adjusted R² suggests that the model variables
explain approximately one-half of the inter-industry variation of the changes in the CERCs from
the first to the second subperiod.

The results in column 2 of Table 3 reflects equation (10) replacing ΔERC with ΔPERSIST.
Column 2 indicates that the coefficient on ΔPERSIST is significantly greater than zero as predicted
at the 5% level. The results of this estimation suggest that, ceteris paribus, earnings persistence, a
key determinant of ERCs, is an important factor in explaining changes in CERCs. In addition, the
ΔGRO_OP and ΔNOISE_RET remain significant with predicted signs and ΔNOISE_EARN is now
significant and negative, as predicted. The coefficient on ΔREG is significantly less than zero,
opposite to our prediction. Column 3 reports the results of estimating equation (10) with both
ΔERC and ΔPERSIST included. The coefficients on ΔERC and ΔPERSIST are both positive and
significant with coefficients on other variables similar in sign and significance to those of column 2.
Further, the explanatory power of the column 3 estimations is quite high relative to the other
models (R² = 0.61). The significance of both ΔERC and ΔPERSIST suggests that while persistence
is associated with CERCs through its role in determining ERCs, other factors captured by ERCs
may also linked with CERCs.

In summary, the empirical results of our cross-sectional model of determinants of absolute
CERCs support the notion of a positive association between ERCs and CERCs. The link between
ERCs and CERCs appears to be driven, in part, by the role of persistence in determining ERCs, but
our results also suggest that other factors impacting ERCs are important to the pay-earnings sensitivity. Our empirical analysis, thus, is consistent with our conjecture that ERCs are a fundamental determinant of the manager’s overall marginal product of effort that captures, among other things, the multi-period effects of managerial actions on earnings as measured by persistence. Further, the analyses provide new evidence that absolute CERCs are associated with other agency factors analyzed in the model, including growth opportunities and performance measure noise, in the predicted way.

4.3 Analysis of temporal shifts in ERCs and CERCs

We examine whether and how the use of earnings in the determination of cash compensation, in both an absolute sense and relative to other available performance information, has changed over the 25-year sample period. Our investigation of trends in CERCs is motivated, in part, by recent findings in academic research about the declining role of earnings in determining equity values.\(^{33}\) Although we learn from our models and the results in section 4, that CERCs and ERCs are positively linked, our models (along with Gjesdal (1981) and Paul (1992)) suggests that the use of earnings in both settings is not likely to be identical. Our goal is to provide evidence on whether trends in ERCs documented in prior research are accompanied by a corresponding decline in CERCs.

We conduct our tests of a general trend over the 25-year sample period in two ways: 1) the sensitivity of executive cash compensation to reported earnings (section 4.3.1), and 2) the importance of earnings in explaining executive pay relative to other performance information in general (section 4.3.2) and relative to other accounting-based information (section 4.3.3).

\(^{33}\) Several existing studies analyze the trend in the relation between stock returns and earnings over time (e.g., Collins, Maydew and Weiss (1997), Chang (1998), Brown, Lo and Lys (1999), Francis and Schipper (1999) and Lev and Zarowin (1999)). While most of these studies focus on value relevance (i.e., explanatory power) of earnings, several report information on earnings and book value coefficients with respect to returns. Our analysis of reported annual earnings and book value coefficients in Francis and Schipper reveal a statistically significant decline (increase) in ERCs (book values) over their sample period (1953-1994) as well as the 25 year sample period of our study.
4.3.1 Temporal Analysis of CERCs

We begin with an analyses of inter-temporal industry shifts of CERCs and ERCs from the first-half (1971-83) to the second half (1984-95) of our sample period based on the estimation of equations (8) and (9) for each of the 20 sample industries. As noted in section 4.1, for each industry, \( \gamma_1 (\delta_1) \) reflects the ERC (CERC) in the first subperiod, while \( \gamma_2 (\delta_2) \) reflects the change in the ERC (CERC) from the first subperiod to the second subperiod. The results of the estimation of equations (8) and (9) are presented in Table 4. The mean industry ERC in the first subperiod is 1.52 and drops by an average of .39 in the second subperiod, a 26 percent decline on average. The average shift in ERCs for the 20 industries from the first to the second subperiod is negative and significant (Z-statistic=-2.26, p-value=.024), consistent with the documented decline in ERCs in prior studies. In contrast, the mean industry CERC in the first subperiod is 0.95 and drops by 0.15, on average, in the second subperiod, which is less than a 16 percent decline.\(^{34}\) The average shift in CERCs for the 20 industries from the first to the second subperiod is not significantly different from zero (Z-statistic=-.23, p-value=.82).\(^{35}\)

4.3.2 The Changing Relative Role of Earnings in Determining Cash Compensation

The tests in section 4.3.1 fail to document a significant decline in the pay-earnings sensitivity of CEO cash compensation. We now examine trends in the relative pay-earnings sensitivities to determine whether firms have substituted away from earnings toward other information in determining executive cash compensation. The informativeness principle (Holmstrom (1979)) states that for contracting purposes, a performance measure will only be

\(^{34}\) The ERC in the first subperiod is positive for 19 of the 20 industries (and significantly greater than zero at the 5% level in 17 of these cases). The ERC decreased significantly for six industries and increased significantly for only two industries from period 1 to period 2. The CERC in the first subperiod is positive for all 20 of the industries (and significantly greater than zero at the 5% level) for 11 industries. The CERC decreased significantly for five industries and increased significantly for two industries from period 1 to period 2.

\(^{35}\) We also conduct nonparametric binomial tests of the direction (ignoring magnitude) of the change in ERCs (CERCs). The binomial tests suggest a weakly negative shift in ERCs with 13 of 20 industries (p=0.07) experiencing a negative change in ERCs and a statistically insignificant change in CERCs between the two subperiods with 11 of 20 industries experiencing a negative change in CERC (p=0.16).
included in a portfolio of performance measures if it has incremental information content over and above the other available measures. A shift toward the use of other information in compensation contracts can then be interpreted as implying that earnings are capturing less of the relevant information about executives’ contributions to firm value. From prior literature, we know that firms use measures beyond earnings in their annual bonus plans. In this section we consider annual stock returns as a proxy for other (non-earnings) information released during a given year. Our focus is on how the relative sensitivity of cash compensation to earnings versus non-earnings information captured in the firm’s stock returns changes over time.

We measure the relative earnings-sensitivity of compensation as the ratio of the coefficient on earnings (\(CERC\)) to the coefficient on returns (\(CRRC\)) in compensation models. Examining the ratio \(\frac{CERC}{CRRC}\) allows us to control for any changes over time in the general incentive intensity of cash compensation. A decline in the ratio implies a decrease in the weight placed on earnings relative to the weight on other information reflected in stock returns, consistent with a decline in the “sufficiency” of earnings as a measure of CEO performance. Analogous to the tests of \(CERCs\) in section 4.3.1, we test whether there has been an average inter-industry shift in the relative importance of earnings over the subperiods 1971-83 and 1984-95.

To examine average industry shifts in the relative importance of earnings, we compute estimates of \(CRRCs\) by industry from the model of changes in compensation and both earnings and stock return measures as reflected in equation (9) in section 4.1. Similar to estimated \(CERCs\) from equation (9), for each industry, \(\delta_j\) reflects the \(CRRC\) in the first subperiod, while \(\delta_3 + \delta_4\) reflects the \(CRRC\) in the second subperiod, and \(\delta_4\) reflects the change in the \(CRRC\) from the first subperiod to the second subperiod. We estimate the shift in the ratio of the coefficient on earnings to the coefficient on returns, \(\Delta(CERC/CRRC)\), computed using information about \(CERCs\) and \(CRRCs\) for

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36 Bushman, Indjejikian, and Smith (1996) and Ittner, Larcker and Rajan (1997) provide evidence on the determinants of the use of individual performance evaluation and non-financial performance measures in determining annual bonuses. While both papers show that these non-traditional performance measures are used in determining bonus payments in situations where current earnings are likely to poorly reflect managerial contributions to long-term equity value, neither paper investigates trends over time.
each period from the estimation of equation (9). Specifically, $CERC/CRRC_{period\ 1}$ is computed as $\delta_1/\delta_3$ while $CERC/CRRC_{period\ 2}$ is computed as $(\delta_1 + \delta_2)/(\delta_3 + \delta_4)$. The change in the ratio, $\Delta(CERC/CRRC)$ is the difference in the ratio between the two periods: $CERC/CRRC_{period\ 2} - CERC/CRRC_{period\ 1}$.

We use the absolute value of the coefficient on stock returns in the denominator in each subperiod in the five cases where the weight is negative in either subperiod.

Table 4 presents a summary of $CRRCs$ and $\Delta(CERC/CRRC)$ estimated from equation (9) for the 20 industries. The average $CRRC$ is significantly greater than zero in the first subperiod ($Z$-statistic=3.51). The average change in the coefficient on stock returns from the first to the second subperiod is significantly greater than zero ($Z$-statistic=5.45) suggesting an increasing weight on other performance information in the determination of cash compensation across the two subperiods. The significant, positive shift in $CRRCs$ is in contrast to the results for $CERCs$ which fail to detect a shift across the two subperiods. Table 4 also shows that the change in the ratio, $\Delta(CERC/CRRC)$ is negative in 13 of 20 industries. The average change in the ratio of the coefficient on earnings to the absolute value of the coefficient on stock returns is significantly less than zero (t-statistic=-2.27).

We also attempt to capture whether the relative importance of earnings has changed over time by examining the relative explanatory power of earnings versus returns in explaining changes in CEO pay in our industry models. A significant increase in the incremental $R^2$ of stock returns (in compensation models including both earnings and returns) over and above earnings alone, with no increase in the incremental $R^2$ of earnings over and above stock returns, would be consistent with a

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37 All results with respect to shifts in relative pay-earnings sensitivities in this section are qualitatively similar if we instead calculate the numerator of the ratio $CERC/CRRC$ from the coefficient on $\Delta EARN$ in a model with earnings only. This alternate ratio captures the sensitivity of pay to all information in earnings relative to the sensitivity of pay to the portion of returns orthogonal to earnings (i.e., controlling for information common to returns and earnings).

38 As two alternatives to using the absolute value of the weight on stock returns in the denominator, we estimate t-statistics 1) excluding the five industries which have a negative coefficient on stock returns in either subperiod, and 2) deleting the seven industries which have a negative coefficient on stock returns and/or earnings in either subperiod (a similar approach is used in Lambert and Larcker (1987)). The t-statistics are -2.06 and -2.05, respectively, consistent with a significant average decline in the weight placed on earnings relative to the weight placed on stock returns.
substitution away from earnings toward other public, value-relevant information unrelated to current earnings. We calculate the incremental adjusted R² of adding stock returns (earnings) to a regression of compensation on earnings (returns) alone for each subperiod. The final two columns of Table 4 report the change from the first to the second subperiod in the incremental R² of earnings over and above stock returns (\(\Delta \text{Incr.} R^2_{\Delta \text{EARN}}\)) and the incremental R² of stock returns over and above earnings (\(\Delta \text{Incr.} R^2_{\text{RET}}\)). The t-statistics indicate that the average change from the first to the second subperiod in the incremental R² of earnings over and above stock returns is negative, but not significant (t-statistic=-1.33). In contrast, the change in the incremental R² of stock returns over and above earnings is significantly greater than zero (t-statistic=2.45).

Collectively, the results in Table 4 provide consistent evidence of an average decline in the importance of earnings in determining the cash compensation of CEOs relative to other public, value-relevant information proxied by stock returns over the period 1971-1995. This evidence includes a significant average increase in the coefficient on stock returns (\(\text{CRRC}\)) in compensation models which include both stock returns and earnings, a significant decline in the ratio of the coefficient on earnings to the coefficient on stock returns (\(\text{CERC}/\text{CRRC}\)), and a significant increase in the incremental R² of stock returns over and above earnings (\(\Delta \text{Incr.} R^2_{\text{RET}}\)) without a corresponding increase in the incremental R² of earnings over and above stock returns (\(\Delta \text{Incr.} R^2_{\Delta \text{EARN}}\)).

4.3.3 Changes in the importance of earnings relative to other accounting-based measures

We next investigate whether there has been a shift in the sensitivity of cash compensation from accounting earnings toward accounting performance measures that incorporate balance sheet information. This analysis explores a subgroup of information captured by stock returns and is motivated by recent studies examining trends in the value-relevance and in information content of accounting information with respect to stock prices. Collins, Maydew and Weiss (1997) report a declining weight on earnings and a increase in the weight placed on book values of equity in
regressions of stock prices on both earnings and book values. Lev and Zarowin (1999) discuss the existing mixed evidence concerning the value-relevance of earnings and book values over time. Recent empirical and anecdotal evidence suggests that firms use both earnings and other accounting-based measures in compensation contracts. Our analysis provides a test for whether the decline in the relative pay-earnings sensitivity documented above is related to a shift toward other accounting measures capturing balance sheet information or rather information beyond the balance sheet, including nonfinancial measures.

We replicate the analyses in section 4.3.2 of the relative importance of pay-earnings sensitivity after including in equation (9) a measure that specifically incorporates balance sheet information. We separately consider three balance sheet-based measures: return on assets, calculated as earnings before extraordinary items and discontinued items divided by average total assets, the book value of common equity, and residual income. We compute the coefficients on the new performance measures, including the coefficient capturing average industry changes in the weight on the measures in a manner analogous to those of CERC and CRRC described in section 4.3.2. In the tests incorporating the balance sheet information, we are interested in examining whether there is significant weight placed on other accounting measures incremental to that placed on earnings to allow an assessment of whether other accounting-based performance measures are correlated omitted variables and affect the interpretation of our earlier findings regarding changes in CERCs and CRRCs. We also are interested in whether the inclusion of an additional accounting measure in the compensation model impacts the results of our analysis of trends in the weight on earnings relative to other information. If the decline over the sample period in the relative weight

39 Examples include Krolick (1997) which discusses the prevalence of the use of rate of return measures (e.g., ROE and ROA) either alone or along with earnings in compensation contracts and Stern, Stewart and Chew (1995) which discusses the value of using residual income-based measures in performance evaluation.

40 The model uses average industry changes in each performance measure between the subperiods. The changes in book value of equity and residual income are deflated by beginning of period market value of equity. Residual income is calculated as net operating profit (after tax) less a capital charge (i.e., the weighted average cost of capital multiplied by beginning of period total invested capital).
placed on earnings to that placed on information in stock returns is primarily due to information in an alternative accounting measure, the negative trend in $\Delta CERC/CRRC$ over the sample period will disappear when $CRRC$ is computed from the expanded model.

The results of these analyses (not tabulated) suggest that the inclusion of other summary accounting performance measures incorporating the balance sheet in our compensation model does not affect the interpretation of our results of changes in $CERC$s and relative $CERC$s: the average $CERC$ is significantly greater than zero in each subperiod, there is no significant shift in $CERC$ across the two subperiods, the shift in $CRRC$s remains positive and significant and there is a significant negative shift in $CERC/CRRC$. Thus, inclusion of other accounting performance measures in our model incorporating other available information suggests that the observed decline in relative pay-earnings sensitivity and increase in $CRRC$ above are not likely attributed to a shift away from earnings toward accounting measures summarizing balance sheet information (including ROA, book value of equity and residual income). The decline is more likely due to non-financial information reflected in stock returns. This is in contrast to the results in the existing valuation studies which document a decline in $ERC$s while the information content of other accounting information (i.e., book values) is increasing over time.

5. Sensitivity analyses

5.1 Estimates of $CERC$s and $ERC$s from firm-specific models

Our primary analyses in section 4 involve by-industry estimations of $ERC$s and $CERC$s. Some prior studies of the relation between compensation and performance have adopted a firm-specific research design (e.g., Lambert and Larcker (1987)). While a firm-specific design may provide a better control for inter-firm differences in production functions and risk aversion of executives, two potential disadvantages of a firm-specific design arise in the current study due to the length of the sample period: survivorship bias and the relatively small number of degrees of freedom in the time-series for each firm. In this section we probe the association between $ERC$s
and CERCs estimated from firm-specific regression analysis to test the sensitivity of our primary results in sections 4.1 and 4.2 to the empirical specification. We conduct firm-specific estimations for the 153 firms that have at least 10 observations in each of the sample subperiods with which to estimate firm-specific ERCs (CERCs). We compute CERCs and ERCs based on estimates from firm-specific regressions over the sample period. The Pearson (Spearman) correlations of ERCs and CERCs across firms is 0.46 (0.35) (p-values less than 0.001) which is consistent with our inferences in section 4. The significant positive association between CERCs and ERCs continues to hold in the multivariate regression of the determinants of CERCs after controlling for proxies for firm-specific growth opportunities, performance measure noise and earnings persistence. Although the number of degrees of freedom in each period is small, we also compute firm-specific estimates of changes in CERCs and ERCs using a model in which slopes in each subperiod are allowed to differ similar to that of equations (8) and (9). The Pearson and Spearman correlations of changes in CERCs and ERCs across the subperiods are not significant. Overall, the results of the firm-specific analyses provide mixed evidence of an association between CERCs and ERCs, with positive association between overall levels of CERCs and ERCs and insignificant association between changes in CERCs and ERCs over the sample period.

5.2 Estimates of annual ERCs and absolute and relative CERCs from a pooled model

Prior valuation work that analyzes trends in ERCs and the value relevance of earnings produces annual estimates of ERCs from yearly cross-sectional models. We supplement our analyses of inter-temporal industry shifts in CERCs and ERCs in section 4.3 with a research design that more closely parallels that of prior studies of trends in annual estimates of ERCs. Unlike prior studies, however, rather than estimate annual cross-sectional regressions, our design is a single pooled model over the sample period allowing regression intercepts and slope coefficients on performance measures to vary by year and industry. Allowing for separate intercepts and slopes for each industry addresses the important role that additional factors can play in determining CERCs.
The pooled specification supplements the by-industry analyses in that the design explicitly controls for the effect of industry based factors, including any differences in the industry mix of sample firms over time, in the estimation of annual CERCs and ERCs. The variation in the estimates of CERC_t and ERC_t, therefore, captures the effect of economy-wide factors.

We estimate both yearly ERCs and CERCs from models that allow for the intercept and slope on earnings to vary by year and industry. Our estimate of the sensitivity of stock returns to earnings for any given year, ERC_t, is then computed from the results of the pooled estimation by summing the coefficients on the relevant earnings terms. ERC_t thus represents the estimated coefficient for year t averaged across industries where the average industry component is constant across years. We estimate the yearly sensitivities of compensation to earnings (CERCs) in an analogous fashion to that of yearly ERCs.

We use the estimates of annual CERCs and ERCs to test the extent of positive correlation between pay-earnings and price-earnings sensitivities. The Pearson (Spearman) correlation between the time series of annual CERCs and ERCs is .38 (.45) which is significant at less than the 5% (1%) level. The significant positive correlation between CERCs and ERCs is consistent with the results of the correlation analysis across industries in section 4.1.

We examine whether there is a general trend in the sensitivity of CEO compensation and stock returns to earnings over the years 1971-1995 by conducting regressions of the estimated annual CERC and ERC against a time index, t, where t = 1 to 25 corresponding to the year 1971-

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41 Existing valuation studies generally estimate a pooled regression that assumes a constant slope on earnings for all industries. We conduct a test of the appropriateness of restricting the earnings coefficient to be the same for all industries. F-tests of the null hypothesis of common coefficients across industries reject the null hypotheses in both the valuation (F-stat= 11.07) and stewardship (F-stat=10.56) settings with p-values of both less than 0.0001 suggesting that allowing the earnings slope to vary by industry is an appropriate specification. An alternative approach more consistent with the annual regressions in the existing studies that would also consider industry effects would be to conduct annual estimations with varying coefficients on ΔEARN for each major industry. Numerous industries, however, have a limited number of firms in any particular year resulting in less efficient estimations using the alternative approach.

42 For example, ERC for year 1995 is equal to the sum of the coefficients on ΔEARN and ΔEARN*1995 dummy variable and the average incremental industry-specific slope on the earnings measure compiled from the coefficients on (ΔEARN*Industry dummy variable) for each industry.
The results (not tabulated) indicate that the coefficient on the time trend, $t$, in the ERC model is significantly negative ($t$-statistic=$-3.59$), suggesting a significant downward trend in ERCs, consistent with the results of prior studies. The estimated trend in the CERC, is also negative, but is not significant at conventional levels ($t$-statistic = $-1.18$).

We also use the annual estimation framework to conduct supplemental tests for a change over time in the relative importance of earnings and other public, value-relevant information in determining CEO pay. We obtain estimates of annual compensation returns response coefficient ($CRRC_t$) and $CERC_t/CRRC_t$ from the pooled compensation model discussed above. The results of estimation of $CRRC$s and $CERC/CRRC$ against the time index, $t$, suggest that the sensitivity of CEO compensation to the portion of value-relevant information that is not captured in earnings (i.e., CRRC) has significantly increased over the period 1971-1995 ($t$-statistic=$5.22$). Consistent with the finding of an insignificant change in the sensitivity of compensation to earnings and a significant increase in the sensitivity of compensation to returns, the ratio $CERC / CRRC$ has decreased significantly over time ($t$-statistic=$-4.09$).

Overall, the results of the alternative pooled specification to estimate valuation and compensation-earnings sensitivities are consistent with those of the industry estimations in section 4. The results suggest a positive correlation between changes in CERCs and ERCs (across industries and over time). ERCs display a significant decline over the sample period while the trend in CERCs, although negative, is not significant. Evidence of a significant increase in CRRCs and a decrease in $CERC/CRRC$ over the sample period suggest that the relative importance of earnings to other public, value relevant information in determining annual executive cash compensation has declined over the sample period.

### 6. Summary and Conclusions

We analytically and empirically investigate the association between compensation-earnings sensitivities (CERCs) and valuation-earnings sensitivities (ERCs). We conjecture that a key driver
of the link is the marginal product of current period manager actions. We present two theoretical formulations that show a positive association between the weights on earnings in valuation and in determining compensation. The results of our models contrast with those of the standard LEN framework which generally finds that the valuation weight on earnings is not linked with the marginal product of effort. The link deriving from marginal product of effort is driven by the multiperiod nature of managerial effort in our first formulation while the link in our second setting is due to the stochastic nature of marginal product of effort.

We conduct empirical analyses of the association between CERCs and ERCs by examining cross-sectional correlations of industry-based changes in CERCs and ERCs from the first half to the second half of the 1971-1995 sample period. We document a strong positive associate between average industry changes in CERCs and ERCs across the two subperiods before and after controlling for other agency theory-based determinants of CERCs. We also find that earnings persistence is positively associated with CERCs and that ERCs have incremental explanatory power over and above earnings persistence, suggesting that factors impacting ERCs other than persistence also impact CERCs. The model of the determinants of CERCs explains approximately one-half of the cross-sectional variance of the changes in CERCs.

Our analyses add to the small body of evidence in support of agency theory’s predictions concerning pay-performance sensitivities. In addition, our theoretical and empirical analyses extend existing research by introducing a direct link between pay-earnings and price-earnings sensitivities as a means of connecting the literature addressing the stewardship and valuation roles of reported earnings. In doing so, we find that along with its previously documented association with price-earnings sensitivities, earnings persistence appears to display significant association with pay-earnings sensitivities.

We also conduct an empirical investigation of whether the compensation weight placed on earnings has changed over time. This issue is motivated by recent research which documents a significant decline in the weight placed on earnings in the valuation of equity securities and our
interest in the relation between the role of earnings in the valuation versus stewardship settings. Our analyses suggest that, in contrast to recent evidence of declines in price-earnings sensitivities, CERCs display no trend over the sample period. The sensitivity of earnings relative to other performance information reflected in stock returns, however, displays a significant negative trend over time. This suggests that over the 25-year sample period examined, earnings have become a smaller portion of the total performance information used to determine the cash compensation of CEOs in large public corporations.

We suspect that our evidence of trends in CERCs understates the increasing role of non-earnings information in determining executive pay for two reasons. First, the use of stock-priced based long-term incentives (e.g. stock options) has increased considerably in recent years. Our focus on cash compensation does not incorporate the effect of these equity-based incentives on the relative importance of earnings versus stock returns. Second, our proxy for other performance information, stock returns, fails to capture proprietary information used by boards to determine cash compensation. Given increased attention to the development of forward-looking measures of strategic performance in recent years, and the infrequency with which such measures are publicly disclosed (and hence, likely to be captured in our measure of other performance information), we suspect that our proxy for other performance information is less complete in recent years.

We think that future theoretical and empirical research into the link between the valuation and stewardship roles of earnings and other measures of performance has the potential to contribute in an important way to our understanding of the informational role of accounting. New proxy statement disclosures in compensation committee reports of the performance measures used in compensating executives provide an opportunity to empirically explore this link in a way not previously possible on the basis of publicly available data.
APPENDIX

Derivation of firm value in equation (4)

The linear dynamic (3) implies that

\[ E_t[EARN^a_{t+1}] = \omega EARN^a_t + a\hat{e}_{t+1}, \]  

and by recursive substitution we get

\[ E_t[EARN^a_{t+k}] = \omega^k EARN^a_t + \sum_{j=1}^{k-1} \omega^j a\hat{e}_{t+k-j} + a\hat{e}_{t+k}. \]  

Substituting (A1) into \( \sum_{k=1}^{\infty} \omega R^{-k} E_t[EARN^a_{t+k}] \), we get

\[ \sum_{k=1}^{\infty} R^{-k} \omega^k EARN^a_t + \sum_{k=1}^{\infty} R^{-k} (1 + \sum_{k=1}^{\infty} R^{-k} \omega^k) a\hat{e}_{t+k}. \]  

Using the properties of geometric series,

\[ \sum_{k=1}^{\infty} R^{-k} \omega^k = \frac{\omega}{R - \omega}, \]  

as long as \( R > \omega \). Substituting (A3) into (A2) gives the result.
References


### Table 1
Industry membership of sample firms over the period 1971-1995

<table>
<thead>
<tr>
<th>2-digit SIC code</th>
<th>Short Name</th>
<th>Description of industry code</th>
<th>#firm-years in period 1 (1971-83)</th>
<th>#firm-years in period 2 (1984-95)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Food</td>
<td>Food and kindred products</td>
<td>366</td>
<td>242</td>
</tr>
<tr>
<td>26</td>
<td>Paper</td>
<td>Paper and allied products</td>
<td>199</td>
<td>204</td>
</tr>
<tr>
<td>28</td>
<td>Chemical</td>
<td>Chemicals and allied products</td>
<td>570</td>
<td>451</td>
</tr>
<tr>
<td>29</td>
<td>Petroleum</td>
<td>Petroleum refining and related industries</td>
<td>258</td>
<td>184</td>
</tr>
<tr>
<td>30</td>
<td>Rubber</td>
<td>Rubber and miscellaneous plastic products</td>
<td>73</td>
<td>65</td>
</tr>
<tr>
<td>33</td>
<td>Metal</td>
<td>Primary metal industries</td>
<td>127</td>
<td>92</td>
</tr>
<tr>
<td>34</td>
<td>Heavy Equip.</td>
<td>Fabricated metal, ex machinery, transportation equipment</td>
<td>116</td>
<td>76</td>
</tr>
<tr>
<td>35</td>
<td>Computer</td>
<td>Industrial, commercial machinery, computers</td>
<td>333</td>
<td>295</td>
</tr>
<tr>
<td>36</td>
<td>Elec. Equip.</td>
<td>Electric, other electrical equipment,</td>
<td>261</td>
<td>193</td>
</tr>
<tr>
<td>37</td>
<td>Trans. Equip.</td>
<td>Transportation equipment</td>
<td>302</td>
<td>245</td>
</tr>
<tr>
<td>38</td>
<td>Instruments</td>
<td>Measurement instruments, photo goods, watches</td>
<td>160</td>
<td>165</td>
</tr>
<tr>
<td>45</td>
<td>Airlines</td>
<td>Transportation by air</td>
<td>80</td>
<td>69</td>
</tr>
<tr>
<td>48</td>
<td>Telecom.</td>
<td>Communications</td>
<td>118</td>
<td>166</td>
</tr>
<tr>
<td>49</td>
<td>Utilities</td>
<td>Electric, gas, sanitary services</td>
<td>727</td>
<td>679</td>
</tr>
<tr>
<td>51</td>
<td>Nondur.</td>
<td>Nondurable goods, wholesale</td>
<td>146</td>
<td>122</td>
</tr>
<tr>
<td>53</td>
<td>Merch.</td>
<td>General merchandise stores</td>
<td>114</td>
<td>107</td>
</tr>
<tr>
<td>59</td>
<td>Retail</td>
<td>Miscellaneous retail stores</td>
<td>61</td>
<td>70</td>
</tr>
<tr>
<td>60</td>
<td>Com. Bank</td>
<td>Depository institutions</td>
<td>958</td>
<td>1,200</td>
</tr>
<tr>
<td>61</td>
<td>Other Bank</td>
<td>Nondepository institution</td>
<td>64</td>
<td>63</td>
</tr>
<tr>
<td>63</td>
<td>Insurance</td>
<td>Insurance carriers</td>
<td>205</td>
<td>344</td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td></td>
<td>5,238</td>
<td>4,957</td>
</tr>
</tbody>
</table>
Table 2
Descriptive statistics for change in industry values of regression independent variables
from the first subperiod (1971-83) to the second subperiod (1984-95)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev.</th>
<th>25%</th>
<th>75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔERC</td>
<td>-0.364</td>
<td>-0.190</td>
<td>2.033</td>
<td>-0.792</td>
<td>0.322</td>
</tr>
<tr>
<td>ΔGRO_OP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔMTB</td>
<td>0.808  **</td>
<td>0.628  **</td>
<td>0.484</td>
<td>0.471</td>
<td>1.010</td>
</tr>
<tr>
<td>ΔSALES_GROW</td>
<td>-1.473 **</td>
<td>-1.313 **</td>
<td>1.366</td>
<td>-2.016</td>
<td>-0.665</td>
</tr>
<tr>
<td>ΔPERSIST</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔPERS_TS1</td>
<td>-0.038 *</td>
<td>-0.053 *</td>
<td>0.085</td>
<td>-0.100</td>
<td>0.037</td>
</tr>
<tr>
<td>ΔPERS_TS2</td>
<td>-0.177 **</td>
<td>-0.186 **</td>
<td>0.249</td>
<td>-0.349</td>
<td>-0.016</td>
</tr>
<tr>
<td>ΔLW_SW</td>
<td>0.081</td>
<td>0.029</td>
<td>0.657</td>
<td>-0.201</td>
<td>0.254</td>
</tr>
<tr>
<td>ΔNOISE_EARN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>σ^2EARN</td>
<td>-0.001</td>
<td>0.000  *</td>
<td>0.022</td>
<td>-0.001</td>
<td>0.003</td>
</tr>
<tr>
<td>σ^2SYS_EARN</td>
<td>0.001</td>
<td>0.000  *</td>
<td>0.004</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>σ^2ABS_ONETIME</td>
<td>0.368  **</td>
<td>0.054  **</td>
<td>0.721</td>
<td>0.023</td>
<td>0.320</td>
</tr>
<tr>
<td>ΔNOISE_RET</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>σ^2RET</td>
<td>-0.029</td>
<td>-0.019  *</td>
<td>0.074</td>
<td>-0.045</td>
<td>-0.001</td>
</tr>
<tr>
<td>σ^2SYS_RET</td>
<td>-0.014  **</td>
<td>-0.013  **</td>
<td>0.022</td>
<td>-0.023</td>
<td>-0.001</td>
</tr>
</tbody>
</table>

**,* Paired t-test (Mean) or Wilcoxon Sign Rank test (Median) that the change is equal to zero is rejected at the 1 and 5% probability levels, respectively.

ΔERC = The change in the earnings response coefficient from period 1 to period 2 for industry j (i.e., γ̂; from equation (8));
ΔMTB = The change in the median market-to-book ratio from period 1 to period 2 for industry j;
ΔSALES_GROW = The change in median sales growth from period 1 to period 2 for industry j;
ΔPERS_TS1 = The change in the median persistence in earnings estimated from an ARIMA (2,1,0) model from period 1 to period 2 for industry j;
ΔPERS_TS2 = The change in the median persistence in earnings estimated from an IMA(1,1,0) model from period 1 to period 2 for industry j;
ΔLW_SW = The change in the difference between the long-window (3 years) and short window (1 year) earnings response coefficient from period 1 to period 2 for industry j;
σ^2EARN = The change in the median variance of earnings changes from period 1 to period 2 for industry j;
σ^2SYS_EARN = The change in the median variance of the systematic component of earnings changes from period 1 to period 2 for industry j;
σ^2ABS_ONETIME = The change in the median of the ratio of one time items to core earnings from period 1 to period 2 for industry j;
σ^2RET = The change in the median variance of total stock market returns from period 1 to period 2 for industry j;
σ^2SYS_RET = The change in the median variance of the systematic component of total stock market returns from period 1 to period 2 for industry j;
Table 3
Cross-sectional regression results for determinants of the changes in compensation earnings response coefficients ($\Delta CERC$) from subperiod 1 (1971-83) to subperiod 2 (1984-95).

$$\Delta CERC_j = \beta_0 + \beta_1 \Delta ERC_j + \beta_2 \Delta GRO_{OP} + \beta_3 \Delta NOISE_{EARN} + \beta_4 \Delta NOISE_{RET} + \beta_5 \Delta REG_j + \nu_j$$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pred.</th>
<th>$\Delta CERC$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INTERCEPT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.09</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>(0.41)</td>
<td>(0.56)</td>
</tr>
<tr>
<td>$\Delta ERC$</td>
<td>(+)</td>
<td>0.32**</td>
</tr>
<tr>
<td></td>
<td>(2.89)</td>
<td></td>
</tr>
<tr>
<td>$\Delta PERSIST$</td>
<td>(+)</td>
<td>- 0.40*</td>
</tr>
<tr>
<td></td>
<td>(2.17)</td>
<td>(2.20)</td>
</tr>
<tr>
<td>$\Delta GRO_{OP}$</td>
<td>(-)</td>
<td>-0.32*</td>
</tr>
<tr>
<td></td>
<td>(-1.74)</td>
<td>(-2.71)</td>
</tr>
<tr>
<td>$\Delta NOISE_{EARN}$</td>
<td>(-)</td>
<td>-0.27</td>
</tr>
<tr>
<td></td>
<td>(-1.38)</td>
<td>(-2.41)</td>
</tr>
<tr>
<td>$\Delta NOISE_{RET}$</td>
<td>(+)</td>
<td>0.50**</td>
</tr>
<tr>
<td></td>
<td>(2.65)</td>
<td>(3.43)</td>
</tr>
<tr>
<td>$\Delta REG$</td>
<td>(+)</td>
<td>-0.59</td>
</tr>
<tr>
<td></td>
<td>(-0.98)</td>
<td>(-2.31)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td></td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>0.40</td>
<td>0.61</td>
</tr>
<tr>
<td>N</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

*,** Significant at the 5% and 1% levels, respectively for a one-tailed test where sign is predicted, two-tailed test otherwise.

$\Delta CERC$ = The estimated change in the compensation earnings response coefficient for industry $j$ from equation (9) (i.e., $\hat{\delta}_2$)

**Explanatory variables:**
$\Delta$ denotes the change in the dependent variable from subperiod 1 to subperiod 2 for industry $j$;
$\Delta ERC$ = Estimated change in the earnings response coefficient from subperiod 1 to subperiod 2 for industry $j$ from equation (8) (i.e., $\hat{\gamma}$);
$\Delta PERSIST$ = Principal component for persistence construct formed from $\Delta PERS_{TS1}$, $\Delta PERS_{TS2}$ and $\Delta LW_{SW}$ (see Table 2);
$\Delta GRO_{OP}$ = Principal component for growth opportunities not reflected in current earnings formed from $\Delta MTB$ and $\Delta SALES_{GROW}$ (see Table 2);
$\Delta NOISE_{EARN}$ = Principal component for noise in earnings construct formed from $\sigma^2 EARN$, $\sigma^2 SYS_{EARN}$ and $\sigma^2 ABS_{ONE}$ (see Table 2);
$\Delta NOISE_{RET}$ = Principal component for noise in other performance information construct formed from $\sigma^2 RET$ and $\sigma^2 SYS_{RET}$ (see Table 2);
$\Delta REG$ = 1 if 2-digit SIC code is 45, 48, 49, or 60 - industries which underwent a major deregulation from subperiod 1 to subperiod 2;
Table 4  
Tests of the changing sensitivity of returns to earnings and cash compensation to earnings, returns and earnings relative to other performance information over the period 1971-95

\[
XRET_{i,t} = \sum_{t=1}^{65} \gamma_{0,t} + \gamma_1 \Delta EARN_{i,t} + \gamma_2 \Delta EARN^2_{i,t} + \epsilon_{i,t} 
\]  \hspace{1cm} (8)

\[
COMP_{i,t} = \sum_{t=1}^{65} \delta_{0,t} + \delta_1 \Delta EARN_{i,t} + \delta_2 \Delta EARN^2_{i,t} + \delta_3 RET_{i,t} + \delta_4 RET^2_{i,t} + \epsilon_{i,t} 
\]  \hspace{1cm} (9)

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Market-adjusted Returns (XRET)</th>
<th>% Change in Compensation (COMP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( ERC1 ) ( \Delta ERC )</td>
<td>( CERC1 ) ( \Delta CERC )</td>
</tr>
<tr>
<td>Mean</td>
<td>1.52  -0.39  0.41</td>
<td>0.95  -0.15  0.06  0.11  -35.11  -0.03  0.03  0.16</td>
</tr>
<tr>
<td>Median</td>
<td>1.14  -0.28  0.43</td>
<td>0.47  -0.07  0.07  0.11  -3.40   0.01  0.01  0.15</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>1.73  2.00   0.15</td>
<td>1.05  1.28   0.08  0.11  69.25   0.09  0.05  0.08</td>
</tr>
<tr>
<td>Z-stat (p-value)</td>
<td>7.04  (0.001) (0.024)</td>
<td>5.57  (0.001) (0.001) (0.001) 5.45  (0.035) (0.18) (0.01)</td>
</tr>
<tr>
<td># positive (p-value – binomial test)</td>
<td>19  (0.00) (0.07)</td>
<td>20  (0.00) (0.16) (0.01) 16  (0.00) (0.07) 7  (0.01) (0.16) (0.02)</td>
</tr>
</tbody>
</table>

See next page for description of variables.
Table 4 (cont’d)
Tests of the changing sensitivity of returns to earnings and cash compensation to earnings, returns and earnings relative to other performance information over the period 1971-95

<table>
<thead>
<tr>
<th>Description of variables:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>XRET</strong>, = the cumulative, market adjusted return for firm <em>i</em> over the 12 month period of the firm's fiscal year.</td>
</tr>
<tr>
<td><strong>COMP</strong>, = the percentage change in annual cash compensation for firm <em>i</em> between year <em>t</em> and year <em>t-1</em>.</td>
</tr>
<tr>
<td><strong>EARN</strong>, = the change in earnings before extraordinary items for firm <em>i</em> between year <em>t</em> and year <em>t-1</em>, deflated by the market value of equity at the beginning of year <em>t</em>.</td>
</tr>
<tr>
<td><strong>EARN2</strong>, = <strong>EARN</strong>, if year ≥ 1984, and = 0 otherwise.</td>
</tr>
<tr>
<td><strong>ERC</strong>, = estimate of ERC for the first subperiod computed as the coefficient on <strong>EARN</strong>, from the estimation of equation (8) (i.e., <em>γ</em>).</td>
</tr>
<tr>
<td><strong>CERC</strong>, = estimate of CERC for the first subperiod determined by the coefficient on <strong>EARN</strong>, from the estimation of equation (9) (i.e., <em>δ</em>).</td>
</tr>
<tr>
<td><strong>∆ERC</strong>, = estimate of the change in CERC between the two subperiods determined by the coefficient on <strong>EARN2</strong>, from the estimation of equation (8) (i.e., <em>γ</em>).</td>
</tr>
<tr>
<td><strong>CERC2</strong>, = estimate of CERC for the second subperiod determined by the coefficient on <strong>EARN2</strong>, from the estimation of equation (9) (i.e., <em>δ</em>).</td>
</tr>
<tr>
<td><strong>∆CERC</strong>, = estimate of the change in CERC between the two subperiods determined by the coefficient on <strong>EARN2</strong>, from the estimation of equation (9) (i.e., <em>δ</em>).</td>
</tr>
<tr>
<td><strong>CRRC</strong>, = estimate of CRRC for the first subperiod determined by the coefficient on <strong>RET</strong>, from the estimation of equation (9) (i.e., <em>δ</em>).</td>
</tr>
<tr>
<td><strong>∆CRRC</strong>, = estimate of the change in CRRC between the two subperiods determined by the coefficient on <strong>RET2</strong>, from the estimation of equation (9) (i.e., <em>δ</em>).</td>
</tr>
<tr>
<td><strong>∆CERC/CRRC</strong>, = <strong>CERC/CRRC</strong>, estimated from equation (9) as <strong>CERC/CRRC</strong>, (i.e., <em>δ</em>).</td>
</tr>
<tr>
<td><strong>∆Incr.R² RET</strong>, = the change over the two subperiods in the adjusted R² due to adding returns to the compensation regression of earnings alone (Incr.R² RET for subperiod 2 less Incr.R² RET for subperiod 1), where Incr.R² RET is the adjusted R² from the estimation of compensation on both earnings and returns for each subperiod less the adjusted R² of a regression of compensation on earnings alone in the subperiod for each industry.</td>
</tr>
<tr>
<td><strong>∆Incr.R² EARN</strong>, = the change over the two subperiods in the adjusted R² due to adding earnings to the compensation regression of returns alone (Incr.R² EARN for subperiod 2 less Incr.R² EARN for subperiod 1 where Incr.R² EARN is the adjusted R² from the estimation of compensation on both earnings and returns for each subperiod less the adjusted R² of a regression of compensation on returns alone in the subperiod for each industry.</td>
</tr>
<tr>
<td><strong>Z-stat</strong>, = test of whether the average coefficient from the 20 industry regressions is different from zero, adjusting for cross-sectional dependency between the 20 observations, calculated as:</td>
</tr>
<tr>
<td><strong>t-stat</strong>, = test of whether <strong>∆CERC/CRRC</strong>, <strong>∆Incr. R2 EARN</strong> or <strong>∆Incr. R2 RET</strong> for the 20 industry regressions is different from zero.</td>
</tr>
</tbody>
</table>

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