What death can tell:
Are executives paid for their contributions to firm value?*

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Abstract

Using stock price reactions to sudden deaths of top executives as a measure of expected contribution to shareholder value, we examine the relationship between executive pay and managerial contribution to shareholder value. We find, first, that the managerial labor market is characterized by positive sorting: managers with high perceived contributions to shareholder value obtain higher pay. The executive pay-contribution relationship is stronger for professional executives and for executives with high compensation. We estimate, second, that an average top executive (CEO) appears to retain 71% (65%) of the marginal rent from the firm-manager relationship. We examine, third, how the executive pay-contribution relationship varies with individual, firm, and industry characteristics. Overall, our results are informative for the ongoing discussion about the level of executive compensation.

Keywords: Executive compensation; Managerial ability; Sudden death; Corporate governance; Value of top executive

JEL Classifications: G3; G30

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Few topics in financial economics rival executive compensation in the degree of interest they elicit from academia, media, policymakers, and the general public. Is executive pay related to executives' contribution to firm value? Are CEOs' contributions to shareholder value sufficient to offset their pay? Despite a rich literature on the subject, these important questions remain open avenues for research. Using the stock price reaction to sudden deaths as a measure of expected contribution to shareholder value, this paper examines the relationship between executive pay and contribution to shareholder value. We find that managers with high perceived contributions to shareholder value obtain higher pay. We estimate that top executives (CEOs) retain 71% (65%) of the marginal rent from the firm-manager relationship.

Theories of wage determination commonly suggest that the level of pay is set by a bargaining process between the manager and the firm. The equilibrium pay level must satisfy both parties' participation constraints and allow a split of quasi-rents according to the relative bargaining power of the participants (Lazear and Rosen, 1981; Harris and Holmstrom, 1982; Rosen, 1992).

In the growing literature on executive compensation, surprisingly, few studies have attempted to measure whether and to what extent top executives' pay levels are set as a function of their contributions to shareholder value. One obvious explanation for the scant empirical evidence is that an executive's contribution to shareholder value is empirically hard to observe, let alone identify. We use stock price reactions to exogenous (albeit tragic) events—sudden deaths of executives—to identify executives' perceived contributions to shareholder value, and examine the relationship between perceived contribution and pay. The intuition behind this approach is that the stock price reaction to sudden deaths equals the expected value of the deceased executive's contribution net of compensation relative to the expected replacement. Our methodology extends a line of investigation found in Johnson et al. (1985), who use sudden deaths to identify managerial contribution to firm value. Although several recent papers make

use of the event of sudden death, no prior studies use the methodology to test whether executives are paid for their contribution to shareholder value along the lines we propose.

We collect data on the events of the sudden deaths of 149 top executives in the U.S. between 1991 and 2008. We examine the relationship between executives' perceived contribution to shareholder value measured by the stock price reaction to sudden death and abnormal compensation. Abnormal pay is measured as the deceased executive's actual compensation minus the expected compensation of the replacement. We focus on abnormal compensation because the stock price reaction reflects the difference between the deceased's and the replacement's perceived contributions to shareholder value net of pay. The replacement's expected pay is estimated from a regression of total compensation on firm size, year, and industry effects; while the deceased's abnormal pay is the residual from this regression. We infer the fraction of the rent captured by executives from a regression of stock price reaction to sudden death on the deceased executives' expected abnormal compensation.[1]

Our analysis reveals a negative and significant relationship between the stock price reaction to sudden deaths and the deceased executive's expected abnormal compensation. Thus, executives who receive large compensation are perceived to be more valuable to shareholders. The relationship is stronger for professional executives and for executives at the top of the distribution of pay, which is consistent with a labor market driven by rare managerial talent.

From the relationship between perceived contribution to value and expected abnormal compensation, we elicit an estimate of how rent is shared between executives and shareholders. Our estimate indicates that an average top executive keeps 71% of the marginal rent. The estimate of the executive's fraction of rent has a 95% confidence interval from 59% to 88%. We estimate that an average CEO keeps 65% of the rent and from 52% to 85% of the rent with a

[1] Expected abnormal compensation equals abnormal compensation multiplied by expected tenure and scaled by market capitalization. In a previous version of the paper, we obtain similar results when we analyze the relationship between total compensation and stock price reaction. Section III. A provides the rationale for the use of abnormal compensation.

95% confidence interval. The relationship between top executives' abnormal pay and contribution varies with individual, firm, and industry characteristics.

The relationship between perceived contribution to value and expected abnormal compensation is also informative about the variation in the magnitude of surpluses executives bring to firms. This question is interesting because it sheds light on whether executives matter for value creation. Our approach suggests that the standard deviation on differences in skills across executives equals 5.6% of firm value, and ranges from 5.1% to 6.4% with a 95% confidence interval. The estimate is upward biased because our method attributes all variation in abnormal returns around sudden deaths to differences in skills across executives. Thus, the 5.6% estimate is an upper bound on how much executives matter. In comparison, Bertrand and Schoar (2003) estimate manager-specific fixed effects in annual profitability and find a 7% standard deviation in fixed effects across managers. Taylor (2010, 2013) use structural models and find standard deviations in prior beliefs about managers' effect on profitability of 2.4% and 4.1% of assets, respectively. Our estimate of the standard deviation of differences in skills across executives of 5.6% indicates that executives do matter for firm value.

Our estimates of how rent is shared are remarkably consistent across empirical specifications. The fraction of rent to executives varies from 68.6% to 73.3% when we alter the control variables and the measure of compensation. At first glance, our estimate of rent sharing appears large. However, our estimate of rent sharing is lower than expected under the skimming view on executive pay, according to which powerful CEOs receive more than 100% of the marginal rent from the firm-manager relationship. Our estimate of rent sharing is more in line with the literature on optimal contracting (Gabaix and Landier, 2008), according to which the executive receives a fraction of the marginal rent. Moreover, our estimate of rent sharing is positively affected by a significant fraction of executives who are overpaid. In fact 42% (63 out of 149) of all executives have positive stock price reactions and thus receive more than 100% of

the total rents. As a result, the average rent sharing between executives and shareholders deviates from an equal sharing rule.

Our approach of eliciting rent sharing from the estimated relationship between perceived contribution to value and abnormal compensation is attractive because other potential determinants of stock price reaction to sudden deaths—such as search costs, succession plans, and uncertainty—will only affect the estimated rent sharing if they correlate with expected abnormal compensation for reasons that are unrelated to the bargaining process. A priori search costs and replacement costs will positively affect compensation because they increase the bargaining power of the executive vis-à-vis the board. In such cases, our approach will correctly find that executives receive a larger fraction of rent because of higher bargaining power. Overall, we note that the stability of the estimated rent sharing across empirical specifications bolsters our approach of eliciting an estimate of rent sharing from the relationship between stock price reactions to sudden deaths and executive compensation.

Our study contributes to the literature on executive compensation and the ongoing discussion about the level of executive pay along several lines. First, it joins a growing literature that addresses the challenging question of whether and how rent from the firm-manager relationship is shared between executives and shareholders (Gabaix and Landier, 2008; Terviö, 2008; Alder 2009; and Taylor, 2013). These studies find varying results. For example, Gabaix and Landier (2008) calibrate an assignment model between firm size and executive ability and find that CEOs capture only 2% of the value they create. Tervio (2008) finds that CEOs capture roughly 20% of the value they add to their firms. Alder (2009) relaxes the Gabaix and Landier (2008) assumption of a unity elasticity of substitution between firm quality and executive ability, and finds that CEOs might capture greater rent than the amount that Gabaix and Landier (2008) and Tervio (2008) suggest. In contrast, Taylor (2013) uses a structural model and finds that the surplus from learning is split equally between the executive and shareholders when news about

CEO ability is good, and that the CEO completely avoids the negative surplus resulting from bad news.

In comparison to the related papers that measure how surpluses are split and find varying results, our empirical strategy uses stock price reactions to sudden death to measure the expected contribution to shareholder value. The main advantage of this approach is that it offers clean identification of executive contributions and does not rely on the strong assumptions of a full structural model. Second, the estimated relationship between executive contributions and compensations is informative for the ongoing discussion of the level of executive compensation. A large body of literature argues that executive compensation is excessive. But, without a measure of executives' perceived contribution to shareholder value, an assessment of whether executive compensation is excessive is difficult. Our study contributes to this ongoing discussion by comparing a measure of executives' contribution to value to their level of pay. One potential caveat with our approach is that we rely on market perceptions of managerial contributions to shareholder value. To the extent that market perception differs from true value, our contribution is in showing that boards pay more to executives whom they think are better.

The paper proceeds as follows. Section I provides a survey of prior literature on executive compensation. Section II describes the data. Section III presents the results. Section IV provides further evidence for the interpretation. Section V reports robustness checks. Section VI concludes.

I. Prior literature on executive compensation

In theory, executive pay should be designed by the board to maximize shareholder value. Optimal contracting assumes that boards bargain at arm's length with executives over their pay. However, executive compensation remains a controversial topic, as proponents of the "skimming view" argue that some empirical facts about pay appear to contradict theoretical

predictions of optimal contracting. Prior literature has discussed the level and structure of executive pay intensively, resulting in three dominant views.

The first strand of literature studies the pay-to-performance sensitivity. Jensen and Murphy (1990) show that CEO wealth is only weakly related to firm performance. An increase of one thousand dollars in firm value leads to an average increase in CEO wealth of only three dollars. Subsequent literature provides abundant evidence of a significant increase in CEO pay in both absolute and relative terms since 1990. This increase is largely attributed to an increase in the equity and stock option component of pay, which is consistent with a better alignment of interest between managers and shareholders (Murphy, 1999; Aggarwal and Samwick, 1999; Bertrand and Mullainathan, 2001; Bebchuk and Fried, 2004; Bebchuk, Grinstein, and Peyer, 2010; Frydman and Saks, 2010; and Bebchuk, Cremers, and Peyer, 2011, among others).

Another important strand of literature explains the level and the functional form of pay as "skimming" issues. Differences in pay are, in part, attributed to entrenchment, luck, and change in social norms relating to pay (Yermack, 1997; Bertrand and Mullainathan, 2001; Bebchuk and Fried, 2004; Kuhnen and Zwiebel, 2008; and Kuhnen and Niessen, 2012, among others). According to this view, top executives have, to some extent, power and leverage to set their own pay. In particular, Bebchuk and Fried (2004) point out that many facets of compensation can be better explained as governance issues than as optimal contracting outcomes.

A third strand of the literature attributes the recent increase in the level of pay to changes in the nature and risk of the CEO's job. Gabaix and Landier (2008) show that, if we attribute the pay rise only to agency problems, an average U.S. CEO might steal 80% of his/her pay, which is implausible. Among the explanations for the recent pay rises are: increasing competition for managerial talent—both domestically and internationally (Lucas, 1978; Rosen, 1981, 1982; Frydman, 2005; Murphy and Zábojnik, 2007; Terviö, 2008; and Marin and Verdier, 2012); increasing firm size (Gabaix and Landier, 2008); increasing firm complexity (Garicano and Rossi-Hansberg, 2006); use of peer group in compensation (Bizjak, Lemmon, and Naveen, 2008; and

Hayes and Schaefer, 2009); new managerial technologies (Garicano and Rossi-Hansberg, 2006; Giannetti, 2011); and tighter governance regimes (Peters and Wagner, 2014). More recently, Fernandes et al. (2013) shed light on the increase in the level of executive pay by comparing the U.S. against 14 countries with mandated pay disclosures. They show that U.S. and non-U.S. CEO pay has largely converged in the 2000s.

Despite a rich literature on executive compensation, direct empirical evidence on whether and to what extent pay reflects executives' contribution to shareholder value is scant (Frydman and Jenter, 2010). Our paper draws inspiration from a growing body of literature that uses sudden deaths to overcome the identification issues related to the contribution of top executives to shareholder value. In a seminal paper, Johnson et al. (1985) use sudden deaths of 53 executives to estimate the value of executives' continued employment. They find positive stock price reaction to the death of founder-CEOs and negative reaction to that of professional CEOs. Later papers have applied this approach to examining the value of various CEO characteristics (Worrell et al., 1986; Slovin and Sushka, 1993; Borokhovich et al., 2006; and Salas, 2010). Bennedsen, Pérez-González, and Wolfenzon (2007) study the event of the deaths of CEOs, and of their relatives, and show that CEOs are instrumental for corporate performance. More recently, Nguyen and Nielsen (2010) use sudden deaths to estimate the value of independent directors.

Our paper is similar in spirit to two recent papers. First, it shares with Chang, Dasgupta, and Hilary (2010) a focus on the event of CEO turnovers, showing that the stock market reacts negatively when highly paid CEOs leave. Second, Taylor (2013) provides a dynamic learning model in which shareholders update their beliefs about CEO ability through past stock price performance and adjust pay accordingly. Taylor (2013) finds that the average CEO captures approximately half of surpluses from good news, and bears none of the negative surplus from bad news. In contrast to Chang, Dasgupta, and Hilary (2010) and Taylor (2013), this study uses stock price reactions to sudden deaths to examine whether executives are paid for their

contribution to shareholder value; it then uses this relationship to elicit an estimate of how rent is shared between executives and shareholders. The main advantages of our experiment are that deaths are exogenous, unlike the turnover events in Chang et al. (2010), and that our method does not require the strong assumptions of a structural model, as do the models of Gabaix and Landier (2008), Terviö (2008), Alder (2009), and Taylor (2013).

II. Sample and data

A. Sample selection and definition of sudden deaths

The sample consists of 149 sudden deaths of top executives between January 1, 1991 and December 31, 2008. A gross sample of 520 deceased top executives of firms listed on AMEX, NASDAQ, and NYSE was identified by searching Factiva, Lexis-Nexis, and Edgar Online, using keyword search terms for executives (CEO, president, chairman, executive, etc.) and for death (passed away, died, deceased, etc.). Among these we then identify sudden deaths by classifying the causes of death. Our sample of 149 executive deaths was identified from more than 10,000 newspaper articles and more than 2,000 corporate filings to the SEC related to executive changes. Using the same keywords on a search on the SEC filings, we find that death events from the news are also reported in the SEC filings and vice versa. This alleviates the concern that news coverage of sudden deaths is skewed toward eventful executives with large stock price reactions, because all firms are required to file changes in executive positions with the SEC.

Identifying the value of the services provided by executives requires that the deaths be sudden and unanticipated by the stock market. Given that we identify a gross sample of deceased executives, we attempt to apply a medical definition of sudden deaths whenever possible. Among natural deaths (deaths caused by diseases), we include heart attack and stroke, as well as cases in which the cause is unknown but the death is described as sudden and unexpected, with an absence of news about declining health prior to the death. Among unnatural deaths, we include

accidents and traumatic deaths but exclude suicides, because such cases might relate to the current situation surrounding the firm.[2]

Our ability to follow such a stringent medical definition is obviously limited by our use of newspaper articles to classify causes of death. We therefore verify causation by conducting additional searches for news containing the name of the executive. In cases of inconsistency in the reported cause of death across various sources, we conservatively do not classify the death as sudden. As a result, deaths caused by heart attack, for example, are only classified as sudden if we cannot find any evidence of a prior history of heart problems or declining health.

Panel A of Table 1 reports the causes of death. Out of the 520 deceased executives in our gross sample, 149 (28.7%) of the deaths were sudden. Of the remaining decedents, 143 executives died of cancer; 55 died from various diseases; 13 died from complications related to surgery; 6 committed suicide; and 78 were reported to have died from unspecified illnesses, while the cause of death is unknown for the remaining 76 cases.

[Insert Table 1 about Here]

Panel B of Table 1 shows that the most common cause of sudden death is heart attack (72 cases), followed by accidents (25 cases), and strokes (10 cases). Finally, 42 deaths are described in the news as sudden and unexpected without specific details given about the cause of death.

Panel C of Table 1 reports the position of the suddenly deceased executives. Out of the total sample of 149 executives, 81 are CEOs; 28, executive presidents or chairmen; and 40, CFOs, COOs, or vice presidents.

For the sample of sudden deaths, the death date and the earliest news date were verified by an additional search of news containing the name of the executive. The average (median) time lag between death and news dates is 1.3 calendar days (1 day). Our sample includes one extreme case in which a firm held back the announcement for 12 days. Otherwise, the delay is mainly

[2] Our definition of sudden deaths is similar to those in Johnson et al. (1985) and Nguyen and Nielsen (2010).

caused by intervening weekends. Thus, the average time lag between death and news dates is 0.76 trading days, and 86.6% of all firms reported within one trading day.

We also check the possibility of confounding news surrounding the event. Whenever important corporate news occurs from day -1 to day +1 around the news date, the events are eliminated from the sample. Examples of confounding news include quarterly earnings, merger, acquisitions or asset sales, major strike, drug development or patent grant, and stock repurchases. A special case is the cancellation of the pending merger between Danielson Holding Corp. and Midland Financial Group, because presidents of both companies died in the same plane crash. In two cases, multiple executives from the same company were involved in the same fatal accident.[3] Executives from these special cases are excluded from the final sample because we cannot identify the value of each individual. Finally, six cases of deaths related to firms with market capitalizations of less than $10 million. To alleviate potential bias from these extremely small firms, we excluded them from the analysis. Our final sample, therefore, includes 149 executives.

B. Executive compensation

Existing studies of executive compensation rely mainly on S&P 1500 firms that are covered by the ExecuComp database. Because sudden deaths of top executives provide a close to random draw of U.S. listed firms, we cannot rely exclusively on compensation data from ExecuComp. A large number of firms and executives in our sample are simply not covered by ExecuComp.[4] In keeping with existing literature, we therefore follow ExecuComp's data procedures and calculate total annual compensation (*tdc1* variable in Execucomp) using information in SEC Def14a filings.

For most compensation items, we can directly observe the dollar value from the SEC filings. For options, we calculate the Black-Scholes value, using dividend yield and volatility data

[3] Bruno's Inc. suffered a devastating loss of five executives when its corporate jet crashed on December 11, 1991, and Agco Corp. lost its president and vice president when a private jet crashed on January 4, 2002.

[4] Out of 149 firms in our sample 44 firms (29.5%) are included in the ExecuComp database.

from Compustat. To assess the accuracy of our ability to follow ExecuComp's procedures, we check the consistency of the data with the information provided by ExecuComp for S&P 1500 firms in our sample. Generally, our estimates exactly match the values reported in ExecuComp. In the few cases showing a discrepancy, our estimates are very close to ExecuComp values. Thus, our measures of executive compensation are identical to those in prior literature.[5]

C. Descriptive statistics

Table 2 provides descriptive statistics for our sample of deceased top executives. Panel A reports individual characteristics. The average (median) age is 59.0 (58.0) years for all executives and 59.4 years (60 years) for CEOs. A substantial variation exists in executive age, with a range at the time of death from 38 to 91 years, and 98.7% of our executives are male.

[Insert Table 2 about Here]

Panel B of Table 2 reports firm characteristics. The average firm in our sample has $1.5 billion in market capitalization, has a market-to-book ratio of assets of 2.4, and is 36.6 years old.

Panel C shows statistics on executive compensation. Total compensation averages $1,102,200 ($273,700 in salary; $162,800 in bonus; $352,000 in option and restricted stock; and $313,700 in other forms) with a median of $456,700. The average CEO was compensated with $1,424,400, whereas other executives received, on average, $718,500. In comparison, the average (median) executive in the ExecuComp universe, for instance, receives $2,128,200 ($940,300) in total compensation. At the same time, the average (median) S&P 1500 firm has market capitalization of $7.2 billion ($1.5 billion)—larger than our event firms. Not surprisingly, therefore, executives receive lower pay in our sample of listed firms in the United States.

[5] In 2006 the proxy statement disclosure rules changed due to new SEC's requirements. As a result, the definition of *tdc1* in ExecuComp changes at that time. For all executives in our sample, we compute pay and value option directly from proxy statements, using ExecuComp's method before 2006. The 2006 change in reporting requirements, therefore, does not contaminate our results because the compensation of the executives in our sample are computed consistently using the same method. The correlation between our measure of total compensation and the *tdc1* variable in ExecuComp (before the 2006 change) is 0.99.

Panel D reports expected remaining tenure of executives in our sample based on a one-year turnover probability model and a half-life model. Following Huson, Parrino, and Starks (2001), we first estimate a probit model of the one-year turnover probability in the ExecuComp universe, controlling for indicators on executive age, total annual compensation, return on assets, and industry and year effects. Expected remaining tenure is calculated as the inverse of the predicted turnover probability from this model. An average executive in our sample is expected to hold office for 5.35 years. CEOs are expected to stay for 5.17 years, and other executives for 5.58 years. In comparison to Huson, Parrino, and Starks (2001), our estimate of expected remaining tenure is lower. We attribute part of this difference to the fact that executive turnover has recently increased (Peters and Wagner, 2014).

One potential problem with using one-year turnover frequencies to estimate expected remaining tenure is that turnover tends to spike around the retirement ages of 65 and 70. For example, if retirement spikes around age 65, executives of age 63 might have a low one-year, but a high two-year, turnover probability. In such a case, we overestimate expected remaining tenure when using a one-year turnover probability. To address this issue, we construct a half-life estimate of expected remaining tenure. For each executive, we estimate the number of years it takes for the predicted cumulative turnover probability to reach 0.5. This estimate is then doubled to obtain a half-life estimate of expected remaining tenure. The half-life estimate will thus capture spikes in the turnover probability for executives that are close to retirement but not expected to retire within the next year. The half-life estimation yields an average expected remaining tenure of 6.60 years (6.19 years for CEOs and 7.09 years for other executives), which is slightly larger than the one-year turnover probability model.

D. Stock price reactions to sudden deaths

Stock price reactions to sudden deaths of executives should reflect the expected incremental value of cash flows under the deceased executive net of this pay, relative to the

expected incremental value of the replacement net of his pay. In addition, the firm may incur replacement and search costs, which will affect stock price reactions negatively.

To measure the stock price reaction to sudden deaths, we access daily returns from the Center for Research in Security Prices (CRSP) for an eleven-trading-day period around the death. The event day is defined as the trading day of the executive's death or the first trading day following the death, if it occurred on a non-trading day. To calculate the abnormal return, we assume a single-factor model, where beta is estimated using the data from the pre-event window. We obtain similar results if we alternatively use market-adjusted returns.

Panel A in Table 3 presents the time series of abnormal returns around the death date. On average, a small and negative share price adjustment is associated with the unexpected loss of executives. In particular, the stock price reaction is negative for three straight days, from trading day -1 to +1. This pattern suggests that deaths are incorporated into market prices in the period from the death until the event becomes publicly known to market participants. We also observe that stock reactions, on average, become positive from day +2 to +3, which tend to be the days during which the firms nominate the interim executive or replacement.

[Insert Table 3 about Here]

In Panel B, we report the average cumulative abnormal returns (CARs) for the two-, three-, and four-day event windows from trading day -1 to 0, -1 to +1, and -1 to +2, respectively (day 0 is the death date or the first trading day after the death). We note that the CARs are negative, but statistically insignificant.[6]

In general, our analysis will use the event window from -1 to +1 around the death date.[7] This approach is motivated by two observations. First, our definition of sudden death allows for a 24-hour time interval from the change in the prior clinical state until sudden death. Our sample

[6] Throughout the analysis event windows will refer to trading days around the death date where day 0 is the death date or the first trading day after the death.

[7] In a robustness check in Section V, we propose alternative event windows, including one anchored around the news date. Our results are not affected in any meaningful way by the definition of the event date.

includes cases in which the media reports that an executive has been hospitalized due to an accident on day -1, resulting in death the following day. Second, on average, the time lag between death and news dates is short (0.76 trading day).

The cumulative abnormal return provides an estimate of the average executive's perceived contribution to shareholder value relative to his/her expected replacement, which, according to our methodology, equals 1.22%. The estimate has a 95% confidence interval from -2.63% to 0.19% and is not statistically different from zero. When compared to prior literature, our average stock price reaction of -1.22% differs. Johnson et al. (1985) find an increase in the stock price of 3.5% following the sudden deaths of founder CEOs, compared to a decrease of -1.16% following those of non-founder CEOs. Hayes and Schaefer (1999) and Salas (2010) find positive CARs of 2.84% and 0.9%, respectively. In comparison, our sample covers a more recent time period with fewer founders (21.4% in our sample versus 31.9% and 27.7% in Johnson et al. 1985; and Salas 2010, respectively). In addition, our study includes other top executives, rather than focusing exclusively on CEOs.

Finally, Panel C of Table 3 reports the cumulative abnormal return in the months leading up to the sudden death to verify that the deaths are unexpected and unrelated to firm performance. We note that the abnormal stock returns are not systematically different from zero prior to the sudden death.

III. Are executives paid for their contribution to shareholder value?

In this section, we first relate the stock return in the period coincident with the sudden death of executives to their expected abnormal compensation. Second, we use the estimated relationship to elicit how rent from the firm-manager relationship is split between shareholders and executives. Third, we examine the cross-sectional variation in the relationship between

executive contributions and abnormal pay to corroborate the interpretation of the relationship as driven by executive talent.

A. Executives' contributions to shareholder value and their pay

We examine the relationship between executives' perceived contribution to shareholders value measured by the stock price reaction to sudden death and expected abnormal compensation:

$$CAR_i = \beta * Expected\ abnormal\ compensation_i + \varepsilon_i. \quad (1)$$

Expected abnormal compensation is measured as the deceased executive's actual compensation minus the expected compensation of the replacement. We focus on abnormal compensation because the stock price reaction reflects the difference between the deceased's and the replacement's perceived contributions to shareholder value net of pay.

We follow prior literature and estimate abnormal compensation by decomposing pay into market and abnormal pay (Core, Holthausen, and Larcker, 1999; Murphy, 1999; Bebchuk and Fried, 2004). Abnormal pay is the difference between the actual and predicted total annual compensation. We use data from Execucomp to predict total annual compensation using a model that regresses total annual compensation on logarithm of book value of assets, industry, and time effects.[8] The estimated residual—actual pay minus predicted pay—measures abnormal pay, while market pay is the expected pay of the replacement. To measure the perceived contribution to shareholder value and expected abnormal compensation in the same unit (percentage of firm value), we scale expected abnormal compensation by market capitalization.

[8] Our results are robust to including a wider set of firm characteristics in the compensation model.

To capture the total expected abnormal compensation, we multiply the annual abnormal compensation with the expected remaining tenure.

If the marginal rent from the firm-manager relationship is shared between shareholders and executives, we expect a negative correlation between expected abnormal compensation and stock price reactions because executives with large abnormal compensation are perceived to be more valuable to shareholders. If executive pay exceeds the marginal contribution relative to the replacement, we expect, because of entrenchment, a positive correlation between stock price reactions and expected abnormal compensation.

Table 4 relates the value of executives' continued service to their expected abnormal pay. Panel A provides descriptive statistics for all top executives, CEOs, and other top executives, respectively. We observe large variations in the stock price reaction to sudden deaths. Although the average CAR is negative, 63 out of 149 events are associated with positive CARs. More interestingly, the level of expected pay is lower in firms with positive CARs. Current compensation of executives with positive CARs is equal to 0.5% of firm value, as compared to 0.69% of firm value for executives with negative CARs.

[Insert Table 4 about Here]

We find a similar pattern once we multiply current compensation with expected remaining tenure to estimate the expected compensation; expected compensation equals 2.58% of firm value for executives with positive CARs, as compared to 3.25% of firm value for executives with negative CARs. The difference in total compensation is driven by abnormal compensation. Executives with negative CARs expected abnormal compensation of 1.42% compared to 0.61% for executives with positive CARs. When we focus on CEOs, an identical picture emerges. CEOs with positive CARs are expected to receive lower compensation than CEOs with negative CARs. Indeed, we find that CEOs with positive (negative) CARs receive a total expected compensation of 2.43% (4.34%) of firm value and a total expected abnormal pay of 0.48% (2.36%) of firm value, respectively.

In Panel B we regress stock price reactions on expected abnormal compensation. The regression includes an intercept that is not statistically different from zero.[9] In Column 1, we find a negative correlation between expected abnormal pay and stock returns. Column 2 shows that the estimated coefficients on the CEOs are larger than the coefficient of the average executive in the pooled sample. The negative correlation in Column 1 is thus driven by the CEOs. If the negative correlation is related to rent sharing, we expect the negative correlation to be driven by the subsample of executives with negative stock price reactions. On the other hand, if managers take away more than they contribute, we expect a positive correlation between the stock price reaction and expected abnormal compensation among firms with a positive stock price reaction. To bolster the interpretation of the empirical evidence, we therefore split the sample according to the sign of the cumulative abnormal return. In Column 3, we find a positive correlation between expected abnormal compensation and contribution to shareholder value for executives with positive CARs, while Column 4 shows a negative and significant correlation between CARs and expected abnormal compensation for executives with negative stock price reactions. Columns 5 and 6 show correlations between CARs and abnormal compensation when we use the half-life estimate of expected remaining tenure instead. Since estimated remaining tenure from half-life models are generally larger than estimated remaining tenure, estimated coefficients from columns 5 and 6 are slightly smaller than coefficients from columns 1 and 2. In relation to expected remaining tenure, we emphasize that the estimated correlations between stock price reactions and compensation are not an artifact of the interaction between compensation and expected remaining tenure. All coefficients in Panel B of Table 4 have the same sign and statistical significance if we alternatively regress stock price reactions on actual abnormal compensation.

[9] Note that Equation 1 suggests that the model should not include an intercept or that, alternatively, the intercept is zero. Consistently, we find that the intercept is statistically insignificant. We find (almost) identical results when we exclude the intercept.

Because total rent from the firm-manager relationship is divided between shareholders and the manager, we can elicit how surplus from the firm-manager relationship is shared between executives and shareholders. To illustrate this inference, suppose that manager *i* produces π_i of value per year. Shareholders capture a fraction θ of the rent from the firm-manager relationship. The manager's compensation is then $w_i = (1- \theta)\pi_i$, while shareholders keep $\theta\pi_i$ per year. If the firm-manager relationship is terminated, the firm will hire a replacement *r* who produces π_r of value per year. Thus, the stock market reaction to the sudden death of manager *i* depends on the difference between the deceased manager's and the replacement's perceived contribution to shareholder value and the expected remaining tenure $E[\tau]$ of the deceased:

$$CAR_i = -\theta(\pi_i-\pi_r)E[\tau] \qquad (2)$$

In Equation 1, the coefficient β relates the stock price reaction, CAR_i, to the expected abnormal compensation. Expected abnormal compensation equals $(1-\theta)(\pi_i-\pi_r)E[t]$, which is the difference between the compensation of manager *i* and his replacement *r* during the expected remaining tenure $E[t]$. Substituting CAR_i and expected abnormal compensation into Equation 1 yields:

$$CAR_i = \beta * Expected\ abnormal\ compensation_i + \varepsilon_i.$$

$$-\theta(\pi_i-\pi_r)E[\tau] = \beta(1-\theta)(\pi_i-\pi_r)E[t]) + \varepsilon_i.$$

Taking expectations and dividing, we obtain

$$\hat{\beta} = \frac{-\theta}{1-\theta}$$

$$\theta = \frac{-\hat{\beta}}{1-\hat{\beta}}. \qquad (3)$$

Thus, given the estimated relationship between contribution to shareholder value and expected abnormal compensation, $\hat{\beta}$, we can elicit the fraction of rent to shareholders, θ, and the fraction of rent to executives, (1-θ).

Following Equation 3, the estimated coefficient of -0.408 in Column 1 of Table 4 implies that for each dollar of surplus created, the executive keeps 71 cents, while shareholders obtain 29 cents. The 95% confidence interval suggests an estimated range of the shareholders fraction of rent from 12% to 41%. Column 2 reports the results for the subsample of CEOs. We note that shareholders' fraction of surplus from CEOs is slightly higher. Table 4 also shows that, in our sample, 58% of firms have negative stock price reactions and are thus paying the executive a fraction of his contribution consistent with the optimal contracting view on executive pay (e.g., Gabaix and Landier 2008). Meanwhile, the remaining 42% of executives with positive stock price reactions appear to be paid more than their perceived contribution, which is consistent with the skimming view of executive compensation (e.g., Bebchuk and Fried, 2004). Our estimate of the average rent sharing of 71% reflects the coexistence of both views.

Our approach also allows us to infer the magnitude of surpluses that executives bring to their firms. Differences in skills across CEOs, (π_i-π_r), can be elicited from the stock price reactions given our estimate of rent sharing, θ, and expected tenure, $E[\tau]$. For instance, if we assume $E[\tau]$ is constant, we can calculate the variance in skills across executives from Equation 2:

$$\mathrm{Var}\,Var[\pi_i - \pi_r] = \frac{1}{E[t]} Var\left[\frac{-CAR_i}{\theta}\right] \qquad (4)$$

Using a Taylor approximation and average expected tenure of 5.35 yields a standard deviation of differences in skills across executives of 5.6% of firm value with a 95% confidence interval from 5.1% to 6.4%.[10] The estimate is upward biased because our method attributes all

[10] Confidence intervals are calculated assuming a normal distribution.

variation in abnormal returns around sudden deaths to differences in skills across executives. Thus, the 5.6% estimate is an upper bound on how much executives matter. In comparison, Bertrand and Schoar (2003) estimate manager-specific fixed effects in annual profitability and find a 7% standard deviation in fixed effects across managers. Taylor (2010, 2013) use structural models and find standard deviations in prior beliefs about managers' effect on profitability of 2.4% and 4.1% of assets, respectively. Our estimate of the standard deviation of differences in skills across executives of 5.6% indicates that executive talent matters for firm value.

In the following sections, we address concerns about whether our estimate of rent sharing is confounded by search costs, the expected replacement, and the possibility that sudden deaths introduce uncertainty about future firm policies. We note that while these confounding effects are likely to affect stock price reactions to sudden death, they will only affect our estimated relationship between contributions to firm value and pay if they correlate with abnormal compensation for reasons that are unrelated to the bargaining process.[11] Economically, arguing for such a case is difficult. For instance, search costs naturally affect compensation positively, but only because these costs increase the bargaining power of the executive vis-à-vis the board.

One might also be concerned about whether the estimated rent sharing is driven by correlation between the compensation of the deceased and the expected replacement. For instance, firms might target executives with a particular level of ability (or style). While this practice causes the compensation of the deceased and the expected replacement to be positively correlated, it also implies that the stock price reactions to sudden deaths should be close to zero and uncorrelated with pay. If the deceased executive, on the other hand, had higher ability (or fit the desired style better) than the expected replacement, we would expect his abnormal compensation to be higher because the higher ability increases his bargaining power vis-à-vis the board.

[11] Again, note that the correlation between stock price reactions and expected compensation is driven by current compensation and not by expected remaining tenure. Search costs and uncertainly should therefore be positively correlated with current compensation to explain our results.

Even if one is willing to argue that search costs or the compensation of the expected replacement are correlated with the deceased's abnormal compensation, these concerns cannot explain why we find different correlations for the subsamples of executives with positive and negative stock price reactions. If the correlation between the deceased's compensation and search costs (or compensation of the expected replacement) is driving the results, one would expect to find the same sign on the estimated relationship across these two samples. The intuition behind our approach, on the other hand, suggests that executives with positive stock price reactions are paid more than they contribute, while executives with negative contributions are paid a fraction of the rent from the firm-manager relationship.

While these arguments are helpful in asserting that our key identifying assumption—that frictions in the labor market or in succession planning are uncorrelated with abnormal compensation—is satisfied, identifying executive talent rankings is prohibitively difficult. In the following, we therefore control for other determinants of executives' contribution to shareholder value and examine the cross-sectional variation in the relationship between contribution and pay. Exploring the cross-sectional relationship is helpful in corroborating the interpretation of the evidence as being driven by executive talent.

B. Controlling for other determinants of executives' contributions to shareholder value

Our analysis, so far, does not take other determinants of stock price reactions to sudden death into account. In particular, Johnson et al. (1985) show that founder CEOs differ from professional CEOs, while Salas (2010) emphasizes the effect of executive entrenchment. Firms might also incur substantial search costs or turnover-related costs when their executive suddenly dies. Similarly, uncertainty about future firm policies might negatively affect firm value if succession plans are incomplete or no well-qualified replacement currently exists inside the firm. To address these concerns, we introduce firm characteristics as control variables:

$$CAR_i = a + \beta\ Expected\ abnormal\ compensation_i + \gamma\ X_i + \eta. \qquad (5)$$

In this specification, the intercept will capture general search costs and disruption costs due to lack of succession planning, while covariates, X_i, allow us to control for executive entrenchment and firm characteristics while estimating the sharing rule. We note that the intercept in Equation 5 measures the change in the present value (PV) of future search costs as a result of the death.

For the sake of presentation, we only present regression results using expected remaining tenure resulting from the one-year turnover probability model, as results from the half-life model are qualitatively similar. Our results are reported in Table 5.

[Insert Table 5 about Here]

As reported in Column 1, we find that stock market reactions to CEO deaths appear more positive, although the effect is insignificant. Remaining tenure is negative and insignificant. We also control for firm characteristics such as firm size (market capitalization), market-to-book ratio, returns on assets, stock price volatility, board size, outsider ratio, and staggered board.[12] We note that few of these control variables are significant. More importantly, the coefficient of expected compensation remains negative and significant when individual and firm characteristics are taken into account.

Columns 2, 3, and 4 repeat the regression in Column 1 on the subsamples of CEOs and top executives with positive and negative stock reactions, respectively. In Column 2, the estimated coefficient of expected compensation is -0.459 and is significant at the 5% level. This coefficient is equivalent to an estimated rent share of 68.6% for the CEO against 31.4% for the shareholders. Among executives with positive stock reactions, in Column 3 we find a coefficient

[12] In unreported regression, we include other corporate governance characteristics, but they appear to have little impact on the estimated relationship between stock price reactions and abnormal compensation. The results are, thus, robust to expanding the list of corporate governance characteristics among the control variables.

of expected compensation of 0.502, while Column 4 shows a coefficient equal to -0.469 for negative stock price reactions.

In Column 5 we add controls for search costs. We follow Cremers and Grinstein (2014), who argue that hiring and search costs depend on the industry talent pool and the need for firm-specific human capital. We therefore include the fraction of CEOs in the industry hired from the outside (*Outside fraction*) and the *Herfindahl index* to capture search costs. The Herfindahl index in Table 5 is computed from the distribution of sales across firms in the same industry as the firm associated with an executive who died suddenly. The argument of having this index as a proxy for the search cost is that in an industry with a greater level of competition, it is easier and less costly to find a top executive. Consistent with search costs, we find lower stock price reactions in industries where firms tend to hire from the outside. Similarly, we find more negative stock price reactions in concentrated industries, where the industry talent pool is smaller. However, the effect is not statistically significant. More importantly, we note that the correlation between expected compensation and perceived contribution to shareholder value does not change when we add controls for search costs.

In Column 6 we add indicators for whether the firm has a succession plan or announces an interim replacement in the week following the death. We search the firm's annual reports and all corporate disclosure to the SEC 3 years before the deaths, and all the news 3 months after the deaths. If any mention shows that the firm has a succession plan, we then code the firm as having a succession plan. We note that executive deaths are less disruptive when firms have a succession plan, while announcements of interim replacements have a small negative effect. Again, we note that our main results are unaffected once we attempt to control for succession plans.

Results from Table 5 confirm the findings from the parsimonious model in Table 4. We obtain broadly consistent results on the relationship between executives' abnormal compensation

and their contributions to firm value when including the control variables. The average executive appears to retain 68.6% to 73.3% of the rent from the firm-manager relationship.

C. Cross-sectional variation in the relationship between perceived contributions and pay

We have reported evidence thus far on the average relationship between perceived contribution and abnormal pay. In this section, we explore the cross-sectional variation of the relation between CARs and abnormal pay as a function of individual, firm, and industry characteristics. The cross-sectional variation is helpful in corroborating the interpretation of the correlation between announcement CARs and expected abnormal compensation as based on executive talent. Due to our small sample size we do not formally test the differences in the correlation between CARs and abnormal pay across individual and firm characteristics. We also report the standard deviation on differences in skill across subsamples. Table 6 summarizes our results.

To facilitate the comparison, Specification 1 reports the main results from Column 1 of Panel B in Table 4, while Specifications 2 to 9 focus on the correlation between CARs and abnormal pay without control variables.

[Insert Table 6 about Here]

Specification 2 focuses on the subsample of professional executives (i.e., non-founders with ownership lower than 5%). If the correlation between contribution and pay is driven by talent, we expect to see a stronger correlation for professional executives because founders and managers with high ownership might have the power to set their own pay. Consistently, we note that the correlation between expected contribution and expected abnormal pay becomes stronger when we exclude founders and managers with large ownership. Shareholders enjoy a greater share of rent (37.3%) when a firm employs a professional executive.

Specifications 3 and 4 focus on the distribution of total compensation and incentive compensation as a fraction of total compensation, respectively. If the correlation between

expected contributions and pay is driven by executive talent, optimal contracting predicts a stronger correlation at the top of the distribution of compensation, while the "skimming view" would predict the opposite. In specifications 3 and 4, we find stronger correlations for executives with compensation above the median and for executives in the top half of the distributions of incentive pay, respectively. Our results indicate that shareholders retain 38% (44%) of the rent for executives in the top half of the distribution of total compensation (incentive compensation).

Prior literature on executive compensation has argued that executive age and tenure are proxies for executive competence and performance as these executives survive many of the board of directors' reviews (Hermalin and Weisbach, 1998; and Carter and Lorsch, 2003). As executive competence increases the bargaining power of the executive vis-à-vis the board, we expect a stronger correlation between contribution and pay for young executives with low tenure. Prior literature has also argued that executive age and tenure proxies for entrenchment (Shivdasani and Yermack, 1999). If older executives with long tenure are entrenched, we similarly expect a stronger correlation for young executives with low tenure. As these two explanations are observationally equivalent, we unfortunately cannot distinguish between them. Specifications 5 and 6 report a slightly stronger correlation between perceived contributions and pay for executives with age and tenure below their median, respectively.

In assortative matching models of executive compensation, top talented executives are assigned to large firms and enjoy large pay. As a result, pay and talent are positively related to firm size. Thus, one might expect to see a stronger correlation at the top of the firm size distribution. Our framework, however, scales both expected contribution and pay by firm size and, therefore, eliminates the effect of assortative matching. It is still interesting to examine the correlation between perceived contribution and pay for large firms. Specification 7 shows that for large firms (the ones with above the median market capitalization) the correlation between abnormal pay and contribution is lower.

We also expect a stronger correlation between expected contributions and pay in industries with wide executive talent pools, because wider talent pools lower the bargaining power of the executive vis-à-vis the board. In specifications 8 and 9, we follow Cremers and Grinstein (2014) and use the fraction of outside hirings in the industry and the level of industry competition as proxies for the width of the industry talent pool. As expected, we find a stronger negative correlation in firms that operate in industries with above-median outside hiring, and in competitive industries (i.e., industries with a low Herfindahl index). Shareholders enjoy a greater share of the rent when the board's bargaining power is stronger.

In sum, results from Table 6 show that the relationship between top executives' abnormal pay and contribution varies predictably with individual, firm, and industry characteristics in ways that are broadly consistent with the intuition of talent models of CEO pay.

IV. Interpretation and limits of estimations

A. Estimation of rent sharing

Our estimates suggest that the surplus created by the firm-manager relationship is split in favor of the executive. On average, top executives (CEOs) appear to retain 71% (65%) of the rent. This estimate of rent sharing is positively affected by the fact that 42% (63 out of 149) of all executives have positive stock price reactions and thus receive more than 100% of the total rents. For instance, if 90% of all shareholders and executives share the rent equally, and the remaining 10% of executives, because of entrenchment, are paid twice as much as they contribute, then the average executive would receive 65% of the rent from the firm-manager relationship. Thus, even if a small fraction of executives are overpaid, the average sharing rule might deviate significantly from the equal sharing rule.

One caveat related to the interpretation is that our model specifications assume that we are counting all of the compensation that executives earn. Our pay measures are based on SEC disclosure rules. Before 2006, only incomplete disclosures about perks, and no disclosure about deferred compensation and pensions, were released. To the extent that SEC disclosures under-count executive compensation, managers (CEOS) might capture more than 71% (65%) of the rents from the firm-manager relationship. However, for a sample of S&P 1500 firms, Grinstein, Weinbaum, and Yehuda (2009) show an average value of perks of $127,200, which represents 6% of an average executive's total compensation in ExecuComp.[13] Thus, unreported perks are unlikely to change our main results.

B. Contingent payment upon death

Another potential caveat to our analysis is that the stock price reaction might reflect contingent payments upon executive deaths. An example of contingent payment might be, for instance, if the employment contract implies that firms have to pay significant incremental compensation to the deceased's estate. The relationship between compensation and perceived contribution to shareholder value might be spurious if such contingent payments are a function of annual compensation. Unfortunately, before 2007, firms were not obliged by the SEC to disclose information on contingent payments to executives in cases of retirement, resignation, or death. Thus, we examine executive deaths occurring after the spring of 2007.

In total, we have 8 events occurring after the new SEC-imposed disclosure requirements. In general, we find that contingent payments include deferred cash compensation (pension benefits); base-salary balance payments; and options and restricted stocks with immediate vesting and shortened exercise. Because deferred benefits are paid out irrespective of the incidence of death, and because death moves these payments forward in time, only time value of money produces an effect on stock prices, which is arguably very small, or insignificant. Base-salary

[13] Our average firm is smaller than the average S&P 1500. More appropriate benchmarks for the level of perks are S&P Midcap 400 or SmallCap 600 indices, with total perks equal to $102,900 and $44,900, respectively.

balance payments refer to a firm's practice of paying the base salary for the full calendar year—continuing after the death. Thus, for the average firm in our sample, this incremental contingent payment would amount to six months of base salary, equivalent to $136,900, which is a tiny fraction of the average loss of $18.8 million in market capitalization. For options, firms appear to allow immediate vesting (7 out of 8 firms in our sample), but shorten the exercise period to a maximum of one year after death (3.15 years in Dahiya and Yermack, 2008). This practice will change the value of granted options and restricted stocks. Dahiya and Yermack (2008) find that these "sunset" provisions reduce the value of equity compensation when managers retire, resign, or die, for a sample of S&P 500 firms. Contingent payments related to sunset provisions are thus negative. Collectively, no mechanical or significant relationship appears to exist between contingent payments and total annual compensation.

V. Alternative specifications and robustness checks

In this section we provide additional evidence, using alternative specifications of our event study. Our robustness analysis focuses on three important issues: a) the event dates, b) our sample of sudden deaths, and c) the potential impact of outliers in executive compensation. Table 7 summarizes this exercise.

A. Alternative specifications of the event study

The focus of our analysis is on the three-day event window, from -1 to +1. As the chosen event date specification is simply one among several possibilities, Table 7 reproduces our main result from Column 1 in Table 4, using two alternative approaches: Column 1 uses the two-day event window surrounding the news announcement date, while Column 2, as in Johnson et al. (1985), uses a firm-specific announcement period from the death date to the news date. As roughly 75% (95%) of our events have an announcement period of one (two) trading day(s) or

less, the announcement period is quite short for the majority of the sample. In both cases we obtain similar results.

B. Age of executives and known cause of death

Another valid concern relates to the sample selection. To be able to identify the perceived contribution to shareholder value, we require deaths to be sudden and unexpected by the market. Although our definition of sudden deaths attempts to ensure that this criterion is satisfied, executive age implies an increased probability of mortality or retirement. Simply put, a sudden death of an eighty-year-old executive is less surprising than the sudden death of a fifty-year-old. We address this concern by conducting complementary tests that take age into consideration. We first restrict the sample to executives who are aged 65 or under at the time of death in Column 3 of Table 7. In Column 4, we take the robustness exercise one step further by requiring that we know the causes of death. In both cases our results are robust to alternative specifications.

C. Alternative measures of compensation

We use the compensation of the year before the death as our main measure of executive pay. The possibility remains that this one-year benchmark does not, somehow, represent the average pay level. Although our sudden death approach provides us with a random sample of executives, we provide further evidence that our results are robust to this specification.

In columns 5 and 6 of Table 7 we use average compensation over the last two and three years, respectively, in the estimation of expected abnormal compensation. We obtain a coefficient of similar magnitude to the estimates in Table 4.

As we observe large variations in stock price reactions, outliers might affect our estimates. In particular, a concern could exist that our sampling procedure leads to an oversampling of eventful executive deaths with large stock price reactions due to a bias in the news coverage toward such cases. To evaluate this effect, we run a median regression, which minimizes the sum of the absolute residuals rather than the sum of the squared residuals, and reduce the bias caused

by potential outliers. Column 7 of Table 7 reports the estimated coefficients from the median regression, which results in similar estimates. Finally, Column 8 of Table 7 shows that our results are robust to including year fixed effects, to rule out the possibility that the results are driven by time effects.

In summary, Table 7 provides evidence that our results are robust to alternative specifications of the event study and to our sample selection of sudden and unexpected deaths.

VI. Conclusions

This paper attempts to investigate whether executive compensation is related to executive contributions to shareholder value.

Compiling a sample of 149 executives who died suddenly in the United States from 1991 to 2008, we find evidence of positive sorting between perceived contribution to value and abnormal pay: managers with higher contribution to shareholder value receive higher compensation. We use the estimated relationship to elicit how rent from the firm-manager relationship is shared between executives and shareholders. Based on this methodology, we estimate that executives (CEOs) retain 71% (65%) of the rent from the firm-manager relationship. This fraction appears large, and is subject to debate and discussion. On the one hand, this rent share might reflect the prospect of the scarcity of managerial talent. On the other hand, as our estimates show, some executives extract more rent than they create.

Our study joins a growing literature that addresses the challenging question of whether and how rent from the firm-manager relationship is shared between executives and shareholders. In comparison to prior studies that measure how surpluses are split and find varying results, our empirical strategy uses stock price reactions to sudden death to measure the expected contribution to shareholder value. The main advantage of this approach is that it offers clean

identification of executive contributions and does not rely on the strong assumptions of a full structural model.

Overall, our results are informative for the ongoing discussion of the level of executive compensation. A large body of literature argues that executive compensation is excessive. But, without a measure of executives' perceived contribution to shareholder value, an assessment of whether executive compensation is excessive is difficult. To this end, our study proposes a novel approach to measure executives' perceived contribution to shareholder value and its relationship to pay.

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Table 1.
Cause of executive deaths

This table reports the composition of our sample of executives of AMEX-, NASDAQ-, and NYSE-listed firms who died suddenly between the dates of January 1, 1991 and December 31, 2008. Based on the cause of death cited in newspaper reports of the deaths, Panel A classifies the causes into: *cancer*; *complications from specified diseases* (other than cancer); *complications from surgery*; *sudden death* (accidents, heart attack, strokes, and deaths described as sudden and unexpected with no other cause cited); *suicide* (self-inflicted gunshots; death from carbon-monoxide poisoning); *unspecified illness* (cause of death described as brief or long illness); and *undisclosed* (in cases in which no cause is reported but the death is not described as sudden or unexpected). Panel B shows the reported cause of death for the subsample of sudden deaths from Panel A. Panel C shows the positions held by the suddenly deceased executives.

	N	**Share of total**
A. Cause of death		
Cancer	143	0.275
Complications from specified diseases	55	0.106
Complications from surgery	13	0.025
Sudden death	149	0.287
Suicide	6	0.012
Unspecified illness	78	0.150
Undisclosed	76	0.146
All	520	1.000
B. Cause of sudden death		
Heart attack	72	0.483
Stroke	10	0.067
Accident or murder	25	0.168
Sudden and unexpected death, but unspecified cause	42	0.282
All	149	1.000
C. Position held by suddenly deceased executive		
CEO	81	0.544
President and Chairmen	28	0.188
Other executives: CFO, COO, and Vice Presidents	40	0.269
All	149	1.000

Table 2.
Descriptive characteristics of executives who died suddenly

This table reports descriptive statistics for our sample of executives of AMEX-, NASDAQ-, and NYSE-listed firms who died suddenly between January 1, 1991 and December 31, 2008. We follow a strict definition of sudden death from medical literature, which defines sudden death as an unexpected death that occurs instantaneously or within a few hours of an abrupt change in the person's previous clinical state. We also include accidental and traumatic deaths that are unanticipated by the stock market and unrelated to current firm conditions. Panel A reports the following executive characteristics: *age* (measured in years); *gender* (indicator taking the value one if the executive is male); and *tenure* (measured in years). Panel B shows the following firm characteristics: *market capitalization* (in millions of $); *market-to-book ratio* of assets; and *firm age* (measured in years). Panel C reports executive compensation in $1,000s: *salary*; *bonus*; *options and restricted stocks*; *other compensation*; and *total compensation*. Option grants are valued using the Black-Scholes formula, following documentation from ExecuComp prior to 2006. Panel D reports expected remaining tenure of top executives from a 1-year turnover probability model and from a half-life model. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

	All	**Type of Executive**			
		CEO	**Other**	**Difference**	
		(1)	**(2)**	**(1)-(2)**	**t-stat**
A. Executive characteristics					
Age (years)	59.00	59.44	58.47	0.97	0.55
Gender (male=1)	0.987	0.988	0.985	0.002	0.12
Tenure (years)	9.426	9.469	9.375	0.094	0.06
B. Firm characteristics					
Market capitalization (mill. $)	1541.7	1259.6	1877.8	-618.2	-0.82
Market-to-book ratio	2.364	2.683	1.984	0.698	1.21
Firm age (years)	36.58	34.42	39.15	-4.73	-0.83
C. Executive compensation (in thousand $)					
Salary	273.7	302.9	239.0	64.0	1.74*
Bonus	162.8	129.1	203.0	-73.9	-1.23
Option and restricted stocks	352.0	532.3	137.1	395.2	1.65
Other compensation	313.7	460.1	139.4	320.7	1.07
Total compensation	1102.2	1424.4	718.5	705.9	1.54
D. Expected remaining tenure (years)					
1-year turnover probability model	5.35	5.17	5.58	-0.41	-1.55
Half-life model	6.60	6.19	7.09	-0.89	-2.57**
N	149	81	68		

Table 3.
The stock price reaction to sudden death of executives

This table shows the stock price reaction to the sudden death of executives. Panel A shows the mean abnormal return for each trading day from five days before the death to five days after. Panel B shows the cumulative abnormal return for various event windows surrounding the death date or the first trading day following the death. In addition to the mean abnormal return, we report the corresponding Patell Z-score and the number of positive and negative stock price reactions. Panel C reports the cumulative abnormal return in the months leading up to the sudden death to verify that the deaths are unexpected and unrelated to firm performance. Our sample includes executives of AMEX-, NASDAQ-, and NYSE-listed firms who died suddenly between the dates of January 1, 1991 and December 31, 2008. We follow a strict definition of sudden death from medical literature, which defines sudden death as an unexpected death that occurs instantaneously, or within a few hours of an abrupt change in the person's previous clinical state. We also include accidental and traumatic deaths that are unanticipated by the stock market and unrelated to current firm conditions. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Trading day / Event window	N	Mean abnormal return	Patell Z	Number of Positive: Negative	Median return	Sign rank test
A. Daily abnormal returns						
-5	149	0.15	0.505	78:71	0.02	1.288
-4	149	-0.47	-0.343	69:80	-0.10	-0.190
-3	149	0.09	-0.768	65:84	-0.21	-0.846
-2	149	0.23	0.744	71:78	0.06	0.139
-1	149	-0.17	-0.380	76:73	0.01	0.959
0	149	-0.74	-0.381	66:83	-0.43	-0.982
+1	149	-0.32	-0.732	72:77	-0.09	0.303
+2	149	0.42	1.692**	79:70	0.13	1.452*
+3	149	0.35	0.122	74:75	-0.07	0.631
+4	149	0.05	-0.276	69:80	-0.08	-0.190
+5	149	-0.15	-1.579*	70:79	-0.22	-0.025
B. Cumulative abnormal returns						
(-1,+0)	149	-0.90	-0.538	74:75	-0.04	-0.631
(-1,+1)	149	-1.22	-0.861	63:86	-0.59	-1.174
(-1,+2)	149	-0.80	-0.100	67:82	-0.48	-0.518
C. Cumulative abnormal returns prior to death						
(-120;-2)	147	1.54	-0.579	69:78	-2.45	0.050
(-90;-2)	147	0.56	-0.800	65:82	-2.32	-0.611
(-60;-2)	147	0.18	-0.734	70:77	-1.12	0.216
(-30;-2)	147	-0.57	-0.780	68:79	-0.56	-0.115

Table 4.
Executives' contributions to firm value and their expected compensation

This table shows the relationship between the value of executives' perceived contributions to shareholder value and their expected compensation. Panel A reports descriptive statistics on the executive contribution to shareholder value and expected compensation. The contribution to shareholder value is measured by the cumulative abnormal return (CAR) in the event window from (-1,+1) around the death date. Annual compensation is total compensation in the year prior to death scaled by market capitalization. Expected compensation is total compensation multiplied by expected remaining tenure, and scaled by market capitalization. Total compensation is the sum of salary, bonus, option and stock grants, and other compensation that the executive received in the year prior to his death. Expected abnormal compensation is abnormal pay multiplied by expected remaining tenure, and scaled by market capitalization. Abnormal pay is calculated as the difference between the actual and predicted total annual compensation from a model that takes firm size (log. book value of asset), industry, and time effects into account. Expected remaining tenure is estimated using a 1-year turnover probability model in Panel A and a 1-year turnover probability model and a half-life model in Panel B (see Section II.C). Panel B shows OLS regressions of the contribution to shareholder value on expected abnormal compensation. t-stats are in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

A. Descriptive statistics

Sample	**All**		**CEOs**		**Others**	
Stock market reaction	**Pos.**	**Neg.**	**Pos.**	**Neg.**	**Pos.**	**Neg.**
CAR (-1,+1)	4.99	-5.77	6.50	-6.84	3.21	-4.48
Expected remaining tenure (years)	5.36	5.35	5.14	5.19	5.62	5.54
Annual compensation (%)	0.50	0.69	0.53	0.95	0.45	0.39
Expected compensation (%)	2.58	3.25	2.43	4.34	2.76	1.94
Expected abnormal compensation (%)	0.61	1.42	0.48	2.36	0.75	0.28
N	63	86	34	47	29	39

B. OLS estimation of fraction of rent to shareholders (θ)

Sample	**All**	**CEOs**	**All**	**All**	**All**	**CEOs**
Stock market reaction	**All**	**All**	**Pos.**	**Neg.**	**All**	**All**
Exp. remain. tenure model	**1-year**	**1-year**	**1-year**	**1-year**	**Half-life**	**Half-life**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Expected abnormal compensation	-0.408*** (-2.93)	-0.543*** (-2.94)	0.630** (2.63)	-0.540*** (-4.58)	-0.298*** (-2.92)	-0.386*** (-2.82)
Intercept	-0.008 (-1.10)	-0.004 (-0.34)	0.046*** (5.75)	-0.050*** (-6.95)	-0.008 (-1.12)	-0.005 (-0.42)
R-squared	0.055	0.099	0.102	0.200	0.055	0.091
N	149	81	63	86	149	149
Rent to shareholders (θ)	0.290	0.352	-	-	0.230	0.278
Rent to executives (1-θ)	0.710	0.648	-	-	0.770	0.722
95% confidence interval on θ	0.12-0.41	0.15-0.48	-	-	0.09-0.33	0.10-0.40

Table 5.
Executives' contribution to firm value and their abnormal pay

This table shows the relationship between the value of executives' contribution and their expected abnormal compensation. The dependent variable is the cumulative abnormal return in the event window from (-1,+1) around the death date. Expected abnormal compensation is abnormal pay multiplied by expected remaining tenure, and scaled by market capitalization. Abnormal pay is calculated as the difference between the actual and predicted total annual compensation from a model that takes firm size (log. book value of asset), industry, and time effects into account. Expected remaining tenure is estimated using a 1-year turnover probability model. Columns 1, 5, and 6 include all executives, whereas Column 2 includes CEOs. Columns 3 and 4 include executives with positive and negative stock price reactions, respectively. t-stats are in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Sample	**All**	**CEOs**	**Pos. CAR**	**Neg. CAR**	**All**	**All**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Expected abnormal compensation	-0.365**	-0.459**	0.502*	-0.469***	-0.447***	-0.374**
	(-2.53)	(-2.52)	(1.95)	(-4.01)	(-3.15)	(-2.61)
CEO	0.011		0.018	0.012	0.007	0.016
	(0.78)		(1.16)	(0.91)	(0.54)	(1.04)
Ownership	0.001*	0.001	0.001**	-0.001**	0.001*	0.001
	(1.84)	(1.63)	(2.30)	(-2.00)	(1.91)	(1.61)
Tenure	0.001	0.002	0.001	0.001	-0.001	0.001
	(0.69)	(1.52)	(0.15)	(0.80)	(-0.01)	(0.21)
Market capitalization	0.001	-0.007	0.001	0.004	-0.001	0.001
	(0.09)	(-0.93)	(0.10)	(0.90)	(-0.30)	(0.08)
Market-to-book ratio	-0.004*	-0.005*	0.003	-0.001	-0.003	-0.004
	(-1.79)	(-1.71)	(0.38)	(-0.63)	(-1.43)	(-1.48)
Return on assets	0.022	0.005	-0.133***	0.035**	0.023	0.025
	(1.07)	(0.21)	(-2.82)	(2.19)	(1.14)	(1.21)
Volatility	-0.003	0.011	-0.008	0.005	-0.003	-0.002
	(-0.27)	(0.54)	(-0.53)	(0.58)	(-0.35)	(-0.19)
Board size	0.003	0.008*	0.002	0.003	0.002	0.002
	(1.01)	(1.69)	(0.60)	(1.02)	(0.69)	(0.78)
Outsider ratio	0.062	0.141**	0.065	0.030	0.065*	0.060
	(1.65)	(2.29)	(1.42)	(0.83)	(1.76)	(1.60)
Staggered board	0.008	0.022	-0.003	-0.003	0.014	0.006
	(0.54)	(1.03)	(-0.20)	(-0.20)	(0.98)	(0.44)
Outside hiring fraction					-0.205***	
					(-2.93)	
Herfindahl index					-0.144	
					(-1.38)	
Succession plan						0.023
						(1.10)
Interim executive						-0.025*
						(-1.66)
Intercept	-0.080**	-0.136***	-0.035	-0.111***	-0.005	-0.063*
	(-2.47)	(-2.76)	(-0.86)	(-3.53)	(-0.13)	(-1.90)
R-squared	0.211	0.361	0.382	0.462	0.270	0.232
N	149	81	63	86	149	149
Rent to shareholders (θ)	0.267	0.314	-	-	0.309	0.272
Rent to executives (1-θ)	0.733	0.686	-	-	0.691	0.728
95% conf. interval on θ	0.07-0.39	0.09-0.45	-	-	0.14-0.42	0.08-0.40

Table 6.
Cross-sectional correlation between executives' contribution and their abnormal pay

This table shows the relationship between the value of executives' contribution and their expected abnormal compensation for subsamples of the data. The dependent variable is the cumulative abnormal return in the event window from (-1,+1) around the death date. Expected abnormal compensation is abnormal pay multiplied by expected remaining tenure, and scaled by market capitalization. Abnormal pay is calculated as the difference between the actual and predicted total annual compensation from a model that takes firm size (log. book value of asset), industry, and time effects into account. Expected remaining tenure is estimated using a 1-year turnover probability model. *Professional executives* exclude founders and executives with more than 5% of the ownership. *Incentive pay* is the fraction of incentive pay (options and restricted stocks) to total compensation. *Firm size* is measured by book value of assets. *Outside hiring* is the fraction of executives in the industry that are hired from the outside. *Industry competition* is measured by the Herfindahl index on sales in the industry. Industry competition is above median when value of the Herfindahl index is below median. t-stats are in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Sample	Expected abnormal compensation	Intercept	R-square	N	Rent to share-holders (θ)	95% conf. interval on θ	Std. dev. on differences in skills
1. All executives	-0.408***	-0.008	0.055	149	0.290	0.12-0.41	5.6%
	(-2.93)	(-1.10)					
2. Professional executives	-0.593***	-0.009	0.212	91	0.372	0.26-0.45	3.6%
	(-4.89)	(-1.24)					
3. Total compensation above median	-0.614***	0.010	0.165	75	0.381	0.23-0.48	4.6%
	(-3.80)	(0.93)					
4. Incentive pay above median	-0.784***	-0.007	0.309	62	0.440	0.32-0.52	3.9%
	(-5.18)	(-0.70)					
5. Executive age below median	-0.510***	-0.024**	0.130	76	0.338	0.17-0.45	4.7%
	(-3.32)	(-2.35)					
6. Executive tenure below median	-0.519***	-0.010	0.109	74	0.342	0.15-0.46	5.5%
	(-2.97)	(-0.88)					
7. Firm size above median	-0.262	0.009	0.033	75	0.208	-0.07-0.37	5.1%
	(-1.59)	(1.26)					
8. Outside hiring above median	-0.950***	-0.027***	0.224	75	0.487	0.35-0.58	3.7%
	(-4.59)	(-2.81)					
9. Industry competition above median	-0.670***	0.010	0.179	74	0.401	0.23-0.50	3.9%
	(-3.96)	(1.10)					

Table 7.
Alternative specifications of event study, compensation, and estimation method

This table shows the relationship between the cumulative abnormal returns to the sudden death of executives and expected abnormal compensation for alternative specifications of the event samples and event windows. Column 1 uses the CARs around the news date. Column 2 uses CARs for the period from death date (day -1) to the news date. Column 3 reports results on a sub-sample of sudden deaths of executives aged 65 or under at the time of death. Column 4 reports results on a sub-sample with known causes of death. Columns 5 and 6 use average compensation over the last two and three years, respectively, in the estimation of expected abnormal compensation. Column 7 exhibits the results from a median regression on the full sample. Column 8 shows results when year fixed effects are included. t-stats are in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Event sample	**All**	**All**	**Age ≤65**	**Known cause**	**All**	**All**	**All**	**All**
Event date	**News**	**Death**	**Death**	**Death**	**Death**	**Death**	**Death**	**Death**
Event window	**(-1,0)**	**(-1, news date)**	**(-1,+1)**	**(-1,+1)**	**(-1,+1)**	**(-1,+1)**	**(-1,+1)**	**(-1,+1)**
Estimation method	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**	**Median regression**	**OLS**
Compensation period	**1 years**	**1 year**	**1 year**	**1 year**	**2 years**	**3 years**	**1 year**	**1 year**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Expected abnormal compensation	-0.208*	-0.412***	-0.416***	-0.513***	-0.535***	-0.473***	-0.309***	-0.339**
	(-1.91)	(-3.42)	(-2.69)	(-3.02)	(-3.67)	(-3.62)	(-3.89)	(-2.24)
Intercept	-0.009	-0.010	-0.012	-0.012	0.006	0.002	-0.005	-0.009
	(-1.57)	(-1.65)	(-1.43)	(-1.58)	(0.76)	(0.26)	(-1.15)	(-1.19)
Year fixed effects	No	No	No	No	No	No	No	Yes
R-squared	0.024	0.074	0.058	0.080	0.091	0.082	-	-
N	149	149	119	107	149	149	149	149
Rent to shareholders (θ)	0.172	0.292	0.294	0.339	0.348	0.321	0.236	0.253
Rent to executives (1-θ)	0.828	0.708	0.706	0.661	0.652	0.679	0.764	0.747
95 % confidence interval on θ	-0.01-0.30	0.15-0.39	0.10-0.41	0.15-0.46	0.20-0.45	0.18-0.42	0.13-0.32	0.04-0.39