

Examining Shareholder Value Creation over CEO Tenure: A New Approach to Testing Effectiveness of Executive Compensation

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ABSTRACT: This paper examines the relationship between CEO compensation and shareholder value added over CEO tenure. The research design exploits two fundamental attributes of CEO compensation and shareholder value added: (1) both CEO compensation and shareholder value added aggregate naturally over CEO tenure, and (2) extending the time interval over which the two variables are measured is likely to result in a better match between CEO compensation and shareholder value created by the CEO. I measure CEO compensation with nominal value of CEO pay, *ex post* realized pay, and *ex ante* pay-for-performance sensitivity. I find that CEOs receiving higher nominal or realized pay create more shareholder value. Further, higher median pay-for-performance sensitivity during CEO tenure is associated with higher aggregate market value changes and cumulative abnormal stock returns. Finally, CEO pay efficiency (calculated as the ratio of shareholder value added to CEO pay, both aggregated over CEO tenure) is higher if median pay-for-performance sensitivity during CEO tenure is higher.

Keywords: executive compensation; pay-for-performance sensitivity; corporate governance; value-based management.

Data Availability: The data are available from public sources identified in this study.

INTRODUCTION

For more than two decades, academics, policymakers, and the media have debated over the high levels of executive compensation, questioning whether they are consistent with shareholder interests (e.g., [Jensen and Murphy 1990](#); [Hall and Liebman 1998](#); [Bebchuk and Fried 2004](#)). Prior studies have not reported consistent results about performance outcome of executive compensation, but instead have raised concerns regarding the ability of executive

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compensation to adequately align the interests of top executives and shareholders (for reviews, see [Murphy 1999](#); [Core et al. 2003](#); [Jensen et al. 2004](#); [Devers et al. 2007](#)). During the current financial crisis, we have witnessed an unprecedented level of interest in executive compensation. Politicians and the media have argued that current executive compensation practices motivate executives to maximize short-term profits at the expense of long-term benefit. Consequently, the federal government and Congress are implementing more regulations to constrain executive compensation ([Bebchuk 2009](#); [Murphy 2010](#)). However, if we do not have a definitive answer to the question of whether executive compensation has the desired effect on shareholders' wealth, then any regulation constraining executive compensation will distort and weaken executives' incentives to deliver long-term results. Carefully designed research will inform and guide policymakers in drafting any potential regulation on executive compensation. In this paper, I examine the relationship between CEO compensation and shareholder value added over CEO tenure.

No prior studies have examined the association between CEO compensation and shareholder value added over CEO tenure. There are four advantages of conducting executive compensation research over the long time frame of CEO tenure. First, by using CEO tenure as the window for observing CEO compensation and performance, we mitigate the horizon problem in executive compensation research. Managers usually have shorter time horizons than shareholders ([Narayanan 1985](#)) and, therefore, the bonus plan in executive compensation contracts motivates them to behave myopically and sacrifice shareholder value ([Dechow and Sloan 1994](#)). For example, [Graham et al. \(2005\)](#) report that a majority of managers would forgo a project with positive net present value (NPV) if the project would cause them to fall short of the current quarter consensus forecast. The labor market for executives also encourages them to invest in projects with quick payback. Managers perceived as having higher ability receive higher compensation ([Murphy and Zabojnik 2007](#)). Thus, managers prefer to invest in short-term projects that produce higher short-term returns in order to generate a perception of greater ability. By acting myopically at the beginning of their tenure, managers can obtain high compensation at the current company, as well as earn a good reputation that will increase their market value. In the long run, however, stock price will drop due to sacrificed long-run profit for short-run profit, and CEO wealth will be negatively affected when the CEO holds a large number of stocks or stock options. It is, therefore, important to examine CEO pay and shareholder value over the long run. [Devers et al. \(2007, 1041\)](#) acknowledge this problem with the conclusion that "time may exhibit a confounding influence on research findings."

The second advantage of examining CEO pay and shareholder value over the long run is the mitigation of the *ex post* settling-up problem. The *ex post* settling-up problem arises when managers are compensated for expected future cash flows that do not result in materialization in the future ([Leone et al. 2006](#)). For example, if the CEO receives a bonus for signing a value-increasing long-term contract, but the contract is later canceled, stockholders cannot recoup the bonus paid for the unrealized cash flows. However, the CEO's wealth in the form of equity holding will shrink after the contract is cancelled. A much less severe *ex post* settling-up problem for the shareholders occurs when CEOs are paid in equity compensation forms ([Leone et al. 2006](#)). Because the long time horizon allows us to examine cash compensation, equity compensation, and shareholder value, we get a complete picture of CEO pay and shareholder value creation.

The third advantage of the long time horizon is that it reduces measurement errors in both the CEO compensation and shareholder value variables. Take stock options as an example. Realized gains from exercising stock options in a particular year are usually from a CEO's stock options accumulated over time, sometimes over the CEO's tenure. If we count the gains as a single year's compensation, it distorts the relation between CEO compensation and shareholder value. Instead, if we aggregate all realized gains over a CEO's tenure and compare the gains with performance during the same period, we present a fair picture of the pay-performance link. Furthermore, short-term stock return can be high or low due to a variety of factors, such as business cycle,

discount rates, and investor sentiment. However, over the long term, these factors tend to even out. [Easton et al. \(1992\)](#) show that aggregation over multiple years effectively reduces measurement errors for such variables as earnings and stock returns.

Finally, aggregation of CEO compensation and shareholder value added over CEO tenure creates a one-to-one correspondence between CEO compensation and CEO performance. Prior studies examining the association of this year's CEO compensation with future years' stock returns fail to consider the factor that this year's CEO may not be the CEO of future years when we examine performance consequences. Given that the annual CEO turnover rate is about 15 percent ([Murphy 1999](#)), it is important that we associate compensation paid to a CEO with shareholder value created by the same CEO.

I use three variables to capture the attributes of CEO compensation contracts: nominal value of annual pay, *ex post* realized pay, and *ex ante* incentives. Nominal value of annual pay includes salaries, bonuses, long-term incentive plan payouts, restricted stock grants, and Black-Scholes value of stock option grants. The *ex post* realized pay includes salaries, bonuses, long-term incentive plan payouts, restricted stock grants, and realized gains from exercising stock options. In addition to these values, the aggregate *ex post* realized pay over CEO tenure considers Black-Scholes value of unexercised in-the-money stock options upon exit to reflect any future gain from unexercised stock options realizable by the departing CEO. The different valuation methods of stock options account for the difference between nominal and realized pay. The nominal value includes the grant date value, while the realized value includes the actual gains from exercised stock options and the value of unexercised stock options at the end of CEO tenure. Prior studies have used the nominal value to capture CEO compensation values, with two exceptions ([Kaplan 2008](#); [Kaplan and Rauh 2010](#)). I believe that the realized value is relevant for this study because it focuses on *ex post* evaluation of CEO compensation.

I also examine the association between *ex ante* incentives and shareholder value added. Following [Core and Guay \(1999, 2002\)](#), I measure the *ex ante* incentives using pay-for-performance sensitivity arising from the CEO's portfolio of stocks and stock options at the beginning of each year of CEO tenure. [Core and Guay \(1999, 2002\)](#) define this pay-for-performance sensitivity as the change in the value of the CEO's stock and option portfolio from a 1 percent increase in the firm's stock price. I use the median pay-for-performance sensitivity over CEO tenure for data analysis.

I measure the shareholder value added with two variables: (1) dividend-adjusted market value changes, and (2) market-adjusted abnormal stock returns. Both variables are aggregated over the length of the CEO tenure.

I test the association between CEO compensation and shareholder value added on a sample of CEOs listed in ExecuComp. I limit the sample to CEOs who took office after January 1, 1992, and left office before December 31, 2007, so that I have a complete set of data on CEO compensation. Furthermore, I restrict the sample to CEOs with tenure of at least two years to ensure that the CEOs have adequate time to influence the company's stock performance.¹ I find that the ratio of aggregate realized CEO pay to aggregate shareholder value was about 2–3 percent, which is higher than [Jensen and Murphy's \(1990\)](#) finding, but similar to [Aggarwal and Samwick's \(1999\)](#) finding. In addition, I show that both aggregate nominal and aggregate realized CEO pay are significantly and positively related to aggregate market value changes and cumulative abnormal stock returns over CEO tenure. I also find that higher median pay-for-performance sensitivity over CEO tenure is positively and significantly related to higher aggregate market value changes and higher cumulative

¹ I run robustness tests by restricting the sample to those CEOs with tenure of at least either one or three years. The empirical results are similar.

abnormal stock returns. Furthermore, I analyze the CEO pay efficiency, which I define as aggregate market value changes divided by the aggregate nominal or realized pay. Here, I use the nominal value because it measures the opportunity cost for shareholders and matches it with the return to shareholders. The realized pay is also relevant because it can be used to compare how value created within a company is split between the CEO and shareholders. I find that higher median pay-for-performance sensitivity for CEOs is associated with higher CEO pay efficiency when I control for the effects of firm size, growth opportunity, firm risk, and corporate governance. The results are similar even when I use nominal or realized CEO pay to calculate the CEO pay efficiency. Overall, the results suggest that interests of CEOs and shareholders are aligned, on average.

This study makes several contributions to the current literature. The first and most important contribution involves the novel research design that mitigates methodological issues in prior studies that examine the relationship between CEO compensation and shareholder value added. Previous studies that address this relationship have either examined the contemporaneous yearly relationship between CEO compensation and performance, or connections between this year's incentives and future performance (e.g., [Abowd 1990](#); [Hanlon et al. 2003](#); see [Devers et al. 2007](#) for a review). No prior studies have examined the association of CEO compensation with shareholder value added over CEO tenure. To examine this particular association, I aggregate nominal and realized CEO pay and shareholder value added over CEO tenure. This aggregation approach naturally matches CEO compensation and shareholder value added, while minimizing measurement errors in both dependent and independent variables. In addition, this aggregation process mitigates the time horizon problem and the *ex post* settling-up problem in executive compensation. Thus, the research design increases the validity of the empirical tests documented in the "Results" section.

I also contribute to the literature by using complementary variable measurements to present new and convincing evidence about the effectiveness of CEO compensation. I measure CEO compensation using nominal CEO pay, *ex post* realized CEO pay, and *ex ante* pay-for-performance sensitivity, and measure shareholder value added using raw market value changes and market-adjusted abnormal stock returns. In addition, I use a new measure, CEO pay efficiency, to evaluate the CEO pay and performance relationship. These measures complement each other and present a complete picture of CEO compensation and shareholder value added.

The remainder of this paper is organized as follows. In the second section, I review previous literature and discuss my hypotheses. In the third section, I describe the data and variable measurement. In the fourth section, I provide empirical results on the association between CEO compensation and shareholder value creation. The fifth section concludes the paper.

RELATED LITERATURE AND HYPOTHESIS DEVELOPMENT

The separation of ownership and control creates agency problems in corporations because managers may not always act in the best interest of the stockholders (e.g., [Berle and Means 1932](#); [Jensen and Meckling 1976](#)). Benchmarking managerial performance in terms of stock market prices provides one solution to the managerial agency problem ([Jensen and Murphy 1990](#)). As [Murphy \(1999\)](#) documents, the dominant component of executive compensation since the mid-1990s has been stock-based compensation, which includes compensation components such as stock options, stock appreciation rights, phantom stocks, stock dividend units, and restricted stock. Furthermore, [Hall and Liebman \(1998\)](#) find that the median exposure of CEO wealth to firm stock price tripled between the years of 1980 and 1994.

Prior studies that have examined the relationship between performance and executive compensation find mixed evidence. The seminal work by [Jensen and Murphy \(1990\)](#) shows that a

CEO's wealth changes \$3.25 per \$1,000 change in shareholder wealth. In a later study, [Aggarwal and Samwick \(1999\)](#) document a median CEO wealth sensitivity of \$14.52 per \$1,000 change in shareholder wealth. However, other studies find that executive compensation has an insignificant or negative effect on performance. For instance, [Larcker \(2003\)](#) replicates a study by [Hanlon et al. \(2003\)](#), and finds that there could be, statistically, a negative or positive association between executive stock option grants and operating performance, depending on the econometric models used. [Cooper et al. \(2011\)](#) find that industry- and size-adjusted CEO pay is negatively related to future abnormal stock returns. In summary, no definite evidence exists that proves CEO compensation is positively or negatively related to shareholder value creation.

The mixed evidence on the relationship between CEO compensation and performance may be due to the confounding effects of the timing issue ([Devers et al. 2007](#)). A typical executive compensation contract consists of bonuses as short-term incentives and stock options as long-term incentives. Other components, such as salaries and perks, serve as retention tools. The gains from these various compensation components will be realized over different time frames. To address this timing issue, some studies include time lags for both performance and compensation variables. For instance, [Hanlon et al. \(2003\)](#) estimate the influence of executive stock option grants of the previous five years on operating earnings in the current year. [Cooper et al. \(2011\)](#) study the effect of executive pay in year t on abnormal stock return on $t+1$. However, it is unclear how many lags or leads we need to take for the variables of interest, and no study acknowledges the time issue in research design.

Another time-related confounding factor is the *ex post* settling up problem. This problem arises when executives receive compensation for expected future cash flows that do not materialize ([Leone et al. 2006](#)). In other words, executives can benefit from shareholder expectations without actual performance changes in the future. For example, a CEO may realize a gain from exercising stock options because the company signed a value-enhancing long-term contract that resulted in an increase in stock price. However, if the contract is later canceled, stock prices will decline. The stockholders will be unable to take back the past realized gains from the CEO. Thus, shareholder value maximization does not imply the maximization of short-run stock price ([Jensen et al. 2004](#)).

In summary, the time horizon over which we measure CEO compensation and shareholder wealth becomes critical in a study that evaluates the alignment of CEO compensation and shareholder interests. As an article in [Forbes \(1998\)](#) states, "You don't expect a neat correlation in any one year . . . But over five years? Shouldn't a fat paycheck be matched by shareholder results?" Consistent with this logic, I use CEO tenure as the time horizon to examine CEO compensation effectiveness.

I develop this research design from observing two previously unrecognized fundamental properties of CEO compensation and shareholder value added. First, both CEO compensation and shareholder value added aggregate naturally over time. CEO tenure is the most optimal choice for the period of this study because it appropriately matches pay and performance, as well as excludes any contamination of mismatch during CEO turnover. Second, the relevance of measurement errors in aggregate CEO compensation and shareholder value added declines over longer periods of aggregation. Aggregation over longer periods proves to be an effective technique to reduce measurement errors in variables ([Easton et al. 1992](#); [Arya et al. 2004](#)). By minimizing measurement errors in both dependent and independent variables, the validity of research results increases.

Using CEO tenure as the duration of observance also mitigates the horizon problems in CEO compensation. Managers usually have shorter horizons than shareholders ([Narayanan 1985](#)) and, thus, often behave myopically at the cost of shareholder value. [Graham et al. \(2005\)](#) report that the majority of managers would forgo a project with a positive net present value (NPV) if the project would cause them to fall short of the current quarter consensus forecast. When asked what actions they might take to meet an earnings target, approximately 80 percent of managers suggest they

would decrease discretionary spending, including R&D and advertising expense, even though these types of discretionary spending are critical for long-term value creation (Lev 2001). Executive compensation provides one reason for such myopic behavior. Managers perceived as having higher abilities receive higher compensation (Murphy and Zabojnik 2007). Thus, managers prefer to invest in short-term projects that produce higher short-term returns to generate a perception of greater ability. This behavior is particularly true for managers at the beginning of their tenure; managers can gain high compensation at the current company and from future employers by acting myopically at the beginning of their tenure. If the manager continues to stay at the company, however, stock price will suffer and negatively affect CEO wealth with holdings of a large number of stocks or stock options.

Another advantage of examining CEO pay and shareholder value over the long run is the mitigation of the *ex post* settling-up problem. As previously discussed, the *ex post* settling-up problem arises when managers are paid for expected future cash flows that do not materialize (Leone et al. 2006). For example, if the CEO receives a bonus for signing a firm value-enhancing long-term contract, but later the contract is cancelled, the stockholders cannot reclaim the bonus paid for the unrealized expected cash flows. However, the CEO's wealth in the form of equity holdings will shrink after the contract cancellation. When CEOs are paid in equity compensation forms, much less severe *ex post* settling-up problems exist for the shareholders (Leone et al. 2006). By adding up cash compensation, equity compensation, and shareholder value added in sequential periods, we get a complete picture of CEO pay and shareholder value creation.

To understand whether executive pay tracks corporate performance, we need to distinguish between nominal pay and realized pay (Anderson and Muslu 2010; Kaplan 2008). In this study, I define aggregate nominal CEO pay as the sum of annual compensation, and aggregate realized CEO pay as the sum of the actual cash salary and bonus, the real value of restricted stock, the payout from performance plans, gains from exercising stock options over CEO tenure, and exercisable in-the-money stock options outstanding at the end of CEO tenure.

Aggregate Nominal CEO Pay and Shareholder Value Added

There are two competing theories on the CEO pay-setting process. The optimal contracting theory, advocated by financial economists (e.g., Jensen and Meckling 1976; Core and Guay 1999), states that companies grant CEOs compensation to reduce the moral hazard problem, which results from CEOs owning very little of the firms they manage. The managerial power hypothesis, advocated by management and legal scholars (e.g., Bebchuk and Fried 2004), claims that executives, particularly the CEOs, dominate over the boards of directors and set their own compensation. Prior empirical studies find that executive ownership levels and stock option grants are set, on average, at a value maximization level (e.g., Core and Guay 1999; Himmelberg et al. 1999). Fong et al. (2010) compare a CEO's nominal pay with market level, and group CEOs into underpaid CEOs and overpaid CEOs. They find that overpaid CEOs put forth effort toward increasing firm profits. Thus, I hypothesize that:

- H1:** Aggregate nominal CEO pay is positively associated with aggregate shareholder value added over a CEO's tenure.

Aggregate Realized CEO Pay and Shareholder Value Added

Nominal pay is essentially the only pay opportunity that a compensation committee grants to a CEO. Whether a CEO can realize substantial gains from the opportunity depends on whether he/she can create shareholder wealth. That is why Fama (1980) suggests that CEO pay is a reward for

performance over the long term. As the definition of realized pay infers, it is determined by the actual financial performance of companies and stock price appreciation. I therefore expect:

H2: Aggregate realized CEO pay is positively associated with aggregate shareholder value added over a CEO's tenure.

Ex Ante Incentives and Shareholder Value Added

The relationship between managerial incentives and shareholder value is one of the fundamental issues in CEO compensation research. Most studies focus on whether managerial equity incentives affect firm value, often measured by Tobin's Q. For example, [Mehran \(1995\)](#) finds that firm value is positively related to managers' stock ownership. However, [Habib and Ljungqvist \(2005\)](#) document a positive association of firm value with CEO stock holdings, but a negative association with option holdings. Other studies fail to find any relationship between firm value and executive equity holdings (e.g., [Himmelberg et al. 1999](#)). This mixed evidence may be due to the lack of theoretical or empirical consensus on the effect of equity incentives on firm performance ([Core et al. 2003](#)). [Edmans et al. \(2009\)](#) find strong support for incentives and value creation. They find that incentive pay (the dollar change in wealth for a percentage change of stock price) effectively mitigates agency problems and positively impacts firm value.

I use [Core and Guay's \(1999, 2002\)](#) measure of equity incentives, which is the value of pay-for-performance sensitivity at the beginning of each year during CEO tenure. I choose the median of these pay-for-performance sensitivity values. I expect:

H3: The median pay-for-performance sensitivity over CEO tenure is positively associated with shareholder value added.

Ex Ante Incentives and CEO Pay Efficiency

The concept of CEO pay efficiency has attracted media attention and has been reported in CEO compensation surveys by business media such as *BusinessWeek* and *Forbes*. However, [Jensen and Murphy \(1990\)](#) criticize the method used by business media for focusing on the association between short-run CEO pay and shareholder return. In recent years, both *BusinessWeek* and *Forbes* have expanded the time horizon for observing CEO pay and shareholder return to five or six years. Following the logic of *BusinessWeek* and *Forbes*, I define CEO pay efficiency, from the shareholder's perspective, as aggregate shareholder value added over CEO tenure divided by total CEO compensation.² I use both the nominal and realized CEO pay in the calculation of CEO pay efficiency. The nominal pay represents the opportunity cost of compensating a CEO. So, when I use the nominal value of CEO compensation as a denominator, the pay efficiency measures the return on compensation cost from the shareholder perspective. On the other hand, when I use the realized CEO pay in the denominator, the pay efficiency measures the wealth distribution between shareholders and CEOs. Despite having little prior research on CEO pay efficiency to reference, I expect that incentive effects of CEO pay can affect CEO pay efficiency (e.g., [Jensen and Meckling 1976](#); [Demsetz and Lehn 1985](#); [Core and Larcker 2002](#); [Core et al. 2003](#)):

H4: Higher pay-for-performance sensitivity is associated with higher CEO pay efficiency.

² *Forbes* defines pay efficiency as performance/pay. Available at: http://www.forbes.com/lists/2009/12/best-boss-09_CEO-Compensation_PayPerfRank.html

TABLE 1
Sampling Process

	Number of Observations
All CEOs in ExecuComp database	7,582
Less observations with missing information on the date of becoming CEO or the date leaving the office	(4,630)
CEOs with tenure information	2,952
Less CEOs whose tenure began before January 1992 or ended after December 2007	(1,203)
CEOs whose tenure was between January 1992 and December 2007	1,749
Less CEOs whose tenure lasted less than two years	(556)
CEOs whose tenure was equal to or longer than two years and who were in the office between January 1992 and December 2007	1,193
Less CEOs with missing values for accounting and stock return data for all CEO tenure years	(154)
Final sample of CEOs used for data analysis	1,039

This table summarizes the process that I use to select the sample for this study.

DATA AND VARIABLE MEASUREMENT

Sample Selection

This section describes the data sources I use to test the hypotheses. I obtain a sample of CEOs from the ExecuComp database. ExecuComp contains data on all aspects of compensation for the top five executives (ranked annually by salary and bonus) at each of the firms in the S&P 500, S&P MidCap 400, and S&P SmallCap 600. Due to enhanced federal reporting requirements for fiscal years ending after December 15, 1992, I can measure CEO compensation from 1992 to 2007. I begin with an initial sample of 7,582 unique CEOs from the database. Complete information on both CEO tenure starting dates and ending dates is available for only 2,952 CEOs. I restrict the sample to CEOs whose tenure began during or after 1992 and ended during or before 2007, which leaves 1,749 CEOs. This step ensures that I have complete data on CEO compensation. To allow sufficient time for CEOs to influence stock performance, I further restrict the sample to CEOs whose tenure was equal to or longer than two years, reducing the number of usable observations to 1,193. I then combine the CEO compensation data with accounting data in Compustat and stock data in CRSP. The final sample contains 1,039 CEOs. Table 1 summarizes this sampling process.

Table 2 presents sample distribution statistics. Panel A displays the distribution of the industries in which CEOs work. A higher incidence of CEOs occurs in two-digit SIC codes 28 (Chemical and Allied Products), 35 (Computer Equipment), 38 (Measuring Instruments), 49 (Electric, Gas, and Sanitary Services), and 73 (Business Services). Panel B reports the distribution of specific years in which CEOs started and ended their tenure in their position. About 80 percent of CEOs started their tenure in the 1990s, and nearly 80 percent of them left in the 2000s. These statistics are reasonable because I restrict my sample to those who became CEO during or after 1992 and left the office during or before 2007.

Table 3 reports comparative statistics on CEO pay of all CEOs in ExecuComp and those in the sample for this study. Panel A compares the components of annual CEO pay. ExecuComp CEOs have lower pay amounts in all components, which can be explained by the fact that my sample consists of CEOs whose tenure lasted at least two years. My sample excludes interim CEOs, who

TABLE 2
Sample Distribution

Panel A: Sample Distribution Across Industries

SIC	Industry Description	n	SIC	Industry Description	n
10	Metal Mining	11	44	Water Transportation	3
13	Oil and Gas Extraction	33	45	Transportation by Air	17
15	Building Construction	3	47	Transportation Services	3
	General Contractors and Operative Builders				
16	Heavy Construction Other Than Building	7	48	Communications	15
	Construction Contractors				
20	Food and Kindred Products	39	49	Electric, Gas, and Sanitary Services	60
21	Tobacco Products	3	50	Wholesale Trade-Durable Goods	21
22	Textile Mill Products	3	51	Wholesale Trade-Non- Durable Goods	18
23	Apparel and Other Finished Products Made From Fabrics and Similar Materials	18	53	General Merchandise Stores	15
24	Lumber and Wood Products, Except Furniture	6	54	Food Stores	6
25	Furniture and Fixtures	6	55	Automotive Dealers and Gasoline Service Stations	12
26	Paper and Allied Products	19	56	Apparel and Accessory Stores	22
27	Printing, Publishing, and Allied Industries	30	57	Home Furniture, Furnishings, and Equipment Stores	10
28	Chemicals and Allied Products	54	58	Eating and Drinking Places	21
29	Petroleum Refining and Related Industries	15	59	Miscellaneous Retail	33
30	Rubber and Miscellaneous Plastics Products	18	60	Depository Institutions	39
31	Leather and Leather Products	3	61	Non-Depository Credit Institutions	6
32	Stone, Clay, Glass, and Concrete Products	3	62	Security and Commodity Brokers, Dealers, Exchanges, and Services	3
33	Primary Metal Industries	27	63	Insurance Carriers	34
34	Fabricated Metal Products, Except Machinery and Transportation Equipment	24	64	Insurance Agents, Brokers, and Service	6
35	Industrial and Commercial Machinery and Computer Equipment	58	67	Holding and Other Investment Offices	6

(continued on next page)

TABLE 2 (continued)

SIC	Industry Description	n	SIC	Industry Description	n
36	Electronic and Other Electrical Equipment and Components, Except Computer Equipment	42	70	Hotels, Rooming Houses, Camps, and Other Lodging Places	3
37	Transportation Equipment	48	72	Personal Services	6
38	Measuring, Analyzing, And Controlling Instruments; Photographic, Medical and Optical Goods; Watches and Clocks	75	73	Business Services	93
39	Miscellaneous Manufacturing Industries	6	80	Health Services	20
40	Railroad Transportation	3	87	Engineering, Accounting, Research, Management, and Related Services	13
Total					1,039

Panel B: Distribution of Years in Which CEO Tenure Started and Ended

Year	Tenure Started	Tenure Ended
1992	90	—
1993	105	—
1994	112	8
1995	102	18
1996	100	29
1997	99	43
1998	81	54
1999	103	64
2000	89	97
2001	67	92
2002	35	73
2003	32	108
2004	18	115
2005	6	128
2006	—	96
2007	—	114
Total	1,039	1,039

are very unsuccessful CEOs, and many founder CEOs, who tend to receive lower annual pay. Panel B reports comparative statistics on aggregate CEO pay. Consistent with Panel A, CEOs in my sample earn higher aggregate pay than those in ExecuComp. The average tenure for CEOs is longer for the sample used in this study (mean = 9.6 years) than for those in ExecuComp (mean = 7.4 years). However, the differences in means of all components (annual or aggregate) are much lower than respective standard deviations. Therefore, the differences in CEO pay between ExecuComp and the sample used in this study are acceptable. In summary, the sample used in this study is representative of all CEOs in ExecuComp. External validity is not a significant concern.

TABLE 3
Comparison between ExecuComp Database and the Sample Used in This Study

Panel A: Comparison of Annual CEO Pay Components

	ExecuComp		Sample of This Study	
	Mean	Std. Dev.	Mean	Std. Dev.
Salary	602	363	678	357
Bonus	593	1,589	740	1,557
Long-Term Incentive Payouts	176	988	233	1,066
Restricted Stock Grants	1,682	3,622	1,882	3,818
Realized Gains from Exercising Stock Options	1,967	10,370	2,485	10,124
Realized CEO Pay	4,441	12,382	5,250	13,393

Panel B: CEO Pay Components Aggregated over CEO Tenure

	ExecuComp		Sample of This Study	
	Mean	Std. Dev.	Mean	Std. Dev.
Tenure	7.4	7.5	9.6	6.5
Aggregated Salary	2,859	2,984	5,344	3,550
Aggregated Bonus	2,976	7,221	5,827	10,108
Aggregated Long-Term Incentive Payouts	924	3,848	1,635	4,954
Aggregated Restricted Stock Grants	2,280	5,346	4,288	8,056
Aggregated Realized Gains from Exercising Stock Options	10,198	38,235	19,518	50,652
Aggregated Realized CEO Pay	21,457	52,527	41,247	72,366

Panel A: These statistics show the differences in annual CEO pay components between all CEOs in the ExecuComp database and the CEOs in the sample used in this study. ExecuComp has 7,582 CEOs and 32,491 CEO-year observations. The sample used in this study has 1,039 CEOs and 8,151 CEO-year observations. Realized CEO pay is TOTAL_ALT2 in ExecuComp (TDC2 in an earlier version of the database), which is the sum of the following data items in ExecuComp: Salary, Bonus, Other Annual, Total Value of Restricted Stock Granted, Net Value of Stock Options Exercised, Long-Term Incentive Payouts, and All Other Total. Mean and standard deviation are expressed in units of \$1,000.

Panel B: These statistics show the differences in CEO pay components aggregated over CEO tenure between all CEOs with complete tenure information in the ExecuComp database and the CEOs in the sample used in this study. ExecuComp has 2,952 CEOs with complete tenure information. The sample used in this study has 1,039 CEOs. Each component of CEO pay is aggregated over CEO tenure. Realized CEO pay is TOTAL_ALT2 in ExecuComp (TDC2 in an earlier version of the database), which is the sum of the following data items in ExecuComp: Salary, Bonus, Other Annual, Total Value of Restricted Stock Granted, Net Value of Stock Options Exercised, Long-Term Incentive Payouts, and All Other Total. Mean and standard deviation are expressed in units of \$1,000.

Measurement of Shareholder Value Added

I measure Shareholder value added using two dimensions. The first is Aggregate market value changes, which is the change of market capitalizations plus dividends paid during the CEO tenure. To make the numbers comparable among CEOs with different tenures, I take an average of market value changes over Tenure, which is equal to Aggregate market value changes divided by the number of years in Tenure. The second measure of shareholder value added is the Cumulative abnormal stock return. I use the CAPM model to estimate abnormal stock returns for each month and then add them up over CEO tenure.

Measurement of CEO Pay

ExecuComp has two definitions of total compensation. The first definition, TOTAL_ALT1, is the sum of salaries, bonuses, other annual compensation, payouts under long-term incentive plans, grant-date market value of restricted stock awards, grant-date Black-Scholes value of stock option awards, and all other forms of compensation.³ Consistent with other studies (e.g., [Anderson and Muslu 2010](#)), I call TOTAL_ALT1 nominal pay. The second definition, TOTAL_ALT2, is the same as the first except that TOTAL_ALT2 includes realized gains from exercising stock options, rather than the grant-date Black-Scholes value of stock option awards. While other studies (e.g., [Kaplan 2008](#); [Anderson and Muslu 2010](#)) define realized pay as TOTAL_ALT2, I also include exercisable stock options at the end of CEO tenure as a part of realized pay. These stock options are clearly valuable to CEOs.⁴ To present a complete picture of the relationship between pay and performance, I use both nominal and realized pay. I aggregate both nominal and realized CEO pay over CEO tenure. To ensure comparability among CEOs of different tenures, I take the mean of CEO pay over tenure. I use both aggregate and average CEO pay over tenure in data analysis.

Measurement of CEO Pay Efficiency

In order to evaluate the efficiency of CEO pay, I follow the logics of business publications such as *Forbes* and *BusinessWeek*, and define CEO pay efficiency as the ratio of aggregate Shareholder value added to aggregate CEO pay. To present a complete picture of CEO compensation, I use both nominal and realized pay. I define the Nominal CEO pay efficiency as aggregate Shareholder value added divided by Aggregate nominal CEO pay. Since Nominal value of CEO pay measures compensation costs from the shareholder's perspective, the corresponding CEO pay efficiency is essentially the shareholder return on every dollar of compensation paid to CEOs. I define the realized CEO pay efficiency as aggregate Shareholder value added divided by Aggregate realized CEO pay. Since realized pay measures CEOs' total realized gains, the corresponding pay efficiency is a measure of how wealth is distributed to CEOs versus shareholders.

Measurement of Pay-for-Performance Sensitivity

Measurement of Pay-for-performance sensitivity is complex. Managers can receive pay-for-performance incentives from a variety of sources, such as annual bonuses, long-term profit sharing plans, restricted stocks, performance shares, and stock options ([Murphy 1999](#)). The vast majority of these incentives comes from ownership of stock and stock options (e.g., [Jensen and Murphy 1990](#); [Hall and Liebman 1998](#); [Aggarwal and Samwick 1999](#); [Murphy 1999](#)). [Hall and Liebman \(1998\)](#) approximate that 95 percent of estimated Pay-for-performance sensitivity for CEOs in manufacturing companies comes from stock options (64 percent) and stock (31 percent). Therefore, I focus on the incentives provided by the manager's ownership of stock and stock options. Consistent with [Core and Guay \(1999\)](#) and [Core et al. \(2003\)](#), I measure Pay-for-

³ According to the Compustat data manual, "other annual" (ExecuComp data OTHANN) includes the dollar value of other annual compensation not properly categorized as salary or bonus. This includes items such as: (1) perquisites and other personal benefits, (2) above-market earnings on restricted stock, options/SARs, or deferred compensation paid during the year but deferred by the officer, (3) earnings on long-term incentive plan compensation paid during the year but deferred at the election of the officer, (4) tax reimbursements, and (5) the dollar value of the difference between the price paid by the officer for company stock and the actual market price of the stock under a stock purchase plan that is not generally available to shareholders or employees of the company. All other compensation (ExecuComp data ALLOTHTO) includes: (1) severance payments, (2) debt forgiveness, (3) imputed interest, (4) payouts for cancellation of stock options, (5) payment for unused vacation, (6) tax reimbursements, (7) signing bonuses, (8) 401K contributions, and (9) life insurance premiums.

⁴ I appreciate Dan Weiss, the discussant, for pointing this out.

performance sensitivity with the variation in executive wealth related to the stock price. More specifically, I measure Pay-for-performance sensitivity as the sensitivity of stock and option values to a 1 percent change in stock price, which is also called the percentage returns measure of Pay-for-performance sensitivity (e.g., [Hall and Liebman 1998](#); [Core and Guay 1999](#)). This measure has been widely used in studies on CEO compensation (e.g., [Bergstresser and Philippon 2006](#); [Brockman et al. 2010](#)).

In calculating the percentage returns-based Pay-for-performance sensitivity, I define the sensitivity of restricted and common stock holdings as the change in the value of these holdings for a 1 percent change in firm value. I obtain the sensitivity of restricted and common stock holdings by multiplying the number of shares of restricted stock/equity held by 1 percent of the stock price. The sensitivity of new restricted stock grants is the value of the stock grant multiplied by 1 percent.

For stock options, I use the [Core and Guay \(1999\)](#) method. To measure incentives from new option grants, I estimate the sensitivity of the Black-Scholes value of the grant to a 1 percent change in the grant-date stock price. The six inputs to the Black-Scholes model (stock price, exercise price, time-to-maturity, expected stock return volatility, expected dividend yield, and the risk-free rate) are readily available in public databases. The quantity of options in the new grant, grant-date stock price, exercise price, stock return volatility, dividend yield, and time-to-maturity are available in the ExecuComp database. I use the treasury bond yield available from the Federal Reserve in St. Louis to estimate the risk-free rate.

I obtain pay-for-performance for stock option holdings by multiplying the option delta by 1 percent of the stock price and the number of options held. Delta for options outstanding is the partial derivative of the option value with respect to stock price, making it the optimal measure of Pay-for-performance sensitivity. [Core and Guay \(1999\)](#) use the Black-Scholes model adjusted for dividend payouts ([Black and Scholes 1973](#)) to value the options. I discuss the inputs to calculate option delta below.

I measure the stock price at fiscal year-end. I obtain volatility and dividend yield from ExecuComp, and the risk-free rate from the Federal Reserve in St. Louis. Since ExecuComp does not offer details on previously granted options, I make assumptions regarding the time to maturity and the exercise price. I calculate the time to maturity for unvested options as the time to maturity of the recent grant of options minus one year. The time to maturity of vested options is the time to maturity of unvested options minus three years. I calculate exercise prices as the price at the fiscal year-end minus the profit per option. The delta and the corresponding option sensitivity are a separate estimation for vested options and unvested options, which I add together to obtain pay-for-performance sensitivity of stock option holdings.

Measurement of Control Variables

Firm Size

Prior studies have documented a well-known positive correlation between CEO pay and firm size (e.g., [Baker and Hall 2004](#)). Larger firms require managers who are more talented and, therefore, these firms award greater compensation. However, [Kole \(1997\)](#) finds little evidence that firm size significantly impacts the effectiveness of pay-for-performance compensations. I use the log of firm Sales to measure Size.

Growth Opportunities

[Smith and Watts \(1992\)](#) and [Gaver and Gaver \(1993\)](#) demonstrate that managerial compensation is more likely to include performance features if the firm has high investment or strong growth opportunities, as measured by the Book-to-market ratio. I measure the ratio as the book value of equity divided by the market value of equity.

Firm Risk

Higher risk indicates higher returns. At the same time, higher risk entails more opportunities for managerial discretion and thereby increases required managerial incentive levels. Consistent with [Core and Guay \(1999\)](#), I measure Risk with the standard deviation of the idiosyncratic component of daily stock prices (constructed from residuals from a standard CAPM regression).

CEO-Chairman

[Bebchuk et al. \(2009\)](#) argue that a board of directors is weak if the CEO is also the Chairman of the Board, due to conflicts of interest. When board governance is poor, a CEO can set his/her own pay. I use a dummy variable to indicate if the CEO is also the Chairman of the Board. The dummy is equal to 1 if the CEO is the Chairman of the Board, and 0 if not.

CEO Tenure

Two fundamental reasons explain why CEO Tenure correlates with both CEO compensation and shareholder value added. First, both CEO compensation and shareholder value added naturally aggregate over CEO tenure. Second, a CEO has a long tenure because he/she takes actions that increase the firm value and please the shareholders. However, a CEO might also become entrenched and set his/her own pay ([Bebchuk et al. 2009](#)).

Corporate Governance

Corporate governance correlates with both executive compensation (e.g., [Core et al. 1999](#)) and stock returns (e.g., [Gompers et al. 2003](#)). This study uses the entrenchment index developed by [Bebchuk et al. \(2009\)](#).

Regression Models

I use the following ordinary least squares (OLS) regression model to test the first hypothesis that Realized CEO pay is positively associated with Shareholder value added:

$$\text{Shareholder value added} = \alpha_1 * \text{CEO pay} + \alpha_2 * \text{Size} + \alpha_3 * \text{Growth opportunity} + \alpha_4 * \text{Risk} + \alpha_5 * \text{Tenure} + \alpha_6 * \text{Corporate governance.} \quad (1)$$

The dependent variable, Shareholder value added, is either aggregate (average) Realized CEO pay over CEO Tenure, or cumulative (average) market-adjusted Cumulative abnormal stock returns. The key independent variable is the aggregated (average) nominal (realized) CEO pay over CEO tenure. Firm Size, Growth opportunity, firm Risk, CEO Tenure, and Corporate governance are control variables.

To test the second hypothesis, that *ex ante* Pay-for-performance sensitivity is associated with Shareholder value added, I use the OLS regression to estimate the following equation. The OLS regression model is as follows:

$$\text{Shareholder value added} = \beta_1 * \text{CEO Pay-for-performance sensitivity} + \beta_2 * \text{Size} + \beta_3 * \text{Growth opportunity} + \beta_4 * \text{Risk} + \beta_5 * \text{Tenure} + \beta_6 * \text{Corporate governance.} \quad (2)$$

In this model, the dependent variable, Shareholder value added, is either aggregate (average) realized CEO pay over CEO tenure, or cumulative (average) market-adjusted Cumulative abnormal stock returns. The key independent variable is the aggregate (average) realized CEO pay over CEO

tenure. Firm Size, Growth opportunity, firm Risk, CEO Tenure, and Corporate governance are control variables.

I use the following OLS regression model to test the third hypothesis, that *ex ante* Pay-for-performance sensitivity is positively associated with CEO pay efficiency:

$$\begin{aligned} \text{CEO pay efficiency} = & \gamma_1 * \text{CEO Pay-for-performance sensitivity} + \gamma_2 * \text{Size} \\ & + \gamma_3 * \text{Growth opportunity} + \gamma_4 * \text{Risk} \\ & + \gamma_5 * \text{Tenure} + \gamma_6 * \text{Corporate governance.} \end{aligned} \quad (3)$$

The dependent variable is either Nominal CEO pay efficiency or Realized CEO pay efficiency. The key independent variable is the median Pay-for-performance sensitivity over CEO Tenure. Firm Size, Growth opportunity, firm Risk, CEO Tenure, and Corporate governance are control variables.

Descriptive Statistics

Table 4 presents descriptive statistics for the variables used in the analyses of CEO pay and Shareholder value added. The Aggregate market value changes have a mean of \$8.99 billion and a median of \$1.20 billion, which suggests that the distribution of total Shareholder value added is disproportionate. The first quartile of the Aggregate market value changes is small (\$131.77 million), while the third quartile is much larger (\$5.76 billion). Cumulative market-adjusted return over CEO tenure has a mean of 12 percent and a median of -14 percent, suggesting that more than half the firms do not earn above market returns for shareholders.

Nominal CEO pay efficiency has a mean of 174.85, a standard deviation of 249.97, and a median of 66.66. Realized CEO pay efficiency has a mean of 158.45, a standard deviation of 198.67, and a median of 58.66. Thus, both variables have a skewed distribution and warrant a log transformation. The median suggests that aggregate Shareholder value added is about 60 times larger than the aggregate compensation paid to CEOs. In other words, total compensation costs of hiring a CEO are close to 1.5 percent of aggregated Shareholder value added.

The mean Aggregate nominal CEO pay is \$38.35 million, while the median is \$15.02 million. The mean Aggregate realized CEO pay is \$51.34 million, while the median is \$26.78 million. The realized CEO pay is larger than nominal pay. This finding is different from [Anderson and Muslu's \(2010\)](#) finding that realized pay is smaller than nominal pay. These different conclusions may be due to differences in our sample selection and variable measurement. First, I only include CEOs with tenure longer than two years. CEOs with longer tenures are more likely to be able to realize gains from exercising stock options. Second, I include unexercised stock options outstanding at the end of CEO tenure as part of Aggregate realized CEO pay. Given that the median Shareholder value added is \$1.2 billion and aggregate CEO pay is \$15–26 million, aggregate CEO pay is between 1 and 2 percent of Shareholder value added. This value is much higher than the figures found by [Jensen and Murphy \(1990\)](#), where CEO wealth change is only 0.3 percent of change in shareholder wealth. The sample difference explains this disparity. My sample period ranges from 1992 to 2007, while [Jensen and Murphy's \(1990\)](#) sample period spanned from 1974 to 1986. Given the explosion in stock option grants during the late 1990s ([Murphy 1999](#)), the difference is not surprising.

The average nominal CEO pay per share is \$4.8 million, with a median of \$2.2 million. CEOs realize an average pay of \$7.2 million every year, with a median of \$2.7 million. This is consistent with [Murphy's \(1999\)](#) finding that the median of total realized pay for CEOs was \$2.5 million a year in 1996.

The mean of median Pay-for-performance sensitivity under [Core and Guay's \(1999\)](#) method is \$1.22 million, with the median at \$397,020. This is consistent with [Burns and Kedia's \(2006\)](#)

TABLE 4
Descriptive Statistics

Variables	Unit	Mean	Std Dev.	Q1	Median	Q3
<i>Aggregate market value changes</i>	\$M	8985.24	32892.06	131.77	1204.24	5755.41
<i>Average market value changes</i>	\$M	945.76	3211.68	18.08	146.45	626.06
<i>Cumulative abnormal stock return</i>		0.12	0.99	-0.51	-0.14	0.4
<i>Average abnormal stock return</i>		0.01	0.16	-0.06	-0.01	0.04
<i>Nominal CEO pay efficiency</i>		174.85	249.97	12.22	66.66	193.52
<i>Realized CEO pay efficiency</i>		158.45	198.67	13.15	58.66	180.32
<i>Aggregate nominal CEO pay</i>	\$K	38345.66	37745.80	7313.34	15022.65	34962.67
<i>Average nominal CEO pay</i>	\$K	4847.27	27609.83	992.19	2207.72	5432.17
<i>Aggregate realized CEO pay</i>	\$K	51343.51	91555.99	11571.36	26780.02	49169.90
<i>Average realized CEO pay</i>	\$K	7252.75	35890.29	995.64	2379.56	6142.81
<i>Pay-for-performance sensitivity</i>	\$K/%	1222.68	4061.37	178.28	397.02	958.84
<i>Sales</i>	\$M	4906.73	10774.65	596.44	1493.62	4662.2
<i>Book-to-market ratio</i>		0.65	0.25	0.46	0.68	0.85
<i>Risk</i>		0.1	0.05	0.07	0.09	0.12
<i>CEO-chairman</i>		0.66	0.48	0	1	1
<i>Tenure</i>	Year	10.09	6.92	5.42	8.01	12.64
<i>Entrenchment index</i>		2.29	1.29	1	2	3

The sample consists of 1,039 CEOs whose tenure began after January 1, 1992, and ended before December 31, 2007, and whose tenure was equal to or longer than two years.

Variable Definitions:

Aggregate market value changes = changes in market capitalization plus dividends paid over CEO tenure;

Average market value changes = *Aggregate market value changes* divided by *Tenure*;

Cumulative abnormal stock return = sum of monthly abnormal stock returns over CEO tenure. Abnormal stock return is calculated with the CAPM model;

Average abnormal stock return = *Cumulative abnormal stock return* divided by *Tenure*;

Nominal CEO pay efficiency = *Aggregate market value changes* divided by *Aggregate nominal CEO pay*;

Aggregate nominal CEO pay = sum of TOTAL_ALT1 in ExecuComp (TDC1 in an earlier version of the database) over CEO tenure. TOTAL_ALT1 itself is the sum of the following annual data items in ExecuComp: Salary, Bonus, Other Annual, Total Value of Restricted Stock Granted, Total Value of Stock Options Granted, Long-Term Incentive Payouts, and All Other Total;

Realized CEO pay efficiency = *Aggregate market value changes* divided by the *Aggregate realized CEO pay*;

Aggregate realized CEO pay = sum of TOTAL_ALT2 in ExecuComp (TDC2 in an earlier version of the database) over CEO tenure plus value of exercisable in-the-money stock options outstanding at the end of CEO tenure. TOTAL_ALT2 itself is the sum of the following annual data items in ExecuComp: Salary, Bonus, Other Annual, Total Value of Restricted Stock Granted, Net Value of Stock Options Exercised, Long-Term Incentive Payouts, and All Other Total;

Average nominal CEO pay = *Aggregate nominal CEO pay*/*Tenure*;

Average realized CEO pay = *Aggregate realized CEO pay*/*Tenure*;

Pay-for-performance sensitivity = median of a number of pay-for-performance sensitivity calculated at the beginning of each year during CEO tenure. I calculate *Pay-for-performance sensitivity* using [Core and Guay's \(1999\)](#) method;

Sales = median of the company sales (Compustat data item SALE or #12) over CEO tenure;

Book-to-market ratio = median of the book value of equity (Compustat data item CEQ or #60) divided by the market value of equity (Compustat data item PRCC_F or #199 * Compustat data item CSHO or #25) over CEO tenure;

Risk = standard deviation of the idiosyncratic component of daily stock prices constructed from residuals from a standard CAPM regression;

CEO-chairman = dummy variable equal to 1 if a CEO is also the chairman of the board, and 0 otherwise;

Tenure = days between the date of becoming a CEO and the date of leaving the office, divided by 365; and

Entrenchment index = CEO entrenchment index calculated using [Bebchuk et al.'s \(2009\)](#) method.

finding that the mean of Pay-for-performance sensitivity is between \$586,526 and \$745,352 in the period from 1995 to 2002.

The mean Sales amount is \$4.91 billion, with the median at \$1.49 billion, the first quartile at \$596 million, and the third quartile at \$4.66 billion. The sample in this study includes small, medium, and large companies in the S&P 1500. Therefore, the sample is probably dominated by value companies rather than high-growth companies, which is evident in the mean Book-to-market ratio of 0.65 (median = 0.68). The mean idiosyncratic Risk is 0.10, while the median is 0.09. This is consistent with descriptive statistics reported in recent studies (e.g., [Core and Guay 1999](#); [Himmelberg et al. 1999](#)). In my sample, 66 percent of CEOs hold the chairman position. The mean CEO Tenure is 10.09 years, which is longer than the six to seven years documented in recent studies (e.g., [Brookman and Thistle 2009](#)). The tenure is longer because this study excludes CEOs with tenure shorter than two years in the sampling process. The mean of the Entrenchment index is 2.29, which is consistent with that of [Bebchuk et al. \(2009\)](#).

Table 5 presents the Pearson correlation matrix for the main independent and dependent variables used in the regression analyses in the “Results” section. Consistent with the hypothesis that CEO compensation provides incentives to create shareholder value, Aggregate market value changes are significantly and positively correlated with aggregate nominal or realized CEO pay. Sales are significantly correlated with both market value changes and CEO pay, suggesting that company size influences both shareholder value creation and CEO compensation. The correlation between Aggregate market value changes and Pay-for-performance sensitivity is also significant. Additionally, market-adjusted return has a low correlation with Pay-for-performance sensitivity.

RESULTS

I conduct three primary analyses on the association between CEO compensation and Shareholder value added. In the first set of analyses, I estimate a model of the association between aggregate (average) nominal (realized) CEO pay and aggregate (average) Shareholder value added. I use the second set of analyses to estimate the statistical association between median CEO Pay-for-performance sensitivity and aggregate (average) Shareholder value added. I analyze the association of CEO pay efficiency with Pay-for-performance sensitivity in the third set of analyses.

Nominal CEO Pay and Shareholder Value Added

Table 6 reports the results for regressions of shareholder value added on nominal CEO pay and control variables. The first two columns report the results from the log linear regression of aggregate (average) Shareholder value added as a function of nominal CEO pay. The logarithm transformation is widely used in executive compensation ([Murphy 1999](#)). The purpose of the transformation is to reduce the skewed distribution of the dependent variables. A mechanical log transformation will eliminate those observations with negative market value changes. To avoid losing observations, I first take the logarithm of the absolute value of Shareholder value added. Next, I assign the transformed value as the log value multiplied by (−1) for negative Shareholder value added.

The results in the first two columns show that the coefficient on nominal CEO pay is positive and significant, indicating that CEO compensation increases shareholder value creation. Specifically, a 1 percent increase in nominal CEO pay will lead to a 1.86 percent increase in shareholder value added. This relationship is consistent with the pay-for-performance hypothesis (e.g., [Abowd 1990](#); [Murphy 1999](#); [Hanlon et al. 2003](#)). Among the control variables, firm Size (measured with Sales) is insignificantly associated with market value changes. Growth opportunities (measured with Book-to-market ratio) are positively associated with market value changes. Idiosyncratic risk is significantly and negatively correlated with Aggregate market value

TABLE 5
Pearson Correlation Matrix of Regression Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
(1) Aggregate market value changes	1.00	0.64	0.30	0.21	0.63	0.48	0.52	0.12	0.55	0.25	0.15	0.57	-0.16	-0.15	0.10	0.13	-0.21
(2) Average market value changes		1.00	0.53	0.69	0.50	0.35	0.31	0.26	0.43	0.58	0.13	0.47	-0.19	-0.07	0.07	-0.07	-0.11
(3) Cumulative abnormal stock return			1.00	0.27	0.11	0.02	0.18	0.07	0.44	0.35	0.16	0.08	-0.14	0.12	0.02	0.00	-0.02
(4) Average abnormal stock returns				1.00	0.07	0.01	0.02	0.77	0.10	0.44	0.03	0.02	-0.06	0.04	0.03	-0.06	-0.01
(5) Nominal CEO pay efficiency					1.00	0.84	0.05	-0.02	0.16	0.08	0.04	0.54	-0.14	-0.25	0.10	0.08	-0.24
(6) Realized CEO pay efficiency						1.00	0.04	-0.03	0.06	0.01	-0.09	0.47	-0.05	-0.32	0.14	0.10	-0.22
(7) Aggregate nominal CEO pay							1.00	0.21	0.75	0.28	0.27	0.39	-0.12	-0.09	0.12	0.12	-0.09
(8) Average nominal CEO pay								1.00	0.13	0.87	0.07	0.10	0.00	0.00	-0.01	-0.08	0.00
(9) Aggregate realized CEO pay									1.00	0.37	0.27	0.25	-0.17	-0.04	0.10	0.11	-0.11
(10) Average realized CEO pay										1.00	0.11	0.16	-0.06	0.02	0.02	-0.09	-0.02
(11) Median pay-for-performance											1.00	0.10	-0.13	0.06	0.04	0.02	-0.08
(12) Sales												1.00	-0.01	-0.23	0.13	-0.08	-0.20
(13) Book-to-market ratio													1.00	-0.07	-0.03	-0.01	0.16
(14) Stock risk														1.00	-0.18	-0.08	-0.03
(15) CEO-chairman															1.00	0.16	-0.05
(16) Tenure																1.00	-0.06
(17) Entrenchment index																	1.00

This table reports Pearson correlations for the regression variables.

Variable Definitions:

Average market value changes = Aggregate market value changes divided by Tenure;
Cumulative abnormal stock return = sum of monthly abnormal stock returns over CEO tenure. Abnormal stock return is calculated with the CAPM model;

Average abnormal stock return = Cumulative abnormal stock return divided by Tenure;

Nominal CEO pay efficiency = Aggregate market value changes divided by Aggregate nominal CEO pay;

Aggregate nominal CEO pay = the sum of TOTAL_ALT1 in ExecuComp (TDC1 in an earlier version of the database) over CEO tenure;

Realized CEO pay efficiency = Aggregate market value changes divided by the Aggregate realized CEO pay;

Aggregate realized CEO pay = the sum of TOTAL_ALT2 in ExecuComp (TDC2 in an earlier version of the database) over CEO tenure plus value of exercisable in-the-money stock options outstanding at the end of CEO tenure;

Average nominal CEO pay = Aggregate nominal CEO pay/Tenure;

Average realized CEO pay = Aggregate realized CEO pay/Tenure;

(continued on next page)

TABLE 5 (continued)

Pay-for-performance sensitivity = median of a number of pay-for-performance sensitivity calculated at the beginning of each year during CEO tenure. I calculate *Pay-for-performance sensitivity* using Core and Guay's (1999) method;

Sales = median of the company sales (Compustat data item SALE or #12) over CEO tenure;

Book-to-market ratio = median of the book value of equity (Compustat data item CEQ or #60) divided by the market value of equity (Compustat data item PRCC_F or #199 * Compustat data item CSHO or #25) over CEO tenure;

Risk = standard deviation of the idiosyncratic component of daily stock prices constructed from residuals from a standard CAPM regression;

CEO-chairman = dummy variable equal to 1 if a CEO is also the chairman of the board, and 0 otherwise;

Tenure = days between the date of becoming a CEO and the date of leaving the office, divided by 365; and

Entrenchment index = CEO entrenchment index calculated using [Bebchuk et al.'s \(2009\)](#) method.

TABLE 6
Regression of Shareholder Value Added on Nominal CEO Pay

Variable	Expected Sign	Log(Aggregate market value changes)	Log(Average market value changes)	Cumulative abnormal stock return	Average abnormal stock return
<i>Log(Aggregated nominal CEO pay)</i>	(+)	1.86*** (0.65)		0.34*** (0.15)	
<i>Log(Average nominal CEO pay)</i>	(+)		1.63*** (0.61)		0.24*** (0.06)
<i>Log(sales)</i>	(?)	0.37 (0.51)	0.40 (0.47)	0.29** (0.13)	0.13** (0.06)
<i>Book-to-market ratio</i>	(-)	-4.46** (2.25)	-4.52** (2.09)	-2.05*** (0.55)	-0.77*** (0.24)
<i>Log(Risk)</i>	(?)	-8.63*** (1.47)	-8.00** (1.37)	1.62*** (0.35)	0.48*** (0.15)
<i>CEO-chairman</i>	(?)	1.77 (1.21)	1.67* (1.12)	0.02 (0.30)	0.03 (0.13)
<i>Log(Tenure)</i>	(+)	4.62*** (0.74)	5.36*** (0.80)	0.32** (0.16)	0.12** (0.06)
<i>Entrenchment index</i>	(-)	-0.70* (0.43)	-0.63** (0.40)	-0.04 (0.10)	-0.06 (0.05)
Industry effects		Yes	Yes	Yes	Yes
Year effects		Yes	Yes	Yes	Yes
Adj. R ²		0.19	0.17	0.15	0.12

*, **, *** Represent significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed).

This table presents log linear regression results of the following equation:

$\text{Shareholder value added} = \beta_0 + \beta_1 \text{CEO realized pay} + \beta_2 \text{Sales} + \beta_3 \text{Book-to-market ratio} + \beta_4 \text{Risk} + \beta_5 \text{CEO-chairman} + \beta_6 \text{Tenure} + \beta_7 \text{Entrenchment index} + \gamma \text{Industry effects} + \delta \text{Year effects} + \varepsilon$.

The dependent variable, *Shareholder value added*, is proxied by four variables, *Aggregate market value changes*, *Average market value changes*, *Cumulative abnormal stock return*, and *Average abnormal stock return*. Because the variables *Aggregate market value changes* and *Average market value changes* have skewed distributions, I take logarithm transformations on them. For negative values, the transformed value = $(-1) * \text{Log}(\text{absolute value of the variable})$. The industry effects are captured by industry dummies. Industry is defined based on Fama and French's 48-industry classification. The year effects are captured by year dummies created for the year in which median pay-for-performance sensitivity is taken over CEO tenure.

Variable Definitions:

Aggregate market value changes = changes in market capitalization plus dividends paid over CEO tenure;

Average market value changes = *Aggregate market value changes* divided by *Tenure*;

Cumulative abnormal stock return = sum of monthly abnormal stock returns over CEO tenure. Abnormal stock return is calculated from the CAPM model;

Average abnormal stock return = *Cumulative abnormal stock return* divided by *Tenure*;

Aggregate nominal CEO pay = sum of TOTAL_ALT1 in ExecuComp (TDC1 in an earlier version of the database) over CEO tenure;

Average nominal CEO pay = *Aggregate nominal CEO pay*/*Tenure*;

Sales = median of the company sales (Compustat data item SALE or #12) over CEO tenure;

Book-to-market ratio = median of the book value of equity (Compustat data item CEQ or #60) divided by the market value of equity (Compustat data item PRCC_F or #199 * Compustat data item CSHO or #25) over CEO tenure;

Risk = standard deviation of the idiosyncratic component of daily stock prices (constructed from residuals from a standard CAPM regression);

CEO-chairman = dummy variable equal to 1 if a CEO is also the chairman of the board, and 0 otherwise;

Tenure = days between the date of becoming a CEO and the date of leaving the office divided by 365; and

Entrenchment index = CEO entrenchment index calculated using the [Bebchuk et al. \(2009\)](#) method.

changes. Also, longer Tenure has a positive effect on shareholder value creation. As evidenced by the negative coefficients on regression in both samples, CEO entrenchment has a negative impact on value creation.

The third and fourth columns present the results of regressions when the dependent variables are cumulative or average abnormal stock return, respectively. The results are similar to the results in the first two columns. That is, nominal CEO compensation positively correlates with abnormal stock returns. The coefficients of Risk present one large difference between the first two columns and the last two columns. While Risk negatively relates to the size of Shareholder value added, it positively relates to abnormal stock return. Thus, the association of high risk and high return is only valid when shareholder return is measured in percentage terms, not in absolute dollar terms. Overall, the results suggest that aggregate nominal CEO compensation is positively associated with aggregate Shareholder value added, which is consistent with H1.

Realized CEO Pay and Shareholder Value Added

Table 7 reports the results for regressions of Shareholder value added on CEO pay and control variables. The first two columns report the results from the log linear regression of aggregate (average) shareholder value added as a function of realized CEO pay. The logarithm transformation is widely used in executive compensation (Murphy 1999). The purpose of the transformation is to reduce the skewed distribution of the dependent variables. A mechanical log transformation will eliminate those observations with negative market value changes. To avoid losing observations, I first take the logarithm of the absolute value of Shareholder value added. Next, I assign the transformed value to be the log value multiplied by (-1) for negative Shareholder value added.

The results in the first two columns show that the coefficient on realized CEO pay is positive and significant, indicating that CEO compensation increases shareholder value creation. Specifically, a 1 percent increase in realized CEO pay is associated with the 3–4 percent increase in Shareholder value added. The third and fourth columns present the results of regressions when the dependent variables are cumulative and average abnormal stock return, respectively. The results are similar to the results of the first two columns. That is, realized CEO compensation positively correlates with abnormal stock returns. These findings are consistent with H2.

The relationships between Shareholder value added variables and control variables are similar to those reported in Table 6. Growth opportunities (measured with Book-to-market ratio) are positively associated with market value changes. Idiosyncratic Risk is significantly and negatively correlated with Aggregate market value changes, but positively associated with abnormal stock returns.

One alternative interpretation of results in Table 7 is that the relationship between market value changes and CEO realized pay is mechanical. For instance, if an exogenous shock to the firm increases stock price, then the CEO's realized pay will also increase. In other words, CEOs can be paid for pure luck without doing anything for shareholders (Bertrand and Mullainathan 2001). However, I argue that the positive relationship between aggregate market value change and aggregate realized CEO pay is evidence of pay-for-performance for three reasons. First, the relationship exists over CEO tenure of eight years, on average. While a CEO may be compensated for good luck in one year, it is not likely for him to receive windfalls for eight continual years. Second, CEOs are paid to manage the exogenous shocks and are expected to take actions to manage the shocks. For instance, if we compare managerial actions with regard to oil prices in the airline industry, we can easily identify Southwest Airlines as the best company in managing exposure to exogenous oil price shocks. Tibken (2008) reports that one major value driver of Southwest is its hedging activities. It is no wonder that Southwest managers are paid more than their counterparts at other airlines. Third, most stock options will not expire until ten years after the grant date. CEOs

TABLE 7
Regression of Shareholder Value Added on Ex Post Realized CEO Pay

Variable	Expected Sign	Log(Aggregate market value changes)	Log(Average market value changes)	Cumulative abnormal stock return	Average abnormal stock return
<i>Log(Aggregated realized CEO pay)</i>	(+)	3.92*** (0.53)		0.90*** (0.13)	
<i>Log(Average realized CEO pay)</i>	(+)		3.55*** (0.49)		0.20*** (0.06)
<i>Log(Sales)</i>	(?)	-0.56 (0.47)	-0.46 (0.44)	-0.01 (0.12)	-0.05 (0.05)
<i>Book-to-market ratio</i>	(-)	-4.60** (2.19)	-4.28** (2.05)	-1.09** (0.57)	-0.54** (0.25)
<i>Log(Risk)</i>	(?)	-8.83*** (1.36)	-8.21** (1.27)	1.39*** (0.35)	0.43*** (0.16)
<i>CEO-chairman</i>	(?)	1.28 (1.16)	1.21* (1.08)	0.02 (0.31)	0.01 (0.13)
<i>Log(Tenure)</i>	(+)	3.56*** (0.72)	6.28*** (0.71)	0.30*** (0.07)	0.03*** (0.08)
<i>Entrenchment index</i>	(-)	-0.59 (0.42)	-0.54 (0.39)	-0.05 (0.10)	-0.07 (0.05)
Industry effects		Yes	Yes	Yes	Yes
Year effects		Yes	Yes	Yes	Yes
Adj. R ²		0.22	0.21	0.19	0.14

*, **, *** Represent significance levels at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed).

This table presents log linear regression results of the following equation:

Shareholder value added = $\beta_0 + \beta_1 \text{CEO realized pay} + \beta_2 \text{Sales} + \beta_3 \text{Book-to-market ratio} + \beta_4 \text{Risk} + \beta_5 \text{CEO-chairman} + \beta_6 \text{Tenure} + \beta_7 \text{Entrenchment index} + \gamma \text{Industry effects} + \delta \text{Year effects} + \varepsilon$.

The dependent variable, *Shareholder value added*, is proxied by four variables, *Aggregate market value changes*, *Average market value changes*, *Cumulative abnormal stock return*, and *Average abnormal stock return*. Because the variables *Aggregate market value changes* and *Average market value changes* have skewed distributions, I take logarithm transformations on them. For negative values, the transformed value = $(-1) * \text{Log}(\text{absolute value of the variable})$. The industry effects are captured by industry dummies. Industry is defined based on Fama and French's 48-industry classification. The year effects are captured by year dummies created for the year in which median pay-for-performance sensitivity is taken over CEO tenure.

Variable Definitions:

Aggregate market value changes = changes in market capitalization plus dividends paid over CEO tenure;

Average market value changes = *Aggregate market value changes* divided by *Tenure*;

Cumulative abnormal stock return = sum of monthly abnormal stock returns over CEO tenure. Abnormal stock return is calculated from the CAPM model;

Average abnormal stock return = *Cumulative abnormal stock return* divided by *Tenure*;

Aggregate realized CEO pay = sum of TOTAL_ALT2 in ExecuComp (TDC2 in an earlier version of the database) over CEO tenure plus value of exercisable in-the-money stock options outstanding at the end of CEO tenure;

Average realized CEO pay = *Aggregate realized CEO pay*/*Tenure*;

Sales = median of the company sales (Compustat data item SALE or #12) over CEO tenure;

Book-to-market ratio = median of the book value of equity (Compustat data item CEQ or #60) divided by the market value of equity (Compustat data item PRCC_F or #199 * Compustat data item CSHO or #25) over CEO tenure;

Risk = standard deviation of the idiosyncratic component of daily stock prices (constructed from residuals from a standard CAPM regression);

CEO-chairman = dummy variable equal to 1 if a CEO is also the chairman of the board, and 0 otherwise;

Tenure = days between the date of becoming a CEO and the date of leaving the office divided by 365; and

Entrenchment index = CEO entrenchment index calculated using the [Bebchuk et al. \(2009\)](#) method.

have the opportunity (time) to create shareholder value before they exercise stock options. A benign CEO can, thus, enrich himself more by creating more shareholder value. As long as the compensation system results in CEOs getting rich while enriching shareholders, it is a fair compensation system. Because the positive relationship between realized CEO pay and shareholder value added is evidence of the alignment of interests between CEOs and shareholders, I do not and cannot conclude that the high CEO pay caused the high performance.

Pay-for-Performance Sensitivity and Shareholder Value Added

Table 8 reports the results from log linear regressions of Shareholder value added on CEO pay-for-performance. The results show that Pay-for-performance sensitivity has positive and significant effects on Aggregate market value changes and abnormal returns. Unreported results show that Pay-for-performance sensitivity alone can explain 6 percent to 8 percent of the variation in Aggregate market value changes and abnormal returns. A 10 percent change in Pay-for-performance sensitivity is associated with 26.2 percent change in Aggregate market value changes or 43.9 percent change in average market value changes. These findings provide support for H3.

Among control variables, results show that larger firms earn lower abnormal stock returns. Idiosyncratic Risk has a significant and negative effect on the size of market value changes, but has a significant and positive effect on abnormal returns. CEO Tenure has a positive and significant effect on the size of market value changes, but has an insignificant effect on abnormal returns. Management entrenchment has a negative, but insignificant or marginally significant, effect on abnormal returns.

***Ex Ante* Incentives and CEO Pay Efficiency**

While prior analyses show that CEO pay is generally effective at motivating CEOs to increment shareholder value, the results show no evidence for the efficiency of CEO pay and determinants of the efficiency. Business press often discusses whether CEO pay generates positive returns to shareholders. To examine the efficiency of CEO pay, I create a measure of CEO pay efficiency which is equal to the aggregate shareholder value added divided by aggregate CEO pay. I consider Pay-for-performance sensitivity as the key determinant of CEO pay efficiency.

Table 9 reports the results of log linear regressions of CEO pay efficiency on Pay-for-performance sensitivity. The results show that Pay-for-performance sensitivity is positively and significantly related to both nominal and realized CEO pay efficiency. A 10 percent increase in Pay-for-performance sensitivity will lead to a 2.1 percent (1.4 percent) increase in nominal (realized) CEO pay efficiency. These findings are consistent with H4. The results also show that larger firms, or firms with more growth opportunities, have high pay efficiency. On the other hand, riskier firms have lower pay efficiency.

CONCLUSION

Core et al. (2003) and Devers et al. (2007) review an extensive body of literature on equity compensation, and both conclude that despite considerable research, the effectiveness of executive compensation remains an open question. The recent financial crisis stirs a controversial debate on executive compensation in the media. As a result, Congress is likely to experience increased pressure to enact even tighter regulation on executive compensation. However, most concerns about executive compensation could be alleviated if high levels of CEO pay and high pay-for-performance sensitivity lead to higher shareholder return. Thus, we need definite answers to the question of whether executive compensation has the desired effect on shareholder value; otherwise, any regulation constraining executive compensation will distort and weaken executives' incentives to

TABLE 8
Regression of Shareholder Value Added on Ex Ante Pay-for-Performance Sensitivity

Variable	Expected Sign	Log(Aggregate market value changes)	Log(Average market value changes)	Cumulative abnormal stock return	Average abnormal stock return
<i>Log(Pay-for-performance sensitivity)</i>	(+)	2.62*** (0.57)	4.39*** (1.53)	0.25*** (0.05)	0.04*** (0.01)
<i>Log(Sales)</i>	(?)	-0.66 (0.49)	0.78* (0.45)	-0.08** (0.04)	-0.02** (0.01)
<i>Book-to-market ratio</i>	(-)	4.06* (2.39)	3.77* (2.22)	0.10 (0.21)	0.05 (0.04)
<i>Log(Risk)</i>	(?)	-4.71*** (1.09)	-7.24*** (1.33)	0.45*** (0.12)	0.07*** (0.02)
<i>CEO-chairman</i>	(-)	-1.85* (1.09)	-1.89* (1.11)	-0.08 (0.10)	-0.01 (0.02)
<i>Log(Tenure)</i>	(+)	4.73*** (0.72)	3.81*** (0.66)	0.06 (0.09)	0.02 (0.02)
<i>Entrenchment index</i>	(-)	-0.57 (0.42)	-0.68* (0.40)	-0.03 (0.04)	-0.02** (0.01)
Industry effects		Yes	Yes	Yes	Yes
Year effects		Yes	Yes	Yes	Yes
Adj. R ²		0.19	0.17	0.12	0.10

*, **, *** Represent significance levels at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed).

This table presents log linear regression results of the following equation:

$$\text{Shareholder value added} = \beta_0 + \beta_1 \text{Pay-for-performance sensitivity} + \beta_2 \text{Sales} + \beta_3 \text{Book-to-market ratio} + \beta_4 \text{Risk} + \beta_5 \text{CEO-chairman} + \beta_6 \text{Tenure} + \beta_7 \text{Entrenchment index} + \gamma \text{Industry effects} + \delta \text{Year effects} + \varepsilon.$$

The dependent variable, *Shareholder value added*, is proxied by four variables, *Aggregate market value changes*, *Average market value changes*, *Cumulative abnormal stock return*, and *Average abnormal stock return*. Because the variables *Aggregate market value changes* and *Average market value changes* have skewed distributions, I take logarithm transformations on them. For negative values, the transformed value = $(-1) * \text{Log}(\text{absolute value of the variable})$. The industry effects are captured by industry dummies. Industry is defined based on Fama and French's 48-industry classification. The year effects are captured by year dummies created for the year in which median pay-for-performance sensitivity is taken over CEO tenure. The sample comprises 1,039 CEOs whose tenure began after January 1, 1992, and ended before December 31, 2007, and whose tenure was equal to or longer than two years. Standard errors are in parentheses.

Variable Definitions:

Aggregate market value changes = changes in market capitalization plus dividends paid over CEO tenure;

Average market value changes = *Aggregate market value changes* divided by *Tenure*;

Cumulative abnormal stock return = sum of monthly abnormal stock returns over CEO tenure. Abnormal stock return is calculated with the CAPM model;

Average abnormal stock return = *Cumulative abnormal stock return* divided by *Tenure*;

Pay-for-performance sensitivity = median of a number of pay-for-performance sensitivity calculated at the beginning of each year during CEO tenure. I calculate pay-for-performance sensitivity using [Core and Guay's \(1999\)](#) method;

Sales = median of the company sales (Compustat data item SALE or #12) over CEO tenure;

Book-to-market ratio = median of the book value of equity (Compustat data item CEQ or #60) divided by the market value of equity (Compustat data item PRCC_F or #199 * Compustat data item CSHO or #25) over CEO tenure;

Risk = standard deviation of the idiosyncratic component of daily stock prices (constructed from residuals from a standard CAPM regression);

CEO-chairman = dummy variable equal to 1 if a CEO is also the chairman of the board, and 0 otherwise;

Tenure = days between the date of becoming a CEO and the date of leaving the office divided by 365; and

Entrenchment index = CEO entrenchment index calculated using the [Bebchuk et al. \(2009\)](#) method.

TABLE 9
Regression of CEO Pay Efficiency on CEO Compensation

Variable	Expected Sign	Log(Nominal CEO pay efficiency)	Log(Realized CEO pay efficiency)
Log(Pay-for-performance sensitivity)	(+)	0.21*** (0.06)	0.14*** (0.04)
Log(Sales)	(?)	0.20** (0.10)	0.14** (0.16)
Book-to-market ratio	(-)	1.77*** (0.51)	1.94*** (0.58)
Log(Risk)	(?)	-2.29*** (0.30)	-1.26*** (0.23)
CEO-chairman	(-)	-0.48* (0.26)	-0.17 (0.21)
Log(Tenure)	(+)	0.89*** (0.15)	0.83*** (0.11)
Entrenchment index	(-)	-0.17* (0.09)	-0.22* (0.13)
Industry effects		Yes	Yes
Year effects		Yes	Yes
Adj. R ²		0.25	0.19

*, **, *** Represent significance levels at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed).

This table presents log linear regression results of the following equation:

$$\text{CEO pay efficiency} = \beta_0 + \beta_1 \text{CEO compensation} + \beta_2 \text{Sales} + \beta_3 \text{Book-to-market ratio} + \beta_4 \text{Risk} + \beta_5 \text{CEO-chairman} + \beta_6 \text{Tenure} + \beta_7 \text{Entrenchment index} + \gamma \text{Industry effects} + \delta \text{Year effects} + \varepsilon.$$

The industry effects are captured by industry dummies. Industry is defined based on Fama and French's 48-industry classification. The year effects are captured by year dummies created for the year in which median pay-for-performance sensitivity is taken over CEO tenure.

Variable Definitions:

Nominal CEO pay efficiency = Aggregate market value changes divided by the sum of *Nominal CEO pay*;

Nominal CEO pay = TOTAL_ALT1 in ExecuComp (TDC1 in an earlier version of the database) over CEO tenure;

Realized CEO pay efficiency = Aggregate market value changes divided by the *Aggregate realized CEO pay*;

Aggregate realized CEO pay = sum of TOTAL_ALT2 in ExecuComp (TDC2 in an earlier version of the database) over CEO tenure plus value of exercisable in-the-money stock options outstanding at the end of CEO tenure;

Aggregate market value changes = changes in market capitalization plus dividends paid over CEO tenure. Because the variables *Nominal CEO pay efficiency* and *Realized CEO pay efficiency* have skewed distribution, I take logarithm transformation on them. For negative values, the transformed value = $(-1) * \text{Log}(\text{absolute value of the variable})$;

Aggregate realized CEO pay = sum of TOTAL_ALT2 in ExecuComp (TDC2 in an earlier version of the database) over CEO tenure. TOTAL_ALT2 itself is the sum of the following annual data items in ExecuComp: Salary, Bonus, Other Annual, Total Value of Restricted Stock Granted, Net Value of Stock Options Exercised, Long-Term Incentive Payouts, and All Other Total;

Pay-for-performance sensitivity = median of a number of pay-for-performance sensitivity calculated at the beginning of each year during CEO tenure. I calculate pay-for-performance sensitivity using the [Core and Guay \(1999\)](#) method;

Sales = median of the company sales (Compustat data item SALE or #12) over CEO tenure;

Book-to-market ratio = median of the book value of equity (Compustat data item CEQ or #60) divided by the market value of equity (Compustat data item PRCC_F or #199 * Compustat data item CSHO or #25) over CEO tenure;

Risk = standard deviation of the idiosyncratic component of daily stock prices (constructed from residuals from a standard CAPM regression);

CEO-chairman = dummy variable equal to 1 if a CEO is also the chairman of the board, and 0 otherwise;

Tenure = days between the date of becoming a CEO and the date of leaving the office divided by 365; and

Entrenchment index = CEO entrenchment index calculated using the [Bebchuk et al. \(2009\)](#) method.

deliver long-term performance. Therefore, carefully designed research on the effectiveness and efficiency of CEO compensation is timely and relevant.

The purpose of this study is to apply a novel research design to examine the association between CEO compensation and shareholder value added over the CEO tenure. The idea of linking CEO compensation and shareholder value added over CEO tenure stems from an application of two fundamental features of CEO compensation and the shareholder value added. First, both CEO compensation and shareholder value added aggregate naturally over CEO tenure. Second, measuring the two variables over long time horizons minimizes the measurement errors in both variables. Therefore, aggregate shareholder value more likely reflects the incentive effects of CEO compensation. This research design increases the construct and internal validity of the empirical tests.

I utilize a sample of CEOs whose tenure began during or after 1992 and ended during or before 2007. I measure CEO compensation with *ex post* realized pay and *ex ante* pay-for-performance sensitivity. I measure shareholder value added with market value changes and abnormal stock returns. All variables are aggregated over CEO tenure. First, I document that aggregate CEO pay is 1 percent to 2 percent of aggregate market value changes. Through the regression analysis, I find that aggregate nominal or realized CEO pay is positively and significantly correlated with aggregate market value changes. Furthermore, I find that median pay-for-performance sensitivity over CEO tenure is positively and significantly correlated with cumulative abnormal stock returns. In addition, I find that CEO pay efficiency is highly associated with pay-for-performance sensitivity. The results suggest that CEOs earning their pay while creating value for shareholders is a pervasive phenomenon.

One limitation of this study arises because CEO compensation is endogenous. It is correlated with a large number of observable and unobservable company and CEO characteristics. The observed association between CEO compensation and shareholder value added may be due to compensation effects on firm performance, performance effects on compensation, or the effects of unobserved firm or CEO characteristics on both variables. For instance, rather than higher equity incentives producing better future firm performance, it may be the case that firms expecting better future performance grant more equity incentives (e.g., [Yermack 1997](#)). In addition, I have not included all possible confounding variables that might otherwise explain the relationship between CEO compensation and shareholder value added.

REFERENCES

- Abowd, J. M. 1990. Does performance-based managerial compensation affect corporate performance? *Industrial and Labor Relations Review* 43 (3): 52–73.
- Aggarwal, R. K., and A. A. Samwick. 1999. The other side of the tradeoff: The impact of risk on executive compensation. *Journal of Political Economy* 107 (1): 65–105.
- Anderson, M., and V. Muslu. 2010. *What Do CEOs Realize from Option Pay?* Working paper, The University of Texas at Dallas.
- Arya, A., J. C. Fellingham, and D. A. Schroeder. 2004. Aggregation and measurement errors in performance evaluation. *Journal of Management Accounting Research* 16: 93–105.
- Baker, G., and B. Hall. 2004. CEO incentives and firm size. *Journal of Labor Economics* 22 (4): 767–798.
- Bebchuk, L. A. 2009. Congress gets punitive on executive pay. *Wall Street Journal* (Feb 16): A17.
- Bebchuk, L. A., A. Cohen, and A. Ferrell. 2009. What matters in corporate governance? *Review of Financial Studies* 22 (2): 783–827.
- Bebchuk, L. A., and J. Fried. 2004. *Pay without Performance: The Unfulfilled Promise of Executive Compensation*. Boston, MA: Harvard University Press.

- Bergstresser, D., and T. Philippon. 2006. CEO incentives and earnings management. *Journal of Financial Economics* 80 (3): 511–529.
- Berle, A. A., and G. G. Means. 1932. *The Modern Corporation and Private Property*. New York, NY: Harcourt.
- Bertrand, M., and S. Mullainathan. 2001. Are CEOs rewarded for luck? The ones without principals are. *Quarterly Journal of Economics* 116 (3): 901–932.
- Black, F., and M. Scholes. 1973. The pricing of options, and corporate liabilities. *Journal of Political Economy* 81 (3): 637–659.
- Brockman, P., X. Martin, and E. Unlu. 2010. Executive compensation and the maturity structure of corporate debt. *Journal of Finance* 65 (3): 1123–1161.
- Brookman, J., and P. D. Thistle. 2009. CEO tenure, the risk of termination and firm value. *Journal of Corporate Finance* 15 (3): 315–330.
- Burns, N., and S. Kedia. 2006. The impact of performance-based compensation on misreporting. *Journal of Financial Economics* 79 (1): 35–67.
- Cooper, M. J., H. Gulen, and P. R. Rau. 2011. *The Cross Section of Stock Returns and Incentive Pay*. Working paper, Purdue University.
- Core, J. E., and W. Guay. 1999. The use of equity grants to manage optimal equity incentive levels. *Journal of Accounting and Economics* 28 (2): 151–184.
- Core, J. E., and W. Guay. 2002. Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. *Journal of Accounting Research* 40 (3): 613–630.
- Core, J. E., W. R. Guay, and D. F. Larcker. 2003. Executive equity compensation and incentives: A survey. *FRRBNY Economic Policy Review* 9 (1): 27–50.
- Core, J. E., R. W. Holthausen, and D. E. Larcker. 1999. Corporate governance, chief executive compensation, and firm performance. *Journal of Financial Economics* 51 (3): 371–406.
- Core, J. E., and D. F. Larcker. 2002. Performance consequences of mandatory increases in executive stock ownership. *Journal of Financial Economics* 64 (3): 317–340.
- Dechow, P., and R. Sloan. 1994. Executive incentives and the horizon problem. *Journal of Accounting and Economics* 14 (1): 51–89.
- Demsetz, H., and K. Lehn. 1985. The structure of corporate ownership: Causes and consequences. *Journal of Political Economy* 93 (6): 1155–1177.
- Devers, C. E., G. P. Reilly, and M. E. Yoder. 2007. Executive compensation: A multidisciplinary review of recent developments. *Journal of Management* 33 (6): 1016–1072.
- Easton, P., T. Harris, and J. Ohlson. 1992. Aggregate accounting earnings can explain most of security returns: The case of long event windows. *Journal of Accounting and Economics* 15 (2/3): 119–142.
- Edmans, A., X. Gabaix, and A. Landier. 2009. A multiplicative model of optimal CEO incentives in market equilibrium. *Review of Financial Studies* 22 (12): 4881–4917.
- Fama, E. F. 1980. Agency problems and the theory of the firm. *Journal of Political Economy* 88 (2): 288–307.
- Fong, E. A., V. Misangyi, and H. L. Tosi. 2010. The effect of CEO pay deviations on CEO withdrawal, firm size, and firm profits. *Strategic Management Journal* 31 (6): 629–651.
- Forbes. 1998. Did they earn it? *Forbes* 161 (May 18): 232.
- Gaver, J. J., and M. C. Gaver. 1993. Additional evidence on the association between investment opportunity set and corporate financing, dividend, and compensation policies. *Journal of Accounting and Economics* 16 (1/3): 127–260.
- Gompers, P. A., J. L. Ishii, and A. Metrick. 2003. Corporate governance and equity prices. *Quarterly Journal of Economics* 118 (1): 107–155.
- Graham, J. R., C. R. Harvey, and S. Rajgopal. 2005. The economic implications of corporate financial reporting. *Journal of Accounting and Economics* 40 (1/3): 3–73.
- Habib, M., and A. Ljungqvist. 2005. Firm value and managerial incentives: A stochastic frontier approach. *Journal of Business* 78 (6): 2053–2094.
- Hall, B. K., and J. B. Liebman. 1998. Are CEOs really paid like bureaucrats? *Quarterly Journal of Economics* 113 (3): 653–691.

- Hanlon, M., S. Rajgopal, and T. Shevlin. 2003. Are executive stock options associated with future earnings? *Journal of Accounting and Economics* 36 (1/3): 3–43.
- Himmelberg, C. P., R. G. Hubbard, and D. Palia. 1999. Understanding the determinants of managerial ownership and the link between ownership and performance. *Journal of Financial Economics* 53 (3): 353–384.
- Jensen, M. C., and W. Meckling. 1976. Theory of the firm: Managerial behavior, agency costs, and ownership structure. *Journal of Financial Economics* 3 (4): 305–360.
- Jensen, M. C., and K. J. Murphy. 1990. Performance pay and top-management incentives. *Journal of Political Economy* 98 (2): 225–264.
- Jensen, M. C., K. J. Murphy, and E. G. Wruck. 2004. Remuneration: Where we've been, how we got to here, what are the problems, and how to fix them? *Harvard NOM Working Paper No. 04-28*.
- Kaplan, S. 2008. Are U.S. CEOs overpaid? A response to Bogle and Walsh. *Academy of Management Perspectives* 22 (3): 28–34.
- Kaplan, S., and J. Rauh. 2010. Wall Street and Main Street: What contributes to the rise in the highest income? *Review of Financial Studies* 23 (3): 1004–1050.
- Kole, S. R. 1997. The complexity of compensation contracts. *Journal of Financial Economics* 43 (1): 79–104.
- Larcker, D. F. 2003. Discussion of: Are executive stock options associated with future earnings. *Journal of Accounting and Economics* 36 (1/3): 91–103.
- Leone, A., J. Wu, and J. Zimmerman. 2006. Asymmetric sensitivity of CEO cash compensation to stock returns. *Journal of Accounting and Economics* 42 (1/2): 167–192.
- Lev, B. 2001. *Intangibles: Management, Measurement, and Reporting*. Washington, D.C.: Brookings Institution Press.
- Mehran, H. 1995. Executive compensation structure, ownership, and firm performance. *Journal of Financial Economics* 38 (2): 163–184.
- Murphy, K. J. 1999. Executive compensation. In *Handbook of Labor Economics*, edited by Ashenfelter, O., and D. Card, 2485–2563. Amsterdam, The Netherlands: North Holland.
- Murphy, K. J. 2010. *Executive Pay Restrictions for TARP Recipients: An Assessment*. Working paper, University of Southern California.
- Murphy, K. J., and J. Zabochnik. 2007. *Managerial Capital and the Market for CEOs*. Working paper, University of Southern California.
- Narayanan, M. P. 1985. Managerial incentives for short-term results. *Journal of Finance* 40 (5): 1469–1484.
- Smith, C. W., and R. L. Watts. 1992. The investment opportunity set and corporate financing, dividend, and compensation policies. *Journal of Financial Economics* 32 (3): 263–292.
- Tibken, S. 2008. Fuel hedging helps Southwest post 15% rise in net profit. *Wall Street Journal* (July 24): B1.
- Yermack, D. 1997. Good timing: CEO stock option awards and company news announcement. *Journal of Finance* 52 (2): 449–476.

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