The Optimal Duration of Executive Compensation: Theory and Evidence*

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Abstract

While much is made of the inefficiencies of "short-termism" in executive compensation, in reality very little is known empirically about the extent of such short-termism. This paper develops a new measure of CEO pay duration that reflects the vesting periods of different pay components, thereby quantifying the extent to which compensation is short-term and the extent to which it is long-term. Using this measure we document a robust negative relationship between CEO pay duration and abnormal accruals: firms that offer short-duration pay contracts to their CEOs have higher abnormal accruals, indicating a stronger proclivity to boost short-term earnings, even after dealing with omitted-variables and endogeneity concerns. We also propose a model that highlights how pay duration will be related to firm characteristics and find supportive evidence for the model's predictions: CEO pay duration is longer in firms with longer-duration projects and in firms with less risky cash flows.

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1 Introduction

It is well recognized that executive compensation is an important tool of corporate governance in aligning the interests of shareholders and managers. Issues related to how executive compensation should be structured have therefore been front and center in corporate governance discussions ever since Jensen and Murphy (1990a) argued famously that what matters in CEO pay is not how much you pay, but *how* you pay. To this end, an active debate has raged on about what should be the optimal duration of executive compensation. On the one hand, critics of the executive pay process (e.g., Bebchuk and Fried (2010)) argue that compensation contracts put too much emphasis on short-term performance and should be modified. They caution that excessive compensation short-termism could lead to self-interested and often myopic managerial behavior. On the other side of the debate, Bolton, Scheinkman, and Xiong (2006) point out that, in a speculative market where stock prices may deviate from fundamentals, an emphasis on short-term stock performance may be optimal from the firm's existing shareholders' perspective.

This debate leads to a number of important yet unanswered questions: Does the duration of the compensation contract affect the executive's investment horizon? In practice, how do firms determine the duration of their executive compensation contracts? How do the observed compensation contracts compare to theoretical benchmarks? Addressing these questions is hampered by an obvious gap in our knowledge – we have no existing measure that helps to quantify the extent to which executive compensation is short-term or long-term. The lack of such a measure renders moot the question of proceeding to the next step of assessing whether the mix of short-term and long-term pay affects executive behavior and ultimately whether the observed executive compensation contracts are inefficiently short-term in nature due to poor corporate governance, or represent the constrained-efficient (second-best) outcomes of tradeoffs by shareholders.

In this paper, as a first step in filling this gap, we develop a new measure, *pay duration*, to quantify the mix of short-term and long-term executive pay. This measure is a close cousin of the duration measure developed for bonds. We compute it as the weighted average of the vesting periods of the different components of executive pay (including salary, bonus, restricted stocks, and stock options), with the weight for each component being the fraction of that component in the executive's total compensation package. With this measure in hand, and motivated by the earlier research on executive compensation, we start our analysis by first addressing a fundamental question: Does pay duration affect the executive's investment horizon?

To construct the pay duration measure, we obtain data on the levels and vesting schedules of restricted stock and stock option grants from Equilar Consultants (Equilar). Similar to Standard and Poor's (S&P) ExecuComp, Equilar collects their compensation data from the firms' proxy statements. We obtain details of all stock and option grants to all named executives of firms covered by Equilar for the period 2006-09. We obtain data on other components of executive pay, such as salary and bonus, from ExecuComp, and we ensure comparability of Equilar and ExecuComp by making sure that the total number of options granted during the year for each executive in our sample is the same across the two datasets. We believe that this is the first time in the literature that such comprehensive data on the vesting schedules of restricted stock and stock options have been brought to bear on the question we address.

We find that the vesting periods of both stock and option grants cluster around three to five years, with a large proportion of the grants vesting in a fractional (graded) manner (see Table 1). There is, however, a significant cross-sectional variation in the pay duration across the Fama-French 48 industries. Industries with longer-duration projects, such as Defense and Utilities, offer longer-duration pay to their executives, suggesting executive pay duration may be matched with project and asset duration. We also find that firms in the Finance-Trading industry have above-median pay duration (they rank 11th among the 48 industries). This is somewhat surprising, given the recent criticism that short-termism in executive compensation at banks may have contributed to the 2007-09 financial crisis.[1] The average pay duration for *all* executives (including those below the CEO) in our sample is around 1.22 years, while CEO pay has a slightly longer duration at about 1.44 years. Executives with longer-duration contracts receive higher compensation, but lower bonus, on average.

We use the level of abnormal accruals as our main proxy for the manager's investment horizon. Accruals shift earnings from the future to the present. Firms with high abnormal accruals will have high current-period earnings and low future earnings. Thus, we expect executives with a short-term investment horizon to increase abnormal accruals. Accruals have been used in the prior literature to measure myopia (e.g., Bergstresser and Philipon (2006), and Sloan (1996)). We calculate abnormal accruals using the procedure outlined in Jones (1991) (modified by including controls for earnings performance as proposed in Kothari, Leone, and Wasley (2005)), and relate CEO pay duration to the level of abnormal accruals.

[1] One caveat is that we only have data on pay contracts for ten CEO-years for the Finance-Trading industry.

In our baseline empirical specification, apart from the control variables suggested by the prior accounting literature (see Hribar and Nichols (2007)), we also include industry and time fixed effects. We find a strong negative association between CEO pay duration and abnormal accruals: firms that offer shorter-duration pay contracts to their CEOs have higher abnormal accruals in the current period. This negative association is only present for earnings-enhancing, positive accruals, and is robust to controlling for known determinants of abnormal accruals.

The identifying assumption in our baseline analysis is that, conditional on the control variables employed, pay duration is exogenous. This assumption will be violated if any omitted variable is correlated with both pay duration and abnormal accruals. One such important omitted variable could be firm risk. We use risk in a broad sense here to denote underlying operating volatility and other sources of volatility that may affect the firm's stock price. Riskier firms are likely to have more volatile cash flows and consequently higher abnormal accruals. They may also have lower pay duration to reduce the risk imposed on the executive. While we explicitly control for operating risk using the standard deviations of sales and cash flows in our baseline specification, these controls could prove inadequate. A related concern is that our identifying assumption could also be violated due to reverse causality. This can happen if CEOs control the pay process and grant themselves short-duration contracts in the years in which the firm is likely to have higher abnormal accruals. To ensure that such omitted variables and reverse causality do not bias our conclusions, we perform three additional robustness tests.

In our first robustness check, we perform cross-sectional tests to see if the negative correlation between pay duration and abnormal accruals is stronger among firms with less liquid stocks. The idea is that it will be easier for the managers of such firms to mislead the market by strategically manipulating current-period earnings. We use firm size, firm age and the bid-ask spread of the firm's stock price as measures of stock liquidity. To the extent that these measures are not perfectly correlated with risk, showing the results to be stronger in specific subsamples will help rule out a risk-based explanation. Consistent with our conjecture, we find that the negative association between pay duration and the level of abnormal accruals is stronger for small firms, young firms, and firms with less liquid stocks.

In our second robustness test, we instrument for pay duration and estimate a switching regression model (see Li and Prabhala (2007)). The advantages of the switching regression model are that, apart from explicitly controlling for *all* private information that may affect pay duration, it allows the control variables to have different coefficients for firms with long-duration and short-duration

pay contracts while at the same time permitting the estimation of interesting counterfactuals. Our instruments for pay duration are the median pay duration of all CEOs in the same *city* as the firm and the part of stock return that is due to market movement. Apart from the controls mentioned above, we additionally include within-industry time fixed effects and abnormal stock return. Our identifying assumption in the switching regression model is that the instruments are correlated with pay duration, but conditional on duration and other controls employed, do not have an independent effect on abnormal accruals. We believe that our instruments satisfy both these requirements. Both instruments are statistically significant in the first-stage regression. We also believe that the instruments satisfy the exclusion restriction: there is *no a priori* reason to expect the pay duration of a neighboring CEO to affect the level of abnormal accruals of a firm after we control for commonality arising from industry affiliation. Furthermore, systematic movements in the stock price should not affect the level of abnormal (or idiosyncratic) accruals, but they *will* affect pay duration by changing the value of stock and option grants. Our estimates from the switching regression model confirm our conclusion that firms that offer their CEOs shorter-duration pay contracts are associated with higher abnormal accruals. The magnitude of the effect is greater in the switching regression model as compared to the OLS model that we employ in our baseline analysis. This indicates that reverse causality and the omitted variable bias are actually diminishing our OLS estimates.

In our final robustness test, we introduce an alternative measure of managerial myopia. The prior accounting literature shows that firms manage both their accounting earnings and real activity so as to avoid reporting a loss (e.g., Burgstahler and Dichev (1997), and Roychowdhary (2006)). We expect CEOs of firms with short-duration pay contracts to be particularly interested in avoiding reporting a loss. Our tests confirm this conjecture. We find that CEOs with shorter-duration pay contracts are more likely to manage both accounting earnings and real activities in order to avoid reporting losses.

Summarizing, using the measure of pay duration developed in this paper, our empirical analysis documents that firms that offer their CEOs shorter-duration pay contracts are associated with higher abnormal accruals.

To examine the sensitivity of our results to the way we define pay duration, we develop an alternative measure of pay duration and show that our results are robust to this alternative measure. This measure differs from our baseline measure along two dimensions. First, it uses the pay-for-performance sensitivities (PPS) of the stock and option grants, instead of the dollar values in

our baseline measure, as the weights to calculate the pay duration. We estimate PPS as the change in the grant value corresponding to a 1% change in the firm's stock price (Core and Guay (2002)). Second, the calculation of duration with the alternative measure uses the executive's *entire* compensation portfolio, including all the prior year grants. We estimate the vesting schedules of unvested prior year grants by looking at their year-on-year changes (see Section 2.1.3 for details).

This analysis raises an important question: If short-duration pay induces CEO myopia, why do firms continue to offer such contracts in practice? That is, is there a benefit of short-term pay that makes it optimal for certain firms? In the second part of the paper, we develop a theoretical model that illuminates one possible benefit: shortening pay duration may improve the alignment of the risk preferences of the manager and the firm's shareholders.

Our model has several features that we believe reflect the real-world contracting environment. The CEO controls the capital budgeting process and can affect both the *length* and the *risk* of the firm's projects. Long-term projects are more productive than short-term projects, and high-risk projects have higher expected returns than low-risk projects. The first-best choice from the risk-neutral shareholders' perspective is the long-term, high-risk project, and shareholders design the CEO's incentive contract to maximize shareholder wealth. In the second-best case, however, shareholders face a tradeoff between project duration and risk. On the one hand, exclusive reliance on long-term compensation induces the CEO to choose the long-term project, but the CEO's risk aversion may result in her choosing inefficiently low risk. On the other hand, exclusive reliance on short-term compensation causes the CEO to prefer the high risk that shareholders prefer but also inclines the CEO to choose the short-term project. Shareholders optimize the second-best solution by employing a mix of short-term and long-term pay to the CEO.

The model reveals that firms that have more valuable long-term projects and those that are less risky offer their CEOs longer-duration pay contracts. To test this prediction, we use firm size, Tobin's Q, and R&D intensity to measure the duration of the firm's projects. We find that executive pay duration is longer in larger firms, firms with more growth opportunities, and in more R&D-intensive firms. Consistent with our model's prediction, we also find that riskier firms offer shorter-duration pay contracts.

Our model predicts an ambiguous relationship between governance and executive pay duration. In additional tests, we find empirical evidence consistent with this ambiguity. While pay duration is shorter for executives in firms with a higher proportion of non-executive director shareholding, for executives with more shareholdings in the firm, and in firms with lower entrenchment index values

(Bebchuck, Cohen, and Ferrel (2009)), it is longer in firms with a larger fraction of independent directors on the board.

Our paper is related to the vast literature on executive compensation. The broader literature has covered a wide-ranging set of issues.[2] These include whether CEOs are offered sufficient stock-based incentives and how these vary cross-sectionally,[3] whether CEOs are judged using relative performance evaluation (RPE),[4] and ultimately whether executive contracts in practice are set by the firm's board of directors or the executives themselves.[5]

With respect to the duration of executive pay, there have been numerous theoretical contributions, even going back as far as Holmstrom and Ricart i Costa (1986) who examine the pros and cons of long-term compensation contracts in a managerial career-concerns setting. Examples of other optimal contracting models that examine executive pay duration include Bizjak, Brickley, and Coles (1993), Bolton, Scheinkman, and Xiong (2006), and Dutta and Reichelstein (2003). Empirically, numerous papers have documented various features of CEO compensation. Walker (2011) describes the evolution of stock and option compensation and the aggregate shift away from options and toward restricted stocks. Core, Holthausen, and Larcker (1999), among others, have examined the determinants of the cross-sectional variation in CEO compensation. Our marginal contribution to this literature is that we develop a novel measure of pay duration that directly captures the mix of short-term and long-term pay, and then use this measure to explain how pay duration varies in the cross-section based on CEO and firm characteristics in a dataset that is much more detailed than ExecuComp, and ultimately examine the effect of pay duration on corporate decisions.

Another important contribution of our work is that our duration measure is materially different from the measures used in the prior literature to characterize executive pay, which include the proportion of non-cash pay in total pay (Bushman and Smith (2001)), the delta and vega of executive stock and option grants and holdings (Coles, Daniel, and Naveen (2006)), and the correlation of pay to stock returns and earnings (Bushman et al (1998)).[6] The key difference is that our pay duration measure explicitly takes into account the *length* of the vesting schedule for each component of the

[2] We do not attempt to provide a thorough review here; the reader is referred to review papers like Frydman and Jenter (2010), and Murphy (1999).

[3] See Aggarwal and Samwick (1999a), Garen (1994), Hall and Liebman (1998), Haubrich (1994), and Milbourn (2003).

[4] See Aggarwal and Samwick (1999b), Garvey and Milbourn (2003), Janakiraman, Lambert, and Larcker (1992), and Oyer(2004).

[5] See Bebchuk and Fried (2003), Bertrand and Mullainathan (2001), Garvey and Milbourn (2006), and Gopalan, Milbourn, and Song (2010).

[6] Much of this work has appeared in the accounting literature where researchers are also interested as to how incentive-based pay loads on both corporate earnings measures and the firm's stock price. See also Banker and Datar (1989), Lambert and Larcker (1987), and Sloan (1993).

executive's pay, of which there are often many during a given compensation year. This is important because, for example, a large stock grant itself is unlikely to contribute to short-term incentives, and this is particularly true if there is a long vesting schedule. Our empirical analysis confirms that pay duration does a better job of predicting executive behavior than the coarser measures used in the previous literature.

The rest of the paper is organized as follows. Section 2 describes our data and the empirical methodology, and discusses the main results from a preliminary analysis of the data. Section 3 conducts a thorough empirical analysis relating pay duration and managerial myopia. Section 4 develops the model to understand the cross-sectional variation of pay duration, and draws out its empirical predictions. Section 5 performs further empirical analysis to test the model's predictions. Section 6 concludes. All proofs and definitions of empirical variables are in the Appendix.

2 Data and Preliminary Empirical Analysis

In this section, we describe our data, construct the measures of pay duration, present the empirical methodology, and provide the main results from a preliminary analysis of the data.

2.1 Data and descriptive statistics

We now describe our data sources, the categories of grants in the data, and the vesting schedules of the grants.

2.1.1 *Data sources*

Our data come from four sources, Equilar, Execucomp, CRSP and Compustat:

- Data on the vesting schedules of restricted stock and stock options are drawn from Equilar Consultants (hereafter, Equilar). Similar to S&P (provider of ExecuComp), Equilar collects their compensation data from the firms' proxy statements. We obtain details of all stock and option grants to all named executives covered by Equilar for the years 2006-09.[7] Equilar also provides the grant date and the present value of the grants. The present value of a stock grant is the product of the stock price on the grant date and the number of stocks granted, while the value of an option grant is estimated by Equilar using the Black-Scholes formula.

[7]The sample of executives covered by Equilar is larger than that covered by S&P's ExecuComp. Since we use data from both sources, our final sample consists of executives covered by both datasets.

Equilar also identifies if either the size or the vesting schedule of the grant is linked to firm performance.

- We obtain data on other components of executive pay, such as salary and bonus, from ExecuComp. We carefully hand-match Equilar and ExecuComp using firm tickers and executive names. Since prior studies on executive compensation predominantly use ExecuComp, we ensure comparability of Equilar and ExecuComp by making sure the total number of options granted during the year for each executive in our sample is the same across the two datasets.

- We complement the compensation data with stock returns from the Center for Research in Security Prices (CRSP) and firm financial data from Compustat.

2.1.2 *Various categories of grants*

In practice, the specific terms of stock and option grants are quite complex. Both the number of securities granted and the vesting schedule can depend on future firm performance. For our analysis, we classify the grants into three categories; see Table 1 for the distribution of our sample grants across the three categories. The first category is the simplest. It includes grants where the number of securities offered is fixed as of the grant date, and the grant has a time-based vesting schedule. Of the total 37,304 (25,738) stock (option) grants in our sample, 21,999 (24,531) or 58.97% (95.31%) belong to this category. For each grant in this category, we have information on the size of the grant, the length of the vesting period (i.e., the time by when the grant is completely vested) and the nature of the vesting, i.e., whether the grant vests in equal installments over the vesting period (graded vesting) or entirely at the end of the vesting period (cliff vesting).

The next category includes grants for which the number of securities offered is fixed as of the grant date but the vesting schedule is contingent on future firm performance. Of all the grants in our sample, 5.73% (2.79%) of the stock (option) grants belong to this category. For such grants, Equilar records the grant size, the period over which performance is measured and the performance metrics used. We assume that these grants vest all at once at the end of the performance-measurement period. Also, for grants with a performance-linked accelerated vesting schedule, we assume that they vest according to the initially-specified vesting schedule. We rely on this approximation because the acceleration provisions in these grants are usually very complex and depend on multiple performance measures. Thus, it is not at all straightforward to determine if and when these grants will vest on an accelerated basis.

The third group of grants are part of long-term incentive plans in which the number of securities awarded is contingent on future performance. Some of these grants are also associated with a time-based vesting schedule for tax purposes (see Gerakos, Ittner, and Larcker (2007)). For such grants, Equilar records the target number of securities expected to be granted, the period over which performance is measured and any time-based vesting schedule associated with the grant. Of all the stock (option) grants in our sample, 35.25% (1.88%) belong to this category. We include all these grants in calculating our duration measure, with the number of securities used in the calculation being the target number of securities to be granted. To estimate the vesting schedules of these grants, we assume that the vesting starts right after the performance measurement period.

We are not able to identify either the performance-measurement period or the vesting period for 23 grants in our sample. They are categorized as other grants and excluded from our analysis. We do not specifically differentiate between time-based and performance-based vestings; see Bettis et al (2010) for a detailed discussion of grants with performance-based vesting.

[Table 1 goes here]

2.1.3 *Vesting schedules of pre-2006 grants*

Although our analysis focuses on the years 2006-09, obtaining a comprehensive measure of pay duration for that period requires that we estimate the vesting schedules of unvested pre-2006 (excluding 2006) stock and option grants in the executive's compensation portfolio. We use ExecuComp to estimate the vesting schedules of these grants. For every executive, ExecuComp provides details on the total outstanding unvested stock and option grants at the end of each year, and then aggregates the option grants into groups with the same exercise price and expiration date. For option grants, our estimation procedure involves the following steps:

1. We first aggregate the outstanding unvested post-2006 option grants (2006 included) from Equilar into unique exercise price-expiration date pairs, and merge Equilar and ExecuComp using executive identity, year, exercise price and expiration date.

2. We then subtract the unvested post-2006 grants from the total outstanding grants (which we get from ExecuComp) to isolate the unvested pre-2006 grants.

3. We use the year-on-year change in the outstanding unvested pre-2006 grants to estimate their vesting schedule. We can do this for all grants except those that remain unvested at the end

of 2010: there are 2,177 such grants for 1,272 executive-years (3.6% of our sample) in our sample. We assume that these grants vest at the end of 2011. We check the robustness of our conclusions by repeating our tests after excluding these executive-years.

We follow the same procedure to approximate vesting schedules of unvested pre-2006 stock grants, except that we match Equilar and ExecuComp using just executive identity and year (since a restricted stock has no expiration date or exercise price).

2.2 Measures of pay duration

In this subsection, we introduce our measures of executive pay duration involving both restricted stock and option grants.[8]

2.2.1 *Baseline measure*

Our baseline measure is constructed using only the data on post-2006 awards provided by Equilar. We follow the fixed income literature and calculate pay duration as the weighted average duration of the four components of pay (i.e., salary, bonus, restricted stock, and stock options). In cases where the stock and option awards have a cliff vesting schedule, we estimate pay duration as:

$$Duration = \frac{(Salary + Bonus) \times 0 + \sum_{i=1}^{n_s} Restricted\ stock_i \times t_i + \sum_{j=1}^{n_o} Option_j \times t_j}{Salary + Bonus + \sum_{i=1}^{n_s} Restricted\ stock_i + \sum_{j=1}^{n_o} Option_j}, \quad (1)$$

where the subscript i denotes a restricted stock grant and the subscript j denotes an option grant. *Salary* and *Bonus* are, respectively, the dollar values of annual salary and bonus. We calculate duration relative to the year end, so *Salary* and *Bonus* have a vesting period of zero. $Restricted\ stock_i$ is the dollar value of restricted stock grant i with corresponding vesting period t_i in years. During the year, the firm may have other stock grants with different vesting periods (different t_i), and n_s is the total number of such stock grants. $Option_j$ is the Black-Scholes value of option grant j with the corresponding vesting period t_j in years; n_o has a similar interpretation as n_s. In cases

[8] Cadman, Rusticus, and Sunder (2010) also introduce a similar measure of pay duration, but use only the vesting schedule of stock options. Thus, their measure only estimates the duration for the option component of pay. Since we include both stock options and restricted stock and estimate the duration for the entire compensation package, our measure is more comprehensive. Chi and Johnson (2009) examine the effect of CEO incentive horizon on firm value, but they only look at the amount of vested stock and option grants relative to unvested ones without estimating a measure of pay duration.

where the restricted stock grant (option grant) has a graded vesting schedule, we modify the above formula by replacing t_i (t_j) with $(t_i+1)/2$ ($(t_j+1)/2$).[9]

2.2.2 *Alternative measure of pay duration*

Our baseline measure of pay duration does not include grants from prior years. To account for that, we construct our alternative measure by expanding the estimation in (1) to include all stock and option holdings and grants from prior years. For each year during 2006-09, we include: (i) all vested stock and option holdings awarded from all prior years (for which we assign a vesting period of zero), (ii) unvested pre-2006 grants (for which we follow the procedures outlined in Section 2.1.3 to estimate the vesting schedules), and (iii) unvested post-2006 grants (for which we have detailed information on vesting schedules from Equilar).

The second change we make in constructing the alternative measure is to use the pay-for-performance sensitivity (PPS) of the stock and option grants, instead of their dollar value, as the weight to calculate the pay duration.[10] We follow Core and Guay (2002) and calculate PPS as the change in the grant's value corresponding to a 1% change in the firm's stock price. We then combine the PPS and the vesting schedules to calculate the alternative pay duration as:

$$Duration^{PPS,\ total} = \frac{\sum_{i=1}^{n_s}\sum_{t=0}^{t_{si}} PPS_{i,t}^{S} \times t + \sum_{j=1}^{n_o}\sum_{t=1}^{t_{oj}} PPS_{j,t}^{O} \times t}{\sum_{i=1}^{n_s} PPS_i^S + \sum_{j=1}^{n_o} PPS_j^O}. \tag{2}$$

In (2), the subscript i denotes a restricted stock grant and the subscript j denotes an option grant. $PPS_{i,t}^{S}$ is the PPS of the portion of stock grant i that vests in t years; t_{si} is the final vesting period of stock grant i, and n_s denotes the total number of stock grants, which equals two plus the number of stock grants from Equilar.[11] PPS_i^S denotes the aggregate PPS of the restricted stock grant i. Similarly, $PPS_{j,t}^{O}$ is the PPS of the portion of option grant j that vests in t years; t_{oj} is the final vesting period of option grant j, and n_o denotes the total number of option grants, including: (i)

[9] To see this, consider a stock grant i' that vests equally over $t_{i'}$ years. Since a fraction $1/t_{i'}$ of the grant is vested each year, the term $Restricted\ stock_{i'} \times t_{i'}$ in (1) should be replaced by $Restricted\ stock_{i'} \times \left(\frac{1}{t_{i'}} + \frac{2}{t_{i'}} + \ldots + \frac{t_{i'}}{t_{i'}}\right) = \frac{Restricted\ stock_{i'}}{t_{i'}} \times \frac{t_{i'}(t_{i'}+1)}{2} = Restricted\ stock_{i'} \times \left(\frac{t_{i'}+1}{2}\right)$. $Option_j \times t_j$ can be modified in the same way.

[10] We thank an anonymous Associate Editor for suggesting that we use PPS in constructing an alternative duration measure.

[11] This is because apart from the post-2006 stock grants from Equilar, we also include: (i) all the vested stock grants (as the first additional count), for which we assign a vesting period of zero, and (ii) the aggregate unvested pre-2006 stock grants (as the second additional count), whose vesting schedules are approximated using the procedures outlined in Section 2.1.3.

post-2006 option grants from Equilar, (ii) the aggregate vested pre-2006 option grants, and (iii) the unvested pre-2006 option grants aggregated into groups with the same exercise price and expiration date. PPS_j^O denotes the aggregate PPS of option grant j.

We also construct another alternative measure, $Duration^{PPS,\ award}$, which is similar to $Duration^{PPS,\ total}$, but includes only annual grants for each year during the period 2006-09, i.e., it does not include grants from prior years. We use this as a control variable in some of our tests.

2.2.3 *Discussion*

Our measure of pay duration has several advantages over the measures used in the prior literature to characterize executive pay. A principal objective of all these measures is to understand the mix of short-term and long-term pay and hence the extent to which overall pay provides short-term incentives to executives. These existing measures include the proportion of stock and option grants (non-cash pay) in total pay, the delta and vega of the executive's stock and option holdings, and the correlation of executive pay with stock returns and accounting earnings. The important difference between pay duration and those measures is that duration explicitly accounts for the length of the vesting schedules of the stock and option grants. Clearly, a large stock grant itself is unlikely to contribute to short-term managerial incentives if it has a long vesting schedule. While the delta and vega of an executive's compensation portfolio capture its sensitivities to movements in stock price and its volatility, respectively, they do not capture the mix of short-term and long-term incentives in the pay contract, which our measure does. And, unlike the correlation measure, we directly measure the mix of short-term and long-term pay in computing pay duration. Finally, our empirical analysis later confirms that our duration measure does a better job in predicting executive behavior than those existing measures.

Our measure does have some limitations. First, we do not include severance and post-retirement benefits that may be important for providing long-term incentives. The main reason for this exclusion is the difficulty in obtaining the vesting schedules of these benefits. Despite this, in our subsequent empirical analysis we find that pay duration is significantly associated with measures of myopic behavior such as the level of abnormal accruals. This association survives controls for the extent of deferred compensation. A second important limitation of our measure (as we explained in Section 2.1.2) is that we ignore the optionality introduced by linking both the size and the vesting schedule of the grant to future firm performance.

In employing our definition of duration to capture the extent of short-term and long-term pay, we implicitly assume that other than the vesting schedule, there are no other restrictions, either explicit or implicit, on the executive's ability to exercise and sell the stock and option grants as soon as they vest. To the extent that such restrictions exist, pay duration will be a noisy proxy that *underestimates* the extent of long-term incentives provided to the executive. Assuming that these restrictions are randomly distributed, they are likely to add noise to duration as a measure of managerial investment horizon and thus bias our estimates downward. Even if the restrictions are systematically correlated with accruals – firms with such restrictions have lower abnormal accruals – by not taking these restrictions into account, pay duration will underestimate the investment horizon of the executives and thus bias against finding the hypothesized relationship between CEO pay duration and abnormal accruals.

2.3 Empirical specification and key variables

In this section, we discuss our empirical specification as well as our robustness checks.

2.3.1 *Baseline regression*

In our main empirical analysis, we estimate how CEO pay duration affects her choice of investment horizon. We achieve this by estimating variants of the following OLS model:

$$y_{kt} = \alpha + \beta_1 \times Duration_{ket} + \beta_2 \mathrm{X}_{kt} + \mu_t \mathrm{T} + \mu_i \mathrm{I} + \epsilon_{kt}, \tag{3}$$

where the subscript k indicates the firm, e the CEO, t time in years, and i the firm's three-digit SIC industry. The terms T, I and X_{kt} refer to, respectively, a set of year dummies, three-digit SIC industry dummies and firm characteristics. The variable y is a measure of investment horizon. In much of our analysis, y represents signed abnormal accruals, *Accruals*. A larger value of *Accruals* implies higher earnings in this period relative to cash flows. Since signed accruals must sum up to zero in the long-run, larger accruals in the current period imply a lower level of accruals and consequently lower earnings in future periods. Thus, managers can use "discretionary accruals" to shift income across time periods. We calculate *Accruals* following the procedure outlined in Jones (1991), modified by including controls for earnings performance as proposed in Kothari, Leone, and Wasley (2005). In some of our tests, we split *Accruals* into positive and negative accruals to

shed further light on the mechanism at work. The standard errors in our regressions are robust to heteroskedasticity and are clustered at the three-digit SIC code industry level.

Our sample for these regressions includes one observation per firm-year. Our choice of control variables is guided by the prior accounting literature (see, for example, Hribar and Nichols (2007)). To control for differences in firm size, we include *Log*(*Total assets*) and *Log*(*Market cap*), the natural logarithm of the firm's book value of total assets and market capitalization, respectively. We control for growth opportunities using the market-to-book ratio (*Market to book*) and annual sales growth (*Sales growth*), for profitability using *Cashflows*, for operating volatility using the standard deviations of cash flows and sales (*S.D. Cashflow* and *S.D. Sales*, respectively), and for leverage using $\frac{Debt}{Total\ assets}$ (the ratio of total debt over total assets). We also include industry and time fixed effects, and only rely on within-industry differences in the level of accruals for our identification.

The identifying assumption in (3) is that conditional on all the control variables employed, *Duration* is exogenous. This allows us to interpret the coefficient on *Duration* as a measure of the causal effect of pay duration on abnormal accruals. Our assumption will be violated if any omitted variable is correlated with both *Duration* and *Accruals*. One such important omitted variable could be firm risk. Riskier firms – those with more volatile operating performance – may have higher abnormal accruals as they try to smooth accounting earnings over time. Such firms may also have shorter pay durations, for example, because pay uncertainty increases the cost of long-term compensation.

We employ two methods in our baseline model to control for such risk differences. First, in calculating *Accruals*, we isolate the discretionary portion of accruals. We calculate *Accruals* as the residuals from regressing total accruals on firm size, firm growth and asset structure. We run this regression individually for every industry-year. This ensures that *Accruals* measures only deviations from the industry average. Second, we explicitly control for operating risk using the standard deviations of sales and cash flows in our baseline model.

However, one could still argue that these two steps may not be enough. Specifically, unobserved risk differences could bias our conclusions. Further, the identifying assumption in our baseline model could also be violated due to reverse causality. This can happen if CEOs control the pay process and grant themselves a short-duration contract especially in the years when the firm is

likely to have higher abnormal accruals.[12] To deal with such a potential omitted-variable bias and reverse causality, we perform three additional tests, which are discussed below.

2.3.2 *Methodologies for robustness check*

For our first robustness check, we observe that if higher *Accruals* among firms with short CEO pay duration reflect managerial effort to boost the short-term stock price, then this should be more prevalent among firms with less liquid stock. Such firms will have less scrutiny in the public equity market, making it easier for the manager to manipulate the stock price by reporting high short-term earnings. To test this conjecture, we conduct cross-sectional tests differentiating firms based on size, age and bid-ask spread. These tests help our identification because any competing risk-based explanation must not only fit our baseline estimates, but also explain why the results are stronger in specific subsamples. Moreover, if the board of directors serves a monitoring role to limit managerial myopia, then the effect of pay duration on *Accruals* should be stronger for firms with weaker board oversight. We use the extent of non-executive director shareholding as a proxy for board oversight to test this.

In our second robustness test, we use a switching regression model to explicitly control for private information that may be correlated with pay duration (see Li and Prabhala (2007)). We do this by instrumenting for *Duration* using the median duration of all CEOs in the *same city* as the firm's CEO (*City duration*) and the part of stock return due to market movement (*Expected return*). The advantages of the switching regression model are that, apart from explicitly controlling for *all* private information that may affect pay duration, it allows the control variables to have coefficients for firms with long-duration pay that differ from those with short-duration pay, while at the same time enabling us to estimate interesting counterfactuals. Apart from the controls mentioned above, we also include abnormal returns, *Abnormal return*, and within-industry time fixed effects in this model. Our identifying assumption for the switching regression model is that the two instruments are correlated with *Duration*, but not related to *Accruals* conditional on *Duration* and the other controls employed (i.e., the exclusion restriction). We believe our instruments satisfy both requirements. First, both instruments are statistically significant in the first-stage regression, where the dependent variable is *Duration*. We also believe that the instruments satisfy the exclusion restriction for the following reasons. Given that we control for within-industry time fixed effects, there

[12]Note that this explanation does not invalidate the assumption that a short-duration pay contract allows the manager to exploit short-term stock mispricing arising from higher accruals.

is no *a priori* reason to expect a relationship between the pay duration of a neighboring CEO and the level of abnormal accruals of a firm. We also believe the portion of stock return due to market movement should be uncorrelated with abnormal accruals that are calculated net of an expected level of accruals based on firm and industry characteristics.

For our third robustness check, we test whether our results are robust to alternative measures of managerial myopia. The prior literature shows that managers are reluctant to report losses. This can be seen from the abnormally high (low) fraction of firms with small positive (negative) earnings (Burgstahler and Dichev (1997)). There is also evidence that managers manipulate both real investment activity (Roychowdhury (2006)) and accruals (Burgstahler and Dichev (1997)) in order to avoid reporting losses. We expect the loss-reporting-avoidance incentives to be stronger for executives with shorter pay durations. We test this to further establish how pay duration affects the manager's investment horizon.

2.4 Summary statistics and univariate analysis

We now present the summary statistics for the distribution of vesting schedules, the industry distribution of pay duration, and the key variables in the analysis. We also present the results of our univariate analysis that examines how pay duration is related to executive and firm characteristics.

2.4.1 *Distribution of vesting schedules*

In Panel A of Table 2, we provide the distributions of the vesting periods for restricted stock and option grants for all executives in our sample. The distributions are somewhat similar for stocks and options, although a chi-squared test rejects the null that the two are identical. The vesting periods cluster around the three to five-year horizon for both stocks and options and a large fraction of the vesting schedules are graded. In Panel B, we provide the distributions of the vesting periods just for CEOs (identified by the CEOANN field in ExecuComp). The distributions are similar to those in Panel A for all executives. For both stocks and options, we find that the distributions of vesting periods for CEOs first-order stochastic dominate (FOSD) those for all other executives. This suggests a longer pay duration for CEOs, which is confirmed later by our univariate evidence. Note that while in Tables 1 and 2 we include all the stock and option grants for which we have vesting schedules from Equilar, our sample in subsequent tables is confined to executive-years for which we are able to exactly match the number of annual option grants across Equilar and Execucomp.

[Table 2 goes here]

2.4.2 *Industry distribution of pay duration*

Table 3 provides the industry distributions of *Duration* and $Duration^{PPS,\ total}$ for CEOs and all executives in our sample. We use the Fama-French 48 industry classification and report the average pay duration of all executives and CEOs in separate columns within each industry. We include all industries with pay duration information for at least five executives. For ease of reference, we sort the data in terms of decreasing *Duration* for CEOs. We find that industries that have assets with longer duration (e.g., Defense, Electrical Equipment, and Coal) are also those that have longer executive pay duration (for CEOs and for all executives). We also find that $Duration^{PPS,\ total}$ is consistently lower than *Duration*. This is because $Duration^{PPS,\ total}$ includes both vested and unvested grants from prior years that have shorter remaining vesting periods.

It is interesting to note that executives in the Finance-Trading industry (e.g., securities broker-dealers) have relatively long pay durations on average; they rank 11th among the 48 industries.[13] This evidence seems to be at odds with the notion of excessive short-termism in executive compensation for financial services firms. In fact, the relatively long pay duration in these firms may reflect recognition by the boards of directors of these firms that it is relatively easy for the CEOs to alter the portfolios of their firms to boost the short-term stock price, so a longer pay duration must be used to counteract this propensity.

[Table 3 goes here]

2.4.3 *Summary statistics of key variables*

Panels A and B of Table 4 provide, respectively, the summary statistics of the key variables used in our analysis for all executives and for CEOs in our sample. Focusing on Panel A, we find that the average annual total compensation for our sample executive is \$2,214,425, which consists of \$447,365 of salary, \$143,252 of bonus, \$908,969 of stock options, and \$711,228 of restricted stocks. These numbers are comparable to those reported in previous studies. The average executive pay duration in our sample, measured by *Duration*, is 1.218 years. Thus, executive pay vests, on average, about one year after it is granted. In comparison, the average value of $Duration^{PPS,\ total}$

[13] It is also interesting to note that Banking firms (e.g., depository institutions) have shorter average executive pay duration than firms in the Finance-Trading industry.

in our sample is 0.61 years. Our sample tilts towards larger firms in Compustat, as shown by the median value of total assets of $2,195 million.

Our next set of variables measure the corporate governance characteristics of the sample firms. As for the shareholding of non-executive directors (*Director shareholding*), the average is 2.334%, whereas the median is less than 1%; note that ExecuComp records director shareholding less than 1% as zero. The average Bebchuk, Cohen, and Ferrell (2009) entrenchment index of our sample firms is about 3 (out of 6), and the average fraction of independent directors on our sample firms' boards (*Fraction independent*) is 76.3%. The average executive in our sample holds about 0.642% of the firm's shares (*Shareholding*), and is 52 years old. The average level of *Accruals* in our sample is 0.002.

In Panel B, we present the summary statistics for the subsample of CEOs. Comparing with Panel A, we find that, as expected, the CEOs in our sample have a higher annual total compensation than the average executive ($4,841,917 vs. $2,214,425). This higher compensation is reflected in four pay components (salary, bonus, options, and restricted stock). The pay duration, measured by *Duration*, is also longer for the CEO than for the average executive (1.44 years vs. 1.218 years). Interestingly, we find that the average CEO has a lower $Duration^{PPS,\ total}$ as compared to the average executive (0.456 years vs. 0.61 years). This is because of a large amount of vested stock and option grants in the average CEO's compensation portfolio. The average CEO is 55 years old, and holds more shares in the firm than the average executive (2.239% vs. 0.642%). To reduce the effects of outliers, our variables of empirical interest are all winsorized at the 1% level and we estimate standard errors that are robust to heteroskedasticity throughout our analysis.

[Table 4 goes here]

2.4.4 *Univariate test*

In this subsection, we present the findings of our univariate analysis of the relationship of pay duration to executive and firm characteristics. In Panel A of Table 5, we split our sample into executives with above and below median pay duration as measured by *Duration* (the difference in *Duration* across the subsamples is 1.595 years), and compare the characteristics across the two subsamples. Executives with above-median pay duration have a higher annual total compensation, which is reflected in three components of pay, but most starkly in the values of option and restricted stock grants. Interestingly, executives with longer-duration pay contracts receive about $62,523

less bonus on average. Pay duration is longer among larger firms (shown by the difference in *Total assets*). Firms awarding longer-duration pay contracts have higher sales growth (7.5% vs. 6.2%), higher market-to-book ratios (1.838 vs. 1.601) and higher R&D expenditures as a proportion of total assets (2.5% vs. 2.2%). These indicate that firms that are growing faster and have more growth opportunities offer longer-duration pay contracts. Executives with longer pay duration are from firms that are more profitable (measured by $\frac{EBIT}{Sales}$), have lower stock volatility, and have greater stock liquidity as reflected in a lower bid-ask spread.

Focusing on the governance characteristics, we find that firms that offer longer-duration pay contracts have higher entrenchment index values and lower shareholdings by both non-executive directors and executives. If larger shareholdings of non-executive directors and executives and a lower entrenchment index value signify firms with better governance, then these results suggest that better-governed firms offer shorter-duration pay contracts. However, firms that offer longer-duration pay contracts also have higher proportions of independent directors. So, if a higher proportion of independent directors signifies a more independent board, then this conflicts with the idea that better-governed firms offer shorter-duration pay contracts. We also find that executives with longer pay duration are younger on average. Finally, firms that offer longer-duration pay contracts have higher abnormal accruals. Since these are univariate comparisons, we do not control for the other firm-level determinants of *Accruals*.

In Panel B, we confine our comparisons to the subsample of CEOs. We only examine pay and executive characteristics as the comparisons of firm characteristics are similar to those in Panel A. We find that CEOs with longer pay durations have significantly higher annual total compensation as well as higher pay along three subcategories: salary, restricted stock, and options. CEOs with longer-duration pay contracts have significantly lower bonus and lower shareholdings on average, and are younger.

In Panel C of Table 5, we split our sample into executives with above and below median $Duration^{PPS,\ total}$, and compare the two subsamples. It is immediately evident from Panel C that the two subsamples here are more similar to each other than the two subsamples presented in Panel A. $Duration^{PPS,\ total}$ is affected by both the vesting schedule of the annual pay contract and the executive's decision to exercise and sell vested stock and option grants. To the extent the latter decision depends on idiosyncratic executive characteristics, the difference in the nature of the pay contract and firm characteristics between executives with above-median and below-median $Duration^{PPS,\ total}$ will be lower than the corresponding difference between executives with above-

median and below-median *Duration*. Executives with longer $Duration^{PPS,\ total}$ have higher annual total compensation, which is mainly driven by more restricted stock grants. Executives with longer $Duration^{PPS,\ total}$ actually have lower salary, bonus and option grants, on average.

There is no significant difference in firm size across the two subsamples, but executives with longer $Duration^{PPS,\ total}$ manage firms with higher leverage (measured by $\frac{Debt}{Total\ assets}$). Firms with longer executive $Duration^{PPS,\ total}$ have lower sales growth, lower market-to-book ratios, lower R&D expenditures (as a proportion of total assets), but higher capital expenditures. Thus, there does not appear to be a consistent relationship between $Duration^{PPS,\ total}$ and growth opportunities. Executives with longer $Duration^{PPS,\ total}$ are from firms that are less profitable, and from firms with higher stock volatility and more liquid stocks (as manifested by lower bid-ask spreads).

Focusing on the governance characteristics, we find that firms with longer executive $Duration^{PPS,\ total}$ have lower shareholdings by both non-executive directors and executives (signifying weak governance), but are associated with a higher proportion of independent directors (signifying good governance). There is no significant relationship between $Duration^{PPS,\ total}$, the entrenchment index and the level of abnormal accruals. We also find that executives with longer $Duration^{PPS,\ total}$ are younger.

Panel D confines the comparisons to CEOs. Here again, we only examine pay and executive characteristics, since the comparisons of firm characteristics are similar to those in Panel C. We find that CEOs with longer $Duration^{PPS,\ total}$ are younger, and have significantly higher annual total compensation (mainly driven by restricted stock grants) and lower shareholdings.

[Table 5 goes here]

3 Pay Duration and Managerial Myopia

In this section, we examine the effect of pay duration on managerial behavior. We first perform baseline regressions, with a host of control variables, that explore the relationship between pay duration and managerial myopia, as reflected in an emphasis on the use of accruals to boost short-term earnings. We then perform three robustness checks to deal with the potential violation of our assumption that pay duration is exogenous. We end the section with an analysis of the robustness of our results to an alternative definition of pay duration.

3.1 Results from baseline regressions

In Panel A of Table 6, we relate CEO pay duration to the level of signed abnormal accruals, *Accruals*. Our specification in these tests follows Hribar and Nicholas (2007). The results in Column (1) show that firms that offer longer-duration pay contracts to their CEOs are associated with lower levels of abnormal accruals. The coefficients on the control variables indicate that firms with higher market-to-book ratios (positive coefficient on *Market to book*), less volatile cash flows (negative coefficient on *S.D. Cashflow*), more volatile sales (positive coefficient on *S.D. Sales*), lower cash flows (negative coefficient on *Cashflows*), higher sales growth (positive coefficient on *Sales growth*) and higher market capitalization (positive coefficient on *Log*(*Market cap*)) have higher abnormal accruals. Note that the R^2 in our regression, 28.6%, is influenced by the inclusion of industry and time dummies. In Column (2), we repeat our estimates after controlling for the fraction of the executives' shareholding and find our results to be robust.

In Columns (3) and (4), we split *Accruals* into positive and negative accruals and repeat our estimation. Specifically, our dependent variable in Column (3) is *Accruals*$\times$*Positive accruals* (where *Positive accruals* is a dummy variable that identifies firm-years with positive abnormal accruals), while the dependent variable in Column (4) is *Accruals* $\times$ (1 $-$ *Positive accruals*). Bergstresser and Philippon (2006) show that the sensitivity of CEO pay to stock price movements affects the executive's incentive to manage earnings. We control for that by including the natural logarithm of the delta of the CEO's stock and option portfolio, *Log*(*Delta*). We measure *Delta* using the procedure in Coles, Daniel, and Naveen (2009). Our results indicate that pay duration is negatively related to positive accruals. We do *not* find a significant relationship between pay duration and negative accruals. This indicates that a longer-duration pay contract reduces the CEO's incentive to engage in earnings-enhancing accruals.

Apart from a long vesting schedule, executives can also be given long-term incentives through deferred compensation. To see if the effect of *Duration* on *Accruals* is robust to controlling for the extent of long-term incentives provided by such deferred compensation, in unreported tests we repeat our estimations after controlling for the extent of deferred pay using *High deferred pay*, a dummy that identifies executives with above median value of deferred compensation as a fraction of total compensation. We obtain results similar to those reported here.

Summarizing, our results in Panel A show that firms that offer their CEOs longer-duration pay contracts are associated with lower levels of accruals and more specifically, less positive accruals,

which is consistent with the intuition that short-duration pay provides incentives for managers to emphasize short-term earnings. Our results are economically significant as well. Comparing the coefficient in Column (3) to the mean value of positive accruals in our sample, we find that a one standard deviation increase in *Duration* (0.967 years) leads to an 8% reduction in the extent of positive accruals as compared to its sample mean.

3.2 Robustness checks

As indicated earlier, because of the possibility of violation of our baseline-regression assumption that pay duration is exogenous, we perform three robustness checks. These are: (i) an examination of whether the effect of pay duration on managerial myopia is stronger for firms that are smaller, younger, have less liquid stocks, and weaker board oversight; (ii) a switching regression model to control for endogeneity; and (iii) the use of an alternative measure of managerial myopia. We show that our results survive all of these robustness checks.

3.2.1 *First robustness check: linking the effect of pay duration on managerial myopia to firm size, age, stock liquidity and governance*

In Panel B of Table 6, we test our cross-sectional predictions by repeating our tests in different subsamples. In Columns (1) and (2), we divide our sample into small and large firms and repeat our tests. We identify firms as small if they have below-sample-median market capitalization. Our results indicate that while *Duration* is negatively related to *Accruals* both for small and large firms, the absolute value of the coefficient for small firms is twice the size of that for large firms. The economic magnitude of the effect is also greater for small firms, because the mean value of absolute *Accruals* is lower for small firms as compared to that for large firms (0.0002 vs. 0.0035).[14] In Columns (3) and (4), we divide our sample based on bid-ask spread. Our results indicate that *Duration* has a statistically significant effect on *Accruals* only for firms with above median bid-ask spreads. In Columns (5) and (6), we divide our sample into young and old firms. We classify firms as young if they have below-median firm age, where firm age is the number of years since the IPO year. Since older firms are likely to have greater institutional shareholding (Bennett, Sias, and Starks (2003)), we expect duration to have a greater affect on accruals for younger firms. Consistent with this, we find *Duration* has a significant effect on *Accruals* only for young firms. Finally, in

[14]We compare the coefficient with the mean value of absolute accruals because signed accruals tend to have an average close to zero.

Columns (7) and (8) we repeat our tests in subsamples of firms with high and low board oversight. We classify firms in which non-executive directors own more than 1% of the shares as having better board oversight. Again, we find that the negative correlation between *Duration* and *Accruals* is present only in the subsample of firms with weak board oversight.

Overall, our results in Panel B show that the effect of *Duration* on *Accruals* is greater for smaller firms, younger firms, firms with less liquid stocks, and firms with weak board oversight. When we repeat our tests using *Short duration* instead of *Duration*, where *Short duration* identifies firms with below median CEO pay durations, we obtain results similar to the ones reported here. These results provide strong evidence that pay duration affects the manager's investment horizon.

[Table 6 goes here]

3.2.2 *Second robustness check: switching regression model to control for endogeneity*

We now perform tests that explicitly control for private information that may affect pay duration and abnormal accruals. In particular, we wish to deal with the possibility that the manager may possess private information about impending high abnormal accruals and may therefore choose a short-duration contract to take advantage of it. In Panels A and B of Table 7, we relate *Accruals* to CEO pay duration after controlling for endogeneity. To do this, we first convert our main independent variable, *Duration*, into a dummy variable, *Short duration*, which takes the value one for CEOs with below sample-median pay duration as measured by *Duration*. To control for endogeneity, we estimate a switching regression model (see Fang (2005), and Li and Prabhala (2007)). The model consists of estimating three regressions: a probit selection model with *Short duration* as the dependent variable, and two separate OLS models with *Accruals* as the dependent variable that are estimated for firms with below-median and above-median CEO pay duration.[15] We augment the two OLS models with the Inverse Mills ratio and the Mills ratio, respectively, estimated from the first-stage regression.[16]

In Column (1) of Panel A, we present the results of the first-stage probit model. We use two exogenous instruments for pay duration. Our first instrument is the median *Duration* of all CEOs

[15]The switching regression model, while similar to a Heckman selection model, is more general because it estimates two second-stage equations and thus allows for different coefficients on the covariates for the "selected" and the "not-selected" samples. Similar to the Heckman model, the identification comes from the non-linearity of the model, which arises from the assumption of joint normality for the error terms.

[16]The Mills ratio and the Inverse Mills ratio are given by the formulas $\frac{\phi(\hat{\gamma}Z')}{\Phi(\hat{\gamma}Z')}$ and $\frac{-1\times\phi(\hat{\gamma}Z')}{1-\Phi(\hat{\gamma}Z')}$, where ϕ and Φ denote, respectively, the probability density function and the cumulative distribution function of the standard normal distribution, Z is the vector of regressors used in the selection model, and $\hat{\gamma}$ denotes the vector of coefficient estimates from the selection model.

of firms in the same city as the CEO (see Hochberg and Lindsey (2010) for a similar idea), *City duration*. Our second instrument is *Expected return*, which is the part of stock return due to market movements. We believe these instruments satisfy the two requirements necessary for our identification. First, we believe *City duration* will be correlated with *Duration* through local peer effects. CEOs are likely to meet each other socially and exchange information on the structure of their compensation contracts. Such interaction is also likely at the board level. These may lead to geographic clustering in the structure of compensation contracts. Apart from Hochberg and Lindsey (2010), Shue (2011) also documents peer effects in the structure of CEO compensation. These studies offer support for why *City duration* will be correlated with *Duration*. To ensure that this relationship is not due to industry similarity, we include within-industry time effects in our regressions. By changing the value of stock and option grants, *Expected return*, is also likely to affect *Duration*.[17] We believe our instruments also satisfy the exclusion restriction. There is *no a priori* reason to expect the duration of a neighboring CEO (of a firm in the same city) to affect the level of abnormal accruals. We also believe the portion of stock return due to market movements should be uncorrelated with abnormal accruals that are net of expected accruals. The Jones (1991) model that we employ is designed to estimate expected accruals using industry and firm characteristics. Since idiosyncratic movements in the stock price may be correlated with *Accruals*, we include *Abnormal return* (part of stock return not due to market movement) as an additional control in our regression.

Apart from the exogenous instruments, we also include all observable firm and executive characteristics that may affect duration and also the level of accruals. We confine this regression to firms in cities with a minimum of three firms. The coefficients in Column (1) indicate that the median pay duration of CEOs in the same city is significantly negatively related to *Short duration*. We also find that firms with higher *Expected return* have longer pay duration. Firms with higher market-to-book ratios, lower leverage, more volatile sales, and lower abnormal returns in the recent past have shorter-duration pay contracts. We find that firm size has an ambiguous effect. While the coefficient on *Log*(*Total assets*) is positive, that on *Log*(*Market cap*) is negative and significant.

In Columns (2) and (3), we present the results of the OLS regressions with *Accruals* as the dependent variable for firms with below-median CEO pay durations (Column (2)) and those with above-median CEO pay durations (Column (3)). The empirical specification in these columns is similar to that in Column (1) in Panel A of Table 6, except that we include the *Inverse Mills*

[17]We thank an anonymous Associate Editor for suggesting this instrument.

ratio and *Mills ratio* as additional regressors in Columns (2) and (3), respectively, to control for unobserved characteristics (i.e., private information) that may affect both pay duration and *Accruals*. A test of whether *Accruals* is higher for firms with below-median CEO pay duration is to compare the actual level of *Accruals* for such firms with the counterfactual level of *Accruals* if the same firms had above-median pay duration. We estimate the counterfactual by combining the coefficient estimates in Column (3) with the firm and executive characteristics for firms with below-median pay durations. In Panel B, we report the result of a t-test for the statistical significance of the difference between the actual accruals and the counterfactual. Our results indicate that the level of accruals for firms with below-median pay durations is significantly higher than the counterfactual level of accruals. Note that the sizes of our estimates from the switching regression model are significantly larger than our OLS estimates. When we estimate (3) with *Short duration* instead of *Duration*, our coefficient on *Short duration* is 0.004. This indicates that unobserved variables that are not included in our baseline model actually bias our estimates downward.

Overall, the switching regression model allows us to explicitly control for the endogenous selection of pay duration based on unobserved characteristics and to estimate the effect of pay duration on *Accruals*. We find that, even after explicitly controlling for such private information, shorter pay duration for CEOs leads to higher accruals.

[Table 7 goes here]

3.2.3 *Third robustness check: alternative measure of managerial myopia*

In Table 8, we relate the CEO's pay duration to her incentives to manage cash flows and accruals to avoid reporting a loss. To do this, we first identify firms with very small positive earnings, the ones we refer to as having "suspect incomes" (*Suspect*), i.e., these are firms that are highly likely to have "managed" their earnings through accounting or real-activity manipulations in order to avoid having to report negative earnings. Following Roychowdhary (2006), we classify firms with $\frac{Net\ income}{Total\ assets} \in [0, 0.05]$ as having "suspect incomes." Roychowdhary (2006) predicts that firms with "suspect incomes" will have abnormally low cash flows – due to higher expenses from trying to pump up sales – along with abnormally high accruals. We expect these effects to be stronger for firms with shorter CEO pay durations.

We first estimate abnormal cash flows using the procedure in Roychowdhary (2006). This involves regressing *Cashflows* on $\frac{1}{Total\ assets}$, $\frac{Sales}{Total\ assets}$ and $\frac{\Delta Sales}{Total\ assets}$ for every industry-year where

we define industry at the level of two-digit SIC code. We use the estimated coefficients to calculate the expected cash flow for all firms in our sample and calculate abnormal cash flows as the difference between the actual cash flows and expected cash flows. Thus, this procedure is similar in spirit to the one we use to calculate abnormal accruals.

In Columns (1) and (2) of Table 8, we estimate a model similar to (3) with *Abnormal cash flow* as the dependent variable. The control variables include $Log(Total\ assets)_{t-1}$, $Market\ to\ book_{t-1}$ and *Abnormal net income*. Our main independent variable of interest is *Suspect*. Roychowdhary (2006) estimates a similar model and interprets the negative coefficient on *Suspect* as being consistent with managers manipulating real activity to affect the reported earnings. In our tests, we divide our sample into firms with above-median and below-median pay duration (measured by *Duration*) and separately estimate the regression in the two subsamples. Our results indicate that firms with "suspect incomes" have relatively low cash flows only if they also have below-median pay durations. Unfortunately, perhaps due to the noise in our estimation, we find that the coefficients across the two subsamples are not significantly different from each other. In Columns (3) and (4), we repeat our tests with *Accruals* as the dependent variable and find that while firms with "suspect incomes" and below-median pay durations have higher abnormal accruals, firms with "suspect incomes" and above-median pay durations have lower abnormal accruals. While the individual coefficients are not significantly different from zero, we find that they are significantly different from each other.

Overall, our results in Table 8 show that firms with "suspect incomes" and shorter pay durations have lower abnormal cash flows and higher abnormal accruals than other firms. Thus, it appears that shorter-duration pay contracts lead to greater managerial myopia even under our alternative measure of myopia.

[Table 8 goes here]

3.3 Further robustness tests with an alternative definition of pay duration

In this section, we repeat our tests with $Duration^{PPS,\ total}$ as our independent variable. Note that in calculating $Duration^{PPS,\ total}$, we include all prior year grants and holdings. Apart from the standard controls, we also include $Duration^{PPS,\ award}$ as an additional control in these regressions. To recall, $Duration^{PPS,\ award}$ is the PPS-weighted duration calculated using annual grants alone. Thus, we control for the structure of the annual compensation contract and hence the coefficient on $Duration^{PPS,\ total}$ only captures the effect of prior year grants on *Accruals*. To the extent that

prior year grants are less affected by time-varying unobserved factors that may affect the current period's *Accruals*, this specification helps to further control for unobserved private information.

In Panel A of Table 9, we repeat our tests from Panel A of Table 6 after replacing *Duration* with $Duration^{PPS,\ total}$. The results in Column (1) show that firms managed by CEOs with longer-duration compensation portfolios are associated with lower levels of abnormal accruals. The coefficients on the control variables are similar to those reported in Panel A of Table 6. In Column (2), we repeat our estimates after controlling for the fraction of the executives' shareholding and find our results to be unaffected. In Columns (3) and (4), we split *Accruals* into positive and negative accruals and also control for the delta of the executive's compensation portfolio. We find that firms with higher $Duration^{PPS,\ total}$ have higher negative accruals.

In Panels B and C, we repeat our estimates with the switching regression model using $Duration^{PPS,\ total}$ as the dependent variable. Here again, we use *City duration*$^{PPS,\ total}$ and *Expected return* as the instruments for *Short duration*$^{PPS,\ total}$, where *City duration*$^{PPS,\ total}$ and *Short duration*$^{PPS,\ total}$ are similarly defined as *City duration* and *Short duration*, respectively. Our identifying assumption behind these estimates is similar to the one in Table 7. Here again, we confine the sample to firms in cities with a minimum of three firms. From Column (1) of Panel B, we find that both *City duration*$^{PPS,\ total}$ and *Expected return* are strongly negatively correlated with $Duration^{PPS,\ total}$. We also find that smaller firms, firms with lower leverage, higher market capitalization of equity, higher bid-ask spreads, higher delta and lower abnormal stock returns have shorter Duration$^{PPS,\ total}$. In Columns (2) and (3), we present the results of the OLS regressions with *Accruals* as the dependent variable for firms with below-median CEO $Duration^{PPS,\ total}$ (Column (2)) and those with above-median CEO $Duration^{PPS,\ total}$ (Column (3)). Here again, we include $Duration^{PPS,\ award}$ as an additional control.

In Panel C, we report the result of a t-test for the statistical significance of the difference between the actual accruals for firms with below-median $Duration^{PPS,\ total}$ and the counterfactual. Note that we calculate the counterfactual by combining the coefficient estimates in Column (3) with the characteristics of firms with below-median $Duration^{PPS,\ total}$. Our results indicate that the level of accruals for firms with below-median $Duration^{PPS,\ total}$ is significantly higher than the counterfactual level of accruals. Note that the sizes of our estimates from the switching regression model are significantly larger than our OLS estimates.

[Table 9 goes here]

Our analysis so far indicates that firms with shorter-duration CEO pay have higher abnormal accruals. To the extent that the stock market does not correctly price accruals, such behavior may lead to temporary mispricing of the firm's shares and prove costly for some shareholders. In some cases, this may even lead to some inefficient corporate decisions. Thus, our analysis highlights a potentially important cost of short-duration pay. An important question suggested by this is: in light of this cost, why do some firms award short-duration pay contracts to their managers? To formally address this question, we now present a theoretical model that attempts to capture both the costs *and* benefits of short pay duration, so as to produce predictions about optimal pay duration. We test some of the cross-sectional predictions of our model in Section 5.

4 A Theoretical Model of Optimal Pay Duration

In this section, we develop a theoretical model of the optimal mix of short-term and long-term pay for executives. The model generates predictions about how the optimal mix is related to firm characteristics and how it affects executive behavior.

4.1 Agents and economic environment

Consider a firm owned by risk-neutral shareholders (who are represented by a board of directors) and run by a risk-averse CEO. There are three dates, $t = 0, 1, 2$, and discount rates between dates are normalized to zero. At $t = 0$, the firm has one unit of capital that can be allocated between a long-term project and a short-term project. The short-term project generates a cash flow X_1 at $t = 1$, while the long-term project's cash flow X_2 is realized at $t = 2$; both X_1 and X_2 are publicly observable and contractible. Let $\kappa \in [0, 1]$ denote the amount of capital allocated by the CEO to the long-term project and $1 - \kappa$ the amount deployed towards the short-term project. Besides making this capital allocation decision, the CEO also chooses the risk of the long-term project (r) at $t = 0$, which can be either low ($r = l$) or high ($r = h$). We assume $X_2 \sim N(\kappa\mu_r, \sigma_r^2)$, with $\sigma_h^2 > \sigma_l^2$ and $\mu_h > \mu_l$, reflecting the usual risk-return tradeoff.

The earnings from the short-term project are modeled as $X_1 = (1 - \kappa)\mu_l - 0.5(1 - \kappa)^2$. This specification for X_1 captures two intuitive ideas. First, capital is more productive in the long-term project than in the short-term project. This is captured by the term $-0.5(1 - \kappa)^2$.[18] Second, the short-term project's cash flow is less volatile than that of the long-term project. This specification

[18]The expected payoff from allocating each unit of capital to the less risky long-term project is μ_l, while for the short-term project it is $\mu_l - 0.5(1 - \kappa)$.

captures the idea that uncertainty grows with time and is similar to a diffusion process in which the variance associated with the terminal distribution increases with the time to termination. While our analysis only requires the short-term project's cash flow to be less volatile than the long-term project's cash flow, to simplify the analysis, without loss of generality we normalize the volatility of X_1 to zero. The earnings from the short-term project are paid out immediately at $t = 1$ as dividends. We further assume $\mu_l > 1.5$, so the net expected return from the investment is always positive.[19] Note that since shareholders are risk neutral, absent delegation, the shareholders prefer the high-risk, long-term project.

The CEO's capital allocation decision and her choice of project risk are not observable to others and hence not contractible. Moreover, instead of investing the capital in the project, the CEO can take some hidden action to divert the capital for perquisites consumption, which is detrimental to firm value. Reflecting this, we assume that each unit of capital diverted by the CEO yields her a private benefit $b > 0$, while the total expected firm value decreases by βb; we assume $\beta > 1$, so such diversion is inefficient. This value loss is reflected in the reduction in the cash flows of both projects in proportion to the capital allocation. That is, if the CEO diverts b, the expected value of the long-term project decreases by $\kappa\beta b$, and the value of the short-term project decreases by $(1-\kappa)\beta b$. The possibility of capital diversion generates the need for an incentive contract.

At $t = 0$, the board designs a compensation contract with three components: (i) w_0 in cash awarded to the CEO at $t = 0$ (salary), (ii) w_1 shares of the firm's short-term earnings at $t = 1$, and (iii) w_2 shares of the firm's long-term value at $t = 2$. The CEO has negative exponential utility, $-e^{-\lambda W}$, where W denotes her total compensation, and $\lambda > 0$ is her coefficient of absolute risk aversion; for mathematical convenience, we will work with her certainty equivalent throughout, $V_E(W) = \mathbf{E}(W) - (\lambda/2)\mathbf{Var}(W)$. We assume that the CEO's reservation utility in terms of the certainty equivalent is a constant $\bar{V}_E$.

To make our setup with two possibilities of risk-return tradeoff meaningful for our analysis of the optimal compensation contract, we make the following parametric assumption throughout:

$$\frac{\mu_h - \mu_l}{\sigma_h^2 - \sigma_l^2} < \frac{\lambda}{2\beta}. \tag{4}$$

This assumption bounds the return of the high-risk, long-term project. If (4) is violated, then the high-risk (long-term) project is so attractive relative to the low-risk (long-term) project and the

[19] Under this condition, $\kappa\mu_r > \kappa$ and $X_1 > 1 - \kappa \ \forall \kappa, r$. Moreover, X_1 is maximized at $\kappa = 0$.

short-term project that not only does the board want to always ensure its selection, but can also design a long-term contract that will make the CEO pick the project. Thus in this case, long-term compensation, which rewards the CEO for picking the long-term project, unambiguously dominates short-term compensation, and there is no cross-sectional variation in pay duration. We make the assumption above to rule out this uninteresting case.

4.2 Optimal compensation contract

We begin our analysis of the optimal compensation contract by examining the polar cases of pure long-term compensation and pure short-term compensation. This sequential analysis helps to sharply delineate the key tradeoffs in the model.

4.2.1 Pure long-term compensation: distorted risk choice

Suppose the CEO's compensation is not linked to short-term earnings, i.e., $w_1 = 0$. It is clear that, conditional on not diverting capital, the CEO invests the entire unit of capital in the long-term project, i.e., $\kappa = 1$.[20] The board's problem at $t = 0$ is to design a contract to maximize the expected payoff to the existing shareholders by making it incentive compatible for the CEO to not divert the capital.

Lemma 1. *Suppose the CEO's compensation is not linked to short-term earnings, i.e., $w_1 = 0$. Then the CEO allocates the entire unit of capital to the long-term project, i.e., $\kappa = 1$, and chooses low project risk, $r = l$.*

The intuition is as follows. To discourage capital diversion, w_2 needs to be set sufficiently high to ensure that the CEO internalizes the cost of the diversion. However, a larger w_2 also exposes the risk-averse CEO to greater pay uncertainty due to the greater randomness in the earnings of the long-term project; choosing high project risk ($r = h$) magnifies such pay uncertainty. Under the parametric assumption in (4), the minimum w_2 that is required to discourage capital diversion is sufficiently large, so that the benefit to the CEO from choosing high project risk (with high expected long-term value) is outweighed by the cost associated with the greater pay uncertainty. As a result, the CEO chooses low project risk ($r = l$). From the risk-neutral shareholders' perspective, this represents a distorted risk choice, where the high-return investment opportunity (by choosing high

[20] One important reason for this result is our assumption that short-term earnings are not retained but paid out immediately at $t = 1$ as dividends.

risk) is foregone. However, this is an inefficiency that shareholders have to accept if they want to discourage capital diversion but are limited to awarding only long-term compensation.

4.2.2 Pure short-term compensation: distorted capital allocation

Now suppose the CEO has no long-term compensation, i.e., $w_2 = 0$. In this case, conditional on not diverting, the CEO will invest all the capital in the short-term project, i.e., $\kappa = 0$.

Lemma 2. *Suppose the CEO's compensation is not linked to long-term firm value, i.e., $w_2 = 0$. Then the CEO allocates the entire unit of capital to the short-term project, i.e., $\kappa = 0$.*

Thus, if the CEO is compensated only with short-term earnings, capital allocation is distorted.

4.2.3 Optimal mix

The above analysis exposes a conflict between the twin objectives of shareholders: ensuring efficient capital allocation ($\kappa = 1$) and efficient risk choice ($r = h$). Pure long-term compensation induces the efficient use of capital but distorts the risk choice, whereas pure short-term compensation distorts capital allocation. This conflict is reminiscent of the classic multitask agency problem analyzed by Holmstrom and Milgrom (1991). In our subsequent analysis, we examine how the optimal mix of long-term and short-term pay can mitigate such problem.

It is useful to see the intuition before the formal details. As explained earlier, the cost of long-term compensation is that it distorts the manager's risk choice. Reducing the contract's weight on long-term value (i.e., lowering w_2) helps to mitigate this distortion, but it may lead to inefficient capital diversion. Since both long-term and short-term compensation are effective in discouraging capital diversion, the board can lower w_2 (so as to ensure the efficient risk choice), and increase w_1 while maintaining sufficient *total* pay-for-performance sensitivity to discourage capital diversion. The optimal contract does involve some inefficient capital allocation to the short-term project ($\kappa < 1$), since part of the CEO's pay is linked to short-term earnings. Such a tradeoff between the benefit and the cost of increasing pay duration results in the optimal mix of long-term pay and short-term pay.

Proposition 1. *In an optimal pay contract:*

1. *the CEO is awarded both short-term and long-term compensation, i.e., $w_1 > 0$ and $w_2 > 0$;*

2. *the CEO chooses high project risk, i.e., $r = h$, and capital is allocated to both the long-term project and the short-term project, i.e., $\kappa \in (0, 1)$; and*

3. *when the Sharpe ratio of the high-risk project relative to the low-risk project, $\frac{\mu_h - \mu_l}{\sigma_h^2 - \sigma_l^2}$, increases, the pay contract shifts more toward long-term compensation relative to short-term compensation, i.e., w_2/w_1 increases, and the CEO allocates more capital to the long-term project, i.e., κ increases.*

To understand the comparative statics results, note that when $\frac{\mu_h - \mu_l}{\sigma_h^2 - \sigma_l^2}$ increases, the benefit of choosing high project risk ($\mu_h - \mu_l$) increases relative to its cost ($\sigma_h^2 - \sigma_l^2$). This elevates the comparative advantage of using long-term compensation and induces the board to rely more on long-term pay relative to short-term pay, i.e., w_2/w_1 increases as well. As more of her compensation is tied to long-term firm value, the CEO optimally allocates more capital to the long-term project (i.e., κ increases).

Our model also predicts that the compensation weight on long-term value, w_2, is decreasing in β. However, the sign of the comparative static of the ratio, w_2/w_1, with respect to β is not unambiguous. One can interpret β, within the context of our model, as the quality of the firm's corporate governance, with a larger β corresponding to better governance: note that when β is larger, the CEO is *ceteris paribus* less likely to divert capital for perquisites consumption.

4.3 Empirical predictions

We now gather the empirical predictions of our model. We know from Proposition 1 that the amount of long-term pay relative to short-term pay, w_2/w_1, is on average higher for larger $\frac{\mu_h - \mu_l}{\sigma_h^2 - \sigma_l^2}$. As mentioned before, $\frac{\mu_h - \mu_l}{\sigma_h^2 - \sigma_l^2}$ is a measure of the attractiveness of the high-risk project relative to the low-risk project. It is reasonable to expect industries with longer-duration projects and longer-lived assets have a larger $\frac{\mu_h - \mu_l}{\sigma_h^2 - \sigma_l^2}$. With w_2/w_1 representing pay duration, our model predicts that:

Prediction 1. *The optimal pay duration is longer in firms with longer-term projects.*

To test this prediction, we use firm size, market-to-book ratio, and R&D intensity as proxies for the duration of the firm's projects.

Ceteris paribus, an increase in the volatility of the cash flows of the high-risk project will reduce $\frac{\mu_h - \mu_l}{\sigma_h^2 - \sigma_l^2}$, leading to predictably lower reliance on long-term compensation.

Prediction 2. *The optimal pay duration is shorter for firms with more volatile cash flows.*

We test this prediction using the volatility of the firm's stock, cash flows and sales. We now present our final prediction.

An important cost of short-term compensation in our model is that it induces the CEO to allocate capital away from the long-term project and in the direction of the inefficient short-term project. From Proposition 1, we know that the amount of capital allocated to the long-term project, κ, is increasing in the contract's weight on the long-term firm value (w_2) relative to the weight on short-term earnings (w_1). This leads to the following prediction, which we have already tested:

Prediction 3. *CEOs of firms with shorter pay durations are more likely to engage in myopic investment behavior.*

Finally, as mentioned before, our model does not yield an unambiguous relation between w_2/w_1 and β, the proxy for the firm's corporate governance quality.

5 Further Empirical Analysis

In this section, we test the first two predictions of our model by estimating variants of the following regression:

$$Duration_{ket} = \alpha + \beta_1 \mathrm{X}_{kt} + \beta_2 \mathrm{X}_{et} + \mu_{it}(\mathrm{I} \times \mathrm{T}) + \epsilon_{ket}, \tag{5}$$

where the subscript k indicates the firm, e the executive, t time in years, and i the firm's three-digit SIC industry. The term T refers to a set of year dummies, I to a set of three-digit SIC industry dummies, X_{kt} is a set of firm characteristics, and X_{et} refers to executive characteristics. Detailed definitions of all the variables used in our analysis are provided in Appendix B. The main firm characteristics we include are firm size measured using *Log*(*Total assets*), leverage as measured by $\frac{Debt}{Total\ assets}$, and growth opportunities as captured by *Market to book* and R&D intensity using the ratio $\frac{R\&D}{Total\ assets}$. We use *Log*(*Total assets*), *Market to book* and $\frac{R\&D}{Total\ assets}$ to measure the "duration" of the firm's assets, with higher values indicating firms with longer-duration assets. We use *Volatility*, *S.D. Cashflow* and *S.D. Sales* to measure the volatility of the firm's operations. To control for stock performance, we also include the firm's stock return over the previous year, *Stock return*, a dummy variable that identifies CEOs, *CEO*, and the liquidity of the firm's stock, *Spread*. Since there is likely to be substantial similarity in the pay contracts for executives of firms in the

same industry, in all our tests we include within-industry time fixed effects. Thus, our identification comes only from cross-sectional within-industry-year differences in firm characteristics.

5.1 Pay duration and firm characteristics

In Panel A of Table 10, we test *Prediction 1* and *Prediction 2* by relating pay duration to firm characteristics. To understand the extent to which pay duration is similar for firms within the same industry, we begin our empirical analysis in Column (1) by estimating equation (5) with only the within-industry time fixed effects. In this specification, we obtain an R^2 of 13.7%. Thus, within-industry clustering is able to explain about 14% of the variation in pay duration in our sample. In Column (2), we include a number of firm characteristics along with the fixed effects and find that the R^2 increases to 24.3%. Thus, firm characteristics are also important determinants of pay duration across firms.[21] The positive and significant coefficient on *Log*(*Total assets*) in Column (2) indicates that, consistent with *Prediction 1*, pay duration is longer for larger firms. From the coefficients on the control variables, we find that shorter-duration pay contracts are offered by firms with higher leverage, lower stock returns in the recent past, and those with a less liquid stock, and such contracts are more likely to be offered to executives other than the CEO.

Our coefficient estimates are also economically significant. The coefficient on *Log*(*Total assets*) in Column (2) indicates that pay duration for an executive in a firm with *Log*(*Total assets*) equal to 8.96 (75^{th} percentile in our sample) is about 0.42 years longer than the pay duration for an executive in a firm with *Log*(*Total assets*) equal to 6.57 (25^{th} percentile in our sample). We also find that, on average, CEOs have pay contracts with about 0.28 years longer duration than other executives.

In Column (3), we use *Market to book* to measure the duration of the firm's projects and find that firms with higher market-to-book ratios offer longer-duration pay contracts. Finally, in Column (4) we use $\frac{R\&D}{Total\ assets}$ to proxy for the duration of the firm's projects and consistent with *Prediction 1*, find that firms with higher R&D expenditures have longer-duration pay contracts.

In Columns (5) – (7), we test *Prediction 2*. In Column (5), we use the lagged volatility of stock prices, *Volatility*, as a measure of firm risk and find that firms with more volatile stock prices have shorter-duration pay contracts. This is consistent with long-term pay being more expensive for

[21] Note that within-industry clustering in pay duration may also result from forces we model. Since we are unable to isolate the different factors that drive the within-industry clustering in duration, in testing our model predictions, we control for within-industry clustering. To this extent, our estimates represent lower bounds on the true magnitude of the effect.

riskier firms. The negative association between volatility and pay duration may also reflect the greater risk taken by executives with shorter-duration pay. To partly control for this latter effect, we use lagged volatility in our analysis. From Columns (6) and (7) we find that, consistent with *Prediction 2*, firms with more volatile cash flows and more volatile sales offer shorter-duration pay contracts.

Overall, our evidence from Panel A indicates that firms with shorter-duration projects and greater risk offer shorter-duration pay contracts. In unreported tests, we find our results are robust to excluding non-CEOs, and to explicitly controlling for the proportion of non-cash pay.

Given the significant clustering in pay duration across firms in the same industry, in unreported tests, we also collapse the dataset to one observation per industry-year and replace the variables by their industry median values. We then repeat our tests on this smaller dataset and find that pay duration is longer in industries with more long-lived assets and more volatile performance. This again is consistent with *Prediction 1* and *Prediction 2*.

5.2 Pay duration and governance characteristics

In Panel B of Table 10, we examine how the firm's governance characteristics affect executive pay duration. In Column (1), we use the extent of shareholding of non-executive directors as a measure of firm governance and repeat our tests after including a dummy variable, *High director shareholding*, which identifies firms with more than 1% shareholding by non-executive directors. Our results indicate that pay duration is shorter in firms with higher shareholding by non-executive directors. If higher director shareholding improves the incentives of the directors to monitor the executive and prevent capital diversion (e.g., Ryan and Wiggins (2004)), then this result is consistent with better-governed firms offering shorter-duration pay contracts. In Column (2), we limit the sample to CEOs, and find that CEOs of firms with higher non-executive director shareholding have shorter-duration pay contracts.

In Column (3), we employ the Bebchuk, Cohen, and Ferrell (2009) entrenchment index as a governance measure and find that firms with higher entrenchment index values offer longer-duration pay contracts. In Column (4), we limit the sample to CEOs and repeat our test in Column (3). We again find pay duration to be longer for CEOs of firms with higher entrenchment index values. If a higher entrenchment index indicates weaker governance, then these results are consistent with those in Columns (1) and (2).

In Columns (5) and (6), we relate the fraction of independent directors on the firm's board to pay duration and find that firms with a larger fraction of independent directors have longer pay durations. If a larger fraction of independent directors improves governance, then this result suggests that better-governed firms employ longer-duration pay contracts. This is inconsistent with our previous results. Finally, in Column (6), we confine the sample to CEOs and again find that CEO pay duration is longer in firms with more independent directors on the board.[22] In unreported tests, we find that the number of directors on the firm's board is not significantly related to pay duration.

Overall, our results in Panel B do not show a consistent relationship between firm governance and pay duration. This seems to be in line with the theory developed earlier which reveals an ambiguous relationship between pay duration and governance.

In unreported tests, we also estimate how pay duration is related to executive age and tenure, and find that pay duration is shorter for older executives and executives with longer tenure. While our model does not have any direct prediction about this relationship, there are several plausible interpretations of this finding. Older executives are likely to have more reputational capital at stake and better-established legacies to lose if caught diverting capital to boost short-term results at the expense of long-term value. Consequently, there is greater self-policing and the need for long-duration pay contracts to prevent such managerial myopia is diminished. Alternatively, in an inefficient contracting framework à la Bebchuk and Fried (2003), one can argue that older executives and those with longer tenure are more likely to be entrenched and thus they give themselves more short-term pay to avoid the higher risk of long-term pay. We will not be able to differentiate between these competing explanations. But our results do indicate that pay contracts are *not* longer for older executives and those with longer tenure.

[Table 10 goes here]

6 Conclusion

There has been a long-standing intuition in the executive compensation literature that the extent to which a CEO's compensation is long-term or short-term will affect the investment and effort

[22] Our failure to find a deterministic relationship between pay duration and firm governance quality suggests that the interaction between pay duration and governance is more complex than simply being substitutes or complements with each other. Exploring the interplay between the two variables, however, is beyond the scope of the paper and awaits further research.

allocation decisions of the CEO. In fact, this is the main reason for the enormous attention devoted – both in research and policy discussions – to the issue of possibly inefficient "short-termism" in executive compensation. However, lacking an empirical measure that quantifies the extent to which compensation is short-term or long-term, it has not been possible to give legs to this intuition. Filling such a gap in the literature has been the motivation for this paper.

We develop a new measure of the extent to which executive compensation is short-term versus long-term. This measure is called *Duration* and is conceptually similar to the duration for fixed-income securities. We also obtain data on the vesting schedules of restricted stock and stock options, the use of which is novel, to calculate the pay duration for a large sample of executives. Our empirical analysis shows that CEOs with short-duration pay contracts are more likely to engage in myopic investment behavior. We find our results to be robust to alternative ways of calculating duration and to instrumenting for pay duration. We also develop a theoretical model that highlights a benefit of short-term pay and generates predictions about the relationship between pay duration on the one hand, and the nature of the firm's projects on the other. Consistent with the predictions of the model, we find that firms with long-term projects and less risky firms offer longer-duration pay contracts.

We believe that potential applications of our pay duration measure in future empirical research could go far beyond what we have done in this paper. For example, it would be interesting to examine the intertemporal properties of pay duration and the factors that impinge on these dynamics. We leave this to future research.

Appendix A: Proofs

Proof of Lemma 1. The CEO chooses $\kappa = 1$, since short-term earnings are not retained. Suppose the CEO diverts θ fraction of the capital and chooses $r \in \{l, h\}$. Her expected utility is $V_E^r = w_0 + \theta b + w_2(\mu_r - \beta\theta b) - \frac{\lambda w_2^2 \sigma_r^2}{2}$. To discourage capital diversion (i.e., $\theta = 0$), the board needs to set $w_2 \geq 1/\beta$, and in equilibrium $w_2 = 1/\beta$. The parametric assumption in (4) ensures that $V_E^h < V_E^l$, so the CEO chooses $r = l$. □

Proof of Lemma 2. It is clear that the CEO chooses $\kappa = 0$, since she has no stake in long-term firm value and X_1 is maximized at $\kappa = 0$. Suppose the CEO diverts θ fraction of the capital to perquisites consumption her expected utility is $V_E = w_0 + \theta b + w_1(\mu_l - 0.5 - \beta\theta b)$. To discourage capital diversion, the board needs to set $w_1 \geq 1/\beta$. The board's expected payoff in this case is $(1 - w_1)(\mu_l - 0.5) - w_0 = \mu_l - 0.5 - \bar{V}_E$. □

Proof of Proposition 1. If the CEO diverts θ fraction of the capital to perquisites consumption, her expected utility is $V_E^r = w_0 + \theta b + w_1[(1-\kappa)\mu_l - 0.5(1-\kappa)^2 - (1-\kappa)\beta\theta b] + w_2(\kappa\mu_r - \kappa\beta\theta b) - \frac{\lambda w_2^2 \sigma_r^2}{2}$. To discourage capital diversion (i.e., $\theta = 0$), we need

$$w_2\kappa + w_1(1-\kappa) \geq \frac{1}{\beta}. \tag{A1}$$

Suppose (A1) is satisfied. The CEO's expected utility becomes $V_E^r = w_0 + w_1[(1-\kappa)\mu_l - 0.5(1-\kappa)^2] + w_2(\kappa\mu_r) - \frac{\lambda w_2^2 \sigma_r^2}{2}$. Given the contract, the CEO chooses

$$\kappa = 1 - \left(\mu_l - \frac{w_2}{w_1}\mu_r\right) \ \forall r \in \{l, h\}. \tag{A2}$$

It is clear from (A2) that κ is increasing in w_2/w_1. We need $w_2/w_1 < \mu_l/\mu_h$ in order to get interior solution for κ; we assume the parametric condition for this to hold is satisfied.

Finally, the CEO needs to be incentivized to choose $r = h$, i.e., $V_E^h \geq V_E^l$, which yields

$$w_2 \leq \frac{2\kappa(\mu_h - \mu_l)}{\lambda(\sigma_h^2 - \sigma_l^2)}. \tag{A3}$$

In equilibrium, (A1) must be binding; otherwise, the board can decrease both w_1 and w_2, while keeping w_2/w_1 unchanged so κ remains unchanged (see (A2)), and this increases the board's expected payoff without violating (A1). In equilibrium, (A3) must also be binding. To see this, suppose (A3) is lax, and the board increases w_2 and w_1 both by $\epsilon > 0$ that is arbitrarily small. The left-hand-side of (A1), $w_2\kappa + w_1(1-\kappa) = w_2(1-\mu_l) + \frac{w_2^2}{w_1}\mu_r + (w_1 - w_2)(\mu_l - \mu_r)$, increases and hence (A1) becomes lax. At the same time, κ increases (see (A2)). As a result, the board's expected payoff increases, which breaks the equilibrium. The equilibrium contract is thus given by the solutions to the system of equations (A1) – (A3). When $\frac{\mu_h - \mu_l}{\sigma_h^2 - \sigma_l^2}$ increases, it is clear from (A3) that w_2 increases as well, say by τ. If w_1 increases to the same extent, then the left-hand-side of (A1) increases by τ, which makes (A1) lax. Thus, w_1 will increase by less than τ in equilibrium, which results in w_2/w_1 increasing since $w_2/w_1 < 1$. □

Appendix B: Empirical variable definitions

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

- *Abnormal return* is the difference between the actual return on the firm's stock and its *Expected return*.
- *Accruals* is the signed abnormal accruals. We calculate this measure following the procedure outlined in Jones (1991), modified by including controls for earnings performance as proposed in Kothari, Leone, and Wasley (2005).
- *Age* is the executive's age in the data year.
- *Bonus* is the executive's yearly bonus value.
- *Capital expenditure* is the ratio of capital expenditure to lagged book value of total assets.
- *Cashflows* is the ratio of cash flows from operations to lagged value of total assets. We calculate cash flows from operations as the difference between operating income after depreciation and accruals for the year. Accruals is the change in net working capital less depreciation expense.
- *CEO* is a dummy variable that takes the value one if the executive is a CEO and zero otherwise.
- *City duration* (*City duration*$^{PPS,\ total}$) is the median pay duration of all CEOs of firms in the same city, where duration is measured by *Duration* (*Duration*$^{PPS,\ total}$).
- $\frac{Debt}{Total\ assets}$ is the ratio of sum of long-term and short-term debt (Compustat items: dltt and dlc) to the book value of total assets.
- *Delta* is the sensitivity of the executive's stock and options portfolio to a 1% change in the level of stock price; *Log*(*Delta*) is the natural logarithm of *Delta*.
- *Director shareholding* is the non-executive directors' share ownership.
- *Duration* is the baseline measure of executive pay duration calculated in (1); *Duration*$^{PPS,\ total}$ is our alternate measure of pay duration calculated in (2); *Duration*$^{PPS,\ award}$ is constructed similar to *Duration*$^{PPS,\ total}$ but only includes annual grants for each year during the period 2006-09.
- $\frac{EBIT}{Sales}$ is the ratio of earnings before interest and taxes over sales.
- *Entrenchment index* is the Bebchuk, Cohen, and Ferrell (2009) entrenchment index.
- *Expected return* is the predicted annual return on the firm's stock based on the market and industry performance. To estimate it, we regress the monthly return on the firm's stock on the equal and value weighted market and industry returns, where industry is defined as the Fama-French industry. We use the coefficient estimates to calculate expected return for each month and compound them over the year to estimate the annual buy and hold expected return.
- *Fraction independent* is the fraction of independent directors on the firm's board.

- *High director shareholding* is a dummy variable that takes the value one if *Director shareholding* is greater than 1%, and zero otherwise.
- *High deferred pay* is a dummy variable that takes the value one for executives with above median value of deferred pay as a proportion of total pay. We calculate deferred pay as the sum of unvested stock and option grants and deferred compensation.
- *Log*(*Market cap*) is the natural logarithm of the firm's market capitalization.
- *Market to book* is the ratio of market value of total assets to book value of total assets.
- *Options* represents the Black-Scholes value of the options granted to the executive during the year.
- *R&D/Total assets* is the ratio of research and development expenditure over the book value of total assets. We code missing values of research and development expenditure as zero.
- *Restricted stock* represents the value of the restricted stock granted to the executive during the year.
- *Salary* is the executive's yearly salary value.
- *Sales growth* is the firm's annual sales growth rate.
- *S.D. Sales* is the standard deviation of the firm's annual sales growth during the prior five years.
- *S.D. Cashflow* is the standard deviation of the ratio of cash flows over lagged total assets over the previous five years.
- *Shareholding* is the executive's share ownership in the firm.
- *Spread* is the average daily stock bid-ask spread during the previous year.
- *Stock return* is the one-year percentage return for the firm's stock over the previous fiscal year.
- *Suspect* is a dummy variable that identifies firms with 'suspect incomes', i.e., $\frac{Net\ income}{Total\ assets} \in [0, 0.05]$.
- *Total assets* is the book value of total assets; *Log*(*Total assets*) is the natural logarithm of *Total assets*.
- *Total compensation* is the sum of salary, bonus, other annual compensation, long-term incentive payouts, other cash payouts, and the value of restricted stock and stock option awards.
- *Volatility* is the stock return volatility calculated as the annualized volatility of daily stock returns during the previous year.

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Table 1: Distributions of stock and option grants

Year	2006	2007	2008	2009	Total
Stock grants					
Total number	9,867	9,969	9,330	8,138	37,304
Grants with time-based vesting	5,797 (58.75%)	5,769 (57.87%)	5,517 (59.13%)	4,916 (60.41%)	21,999 (58.97%)
Grants with performance-based vesting	478 (4.84%)	707 (7.09%)	557 (5.97%)	394 (4.84%)	2,136 (5.73%)
Performance-contingent grants with time-based vesting	3,580 (36.28%)	3,488 (34.99%)	3,255 (34.89%)	2,828 (34.75%)	13,151 (35.25%)
Other grants	12	5	1	0	18
Option grants					
Total number	6,072	7,383	6,447	5,836	25,738
Grants with time-based vesting	5,810 (95.69%)	7,102 (96.19%)	6,104 (94.68%)	5,515 (94.50%)	24,531 (95.31%)
Grants with performance-based vesting	135 (2.22%)	171 (2.32%)	238 (3.69%)	175 (3.00%)	719 (2.79%)
Performance-contingent grants with time-based vesting	127 (2.09%)	105 (1.42%)	105 (1.63%)	146 (2.50%)	483 (1.88%)
Other grants	0	5	0	0	5

Distributions of the restricted stock and option grants in our sample covered by Equilar for the period 2006-09. The fraction of a particular category is provided within brackets.

Table 2: Distribution of vesting schedules

Panel A: All executives

	Restricted stock			Options		
Vesting period (years)	Frequency	Percent (%)	Fraction graded	Frequency	Percent (%)	Fraction graded
0	486	1.31	0.00	674	2.62	0.00
1	1,610	4.34	0.12	1,066	4.14	0.07
2	2,529	6.81	0.59	724	2.81	0.69
3	20,030	53.94	0.31	9,682	37.59	0.86
4	7,524	20.26	0.77	9,774	37.95	0.98
5	4,212	11.34	0.69	3,278	12.73	0.93
6	266	0.72	0.51	289	1.12	0.41
7	174	0.47	0.48	59	0.23	0.85
8	67	0.18	0.58	84	0.33	0.18
9	24	0.06	0.79	9	0.03	0.89
10	189	0.51	0.66	97	0.38	0.42
11	3	0.01	0.33	0	0.00	0.00
12	1	0.00	1.00	4	0.02	0.00
13	6	0.02	1.00	0	0	0.00
14	1	0.00	1.00	15	0.06	0.00
15	4	0.01	0.00	0	0	0.00
20	9	0.02	0.89	1	0.00	0.00
Total	37,135	100		25,756	100	

Panel B: CEOs

	Restricted stock			Options		
Vesting period (years)	Frequency	Percent (%)	Fraction graded	Frequency	Percent (%)	Fraction graded
0	113	1.62	0.01	170	3.46	0
1	371	5.33	0.12	226	4.60	0.07
2	506	7.27	0.59	158	3.22	0.66
3	3,696	53.09	0.32	1,848	37.61	0.86
4	1,347	19.35	0.75	1,776	36.14	0.97
5	790	11.35	0.66	619	12.60	0.94
6	49	0.70	0.49	63	1.28	0.33
7	39	0.56	0.41	9	0.18	0.89
8	10	0.14	0.60	24	0.49	0.04
9	4	0.06	0.50	2	0.04	1.00
10	32	0.46	0.53	17	0.35	0.35
13	2	0.03	1.00	0	0.00	0.00
14	0	0.00	0.00	2	0.04	0.00
20	3	0.04	0.67	0	0.00	0.00
Total	6,962	100		4,914	100	

Distributions of vesting schedules for restricted stock and option grants in our sample covered by Equilar for the period 2006-09. Panel A includes data for all executives, and Panel B only includes the subsample of CEOs. For all the grants with a given vesting period, the percentage of grants that vest in a fractional (i.e., graded) manner is given by the column *Fraction graded*.

Table 3: Industry distribution of pay duration

Industry	CEOs			All executives		
	N	$Duration$	$Duration^{PPS,\ total}$	N	$Duration$	$Duration^{PPS,\ total}$
Candy & Soda	20	2.094	0.740	110	1.421	0.908
Beer & Liquor	28	2.036	0.438	105	2.074	0.439
Defense	17	1.908	0.864	85	1.491	0.810
Electrical Equipment	52	1.796	0.365	278	1.457	0.573
Coal	33	1.756	0.787	184	1.351	0.700
Rubber and Plastic Products	32	1.748	0.283	175	1.327	0.437
Medical Equipment	142	1.730	0.368	783	1.453	0.517
Communication	348	1.726	0.703	1968	1.366	0.797
Machinery	201	1.723	0.557	1117	1.375	0.647
Utilities	269	1.684	0.444	1506	1.444	0.613
Finance - Trading	14	1.660	0.717	61	1.342	0.960
Ship building and Railroad Equipment	34	1.638	0.431	182	1.506	0.604
Transportation	36	1.627	0.422	191	1.365	0.597
Pharmaceutical Products	229	1.595	0.402	1240	1.434	0.525
Construction Materials	107	1.539	0.669	589	1.216	0.686
Measuring and Control Equipment	355	1.534	0.518	1982	1.262	0.633
Healthcare	130	1.514	0.441	685	1.306	0.618
Chemicals	143	1.513	0.516	819	1.266	0.627
Real Estate	348	1.512	0.380	1937	1.229	0.543
Personal Services	148	1.491	0.436	863	1.327	0.662
Wholesale	171	1.490	0.452	960	1.328	0.636
Petroleum and Natural Gas	15	1.481	0.408	82	1.290	0.639
Business Supplies	134	1.471	0.423	686	1.342	0.554
Shipping Containers	101	1.465	0.639	591	1.158	0.785
Business Services	68	1.460	0.422	393	1.085	0.452
Construction	82	1.454	0.441	449	1.164	0.558
Other	422	1.452	0.388	2152	1.284	0.580
Banking	111	1.409	0.384	608	1.108	0.570
Retail	187	1.408	0.463	1009	1.154	0.596
Food and Food Products	114	1.393	0.575	597	1.280	0.643
Computers	633	1.361	0.444	3454	1.169	0.662
Steel Works etc.	95	1.300	0.392	511	1.097	0.635
Printing and Publishing	32	1.250	0.605	193	1.044	0.861
Electronic Equipment	231	1.231	0.450	1166	1.161	0.622
Aircraft	98	1.225	0.569	542	0.949	0.706
Restaurants, Hotels and Motels	320	1.220	0.442	1662	1.078	0.637
Insurance	465	1.184	0.268	2565	0.992	0.403
Recreation	34	1.182	0.415	172	0.983	0.532
Apparel	99	1.169	0.452	510	1.019	0.661
Consumer Goods	69	1.123	0.426	369	1.012	0.721
Textiles	19	1.106	0.774	124	0.683	0.727
Agriculture	17	1.036	0.290	96	0.891	0.476
Automobiles and Trucks	49	0.927	0.396	219	0.909	0.480
Precious Metals	17	0.919	0.217	104	0.659	0.341
Entertainment	72	0.707	0.428	360	0.708	0.614

Distributions of executive pay duration (in years), measured by $Duration$ and $Duration^{PPS,\ total}$, in our sample across industries based on the Fama-French 48 industry classification. Definitions of $Duration$ and $Duration^{PPS,\ total}$ are provided in Appendix B.

Table 4: Summary statistics

Panel A: Full sample

Variable	N	Mean	Median	Std. Dev.
Pay characteristics				
Total compensation ($ thousand)	35084	2214.425	962.429	4832.741
Salary ($ thousand)	35084	447.365	372.83	311.281
Bonus ($ thousand)	35084	143.252	0	953.572
Options ($ thousand)	35084	908.969	26.553	3567.12
Restricted stock ($ thousand)	35084	711.228	148.747	1889.774
Duration (years)	35084	1.218	1.33	0.967
$Duration^{PPS,\ award}$ (years)	32798	2.224	2.5	1.342
$Duration^{PPS,\ total}$ (years)	32233	0.61	0.365	0.745
Firm characteristics				
Total assets ($ million)	35002	17618.78	2195.21	97745.87
Debt/Total assets	34893	0.231	0.201	0.2
Sales growth	34906	0.069	0.059	0.231
Market to book	34636	1.721	1.379	1.009
R&D/Total assets	35002	0.024	0	0.047
Capital expenditure	34863	0.049	0.029	0.062
EBIT/Sales	34961	0.124	0.111	0.168
Volatility	32639	0.323	0.185	0.405
Spread (%)	32639	0.213	0.133	0.309
Director shareholding (%)	25694	2.334	0	7.733
Entrenchment index	19701	3.235	3	1.364
Fraction independent	25694	0.763	0.778	0.129
Accruals	27848	0.002	0.003	0.064
Executive characteristics				
Shareholding (%)	35084	0.642	0	3.796
Age (years)	30013	51.943	52	7.621

Panel B: Subsample of CEOs

Variable	N	Mean	Median	Std. Dev.
Pay characteristics				
Total compensation ($ thousand)	6461	4841.917	2410.1	8530.523
Salary ($ thousand)	6461	735.249	691.667	407.826
Bonus ($ thousand)	6461	287.582	0	1839.468
Options ($ thousand)	6461	2165.038	194.5	6557.308
Restricted stock ($ thousand)	6461	1644.266	542.92	3298.175
Duration (years)	6461	1.44	1.631	1.045
$Duration^{PPS,\ award}$ (years)	6348	2.209	2.5	1.381
$Duration^{PPS,\ total}$ (years)	6264	0.456	0.23	0.641
Executive characteristics				
Shareholding (%)	6461	2.239	0	6.28
Age (years)	6320	54.92	55	7.449

Descriptive statistics of our sample executives and firms. The data are collected for all executives that we are able to match across ExecuComp and Equilar for the period 2006-09. Panel A summarizes the full sample for all executives, and Panel B summarizes the subsample of CEOs. Details on the definition of the variables reported in this table are provided in Appendix B.

Table 5: Univariate comparison

Panel A: Univariate comparison for the full sample based on *Duration*

Variable	Short duration	Long duration	Difference
Pay characteristics			
Total compensation ($ thousand)	840.142	3588.708	-2748.57***
Salary ($ thousand)	383.672	511.058	-127.386***
Bonus ($ thousand)	174.514	111.991	62.523***
Options ($ thousand)	123.862	1694.076	-1570.21***
Restricted stock ($ thousand)	151.894	1270.562	-1118.67***
Duration (years)	0.421	2.016	-1.595***
$Duration^{PPS,\ award}$ (years)	1.407	2.934	-1.527***
$Duration^{PPS,\ total}$ (years)	0.436	0.756	-0.32***
Firm characteristics			
Total assets ($ million)	12950.55	22269.44	-9318.89***
Debt/Total assets	0.231	0.23	0.001
Sales growth	0.062	0.075	-0.013***
Market to book	1.601	1.838	-0.237***
R&D/Total assets	0.022	0.025	-0.003***
Capital expenditure	0.047	0.051	-0.004***
EBIT/Sales	0.102	0.145	-0.043***
Volatility	0.404	0.245	0.159***
Spread (%)	0.285	0.143	0.142***
Director shareholding (%)	2.795	1.968	0.827***
Entrenchment index	3.164	3.296	-0.132***
Fraction independent	0.743	0.779	-0.036***
Accruals	0	0.003	-0.003***
Executive characteristics			
Shareholding (%)	0.812	0.471	0.341***
Age (years)	52.207	51.686	0.521***

Panel B: Univariate comparison for CEOs based on *Duration*

Variable	Short duration	Long duration	Difference
Pay characteristics			
Total compensation ($ thousand)	2101.848	7582.835	-5480.99***
Salary ($ thousand)	651.923	818.601	-166.678***
Bonus ($ thousand)	410.347	164.779	245.568***
Options ($ thousand)	511.492	3819.096	-3307.6***
Restricted stock ($ thousand)	509.49	2779.394	-2269.9***
Duration (years)	0.615	2.265	-1.65***
$Duration^{PPS,\ award}$ (years)	1.398	2.992	-1.594***
$Duration^{PPS,\ total}$ (years)	0.318	0.587	-0.269***
Executive characteristics			
Shareholding (%)	3.041	1.436	1.605***
Age (years)	55.581	54.269	1.312***

Panel C: Univariate comparison for the full sample based on $Duration^{PPS,\ total}$

Variable	Short duration	Long duration	Difference
Pay characteristics			
Total compensation ($ thousand)	2139.509	2601.579	-462.07***
Salary ($ thousand)	470.509	449.748	20.761***
Bonus ($ thousand)	156.215	132.872	23.343**
Options ($ thousand)	1063.685	915.044	148.641***
Restricted stock ($ thousand)	447.428	1100.865	-653.437***
Duration (years)	1.036	1.616	-0.58***
$Duration^{PPS,\ award}$ (years)	1.9	2.715	-0.815***
$Duration^{PPS,\ total}$ (years)	0.12	1.101	-0.981***
Firm characteristics			
Total assets ($ million)	17534.01	18110.83	-576.82
Debt/Total assets	0.218	0.241	-0.023***
Sales growth	0.07	0.064	0.006*
Market to book	1.759	1.675	0.084***
R&D/Total assets	0.024	0.023	0.001**
Capital expenditure	0.047	0.051	-0.004***
EBIT/Sales	0.129	0.122	0.007***
Volatility	0.316	0.334	-0.018***
Spread (%)	0.222	0.195	0.027***
Director shareholding (%)	2.474	2.143	0.331***
Entrenchment index	3.248	3.253	-0.005
Fraction independent	0.749	0.779	-0.03***
Accruals	0.001	0.002	-0.001
Executive characteristics			
Shareholding (%)	1.241	0.136	1.105***
Age (years)	53.387	50.607	2.78***

Panel D: Univariate comparison for CEOs based on $Duration^{PPS,\ total}$

Variable	Short duration	Long duration	Difference
Pay characteristics			
Total compensation ($ thousand)	3902.393	5999.921	-2097.53***
Salary ($ thousand)	703.41	777.635	-74.225***
Bonus ($ thousand)	273.929	280.148	-6.219
Options ($ thousand)	2169.619	2296.636	-127.017
Restricted stock ($ thousand)	751.648	2640.307	-1888.66***
Duration (years)	1.113	1.858	-0.745***
$Duration^{PPS,\ award}$ (years)	1.79	2.722	-0.932***
$Duration^{PPS,\ total}$ (years)	0.068	0.845	-0.777***
Executive characteristics			
Shareholding (%)	3.81	0.77	3.04***
Age (years)	56.118	53.719	2.399***

This table compares the mean values of the key variables across the subsamples of executives with pay duration below (*Short duration*) and above (*Long duration*) the sample median, where pay duration is measured by *Duration* in Panels A and B, and $Duration^{PPS,\ total}$ in Panels C and D. Panels A and C include data for all executives, and Panels B and D only include the subsample of CEOs. Details on the definition of the variables reported in this table are provided in Appendix B. Asterisks denote statistical significance at the 1%(***), 5%(**), and 10%(*) levels.

Table 6: Accruals and pay duration (OLS)

Panel A: Signed accruals and *Duration*

	Signed accruals		Positive accruals	Negative accruals
	(1)	(2)	(3)	(4)
Duration	-.002	-.002	-.002	.0001
	(.0009)**	(.0009)**	(.0007)**	(.0006)
Log(Total assets)	-.004	-.004	-.003	.002
	(.003)	(.003)	(.002)	(.002)
Market to book	.008	.008	.005	-.004
	(.003)***	(.003)***	(.002)***	(.002)**
Debt/Total assets	.005	.005	.002	-.004
	(.008)	(.008)	(.005)	(.005)
S.D. Cashflow	-.167	-.167	.017	.182
	(.041)***	(.041)***	(.026)	(.026)***
S.D. Sales	.021	.021	.024	.003
	(.010)**	(.010)**	(.006)***	(.007)
Cashflows	-.282	-.282	-.151	.140
	(.039)***	(.039)***	(.020)***	(.023)***
Sales growth	.041	.041	.038	-.005
	(.011)***	(.011)***	(.007)***	(.006)
Log(Market cap)	.008	.008	.004	-.005
	(.003)***	(.003)***	(.002)**	(.002)***
Shareholding (%)		.0001		
		(.0002)		
Log(Delta)			-.0004	.0003
			(.0004)	(.0004)
Const.	.002	.002	.025	.024
	(.008)	(.008)	(.005)***	(.006)***
Obs.	4745	4745	4745	4745
R^2	.286	.286	.252	.301

Panel B: Signed accruals and *Duration* – Cross-sectional tests

	Small	Large	Illiquid	Liquid	Young	Old	Low director	High director
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Duration	-.004	-.002	-.003	-.002	-.003	.0002	-.003	-.001
	(.001)**	(.001)*	(.001)**	(.001)	(.002)*	(.001)	(.001)**	(.002)
Log(Total assets)	.001	-.013	-.011	-.00004	-.007	-.0007	-.011	-.011
	(.004)	(.005)**	(.005)**	(.003)	(.004)*	(.004)	(.005)**	(.008)
Market to book	.007	.007	.009	.006	.007	.009	.009	.019
	(.003)**	(.003)**	(.003)***	(.004)	(.003)**	(.004)**	(.004)**	(.006)***
Debt/Total assets	-.006	.019	.025	-.010	.018	-.012	.020	.043
	(.012)	(.009)**	(.010)***	(.011)	(.013)	(.009)	(.010)**	(.019)**
S.D. Cashflow	-.122	-.233	-.170	-.134	-.228	-.123	-.169	-.202
	(.045)***	(.070)***	(.066)**	(.046)***	(.066)***	(.042)***	(.075)**	(.111)*
S.D. Sales	.027	.040	.026	.015	.046	.005	.026	.041
	(.013)**	(.017)**	(.015)*	(.013)	(.018)**	(.013)	(.019)	(.025)*
Cashflows	-.318	-.264	-.307	-.282	-.277	-.288	-.303	-.373
	(.048)***	(.044)***	(.042)***	(.046)***	(.043)***	(.050)***	(.062)***	(.046)***
Sales growth	.049	.030	.050	.037	.027	.052	.040	.051
	(.016)***	(.009)***	(.012)***	(.014)***	(.015)*	(.011)***	(.011)***	(.023)**
Log(Market cap)	.013	.014	.011	.007	.011	.006	.014	.015
	(.004)***	(.005)***	(.005)**	(.004)*	(.003)***	(.004)	(.004)***	(.008)*
Const.	-.056	.030	.041	-.017	.007	-.009	.019	-.019
	(.017)***	(.016)*	(.015)***	(.013)	(.013)	(.012)	(.014)	(.023)
Obs.	2388	2357	2343	2402	2267	2478	2878	767
R^2	.319	.347	.388	.291	.305	.33	.325	.462

This table reports the results of the regression relating signed accruals to CEO pay duration. Specifically, we estimate the OLS regression: $y_{kt} = \alpha + \beta_1 \times Duration_{ket} + \beta_2 \mathrm{X}_{kt} + \mu_t \mathrm{T} + \mu_i \mathrm{I} + \epsilon_{kt}$, where y is *Accruals* in all columns except Columns (3) and (4) in Panel A; y is *Accruals* × *Positive accruals* (*Accruals* × (1 − *Positive accruals*)) in Column (3) (Column (4)) of Panel A. For Panel B, in Column (1) (Column (2)) we report the results for the subsample of firms with below (above) sample median market capitalization, in Column (3) (Column (4)) we report the results for the subsample of firms with above (below) sample median bid-ask spread, in Column (5) (Column (6)) we report the results for the subsample of firms with below (above) sample median firm age, and in Column (7) (Column (8)) we report the results for the subsample of firms with non-executive directors

holding less (more) than 1% shares of the firm. Details on the definition of the variables in this table are provided in Appendix B. The sample includes one observation per firm-year and includes all firm-year data that we are able to obtain by matching Equilar and ExecuComp. Standard errors reported in parentheses are robust to heteroskedasticity and are clustered at the three-digit SIC industry level. Asterisks denote statistical significance at the 1% (∗ ∗ ∗), 5% (∗∗) and 10% (∗) levels.

Table 7: Accruals and pay duration (switching regression model)

Panel A: CEO pay *Duration* and signed accruals

	Short duration	Accruals	
		Short-duration firms	Long-duration firms
	(1)	(2)	(3)
Inverse Mills		-.005 (.016)	
Mills			.008 (.013)
City duration	-.923 (.100)***		
Expected return	-.101 (.094)		
Log(Total assets)	.453 (.117)***	-.014 (.008)*	-.026 (.010)**
Market to book	.209 (.081)***	.005 (.006)	-.00004 (.005)
Debt/Total assets	-.518 (.290)*	.040 (.027)	.023 (.015)
S.D. Cashflow	.571 (1.176)	-.055 (.100)	-.217 (.087)**
S.D. Sales	.709 (.344)**	.049 (.031)	.030 (.033)
Cashflows	-.226 (.290)	-.270 (.057)***	-.308 (.034)***
Sales growth	-.007 (.140)	.023 (.024)	.027 (.027)
Log(Market cap)	-.769 (.111)***	.016 (.008)**	.025 (.012)**
Log(Delta)	.044 (.035)	-.002 (.002)	-.0003 (.001)
R&D/Total assets	-.650 (.770)	-.232 (.054)***	-.265 (.029)***
Spread	.406 (.269)	-.023 (.012)*	-.075 (.027)***
Abnormal return	-.233 (.079)***	-.001 (.011)	-.007 (.006)
Const.	3.608 (.618)***	.024 (.031)	.078 (.028)***
Obs.	2604	777	917
R^2 or Pseudo R^2	.264	.536	.591

Panel B: Test of significance of difference between actual and counterfactual *Accruals*

	Actual	Predicted	Difference
Accruals for firms with short duration	.051	-.013	.065 (.002)***

This table reports the results of the regression relating signed accruals to the CEO pay duration after controlling for endogeneity using the switching regression model. The model consists of a selection equation (Probit) to estimate the probability that a firm has a short-duration pay contract (Column (1) in Panel A), and two outcome equations that examine *Accruals* separately for firms with below and above-median pay duration in Columns (2) and (3) in Panel A. The *Inverse Mills* Ratio and the *Mills* Ratio are used as additional controls in Columns (2) and (3), respectively. Panel B presents the results of a t-test for the difference between the actual *Accruals* for firms with below-median pay duration and the counterfactual *Accruals* (estimated using the coefficient estimates from Column (3)) if the same firm had a long-duration pay contract. Details on the definition of the variables in this table are provided in Appendix B. The sample includes one observation per firm-year and includes all firm-year data that we are able to obtain by matching Equilar and ExecuComp. Standard errors reported in parentheses are robust to heteroskedasticity and are clustered at the three-digit SIC industry level. Asterisks denote statistical significance at the 1% (∗ ∗ ∗), 5% (∗∗) and 10% (∗) levels.

Table 8: Suspect income, real activity, accrual manipulation and pay duration

	Abnormal cashflow		Accruals	
	Short duration	Long duration	Short duration	Long duration
	(1)	(2)	(3)	(4)
Log(Total assets)$_{t-1}$	.006	.008	.001	.001
	(.003)**	(.002)***	(.001)	(.001)
Market to book$_{t-1}$	.008	.018	-.0006	.0003
	(.005)	(.005)***	(.001)	(.001)
Suspect	-.049	-.016	.019	-.009
	(.015)***	(.010)	(.016)	(.014)
Net income	.00005	.00003	.0004	.0001
	(.0001)	(.0003)	(.0001)***	(.0003)
Const.	-.064	-.093	-.0003	-.001
	(.017)***	(.021)***	(.012)	(.012)
Obs.	2210	2178	2572	2371
R^2	.04	.075	.01	.005
Δ Suspect	.009		.043	
	(.017)		(.017)**	

This table reports the results of the regression relating CEO pay duration (measured by *Duration*) and suspectible income to abnormal cashflow (Columns (1) and (2)) and Accruals (Columns (3) and (4)). The specification is similar to that in Table 6. Details on the definition of the variables in this table are provided in Appendix B. The sample includes one observation per firm-year and includes all firm year data that we are able to obtain by matching Equilar and ExecuComp. Standard errors reported in parentheses are robust to heteroskedasticity and are clustered at the three-digit SIC industry level. Asterisks denote statistical significance at the 1% (∗ ∗ ∗), 5% (∗∗) and 10% (∗) levels.

Table 9: Signed accruals and $Duration^{PPS,\ total}$

Panel A: Signed accruals and $Duration^{PPS,\ total}$ (OLS)

	Signed accruals		Positive accruals	Negative accruals
	(1)	(2)	(3)	(4)
$Duration^{PPS,\ total}$	-.003	-.003	-.0007	.002
	(.002)*	(.002)*	(.001)	(.001)*
$Duration^{PPS,\ award}$	.00005	.0001	-.0006	-.0007
	(.0008)	(.0008)	(.0005)	(.0005)
Log(Total assets)	-.004	-.004	-.003	.002
	(.003)	(.003)	(.002)*	(.002)
Market to book	.008	.008	.005	-.004
	(.003)***	(.003)***	(.002)***	(.002)**
Debt/Total assets	.006	.006	.002	-.004
	(.008)	(.008)	(.005)	(.006)
S.D. Cashflow	-.168	-.169	.018	.184
	(.041)***	(.041)***	(.027)	(.027)***
S.D. Sales	.019	.019	.022	.003
	(.010)*	(.010)*	(.006)***	(.007)
Cashflows	-.280	-.281	-.149	.140
	(.039)***	(.039)***	(.020)***	(.023)***
Sales growth	.041	.041	.038	-.006
	(.011)***	(.011)***	(.007)***	(.006)
Log(Market cap)	.008	.008	.004	-.005
	(.003)***	(.003)***	(.002)**	(.002)***
Shareholding (%)		.0001		
		(.0002)		
Log(Delta)			-.0004	.0006
			(.0004)	(.0005)
Const.	.005	.005	.027	.023
	(.009)	(.009)	(.006)***	(.006)***
Obs.	4705	4705	4705	4705
R^2	.287	.287	.249	.304

Panel B: Signed accruals and CEO pay $Duration^{PPS,\ total}$ (Switching regression model)

	Short duration	Accruals	
		Short-duration firms	Long-duration firms
	(1)	(2)	(3)
Inverse Mills		.008 (.018)	
Mills			.005 (.010)
City duration$^{PPS,\ total}$	-1.918 (.337)***		
Expected return	-.234 (.104)**		
Log(Total assets)	-.130 (.102)	-.022 (.008)***	-.013 (.004)***
Market to book	.091 (.062)	-.003 (.005)	.011 (.007)
Debt/Total assets	-.225 (.258)	.030 (.018)*	.024 (.015)
S.D. Cashflow	-.084 (.850)	-.088 (.098)	-.203 (.087)**
S.D. Sales	-.257 (.357)	.045 (.027)*	.036 (.029)
Cashflows	-.516 (.384)	-.254 (.049)***	-.297 (.051)***
Sales growth	-.097 (.141)	.032 (.019)*	.030 (.015)**
Log(Market cap)	.233 (.092)**	.025 (.007)***	.013 (.005)**
Log(Delta)	.381 (.029)***	.00006 (.005)	-.001 (.003)
R&D/Total assets	-.015 (1.043)	-.313 (.062)***	-.205 (.072)***
Spread	.214 (.153)	.0003 (.015)	-.034 (.014)**
Abnormal return	-.216 (.081)***	-.009 (.008)	-.006 (.005)
Const.	-1.470 (.346)***	.017 (.048)	.044 (.021)**
Obs.	2668	1060	1121
R^2 or Pseudo R^2	.212	.471	.516

Panel C: Test of significance of difference between actual and counterfactual *Accruals*

	Actual	Predicted	Difference
Accruals for firms with short $Duration^{PPS,\ total}$	.049	.004	.044 (.001)***

Panel A of this table reports the OLS regression relating the level of signed accruals to the CEO pay duration (measured by $Duration^{PPS,\ total}$). The specification is similar to that in Panel A of Table 6. Panel B of this table reports the results of the regression relating the level of signed accruals to the CEO pay duration after controlling for endogeneity using the switching regression model. The specification is similar to that in Table 7, except that pay duration here is measured by $Duration^{PPS,\ total}$. The model consists of a selection equation (Probit) to estimate the probability that a firm has a short-duration pay contract (Column (1) in Panel B), and two outcome equations that examine *Accruals* separately for firms with below and above-median pay duration in Columns (2) and (3) in Panel B. The *Inverse Mills* Ratio and the *Mills* Ratio are used as additional controls in Columns (2) and (3), respectively. Panel C presents the results of a *t*-test for the difference between the actual *Accruals* for firms with below-median pay duration and the counterfactual *Accruals* (estimated using the coefficient estimates from Column (3)) if the same firm had a long-duration pay contract. Details on the definition of the variables in this table are provided in Appendix B. The sample includes one observation per firm-year and includes all firm-year data that we are able to obtain by matching Equilar and ExecuComp. Standard errors reported in parentheses are robust to heteroskedasticity and are clustered at the three-digit SIC industry level. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Table 10: Project duration, firm governance, and pay duration

Panel A: Firm characteristics and pay duration

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log(Total assets)		.175	.185	.196	.183	.180	.180
		(.010)***	(.011)***	(.011)***	(.011)***	(.011)***	(.011)***
Market to book			.114	.109	.116	.120	.121
			(.027)***	(.030)***	(.026)***	(.027)***	(.027)***
R&D/Total assets				.540			
				(.267)**			
Volatility					-.287		
					(.035)***		
S.D. Cashflow						-.505	
						(.231)**	
S.D. Sales							-.231
							(.091)**
Debt/Total assets		-.267	-.219	-.196	-.145	-.213	-.229
		(.090)***	(.088)**	(.097)**	(.085)*	(.088)**	(.087)***
CEO		.284	.284	.273	.284	.284	.284
		(.018)***	(.018)***	(.018)***	(.018)***	(.018)***	(.018)***
Stock return		.184	.128	.119	.119	.126	.126
		(.025)***	(.026)***	(.028)***	(.023)***	(.025)***	(.025)***
Spread		-.403	-.337	-.321	-.202	-.315	-.322
		(.034)***	(.036)***	(.036)***	(.041)***	(.037)***	(.035)***
Const.	1.221	-.034	-.327	-.392	-.266	-.280	-.265
	(9.56e-18)***	(.086)	(.117)***	(.121)***	(.120)**	(.120)**	(.123)**
Obs.	35002	31995	31988	27536	31988	31960	31982
R^2	.137	.243	.251	.271	.256	.252	.252

Panel B: Governance characteristics and pay duration

	(1)	(2)	(3)	(4)	(5)	(6)
High director shareholding	-.122	-.162				
	(.038)***	(.064)**				
Entrenchment index			.040	.078		
			(.012)***	(.020)***		
Fraction independent					.605	.800
					(.107)***	(.188)***
Log(Total assets)	.182	.169	.189	.185	.182	.165
	(.014)***	(.023)***	(.015)***	(.025)***	(.016)***	(.024)***
Market to book	.128	.093	.143	.092	.119	.095
	(.026)***	(.039)**	(.024)***	(.039)**	(.028)***	(.038)**
Debt/Total assets	-.110	.129	-.035	.140	-.059	.071
	(.103)	(.141)	(.105)	(.153)	(.104)	(.137)
Volatility	-.331	-.366	-.322	-.219	-.289	-.377
	(.043)***	(.064)***	(.066)***	(.105)**	(.046)***	(.063)***
Stock return	.116	.086	.097	.103	.116	.086
	(.025)***	(.039)**	(.036)***	(.053)*	(.027)***	(.038)**
CEO	.288		.304		.274	
	(.019)***		(.020)***		(.018)***	
Spread	-.226	-.319	-.276	-.555	-.234	-.279
	(.087)***	(.108)***	(.117)**	(.263)**	(.086)***	(.115)**
Const.	-.216	.225	-.515	-.225	-.709	-.383
	(.150)	(.240)	(.170)***	(.293)	(.163)***	(.242)
Obs.	24442	4519	18875	3497	20866	4519
R^2	.268	.319	.26	.308	.292	.323

This table reports the results of the regression relating executive pay duration to firm, governance, and executive characteristics. Specifically, we estimate the OLS regression: $Duration_{ket} = \alpha + \beta_1 \mathrm{X}_{kt} + \beta_2 \mathrm{X}_{et} + \mu_{it}(\mathrm{T} \times \mathrm{I}) + \epsilon_{ket}$. The regressions in Columns (2), (4) and (6) of Panel B confine to the subsample of CEOs, whereas the regressions in the rest columns of the table are for all executives. Details on the definition of the variables in this table are provided in Appendix B. The sample includes all firm-year data that we are able to obtain by matching Equilar and ExecuComp. Standard errors reported in parentheses are robust to heteroskedasticity and are clustered at the three-digit SIC industry level. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.