Performance-induced CEO turnover

Dirk Jenter
Stanford University and NBER
djenter@gsb.stanford.edu

Katharina Lewellen
Tuck School at Dartmouth
katharina.lewellen@dartmouth.edu

This draft: December 2010

PRELIMINARY AND INCOMPLETE

ABSTRACT

This paper re-examines the empirical relation between CEO turnover and firm performance. We find that boards aggressively fire CEOs for poor performance, and that the turnover-performance sensitivity increases substantially with board quality. In the first five years of tenure, CEOs who perform in the bottom quintile are 42 percentage points more likely to depart than CEOs in the top quintile. This spread increases to more than 70 percentage points for firms with high quality boards. The turnover-performance spreads remain high for seasoned CEOs in tenure years six to ten, but diminish considerably for the most seasoned CEOs. Our results, based on a new empirical approach, are much stronger than in prior research and show that the threat of performance-induced dismissal is an important source of incentives for most CEOs. We also find tentative evidence that board quality is associated with higher stock returns following performance declines, suggesting that strong boards are more effective at dealing with negative performance shocks.

1 Introduction

Selecting and replacing the CEO is one of the key responsibilities of corporate boards, and CEO turnover has been studied extensively in the literature. Two questions have received the most attention. First, to what extent do turnover decisions depend on firm performance? And second, do certain types of boards make systematically better turnover decisions – from shareholders' point of view – than other boards? This paper extends the literature in both dimensions. We modify the methodology with which the turnover-performance relationship is analyzed, and then use the new approach to study CEO turnover in U.S. firms. The innovations we introduce prove important and change our view of how boards evaluate and replace CEOs. Most importantly, we find that turnover decisions are much more sensitive to stock price performance than previously thought, and that the link between performance and turnover is much tighter for firms with high quality boards. We also find that better governed firms recover more rapidly from performance declines, consistent with more effective responses by their boards.

The prior literature has found only modest effects of firm performance on CEO turnover. Depending on the sample and the performance measure used, the estimated probability of a forced CEO turnover is between 2 and 6 percentage points higher per year for a bottom decile performer than for a top decile performer.[1] As a result, Jensen and Murphy (1990) conclude that dismissals are simply not an important source of CEO incentives. The literature also finds mostly small and often inconsistent effects of governance variables on the turnover-performance relationship, and mixed evidence on the relation between board structure and firm performance.

In contrast, our analysis uncovers large effects of firm performance on CEO turnover in a sample of publicly traded U.S. firms from 1992 to 2005. During the first two years of tenure, 23% of CEOs with performance in the bottom quintile leave their job, compared to only 2% of CEOs in the top quintile. By the end of year four, 52% of CEOs in the bottom performance quintile have left, compared to only 8% of top quintile CEOs. Thus, over the first four years of tenure alone, performance drives a 44 percentage point spread between the turnover frequencies of top and bottom quintile performers. The aggressive dismissal of badly

[1] See, for example, Coughlin and Schmidt (1985), Warner, Watts, and Wruck (1988), Weisbach (1988), Jensen and Murphy (1990), Denis, Denis, and Sarin (1997), Murphy (1999), and Huson, Parrino, and Starks (2001).

performing CEOs is not restricted to the early tenure years. In years 7-10, 54% of bottom quintile CEOs depart, but only 18% of top quintile performers, for a turnover-performance spread of 36%. This implies that most CEOs face a severe threat of performance-induced dismissal for their entire time in office.

The sensitivity of CEO turnover to performance becomes even more impressive for firms with "strong boards", defined as small boards with a majority of independent directors and high director ownership. Over the first five years of tenure, the difference in turnover probabilities between top and bottom quintile performers is 73 percentage points for strong boards, but only 30 percentage points for weak boards. This stark difference is mostly due to the fact that strong boards are much more likely to replace their CEOs after bad performance: For a CEO in the bottom performance quintile, the probability of leaving office in the first five years is 83% if the board is strong, but only 49% if it is weak.

Finding such large differences in turnover frequencies between firms with strong and weak boards at the low-end of the performance spectrum is surprising. It suggests that many weak boards fail to act against their CEOs even when confronted with dismal performance. One plausible interpretation is that the three board characteristics we examine – board independence, stock ownership, and size – capture (or are correlated with) some key aspects of governance quality, and that weak boards, as identified by these variables, make sub-optimal turnover decisions. If so, our findings suggest that strengthening the boards, at least for a subset of our sample firms, would improve shareholder value. On the other hand, it is difficult to rule out the possibility that firms with weak boards are simply different, and that a weaker turnover-performance relationship is optimal for them.

To shed some additional light on this question, we examine whether firms with strong boards react more effectively to declines in firm value. Specifically, we test whether firms with high quality boards recover more rapidly from performance declines. Such a finding would be consistent with the idea that strong boards respond more effectively to crises, either through faster replacement of failing CEOs or other measures. Our tentative results support this hypothesis and suggest a large role of governance in the response to performance problems: Firms in the bottom quintile of stock return performance in year t have substantially higher industry-adjusted performance in year t+2 if the firm's board is of high quality than if it is of low quality (controlling for other determinants of stock returns). The governance effect is economically large, suggesting that high quality boards increase post-

crisis stock returns by eight percentage points in year t+2. There is no evidence that governance is associated with improved stock returns in the year immediately after the negative shock, suggesting some delay in the boards' and/or market's response.

Overall, our results on CEO turnover show a much more aggressive response of boards to bad performance than prior studies. We are able to uncover these large effects because our empirical approach differs in several aspects from the literature. First, we modify the way the literature deals with voluntary turnover. Most prior research focuses on "forced" CEO turnovers and has devised a number of algorithms to distinguish between forced and voluntary departures based on CEO age, press reports, and other information. Inevitably, any algorithm misclassifies some turnovers, and we show that this misclassification causes a downward bias in the estimated turnover-performance slope.[2]

In contrast, our approach makes no a-priori determination whether a particular departure is forced or voluntary, and instead considers almost all departures as potentially performance-induced. Concretely, we treat the turnover frequency of high-performance CEOs as the benchmark and identify the turnover-performance slope from the additional turnovers observed for low-performance CEOs. Thus, the focus is on the rate with which firm-CEO matches are dissolved, independently of who initiates the dissolution, the board or the CEO. This perspective is useful, not only because it avoids the bias due to misclassifications, but also because departures of underperforming CEOs are potentially desirable from shareholders' perspective, whether they are explicitly forced by the board or not.

The second important reason for the stronger link between CEO turnover and performance is that our estimation puts fewer restrictions on how much performance history boards can use in their turnover decisions. Most prior studies focus on the effects of fairly short-term performance (usually 12-24 months) on the probability of a CEO turnover in the subsequent year. This implicitly assumes that boards ignore any performance history older than two years. In contrast, our basic model estimates the cumulative probability of a CEO turnover over a multi-year horizon as a function of the CEO's long-term performance over the same horizon. Importantly, our approach imposes much less structure on the exact

[2] Kaplan and Minton (2008) also find that turnover-performance sensitivities are similar for turnovers classified as forced and unforced and conclude that many turnovers labeled as unforced are likely to be involuntary.

relationship between firm performance and CEO turnover, and as a result does a better job accommodating heterogeneity in the turnover-performance relation across firms.

The stronger sensitivities of CEO turnover to performance captured by our model suggest that boards use longer performance histories when evaluating and replacing their CEOs, and that the length of these histories differs across firms. We therefore investigate in more detail how much performance data boards consider. For this purpose, we define a CEO's performance history as a weighted average of the abnormal stock returns over the CEO's entire tenure, and we estimate a model that flexibly accommodates a wide range of weighting schemes and permits the weights to change with tenure. Consistent with the results from the basic model, we find that this flexibility is important, i.e., stock return information from the more distant past is relevant for turnover decisions, but also that boards overweight the more recent performance.

The third reason for the stronger results is that we allow for non-linear effects of performance on CEO turnover. Extant theory suggests that boards will dismiss a CEO if the board's assessment of CEO quality falls below some lower threshold, and therefore directly predicts that the turnover-performance relationship is non-linear, with most forced turnovers occurring at the low-end of the observed performance distribution.[3] This prediction is confirmed by the data, and replacing the linear performance measure by indicators for performance quintiles further increases the estimated turnover-performance slopes.

The fourth and final reason for finding larger effects of firm performance on CEO turnover is that we account for performance-induced turnovers shortly after the start of a CEO's tenure. CEO turnover is highly performance-sensitive in the first two years of tenure already, with spreads in turnover frequencies between top and bottom quintile performers of 21 percentage points. Dropping these initial two years – which is common in turnover studies – excludes a significant number of performance-based dismissals and biases the estimated turnover-performance sensitivities downward.

In conclusion, we find that boards aggressively fire CEOs for poor performance, and that the threat of dismissal is a first-order source of incentives for most CEOs. Thus, in contrast to the conclusions of the prior literature, measuring CEOs' performance incentives requires

[3] See, for example, Hirshleifer and Thakor (1994, 1998), Hermalin and Weisbach (1998, 2003), Warther (1998), and Adams and Ferreira (2007).

more than simply measuring their stock and option holdings. We also find that the estimated turnover-performance sensitivities increase substantially with board quality. CEOs in firms with small, outsider-dominated boards with above-average director ownership are highly likely to be dismissed for bad performance, while CEOs in firms with weak boards have a good chance of retaining their job in the same situation.

The paper proceeds as follows. Section 1 briefly reviews the prior literature. Section 2 describes the data and sample selection. Section 3 explains our approach to deal with voluntary turnovers. Cumulative turnover probabilities are examined in Section 4. Section 5 estimates annual turnover models, examines how much prior information boards use in their turnover decisions, and reconciles our estimates with the prior literature. Section 6 analyzes the relation between board characteristics and firm performance. The final section summarizes and concludes.

1 Literature Review

1.1 The turnover-performance relationship

The large literature on the effect of firm performance on CEO turnover uses a variety of performance measures, turnover definitions, and econometric models. Typical studies use a logit or probit framework and regress a dummy variable for forced turnover on a measure of firm performance over the previous 12 to 24 months. The common conclusion is that the difference in the implied turnover probabilities between good and bad performers is small: A typical spread between the forced turnover probabilities at the 10^{th} and 90^{th} performance percentile is between 2 and 6 percentage points.[4] In a critical review of the literature, Brickley (2003) concludes that "firm performance continues to explain very little of the variation in CEO turnover."

In the introduction, we have discussed several reasons why the empirical approach used by the prior literature underestimates the effect of firm performance on turnover. Some of these problems have been recognized in prior studies. For example, Warner, Watts, and Wruck (1988) observe that turnovers are concentrated in the lowest performance decile, and

[4] See, among many others, Coughlin and Schmidt (1985), Warner, Watts, and Wruck (1988), Weisbach (1988), Denis, Denis, and Sarin (1997), Hadlock and Lumer (1997), Perry (1999), and Huson, Parrino, and Starks (2001). Murphy (1999) offers a review of the literature and consistent evidence. Kaplan and Minton (2006) have documented a substantial increase in the frequency of CEO turnovers since the 1970s, but continue to find only modest effects of firm performance on turnover.

conclude that the linear-in-performance logit model is unable to capture the empirical relation between turnover and performance. Kaplan and Minton (2006) find that turnovers classified as "voluntary" using the Parrino (1997) algorithm are in fact sensitive to firm performance, and conclude that many of these "voluntary" turnovers are likely to be forced. No prior study has attempted to rectify all the problems simultaneously and to develop a consistent framework to estimate the true turnover-performance relationship.

1.2 The effect of corporate governance on the turnover-performance relationship

A large literature examines whether good corporate governance increases the sensitivity of CEO turnover to firm performance. Relying again primarily on logit and probit regressions, most studies regress an indicator for forced turnover on firm performance, a governance variable, and an interaction term between performance and governance. The governance effects identified by this literature tend to be small and inconsistent across studies. The most popular governance variables are the fraction of independent directors on the board[5], board size[6], equity ownership by directors[7], equity ownership by the CEO[8], and the presence of institutional investors[9]. Probably the most consistent result is a steeper turnover-performance slope for firms with outsider-dominated boards (Weisbach, 1988, Denis, Denis, and Sarin , 1997, and Perry, 1999), but even this finding is only significant in some of the specifications used.[10]

Because the literature on governance and CEO turnover uses the same empirical framework as the literature on the turnover-performance relation, all the concerns raised in the introduction apply with equal force. An additional conceptual issue is that economic theory does not actually predict that better governed firms have a steeper turnover-

[5] See Weisbach (1988), Denis, Denis, and Sarin (1997), Mikkelson and Partch (1997), Perry (1999), and Huson, Parrino, and Starks (2001).
[6] See Mikkelson and Partch (1997), Perry (1999), Huson, Parrino, and Starks (2001), and Yermack (1996).
[7] See Weisbach (1988), Perry (1999), and Huson, Parrino, and Starks (2001).
[8] See Salancik and Pfeffer (1980), Weisbach (1988), Denis, Denis, and Sarin (1997), Mikkelson and Partch (1997), Perry (1999), and Huson, Parrino, and Starks (2001).
[9] See Denis, Denis, and Sarin (1997), Perry (1999), and Huson, Parrino, and Starks (2001).
[10] The literature has had more success identifying significant effects of governance variables on the *level* of CEO turnover. CEO turnovers are less frequent with high CEO equity stakes (Denis, Denis, and Sarin, 1997, Mikkelson and Parch, 1997, Perry, 1999, and Huson, Parrino, and Starks, 2001) and for founder CEOs (Morck, Shleifer, and Vishny, 1989, Denis, Denis, and Sarin, 1997, and Huson, Parrino and Starks, 2001), and are more frequent with high incentive compensation for directors (Perry, 1999) and in the presence of blockholders (Denis, Denis, and Sarin 1997). On the other hand, the level effects of board composition, board size, director ownership, and institutional ownership on the frequency of CEO turnovers are either insignificant or inconsistent across studies.

performance relationship at all levels of performance. Instead, it may well be the case that better governed firms have a steeper turnover-performance slope at intermediate levels of performance, while worse governed firms have a steeper slope at very low levels of performance (as these firms "catch up" with their better-governed peers). Our empirical model allows for such non-monotonic effects of governance on the turnover-performance relation.

2 Sample and data

To construct the CEO turnover sample we start with all firms in the Standard & Poors ExecuComp database from 1992 through 2004. The database lists top executives in all S&P 500, S&P MidCap, and S&P SmallCap firms. We obtain dates of turnover announcements, the stated reasons for departure, and CEO age by searching news articles in the Factiva database. For years 2002-2004, we obtain this supplementary data from Peters and Wagner (2009).

Data on board characteristics come from Linck, Netter, and Yang (2007). Linck et al. collect information on board size, the fraction of insiders, and director ownership for fiscal years 1990 through 2004 from proxy statements available in the Disclosure database. We obtain financial statement data from Compustat and stock return data from the Center for Research in Security Prices (CRSP). Our basic panel consists of 3,232 CEOs and 15,408 CEO-years.

Table 1 shows descriptive statistics for the full sample and for subsamples based on board characteristics. In the full sample, the average firm has book assets of $7.3 billion and a book-to-market ratio of 0.58 (the medians are $869 million and 0.48, respectively). We use three board characteristics in the analysis: board size, stock ownership by non-executive directors, and the percentage of directors who are insiders. The average board consists of nine directors, and non-executive directors own on average 1% of all shares outstanding (the medians are 9 and 0.1%, respectively). Approximately 11% of the boards are insider dominated, which we define as boards on which more than half the directors are executives.

Using the three board characteristics, we construct a governance index that awards one point for meeting each of the following criteria: (1) total stock ownership by non-executive directors exceeds the sample mean; (2) the board is smaller than the sample mean, and (3) the board is not insider dominated. The construction of the index is discussed in more detail in

Section 4.2. The index takes on values from zero to three, with higher values indicating "stronger" boards. In the full sample, the average board index is 1.7, with a median of 2.00. Moving from the weak board category in Panel B (BOARD = 0 or 1) to the strong board category in Panel D (BOARD = 3), the sample firms become smaller, have lower book-to-market ratios, and are less likely to pay dividends.[11]

3 Identifying the turnover-performance slope

Our goal is to estimate the degree to which bad firm performance leads to CEO turnover. The prior literature has devised a number of algorithms to distinguish *forced* from voluntary departures by using information on CEO age, turnover announcements, and press reports. Inevitably, any algorithm that relies on incomplete and often misleading information misclassifies some turnovers.[12] As a result, estimating the firing-performance relation directly from turnover data is difficult.

The approach we adopt in this paper differs in that we make no a-priori determination whether a particular CEO departure is voluntary or forced. Instead, we straightforwardly estimate whether bad firm performance leads to CEO-firm separations. What matters for future firm performance is whether bad CEO-firm matches are dissolved; whether this dissolution involves a CEO firing, a voluntary retirement, or anything between these two extremes is of secondary importance.[13]

Concretely, we propose the difference in the turnover frequency between top- and bottom-quintile performers as a measure of the turnover-performance sensitivity. Intuitively, this approach treats the turnover frequency of top-quintile CEOs as a benchmark, and identifies the turnover-performance slope from the additional turnovers observed for worse performers. For example, if 5% of top-quintile CEOs and 20% of bottom-quintile CEOs depart in a given tenure year, then we interpret the 5% turnover rate in the top quintile as *not*

[11] Cross-sectional relations between board and firm characteristics are studied in Gillan, Hartzell, and Starks (2006), Boone, Cesares, Karpoff, and Raheja (2007), Linck et al. (2008), Coles, Daniel, and Naveen (2008), and others. Overall, these studies find that smaller firms and firms with higher growth options have smaller and less independent boards.

[12] Kaplan and Minton (2008) conclude that many turnovers classified as voluntary by standard algorithms are in fact forced.

[13] In models of competitive CEO assignment to firms such as Eisfeldt and Kuhnen (2010), the CEO-firm match is dissolved when the match productivity falls below the firm's and the CEO's outside options, and many separations cannot be meaningfully classified as either quits or firings.

due to performance, but the additional 15% turnover rate in the bottom quintile as caused by bad performance.

Because this procedure does not distinguish between forced and voluntary turnovers, it avoids any biases resulting from misclassifications. To illustrate this point, the top panel of Fig. 1 shows an example of the bias caused by misclassifying a fraction of forced turnovers as voluntary. In the figure, 5% of the CEOs retire each year, and these retirement decisions are completely independent of firm performance. In addition, 15% of CEOs in the bottom quintile and 0% of CEOs in the top quintile are forced out, resulting in a true turnover-performance spread of 15%. However, the classification scheme mistakenly codes one-third of the forced turnovers in each quintile as "voluntary".[14] As a result, the measured spread in forced turnovers between the top and bottom quintile is only 10%, and thus 5% lower than the true effect of bad performance on CEO turnover. However, this downward bias can be easily avoided (at least in this example) if all turnovers are considered as potentially performance-induced and treated as turnover events in the estimation. This is the approach we adopt.

Fig. 1 also makes clear under which circumstances the effect of performance on turnover we estimate captures the effect of performance on *forced* turnover: if and only if voluntary turnovers are independent of firm performance. In practice, voluntary turnover may not be equally likely at all performance levels. As a result, our approach may under- or overstate the effect of performance on *forced* turnover. There are two cases to consider. First, if voluntary turnovers are more likely after good performance, then the turnover-performance slope we estimate *understates* the effect of performance on forced turnover. For example, CEOs may want to retire after recent increases in their wealth, causing more retirements after high stock returns. Alternatively, successful CEOs may leave voluntarily to take advantage of career opportunities outside their firms. All this suggests more voluntary turnovers in the top than in the bottom performance quintile and, consequently, that our estimation understates the forced turnover-performance slope.

Instead, if voluntary turnovers are more likely after bad performance, then the turnover-performance slope we estimate *overstates* the effect of performance on *forced* turnover. This may be the case if weak stock returns induce some CEOs to leave the firm voluntarily,

[14] As in the literature, misclassified forced turnovers and truly voluntary turnovers are treated as non-turnover observations.

perhaps because failing CEOs are more likely to be dissatisfied with their job. In this case, the overall turnover-performance slope reflects both the board's firing pressure and the CEO's own response to poor performance. Both effects result in more frequent departures after low returns, and thus in (probably desirable) reallocations of managerial talent. Because our estimation does not distinguish between CEOs that give up and CEOs that are forced out, we interpret the additional turnovers after bad performance as *performance-induced*, and not necessarily as forced.

To summarize, this paper estimates the sensitivity of CEO-firm separations to stock price performance. Using the turnover rate of the best-performing CEOs as benchmark, we identify any *additional* turnovers by CEOs with worse performance as performance-induced. What matters for the allocation of talent and ultimately firm performance is that bad performance leads to CEO turnovers, not whether the actual separation involves a "forced" or "voluntary" departure. However, as long as voluntary turnovers are only weakly related to firm performance, the performance-induced turnover rate we measure is a close approximation to the forced turnover rate the prior literature has tried to estimate, and likely a better approximation than can be achieved by classifying turnovers as forced or voluntary.

Finally, it is worth noting that some of the "retiring" CEOs, particularly in the bottom quintile, would have been fired anyway (i.e., even if they had no intention to leave voluntarily). If so, the estimated turnover-performance slope understates the boards' true willingness to dismiss CEOs for poor performance. The bottom panel of Fig. 1 illustrates this idea. The example assumes that the board wants to fire 15% of all CEOs in the bottom quintile and no CEOs in the top quintile. However, 5% of CEOs in every quintile leave voluntarily (and before they can be fired), so that the estimated turnover-performance slope is only 15%*(1-5%) = 14.25%. In this case, the occurrence of voluntary turnovers masks some of the performance pressure exerted by the board. This problem is more severe when voluntary turnover is more frequent, for example for CEOs that are more seasoned or closer to retirement age. It is also more apparent in the cumulative regressions which estimate turnover rates over longer horizons, and we return to this issue in Section 4.2.

4 CEO turnover and performance: a cumulative approach

4.1 Basic tests

In this section, we ask a simple question: what is the probability that a CEO who has performed poorly (well) during her tenure is no longer in office at the end of the first, second, third, fourth etc. year after taking office? To answer this question, we track each CEO's job status and performance starting from the beginning of her tenure. Specifically, we create a set of indicator variables $turnover_{1,t}$ that are set to one if a CEO leaves office at any time from her start as CEO (the beginning of year 1) through the end of year t, and to zero otherwise. We then regress these *cumulative* turnover indicators on the CEO's performance, measured as the average abnormal return from the CEO's first month in office through the end of year t, or – for CEOs who depart before the end of year t – through the end of her tenure. We call this average return the CEO's *tenure performance*. We scale each average return by its standard error to control for the fact that the measurement periods vary in length across CEOs. Finally, to allow for non-linear effects of performance on turnover, we sort the CEOs into quintiles based on their tenure performance and use performance quintile dummies as explanatory variables (instead of the tenure return itself).

Our regressions of cumulative CEO turnover on tenure performance differ in several important aspects from the prior literature. First, the unit of observation in the regressions is a CEO-tenure rather than a CEO-year. Each regression measures the effect of performance on the *cumulative* probability that a CEO leaves office at any point during the examined period. Second, we regress the indicator for whether a CEO-tenure has ended on a performance variable covering the entire CEO tenure up to this point, not just the most recent 12 to 24 months. In contrast, most prior studies focus on the effect of recent performance on the *incremental* probability that a CEO leaves office in any given year. These studies implicitly assume that boards ignore any performance history older than one or two years, while we implicitly assume that boards iuse the entire performance history when evaluating their CEO. This assumption will be examined later in the paper. Third, we make no attempt to distinguish between forced and voluntary turnovers based on CEO or turnover characteristics, and instead let the data show how many turnovers are performance related and how many are not. Finally, by using performance quintile dummies we allow for non-linear effects of performance on turnover.

The probit regressions of cumulative CEO turnover on tenure performance are presented in Table 2. Panel A shows the effect of tenure performance on turnover in the CEOs' first six years.[15] The results (illustrated in Figure 2) are striking and show that CEO turnover in the beginning of tenure is highly performance sensitive: The probability that a CEO leaves office in the first three years of tenure is 40% if performance is in the bottom quintile, but only 3% if it is in the top quintile, for a spread of 37 percentage points. By the end of year four, 52% percent of CEOs in the bottom quintile are no longer in office, compared to only 8% of CEOs in the top quintile. Thus performance drives a 44 percentage point spread between the turnover probabilities of top and bottom performers over the first four years of tenure, a remarkably strong turnover-performance relation. Moreover, because CEO turnover is highly performance-sensitive already in the first two years of tenure (the spread between top and bottom performers for years one and two is 21 percentage points), dropping these initial two years – which is common in turnover studies – excludes a significant number of performance-induced dismissals.

To gain additional perspective on these magnitudes, we ask what cumulative spreads we should expect based on estimates from the prior literature. Most turnover studies estimate the probability that a CEO is dismissed during a one-year period as a function of the firm's stock price performance in the previous one or two years. To compare our results to those in previous studies, we simulate such an "annual" turnover model in Appendix 1. We set the sensitivity of annual turnovers to the prior year's stock return equal to a typical estimate from the prior literature and calculate the implied cumulative turnover probabilities. Using sensitivities close to those reported in prior studies, the model generates a five-year cumulative turnover spread between top and bottom quintile performers of approximately 11%. This is substantially lower than the 42% figure in Table 2, suggesting that CEO turnover is much more sensitive to performance than previously thought. In Section 5, we attempt to reconcile the cumulative estimates in Table 2 with the prior literature's annual turnover models.

[15] The sample used in Panel A consists of CEOs who start their tenure between 1993 and 1999, so that we can observe their subsequent six years with the firm (our data ends in fiscal year 2005). We exclude firms that disappear from Compustat during the examined time-span. We also exclude interim CEOs, CEOs who die or leave for health reasons, and CEOs who start their tenure at the age of 60 or older. These older CEOs reach their retirement age at some time during the following six years, so their departures are more likely voluntary. Following the analysis in Section 3, we examine turnovers by retirement-age CEOs separately in Section 4.1.1.

Panel A of Table 2 focuses on the first six years of tenure. In Panel B, we repeat the analysis for the subsequent six years and find that the high cumulative spreads persist throughout mid-tenure. The regressions are similar to the ones in Panel A: Each regression estimates the cumulative probability that a CEO departs at any time starting from tenure year 7 and ending in tenure year 7+t, where t=0, 1, … 5. Similarly, each CEO's performance is measured as the average excess return from the beginning of tenure year 7 through the end of tenure year 7+t, or through the month preceding the CEO's departure, whichever comes first.

The most notable result from Panel B is that turnover-performance spreads remain high throughout the first 10 tenure years. From column 4, a CEO with bottom-quintile performance in years 7-10 is 36 percentage points more likely to depart than a CEO with top-quintile performance. Thus, more mature CEOs are subject to almost as much scrutiny by boards as their younger peers. This is surprising, as surviving CEOs should be relatively more entrenched (since they had more time to establish their power), but also more valuable to the firm (because survival should be indicative of higher ability), causing declining spreads in tenure time. Table 2 suggests that these selection and entrenchment effects are relatively weak for most CEOs.

The spreads do finally decline for highly seasoned CEOs: In tenure years 7-12, the spread in turnover probabilities between top- and bottom quintile performers is only 25%, compared to 41% for years 1-6. The reason is an increase in non-performance related turnovers, as identified by the rapid increase in turnovers in the top performance quintile.[16] Put differently, tenure years 11 and 12 see a rapid increase in CEO departures across all performance levels, likely driven by voluntary retirements. For example, the turnover frequency for the best performers is 46% in years 7-12, compared to only 24% in years 1-6.

In all regressions in Table 2, we control for firm size, the book-to-market ratio, and a dividend dummy equal to one for dividend payers. In Panel A, all three variables are measured two years before the CEO takes office (i.e. in year -2). We also include each firm's return on assets (ROA) averaged across years -1 through -3, and the firm's board quality index. Because the board index is missing for some years in our sample, we use the index for year -2, -1, or -3, whichever is available (in that order). Finally, the regressions include two

[16] As suggested by the analysis in Section 3 (and the bottom panel of Fig. 1), the decline in spreads following the first 10 years of tenure is driven by

age dummy variables, one for CEOs who are 55 through 59 in year zero, and one for CEOs who are 50 through 54 in that year. In Panel B, the control variables are measured in the same manner before tenure year 7 (see Table 2 for the details).

The coefficient estimates in Table 2 indicate that firms with stronger boards are more likely to dismiss their CEOs during the first five years of tenure. The board quality effect weakens and even switches sign in the subsequent years (Panel B). We examine this finding in detail in Section 4.3. CEO turnover also tends to be higher for non-dividend payers (Panels A) and late in tenure for larger firms (Panel B). Interestingly, firms that did well based on their pre-hiring accounting performance are more likely to dismiss their CEOs early in tenure. It is possible that in such firms, CEOs are benchmarked against their successful predecessors and have difficulties proving themselves to the board. In contrast, positive stock price performance before CEO hiring is associated with fewer subsequent departures. This result may be caused by shorter tenures for specialized "turnaround CEOs", or it may reflect difficulties in finding and retaining CEOs that are capable of running struggling firms.

4.2 Identifying performance-induced turnovers

It is tempting to interpret the spread in turnover probabilities between the top and the bottom quintiles in Table 2 as the frequency of performance-induced turnovers for bottom-quintile performers. For example, over the first five years, 59% of bottom-quintile and 17% of top-quintile CEOs leave office, suggesting a performance-induced turnover rate of 59-17 = 42%. However, this interpretation would be incorrect. Even though 17% of top-quintile performers leave in the first five years for (by assumption) non-performance reasons, the corresponding number for bottom-quintile performers is smaller, simply because many of these bad performers depart for performance reasons *before* they can leave for other reasons.

To account for this, we assume that CEOs can depart for performance reasons up to one year before their estimated regular-departure dates (by "regular" we mean not related to performance). We accomplish this by identifying performance-induced turnovers separately for each tenure-year and then aggregating them over longer periods. For example, to measure performance-induced turnover over tenure years 1-5, we first identify the CEOs in the top quintile (formed based on five-year performance) that departed during tenure years 1-5, noting the year in which each departure occurs. This yields five annual turnover rates for the top-quintile performers. We then use these five annual rates as estimates of the annual regular

departure rates in the lower quintiles. Any additional turnovers observed in the lower quintiles are interpreted as performance-induced. This procedure is described in detail in Appendix 3.

The results are presented in Panel A (tenure years 1-6) and Panel B (tenure years 7-12) of Table 3. Both panels show remarkably high rates of performance-induced turnover, especially for the bottom quintile. By the end of tenure year 5, approximately 50% of CEOs in the bottom quintile have experienced performance-induced turnover, compared to only 14% of CEOs in quintile 3, and (by definition) 0% of CEOs in quintile 1. Surprisingly, the likelihood of performance-induced turnover remains high in subsequent years. For example, for the bottom quintile, it is 30% in tenure years 7-8 and 52% in years 7-12. This suggests that CEOs experience considerable performance pressure even late in tenure and that entrenchment and selection effects are relatively weak.

4.3 The effect of board quality on CEO turnover

Table 2 suggests that stronger boards are more likely to replace their CEOs than weaker boards, at least in the beginning of tenure. In this section, we examine the relation between board quality and CEO turnover in more detail and allow for interactions between board characteristics and CEO performance. The main result is that strong boards are much more likely to replace badly performing CEOs than weak boards, and that the effect of performance on turnover for strong boards is remarkably large.

We focus on three measures of board quality, namely board size, directors' stock ownership, and director independence. Prior literature suggests that these variables affect boards' effectiveness, and that their variation across firms may be driven by both value-maximizing choices (e.g., tradeoffs between costs and benefits of monitoring) and by negotiations between self-serving CEOs and boards.[17] We combine the variables into an overall indicator of board quality (*BOARD)* that takes on values from zero to three, with higher values indicating smaller boards, more independent boards, and boards with higher stock ownership by directors (see Section 2 for the details). The question is whether boards

[17] For a discussion of these issues see, for example, Jensen (1993), Hermalin and Wesibach (1998), Raheja (2005), Haris and Raviv (2007), Boone et al. (2007), Gillan et al. (2006), Linck et al. (2008), Coles et al. (2008), and Masulis and Mobbs (2009).

that appear "stronger" on these three dimensions are more likely to replace badly performing CEOs.[18]

Table 4 shows the combined effects of tenure performance and board quality on cumulative CEO turnover in the first five years of tenure (the results are similar for tenure years 1-4 and 1-6 and are illustrated in Figure 3). To allow for interactions between board quality and performance, we run a separate regression of turnover on board quality for each quintile of tenure performance. Thus, the table presents five different regressions, one for each performance quintile, with performance measured over tenure years 1-5. Below each regression, we compare the implied probabilities of a CEO dismissal in years 1-5 for firms with high quality boards (board index of three) and for firms with low quality boards (board index of one).

Two notable and closely related results stand out from Figure 3 and Table 4. First, high quality boards are much more likely to dismiss CEOs after bad performance than low quality boards. In the worst performance quintile, the cumulative turnover probability over the first five years of tenure is 83% for firms with strong boards, but only 49% for firms with weak boards. This implies a difference (or "governance spread") of 34 percentage points between firms with low to moderate board quality (39% of firm-years in our panel have a board index of one) and firms with the highest board quality (10% of firm-years have a board index of three). This governance spread is substantially lower and not statistically significant at higher performance levels, and its sign actually reverses in the top performance quintile.

Hence, the strong positive effect of board quality on CEO turnover noted in Panel A of Table 2 is driven by the worst performance quintile. The much smaller CEO turnover frequency for weak boards at the low-end of the performance spectrum suggests that many of these boards fail to dismiss their CEOs even when performance is dismal. Interestingly, we find no significant governance effects for the later stages of CEO tenure. When we repeat the

[18] The construction of the board-quality index is based on ideas developed in the prior literature. For example, several studies suggest that smaller boards are more efficient (Jensen (1993), Yermack (1996)), and that board independence enhances its monitoring function (e.g. Fama and Jensen (1983), Weisbach (1988)). Stock ownership should improve directors' incentives by tying their wealth to firm value (Weisbach (1988), Perry (1999)). However, the literature generally recognizes that the overall effect of these variables on board performance is ambiguous. For example, larger boards may be useful in larger and more complex firms, and inside directors could be valuable because they contribute firm-specific expertise (e.g., Coles et al. (2008), and Linck et al. (2008)).

analysis in Table 4 for tenure years 7-10, 7-11, and 7-12, we obtain consistently insignificant (and negative) coefficients on board quality in the bottom-quintile regressions.

The second important result from Table 4 is that the turnover-performance sensitivity for firms with high quality boards is strikingly large, and much larger than for firms with low quality boards. Over tenure years 1-5, the difference in turnover probabilities between bottom and top quintile performers is 73 percentage points for strong boards, but only 20 percentage points for weak boards. This stark difference is due mostly to the fact that strong boards are much more likely to replace their CEOs in the bottom quintile. However, the top quintile CEOs also contribute, in that they appear more likely to leave firms with low quality boards than firms with high-quality boards.

All in all, the results show that CEOs employed by high quality boards are under severe performance pressure and highly likely to lose their jobs if their performance is bad. CEOs employed by low quality boards face much weaker turnover-performance sensitivities in early tenure, and are much more likely to retain their position even if their performance is in the bottom quintile. However, the difference in turnover behavior between high and low quality boards vanishes in late tenure. This may be due to a selection effect, with fewer bad CEOs surviving into late tenure if boards are strong, or due to strong boards losing their edge as CEOs become gradually more entrenched.

The results in Table 4 have at least three possible (and not necessarily mutually exclusive) interpretations. The first is that the three board attributes – size, independence, and stock ownership – capture some underlying aspects of board quality that determine firm behavior, and that weak boards, as identified by these measures, make suboptimal turnover decisions. This interpretation implies that strengthening boards, at least in a subset of our sample firms, would improve their effectiveness and increase firm value.

The second possibility is that board structure does matter for turnover decisions, but that board structures are chosen optimally by firms. Establishing a strong board may be costly to shareholders (for example, it may require that directors' wealth is tied more closely to firm value), and for some firms these costs may outweigh the benefits. For example, strong boards may be less important in firms whose CEOs have little impact on firm value. Such firms may optimally choose weaker boards, which would then lead to less effective turnover decisions.

The final and arguably least likely interpretation is that the board effects in Table 4 are purely coincidental and driven by an omitted variable. This would imply that some firms choose high-quality boards, but that this choice has no impact on CEO turnover. Instead, such firms also happen to exhibit more performance-sensitive CEO turnover for reasons unrelated to internal governance.[19] In Section 6, we attempt to shed some light on these hypotheses by exploring the relation between board quality and firm performance.

5 CEO turnover and performance: the standard approach

The cumulative CEO turnover analyses in Tables 2 and 4 show large effects of firm performance on CEO turnover, in marked contrast to the prior literature. In this section, we explain in more detail where the differences in results are coming from. We begin by estimating the effect of firm performance on the *incremental* probability that a CEO departs in any given year, which corresponds to the approach taken by the literature. We then use this incremental model to gain a more nuanced picture of how boards use performance histories to make turnover decisions.

5.1 Basic estimates of the standard model

We start by estimating the probability that a CEO departs in any given year as a function of her prior performance. In contrast to the previous analysis, the unit of observation is now a CEO-year rather than a CEO-tenure, and the probit regressions estimate the incremental turnover probability by tenure year. The first column in Table 5 replicates a typical specification from the literature and obtains a turnover-performance spread of 4.5%, consistent with the estimates in prior studies.

This basic specification has three key characteristics. First, the model uses a common but narrow definition of forced turnover similar to the one developed by Parrino (1997). The Parrino algorithm uses press reports, the time between the turnover announcement and the actual turnover, and the CEO's age at departure to classify turnovers as either forced or voluntary (see Appendix 2). All CEO-years that are not classified as forced turnovers, including 874 "voluntary" turnovers, are included in the sample as non-events. Second, CEO performance is measured using only twelve months of prior stock price performance,

[19] It is also possible that the strong board indicator is positively correlated with other governance mechanisms (such as takeover pressure) that also discipline and remove CEOs. If so, the board effects identified in Table 3 would have the correct sign but overstated magnitudes.

implicitly assuming that boards ignore any performance history older than one year. Third, performance enters the regression linearly (rather than through the quintile dummies used before). As in the literature, the turnover-performance sensitivity is then computed as the difference in the average implied probabilities of a CEO turnover for firms in the first vs. the fifth performance quintile.

We next successively change each of these three features of the regression to bring the specification in line with our analysis in Table 2. We first replace the stock return with return quintiles (column 2), we then broaden the definition of a turnover event (column 3), and we finally expand the performance measurement period to three (five) years before the turnover decision (columns 4 & 5). Each of these steps increases the estimate of the turnover-performance sensitivity, pushing the estimated turnover-performance spread to almost 11%.

Comparing columns 1 and 2 shows that allowing for a non-linear effect of performance on turnover is somewhat important and increases the turnover-performance spread from 4.5% to 5.7%. However, a much larger effect comes from broadening the definition of a turnover event in column 3. Following the approach outlined in Section 3, this regression estimates the probability of any turnover included in the panel, treating all events as potentially performance-induced.[20] As a result, the number of turnover events increases from 422 in column 2 to 1,296 in column 3. The effect on the turnover-performance slope is stark: The difference in annual turnover probabilities between top and bottom quintile performers increases from 5.7 to 10.2%. This implies that supposedly "voluntary" turnovers, as classified in the prior literature, are much more likely to occur after bad performance. Misclassifying these performance-induced turnovers as non-events mechanically biases the estimated turnover-performance sensitivities towards zero.

Finally, simply expanding the return measurement period from one to three or five years has only a small positive effect on the turnover-performance sensitivity. Using three years increases the spread in turnover probabilities between top- and bottom-quintile performers slightly from 10.2% to 10.5%, but expanding the window further to five years actually reduces the spread to 10.3%. This tentatively suggests that boards use relatively short performance histories when evaluating CEOs. However, the assumptions underlying Table 5 are quite restrictive. For example, we assume that boards evaluate CEOs based on equal-

[20] The panel excludes interim CEOs, CEOs that died or left for health reasons, or CEOs that are older than 65.

weighted averages of prior performance over fixed horizons (of three or five years), and that all boards use identical horizons. We examine the validity of these assumptions in the next sections.

To summarize, the three modifications introduced in this section – non-linearity, a broader definition of turnover, and longer performance histories – more than double the effect of firm performance on CEO turnover. By far the most important modification of the three is the broad definition of turnover.

However based on the analysis in Appendix 1, even an incremental turnover-performance spread of 10.5% per year is much too small to explain the *cumulative* spreads observed in Table 2. Appendix 1 shows that to generate the observed cumulative spread of 43% over five years, the incremental spread must be 20% – nearly twice as large as the empirical estimate. Thus, even when using the same turnover definition and the same performance measure as the cumulative regressions, the incremental CEO turnover regression miss a large part of the turnover-performance relation captured by the cumulative analysis. The next section provides suggestive evidence that heterogeneity in the turnover-performance relation across firms biases the incremental CEO turnover regressions downward, and, importantly, more severely so than the cumulative regressions.

5.2 Board heterogeneity

The previous analysis assumes that all boards use identical decision rules when they choose whether to fire or retain a CEO. This may not be true in practice. For example, boards may differ with respect to the amount of return information they use to evaluate CEOs, the way they aggregate historical performance, or the speed with which they react to performance signals. Moreover, even for the same board, behavior is likely to change over time. Capturing all of this (mostly unobservable) heterogeneity in an empirical model would be difficult, and we do not attempt it in this paper.

Instead, the purpose of this section is two-fold: to illustrate the effects of heterogeneity on the empirical tests using a simple simulation example, and to show actual evidence of heterogeneity in the data. Unobserved heterogeneity introduces measurement error into the turnover-performance relation and likely biases estimates of this relation downward. Moreover, depending on the type of heterogeneity, the magnitude of this effect differs between the cumulative regressions in Table 2 and the incremental regressions in Table 5,

offering an explanation for the much weaker effects on performance on turnover in the incremental analysis.

5.2.1 The effect of board heterogeneity on estimated turnover-performance sensitivities

We focus on one specific type of heterogeneity: we assume that boards differ with respect to the amount of stock return information they use to fire a CEO. To capture this assumption, we simulate a heterogeneous sample consisting of three types of boards denoted as B1, B2, and B3. A type B1 board fires its CEO at the end of year t with probability p if the average monthly return over the past 12 months is in the bottom quintile of the return distribution. Boards B2 and B3 behave similarly, except that they use 24 and 36 months of stock return performance, respectively. The combined sample consists of 15000 firms, 5000 of each type, and each firm enters the sample in the first year of CEO tenure and exits at the end of tenure year five, or when the CEO departs, whichever comes first.

Table 7 shows that with heterogeneous boards, the standard turnover model substantially understates the true performance pressure faced by CEOs. In the third column we assume that boards are heterogeneous with respect to the amount of return information they use (1, 2, or 3 years) and set each board's true sensitivity, p, with respect to its return measure to 16%. However, board type cannot be observed, and the researcher regresses CEO turnover on average returns over the past 12 months, which is the correct return measure for the B1 boards only. As a consequence, the estimated performance pressure is biased downward by nearly half: the difference in turnover probabilities between the first and the fifth quintile is only 9%, instead of the "true" turnover-performance spread of 16%. The estimates of p are downward biased because performance is measured with error for two-thirds of the sample firms.[21]

Notably, the cumulative regressions are less sensitive to board heterogeneity, at least with regard to the heterogeneity modeled here. The right panel of Table 7 shows results analogous to the cumulative regressions in Table 2. Specifically, all CEOs are sorted into quintiles based on their tenure performance, and the table shows, for each quintile, the likelihood that the CEO departs at any time during the first five years of tenure. Using an annual performance pressure p of 16%, the cumulative Q1-Q5 spread is 36% when the sample is homogenous, and it is only one percentage point lower for the mixed sample. This robustness

[21] Not surprisingly, the results are similar when returns are averaged over longer horizons for all boards.

to heterogeneity is not surprising given the cumulative approach: turnover frequencies are cumulated over several years and then related to the CEOs' average performance during their tenure. As the simulation shows, this aggregation makes the model relatively insensitive to the specific return horizon boards use.

Finally, board heterogeneity can explain why in the actual data, the cumulative spreads are so high compared to the estimates from the incremental model in Table 5. The spreads in Table 5 are between 10% and 11%.[22] If 10% per year is interpreted as the true performance pressure, then, based on the simulation in Appendix1, the resulting cumulative spread should be only 25% over five years. However, in the heterogeneous sample a 10% incremental spread implies a "true" p of 17% and a cumulative spread of 37% – much closer to the empirical estimates in Table 2.

To summarize, the simulation results suggest that, unless boards are perfectly uniform, the empirical estimates of turnover-performance sensitivities should be interpreted as a lower bound for the true performance pressure faced by CEOs. Comparing the incremental and the cumulative spreads obtained in actual data suggests that heterogeneity could, in fact, be important. We provide additional evidence of heterogeneity below.

5.2.2 Evidence of board heterogeneity

In this section, we show evidence of board heterogeneity similar to that modeled above. In the previous simulation, we assumed that the length of the return history boards use varies across firms. To examine the empirical relevance of this idea, we explore differences in the boards' utilization of historical (i.e., lagged) return information. We compare broad categories of firms, e.g., large vs. small, or high B/M vs. low B/M. We do not attempt to uncover all (or even most) heterogeneity in the data, especially given that much of it is likely to be unobservable. Our goal is simply to show that heterogeneity is prevalent, and that it has important implications for how we interpret the empirical results in Tables 2 and 5.

Panel A of Table 8 provides the first indication that heterogeneity may be important. The panel shows implied probabilities of CEO turnover for quintiles formed based on more distant historical performance. We measure historical performance, RET(-3,-2), as the average industry adjusted monthly return for years t-2 and t-3 relative to the observation year.

[22] Using the first five years of tenure and a 12-month return also yields a spread of 10%.

The implied probabilities are obtained from a probit model of CEO turnover (described in the table), and they are estimated separately for subsamples split based on total assets, B/M, the board index, and year t-1 performance. The table shows that the responsiveness of turnover to historical performance varies across firms. For example, large firms' turnover decisions are unrelated to historical performance: the spread in turnover probabilities between the bottom and the top quintiles of RET(-2,-3) is 0%. This compares to 6% for small firms and 3% for medium-size firms. Similarly, firms with strong boards, high book-to-market, and poor past-year performance seem to rely more strongly on historical returns.

Panel B shows that these differences are statistically significant. To determine this, we estimate a probit model similar to that in Panel A but using a pooled sample. For example, when the sorting variable is B/M, the pooled sample contains firms with B/M in both the top and the bottom quartiles, and the model includes two interaction terms of the return variables RET(-1) and RET(-2,-3) with an indicator (HIGH) equal to one when B/M is high (top quartile) and equal to zero when B/M is low (bottom quartile). The table shows that all interaction terms of HIGH with RET(-2,-3) are statistically significant. Interestingly, the sign and the magnitude of the interaction terms of HIGH with RET(-1) vary across models. For example when HIGH denotes high B/M, the coefficient on HIGH*RET(-1) has the opposite (positive) sign than the coefficient on HIGH*RET(-2,-3). This suggests that growth and value firms differ with respect to the *relative* importance of recent vs. more distant information. In contrast when HIGH denotes high ASSETS, both interaction terms are positive and significant. This, combined with the results in Panel A, indicates that large firms disregard more distant return information (while small firms do not), and that they are also less responsive to more recent information. In sum, the results reveal significant heterogeneity in boards' use of return information in CEO turnover. This strongly suggests that the estimation problems illustrated in the previous simulation are relevant in practice.

5.3 How much prior performance information is used in CEO turnover decisions?

The previous section suggests that firms consider multiple years of return information when making CEO turnover decisions, but that more recent performance matters more. The incremental CEO turnover model in Table 5 assumed that boards place the same weight on performance in the more recent and more distant past. We estimate a more flexible model in this section.

The model is similar to that in Table 5 (third column), except that CEO performance is measured as a *weighted* average of the monthly excess returns since the start of the CEO's tenure, and the model allows boards to put more weight on more recent performance. The returns are averaged using the flexible weighting function given below, and the weights that best explain observed CEO turnover are estimated from the data. The caveat from the previous section applies: the model estimates *average* weights used by boards of potentially different types. To the extent that weights differ across boards, the model is likely to understate the true turnover-performance sensitivity.

We estimate the following weighting function from observed CEO turnover decisions:[23]

$$\text{Return}_{T,t}(\lambda) = \frac{\sum_{k=1}^{T-1} w_T(k,\lambda) R_{t-k}}{\sum_{k=1}^{T-1} w_T(k,\lambda)} \quad \text{where} \quad w_T(k,\lambda) = \left(\frac{T-k}{T}\right)^{\lambda} \qquad (1)$$

$\text{Return}_{T,t}(\lambda)$ is the prior performance of a CEO with tenure T, calculated as a weighted average of the monthly excess returns R_{t-k} from the CEO's start in office to one month before the turnover decision at time t. The slope of the weighting function is determined by the parameter λ, which is estimated from observed CEO turnover decisions. A λ of zero implies that boards assign equal weights to all months, while higher λs imply more weight on more recent performance. Appendix 4 describes the weighting function in more detail and plots the weights for different values of λ. To allow boards to use different weights for CEOs in different tenure years, we estimate the weighting function separately for CEOs in tenure years 1-2, 3-5, 6-9, and for CEOs beyond tenure year 9.

The results from the joint estimation of the year-by-year turnover regressions and the slope parameter λ are presented in Table 6 and reveal three notable results: First, boards put disproportionally high weight on more recent performance in their CEO turnover decisions. The estimated λ's are all far above zero, which means that a performance measure that overweights recent performance explains turnover better than using the average performance over each CEO's tenure.

[23] The same weighting function is used by Malmendier and Nagel (2009) to aggregate investors' macro-economic experiences.

Second, using the estimated weights in calculating CEO performance increases the implied turnover-performance sensitivities substantially. In tenure years 1-9, the spread in annual turnover probabilities between top and bottom quintile performers is between 12 and 13%, which is significantly higher than the 9 to 10% when prior performance is calculated as an equal-weighted average (as reported in Table 5).

Finally, the slope of the weighting function and hence boards' use of performance information appears to change with CEO tenure. This supports our earlier point that boards' firing rules vary across firms and over time. As tenure increases, the performance measure that best explains CEO turnover puts increasingly more weight on more recent performance. A λ close to 2, which is our best estimate for CEOs with more than five years of tenure, implies that the right performance measure for a CEO with a 60 months performance history assigns almost 50% weight to the most recent 12 months, and more than 85% weight to the most recent 36 months.

All in all, the results in Tables 5 and 6 show that allowing boards to use a performance measure that overweights recent performance produces larger effects of performance on CEO turnover than using only the most recent performance or a simple long-run average. This suggests that boards use more than just the most recent performance when making CEO turnover decisions, but also that the more recent performance plays a much larger role than performance from three or four years ago.

However, determining precisely how boards aggregate and use their CEOs' performance histories is difficult, and made more difficult by the fact that information use appears to change with CEO tenure. In addition, boards likely use more complex weighting functions than the one we estimate, and, as we argue in the previous section, the weighting function varies across firms. Lastly, this study focuses on stock returns, but boards have access to many other performance measures, including soft information that is unavailable to outside observers.

All of this implies that our measure of CEO performance is an inferior predictor of CEO turnover compared to the performance measures actually used by boards, and that the turnover-performance sensitivities we estimate understate the true sensitivities CEOs are confronted with. Given that the sensitivities we estimate are already large, the pressure on CEOs from the threat of performance-induced turnover is even larger.

6 Board quality and firm performance

Section 4 has shown that strong boards are much more likely to replace badly performing CEOs than weak boards. However, it is not a priori clear that the more aggressive CEO dismissals by strong boards improve firm performance. In this section, we therefore investigate whether strong boards are associated with better firm performance. Specifically, we test whether firms with high quality boards recover more quickly from negative performance shocks. We focus on negative rather than positive shocks to capture the effects of CEO turnover, though boards' other functions (such as setting executive compensation or advising management) may be equally or even more important to the firm.

The effects of board quality on firm performance are presented in Table 9. We define a performance "crisis" as a fiscal year in which a firm's raw stock return is in the bottom quintile of all sample firms for that year (Column 1). Alternatively, we form performance quintiles based on industry-adjusted returns and industry returns (Columns 2 and 3, respectively). We examine firm-specific performance shocks because they are most likely to induce forced CEO turnover. However, industry shocks are also interesting because they are likely exogenous to the firm (potentially providing cleaner tests), and because the prior literature has shown that negative industry shocks are associated with increased CEO turnover (e.g., Jenter and Kanaan (2008)).

The dependent variable in Table 9 is the stock price performance after the negative performance shock, with stock price performance measured as the sum of industry-adjusted monthly returns over fiscal year t.[24] The key explanatory variables are a dummy variable for poor stock price performance in year t-2 (*Crisis*), a dummy variable for strong boards (*Strong Board*), and the interaction between the two. The *Crisis* dummy identifies firms for which the cumulative stock performance in year t-2 was in the bottom quintile of all firms for that year. As mentioned above, we define the *Crisis* dummy alternatively based on raw, industry-adjusted, and industry returns, and show results for all three definitions. The *Strong Board* indicator is based on our board quality index, and is set to one for firms with high quality boards (index value of three) and to zero for firms with low quality boards (index value of one). The other explanatory variables are controls for size, book-to-market, asset growth, and stock returns in year t-1, and accounting returns in years t-1 through t-3. We also include

[24] As before, the industry-adjusted monthly returns are computed as the difference between monthly raw returns and industry returns for the 49 equally-weighted industry portfolios from Ken French's website.

interaction terms of the control variables with the *Crisis* dummy to isolate the effect of board quality from that of other firm characteristics.

Table 9 shows that firms that suffered a performance crisis in year t-2 have significantly higher stock returns in year t if their board is of high quality. For example, if the negative shock is measured using raw returns (first column), the interaction term of *Crisis* with *Strong Board* is 0.08 (with a Fama-MacBeth t-statistic of 2.23), suggesting that firms with strong boards outperform those with weak boards by eight percentage points two years after the crisis. The effect appears stronger after industry-induced crises (coefficient of 0.08 and t-statistic of 2.81) than after firm-specific crises (coefficient of 0.04 and t-statistic of 1.39).

One possible explanation for the large positive effect of board quality on firm performance two years after a negative *industry* shock is that weak boards fail to enforce the necessary changes in operating policies required by an industry downturn (such as layoffs, investment cutbacks, and divestitures). Morck, Shleifer, and Vishny (1989) argue that it is much easier for boards to discipline or replace managers after bad firm-specific performance than after bad industry-induced performance. Alternatively, industry shocks may simply provide a cleaner test of the role of boards because such shocks are less affected by the boards' own prior decisions.

In untabulated robustness tests, we have constructed the *Crisis* dummy based on firm performance in years t-1 or t-3 instead of t-2 and found no significant governance effects. Thus the effect observed in Table 9 appears limited to the second fiscal year following the crisis, suggesting some delay in either the board's or the market's response. Finally, we have expanded the regressions in Table 9 by including a dummy variable identifying the *top* quintile performers in year t-2 (in addition to the *Crisis* dummy), as well as the corresponding interaction terms with the *Strong Board* indicator. We find no significant performance reversal for top performers, suggesting that the reversal effect associated with board quality is asymmetric. This is consistent with the hypothesis that strong boards are particularly valuable when firms perform badly, and less relevant when firm-specific or industry performance is high.

There are several important caveats to the results in Table 9. By measuring the effect of board quality on stock price performance subsequent to a negative performance shock, we are implicitly assuming that the market does not fully incorporate the value of good governance

into prices as the performance shock hits. If this value is perfectly and instantaneously understood by the market, then we should be unable to find any governance effect on stock returns in subsequent years. Alternatively, it is possible that investors realize the benefits of good governance with some delay, e.g. only after they observe a board's actions in response to the crisis. For example, investors may need to observe the board's decision to dismiss its CEO after a poor performance (and the identity of the successor) to fully appreciate the benefits of a strong board for firm value.

Finally, it is worth emphasizing that the regressions in Table 9 use accounting information from year t-1 to explain returns in year t and are therefore not predictive regressions in the usual sense. Some of this accounting data becomes publically known within the first few months of fiscal year t when firms disclose their financial statements for the prior year. In unreported regressions, we re-run the regressions in Table 9 using the cumulative returns over the first four months of year t and, for comparison, over the remaining six months (we also experiment with splits of 3 and 7 months, and 5 and 6 months). Overall, the regressions suggest that the governance effects identified in Table 9 are similar in magnitudes in the first and second part of year t, and tend to be statistically weaker than the combined effect reported in Table 9. There is no evidence that a trading strategy based on publicly available data would yield significantly positive returns.

7 Conclusions

This paper's key finding is that CEO turnover is highly sensitive to performance, and especially so for firms with strong boards (defined as small boards with high stock ownership by directors and a low fraction of insiders). A CEO whose performance is in the bottom quintile – based on abnormal stock returns from the beginning of her tenure – has a 59% probability of leaving office during her first five years. The same probability is only 17% for a CEO in the top performance quintile. The spread in turnover probabilities between performance quintiles 1 and 5 increases to 73% for firms with high quality boards. These results stand in stark contrast to the prior literature, which reports low sensitivities of CEO turnover to performance and only weak evidence that better boards make more value-sensitive turnover decisions.

We also find tentative evidence that board quality is positively associated with firm performance. Specifically, firms with higher quality boards recover faster from performance

declines, consistent with the hypothesis that strong boards respond more effectively to negative shocks.

Overall, our results suggest that boards are more focused on shareholder value than previously thought, and that the threat of dismissal is an important source of incentives for most CEOs. There are, however, large cross-sectional differences. Higher quality boards are much more aggressive in firing badly performing CEOs, and higher board quality is reflected in a faster recovery of firm value after performance declines.

Appendix 1: Incremental vs. cumulative turnover probabilities

This appendix illustrates the link between the cumulative CEO turnover probabilities estimated in Section 4 and the more typical annual turnover regressions used in prior studies (and in Section 5 of this paper). To compare the two approaches, we simulate a simple turnover model in which a CEO is fired every year with a probability p that depends on the firm's past stock price performance. We then investigate how different assumptions about p (which we call the incremental turnover probability) and its sensitivity to past performance affect the cumulative turnover patterns.

We start by generating a sample of monthly stock returns for 5000 hypothetical firms over 60 months. For simplicity, we assume that each monthly return is drawn independently from a lognormal distribution with mean zero and a standard deviation of 8.5% (for an annualized standard deviation of 30%). CEOs are hired in the beginning of month one and stay in office for a maximum of five tenure years. At the end of each tenure year, CEOs are fired with probability p, which is a function of each firm's past stock price performance. Following much of the prior literature, we assume that boards consider only performance in the most recent year when making turnover decisions. Specifically, if a firm's average monthly stock return in the prior tenure year is in the bottom quintile, the CEO is fired with probability p. Otherwise, the CEO survives in office until the following year. We vary the incremental turnover probability p from 4% to 20% when simulating the CEO turnover panel.

Table A1 presents the cumulative probability that a simulated CEO is fired during her first five years in office as a function of the stock price performance over that period. As in Table 2, performance is measured as the average monthly return from the beginning of CEO tenure through year five, or, for CEOs that are fired before the end of year five, from the beginning of CEO tenure through the last month before the firing. Each average return is scaled by its standard error to control for the fact that the return measurement periods vary in length across CEOs.

The main result from Table A1 is that, for reasonable levels of p, the simulated model generates much lower cumulative turnover probabilities than those estimated in Table 2. For example, in the first column, p is set to 4%, which is consistent with standard estimates in the prior literature. However, this assumption results in cumulative turnover probabilities over the first five tenure years that differ by only 11% between top and bottom quintile

performers. This is almost four times lower than the corresponding turnover-performance spread of 42% estimated in Table 2 for the same years.

The simulations also show that in order to obtain a cumulative spread consistent with Table 2, we need to assume a incremental turnover probability as high as 20% per year. This is much larger than any estimate found in the prior literature, which suggests that prior studies have underestimated the sensitivity of CEO turnover to performance.

Table A1: Implied cumulative turnover probabilities for years 1-5 of CEO tenure. The table shows cumulative turnover probabilities over tenure years 1-5 for 5000 simulated CEOs, as a function of their performance over the same period. CEOs are fired each year with incremental probability p if their firms' average monthly return in the prior year is in the bottom quintile. Otherwise, the CEO stays in office for another year. The implied cumulative turnover probabilities are shown for different values of the incremental turnover probability p.

Performance quintile over years 1-5	Incremental turnover probability p (per year)				
	4%	8%	12%	16%	20%
1 (low)	0.12	0.22	0.31	0.39	0.46
2	0.05	0.10	0.14	0.19	0.25
3	0.03	0.05	0.08	0.12	0.15
4	0.02	0.03	0.04	0.05	0.07
5 (high)	0.01	0.01	0.02	0.03	0.03
Spread 1-5	0.11	0.21	0.29	0.36	0.43

Appendix 2: The Parrino (1997) classification algorithm

Some of our analyses in Section 5 use a procedure similar to that in Parrino (1997) to identify forced turnovers. This algorithm classifies CEO departures as forced or voluntary based on information in departure announcements and press reports, and all voluntary departures are included in the panel as non-events. The classification algorithm consists of three steps. First, all cases in which the press reports that a CEO is forced out, fired, ousted, or leaves due to policy differences or pressure are classified as forced. Second, all cases not classified as forced and with a CEO under the age of 60 are reviewed and reclassified as forced if (1) the stated departure reason is not death, poor health, or acceptance of another position, or (2) the CEO is retiring but does not announce the retirement at least six months before the departure. Third, all cases classified as forced in the previous step are investigated again and reclassified as voluntary if the press convincingly explains that the CEO is leaving for personal or business reasons unrelated to the firm's activities, or if the CEO remains or becomes chairman of the board after her resignation.

Appendix 3: Identifying performance-induced turnovers

This paper identifies *performance-induced turnovers* as turnovers in excess of the turnover rate for the best-performing CEOs. Concretely, we calculate the implied turnover rate for the best-performing CEOs separately for every tenure year. We then use this turnover rate as benchmark for all other CEOs. Any *additional* turnovers observed at lower levels of performance are interpreted as *performance-induced*.

This appendix demonstrates this calculation for CEOs sorted on their tenure performance over the first five years of tenure. Tenure performance is defined as the average industry-adjusted stock return from tenure start to the end of tenure-year five, or up to the CEO's departure if the CEO leaves before the end of year five.

Sorting all CEOs on their five-year tenure performance, we identify the best performers as CEOs with performance in the top quintile (Q5). From Table 2, we know that 17% of these top performers have left by the end of year five. The corresponding year-by-year turnover rates (or hazard rates) for the top performers are:

Benchmark turnover rates:

	Tenure Years				
	1	2	3	4	5
Q5	0.00	0.01	0.01	0.06	0.09

Multiplying these annual hazard rates by each other results in a total turnover rate of 17% after five years.[25] We interpret these departures as *not* caused by (bad) performance, and use these departure rates as the benchmark for all other CEOs. The year-by-year departure rates for all five performance levels are:

Total turnover rates:

	Tenure Years				
	1	2	3	4	5
Q1	0.08	0.21	0.24	0.17	0.11
Q2	0.07	0.13	0.08	0.16	0.22
Q3	0.07	0.04	0.05	0.08	0.08
Q4	0.02	0.05	0.06	0.04	0.05
Q5	0.00	0.01	0.01	0.06	0.09

[25] The five year survival probability is (1-0.00)*(1-0.01)*(1-0.01)*(1-0.06)*(1-0.09) = 0.83 = 1 – 17%.

Benchmarking against the best performers in quintile 5 yields the *performance-induced* turnover rates:

Performance-induced turnover rates:

	Tenure Years				
	1	2	3	4	5
Q1	0.08	0.20	0.23	0.10	0.02
Q2	0.07	0.11	0.07	0.10	0.13
Q3	0.06	0.03	0.04	0.01	0.00
Q4	0.02	0.04	0.05	0.00	0.00
Q5	0.00	0.00	0.00	0.00	0.00

By assumption, there are no performance-induced turnovers in the top performance quintile (Q5). The performance-induced turnover rates in all other quintiles are calculated by taking the total turnover rate and subtracting the turnover rate observed for the top performers. If the benchmark turnover rate in the top quintile exceeds the turnover rate in any other quintile, then the performance-induced turnover rate for that quintile is set to zero.[26]

Finally, we calculate the cumulative probability of a performance-induced turnover after 1, 2, 3, 4, and 5 years by multiplying this performance-induced turnover rate by the percentage of CEOs still in office at the beginning of the year, and summing the resulting annual turnover probabilities across years:

Cumulative performance-induced turnover probabilities:

	Tenure Years				
	1	1-2	1-3	1-4	**1-5**
Q1	0.08	0.26	0.43	0.49	**0.49**
Q2	0.07	0.17	0.23	0.30	**0.39**
Q3	0.06	0.09	0.13	0.14	**0.14**
Q4	0.02	0.06	0.10	0.10	**0.10**
Q5	0.00	0.00	0.00	0.00	**0.00**

The above table shows that, among CEOs who are in the bottom performance quintile over the first five tenure years, 26% have suffered a performance-induced turnover after 2 years, 43% after 3 years, and 49% after four years. The last column, which is the column

[26] This occurs, for example, in tenure year four for CEOs in performance quintile four: The total turnover rate is 4%, while the benchmark turnover rate for the top performers is 6%. Consequently, all turnovers in quintile 4 are interpreted as not performance-induced, and the performance-induced turnover rate is set to zero.

reported in Table 2 of the paper, shows the cumulative probability of a performance-induced turnover after five years of tenure as a function of tenure performance.

Appendix 4: Weighting past returns

CEO turnover regressions relate an indicator variable for CEO turnover to the CEO's performance history. We want to allow for the possibility that boards put more weight on more recent performance in their turnover decisions, while also permitting them to take the full performance history into account. Simply including separate explanatory variables for each past year of performance is problematic: The number of coefficients would become too large to estimate for long-tenured CEOs, and the number of coefficients would differ across CEOs with different tenures. Moreover, using separate performance variables for each year would ignore that their effects on CEO turnover should interact non-linearly, with, for example, several years of bad performance jointly reinforcing the board's conclusion that a CEO is not up to the job.

To partially address these problems, we summarize a CEO's performance history as a weighted average of past excess returns. The weighting function we estimate has been previously used by Nagel and Malmendier (2009) to summarize investors' macroeconomic experiences. It introduces only one additional parameter but is flexible enough to allow for constant, declining, and even increasing weights on more distant past performance. Specifically, for a CEO with tenure T in turnover decision period t, we calculate the following weighted average of past excess returns:

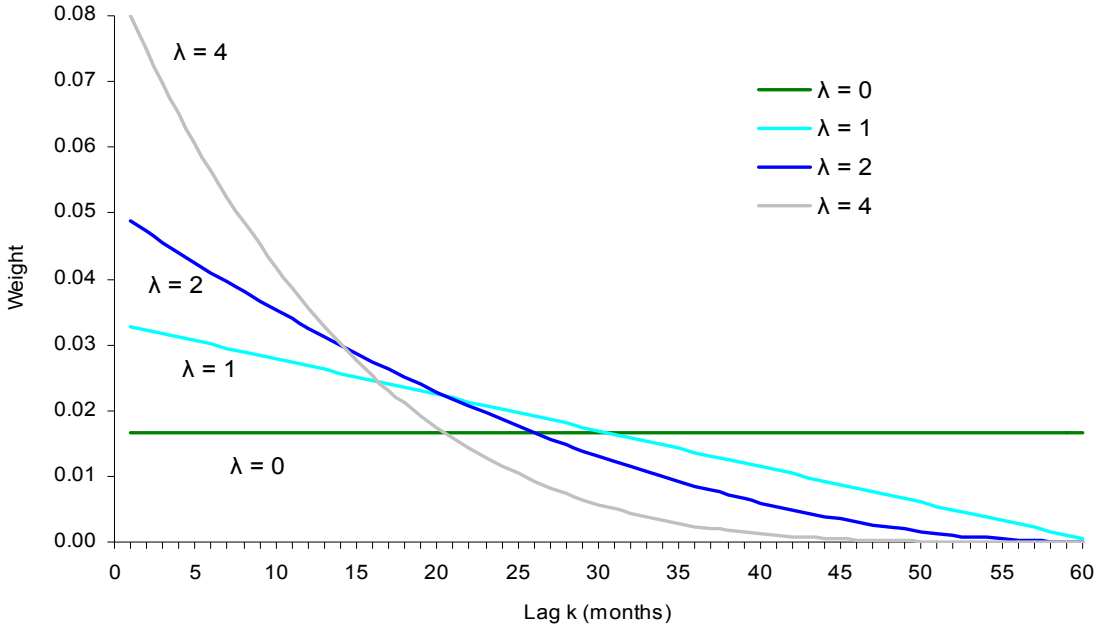
$$\text{Return}_{T,t}(\lambda) = \frac{\sum_{k=1}^{T-1} w_T(k,\lambda) R_{t-k}}{\sum_{k=1}^{T-1} w_T(k,\lambda)} \quad \text{where} \quad w_T(k,\lambda) = \left(\frac{T-k}{T}\right)^{\lambda} \qquad \text{(A1)}$$

The performance measure $\text{Return}_{T,t}(\lambda)$ is a weighted average of the monthly excess returns R_{t-k} from the CEO's start in office to one month before the turnover decision at time t. The slope of the weighting function is determined by the parameter λ, which we estimate from the observed CEO turnover decisions. A λ of zero implies that boards assign equal weights to all months, while higher λs imply more weight on more recent performance.

Figure A1 illustrates the weighting function for four values of λ and a performance history of five years (60 months). As the figure shows, the weighting function can flexible accommodate a wide range of shapes. For λ = 0, the weighting function is flat, resulting in an

equal weighted average. For $\lambda > 0$, the weights are decreasing in the lag k, and are concave for $\lambda < 1$, linear for $\lambda = 1$, and convex for $\lambda > 1$.

Figure A1: Weighting functions with a performance history of 60 months



8 References

Adams, Renée B. and Ferreira, Daniel, 2007, A theory of friendly boards. Journal of Finance 62, 217-250.

Boone, A, L., L. C. Field, J. M. Karpoff, and C. G. Raheja, 2007. The determinants of corporate board size and composition: An empirical analysis. Journal of Financial Economics 85. 66-101.

Brickley, James A., 2003, Empirical research on CEO turnover and firm-performance: A discussion. Journal of Accounting and Economics 36, 227-233.

Coles, J. L., N. D. Daniel, and Lalitha Naveen, 2008. Boards: does one size fit all? Journal of Financial Economics 87, 329-356.

Coughlan, Anne, and Ronald Schmidt, 1985, Executive compensation, management turnover, and firm performance: An empirical investigation. Journal of Accounting and Economics 7, 43-66.

Denis, David J., Diane K. Denis, and Atulya Sarin, 1997, Ownership structure and top executive turnover. Journal of Financial Economics 45, 193-222.

Eisfeldt, Andrea L., and Camelia M. Kuhnen, 2010, CEO turnover in a competitive assignment framework, Working Paper, Northwestern University.

Fama, E. and Jensen, M., 1983. Separation of ownership and control. Journal of Law and Economics 26. 301-325.

Gillan, S. L., J. C. Hartzell, and L. T. Starks, 2006. Tradeoffs in corporate governance: evidence from board structures and charter provisions. Working Paper, Texas Tech University and University of Texas.

Harris, M. and A. Raviv, 2008. A theory of board control and size. Review of Financial Studies, 21. 1797-1832.

Hadlock, Charles J., and Gerald B. Lumer, 1997, Compensation, turnover, and top management incentives: Historical evidence. Journal of Business 70, 153-187.

Hermalin, B. and M. Weisbach, 1998, Endogenously chosen boards of directors and their monitoring of the CEO. American Economic Review 88, 96-118.

Hermalin, B. and M. Weisbach, 2003, Boards of directors as an endogenously determined institution: A survey of the economic literature, Economic Policy Review, Federal Reserve Bank of New York, Issue April, 7-26.

Hirshleifer, David, and Anjan V. Thakor, 1994, Managerial performance, boards of directors and takeover bidding. Journal of Corporate Finance 1, 63-90.

Hirshleifer, David, and Anjan V. Thakor, 1998, Corporate control through board dismissals and takeovers. Journal of Economics and Management Strategy 7, 489-520.

Huson, Mark R., Robert Parrino, and Laura T. Starks, 2001, Internal monitoring mechanisms and CEO turnover: A long term perspective. Journal of Finance 56, 2265-2297.

Jensen, M., 1993. The modern industrial revolution, exit and the failure of internal control systems. Journal of Finance 48, 831-880.

Jenter, Dirk, and Fadi Kanaan, 2008, CEO turnover and relative performance evaluation. Working Paper, Stanford University.

Kaplan, Steven N., and Bernadette A. Minton, 2006, How has CEO turnover changed? Increasingly performance sensitive boards and increasingly uneasy CEOs. Working Paper, University of Chicago.

Linck, James S., Jeffry M. Netter, and Tina Yang, 2008. The Determinants of board structure. Journal of Financial Economics 87, 308-328.

Malmendier, Ulrike and Stefan Nagel, 2009. Depression Babies: Do Macroeconomic Experiences Affect Risk-Taking? NBER Working Paper Series, Vol. W14813.

Masulis, R. W. and Mobbs, S., 2009. Are all inside directors the same? Do they entrench CEOs or facilitate more informed board decisions. Working Paper, Vanderbilt University and University of Alabama.

Mikkelson, Wayne H., and M. Megan Partch, 1997, The decline of takeovers and disciplinary managerial turnover. Journal of Financial Economics 44, 205-228.

Morck, Randall, Andrei Shleifer, and Robert W. Vishny, 1989, Alternative mechanisms for corporate control. The American Economic Review 79, 842-852.

Murphy, Kevin J., 1999, Executive compensation. In Orley Ashenfelter and David Card (eds.), Handbook of Labor Economics Vol. 3b, Elsevier Science North Holland, Chapter 38: 2485-2563.

Parrino, Robert, 1997. CEO turnover and outside succession: A cross-sectional analysis. Journal of Financial Economics 46, 165-197.

Perry, Todd, 1999, Incentive compensation for outside directors and CEO turnover. Working Paper, Arizona State University.

Peters, Florian S. and Alexander F. Wagner, 2009. The executive turnover risk premium. Swiss Finance Institute Research Paper No. 08-11.

Powers, Eric A., 2005, Interpreting logit regressions with interaction terms: An application to the management turnover literature. Journal of Corporate Finance 11, 504-522.

Raheja, C., 2005. Determinants of board size and composition: a theory of corporate boards. Journal of Financial and Quantitative Analysis 40, 283-306.

Salancik, Gerald R., and Jeffrey Pfeffer, 1980, Effects of ownership and performance on executive tenure in U.S. corporations. Academy of Management Journal 23, 653-664.

Taylor, Lucian A., 2008, Why are CEOs rarely fired? Evidence from structural estimation. Working paper, University of Pennsylvania.

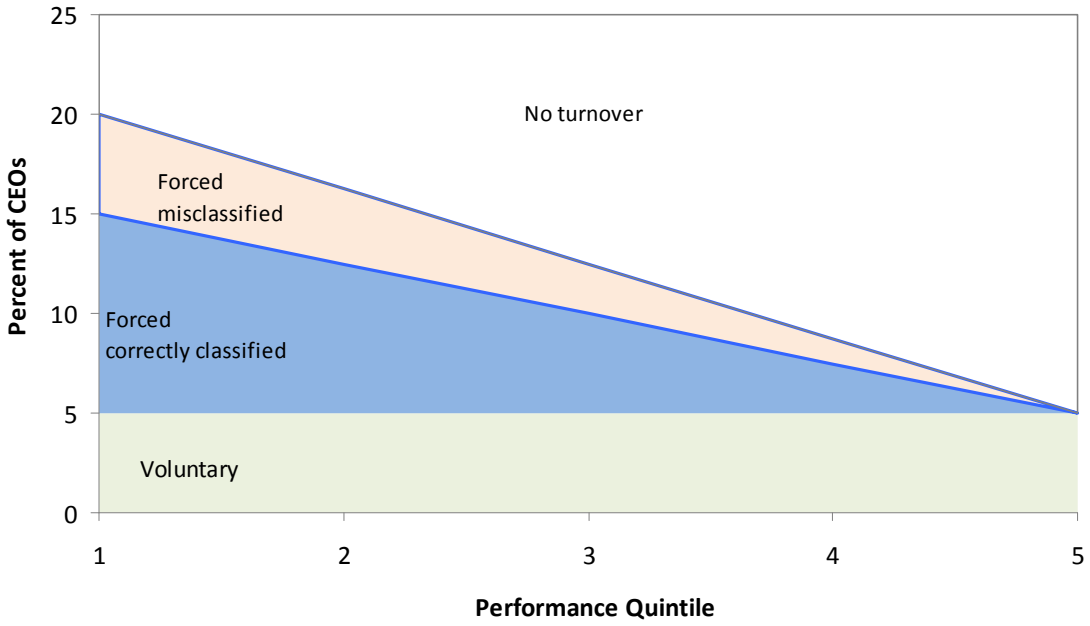
Warner, Jerold B., Ross L. Watts, and Karen H. Wruck, 1988, Stock prices and top management changes. Journal of Financial Economics 20, 461-492.

Warther, Vincent A., 1998, Board effectiveness and board dissent: A model of the board's relationship to management and shareholders. Journal of Corporate Finance 4, 53-70.

Weisbach, Michael S., 1988, Outside directors and CEO turnover. Journal of Financial Economics 20, 431-460.

Yermack D., 1996. Higher market valuation of companies with a small board of directors. Journal of Financial Economics 40, 185-211.

Fig. 1. Potential biases in the estimated turnover-performance slopes. The figures show examples of biases in the estimated relation between forced turnover and performance. In both figures, voluntary turnover is independent of performance and occurs with 5% probability. In the top figure, the difference in firing probabilities between the top and the bottom quintiles is 15%, but one-third of forced turnovers in every quintile are misclassified as voluntary. This results in a 5 percentage point reduction in the estimated turnover-performance slope (from 15% to 10%). In the bottom figure, some of the CEOs who depart voluntarily would have been fired for performance had they attempted to stay. As a result, the estimated turnover-performance slope of 14.25% underestimates the true willingness of the board to fire badly performing CEOs by 5 percent.



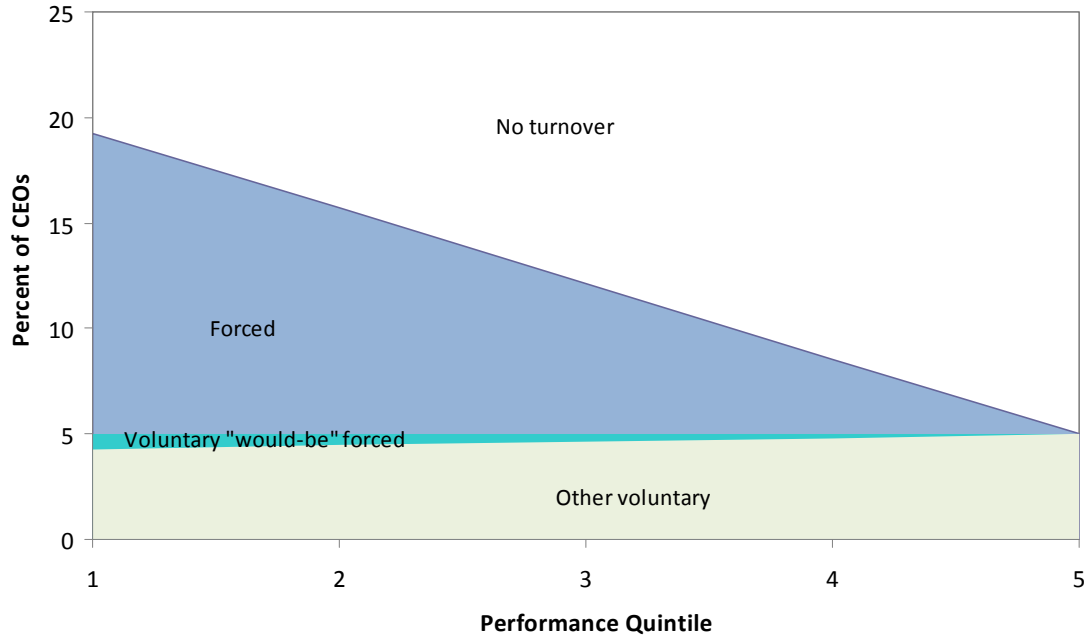


Fig. 2. Cumulative turnover probabilities for firms sorted by CEO tenure performance. The top panel shows the cumulative probability that a CEO departs before the end of her first, second, third, etc. year after taking office. The bottom panel shows the cumulative probability that a CEO who is still in office at the end of her sixth year departs before the end of her eights, ninths, etc. year. The probabilities are calculated from the regression coefficients in Table 2, with all control variables evaluated at their means. Each tenure year, CEOs are sorted into quintiles based on their tenure performance. The performance for a given year is the average monthly industry-adjusted stock return from the beginning of tenure (top panel) or the beginning of tenure year 7 (bottom panel) through the end of that year, or through the month preceding the CEO's departure, whichever comes first.

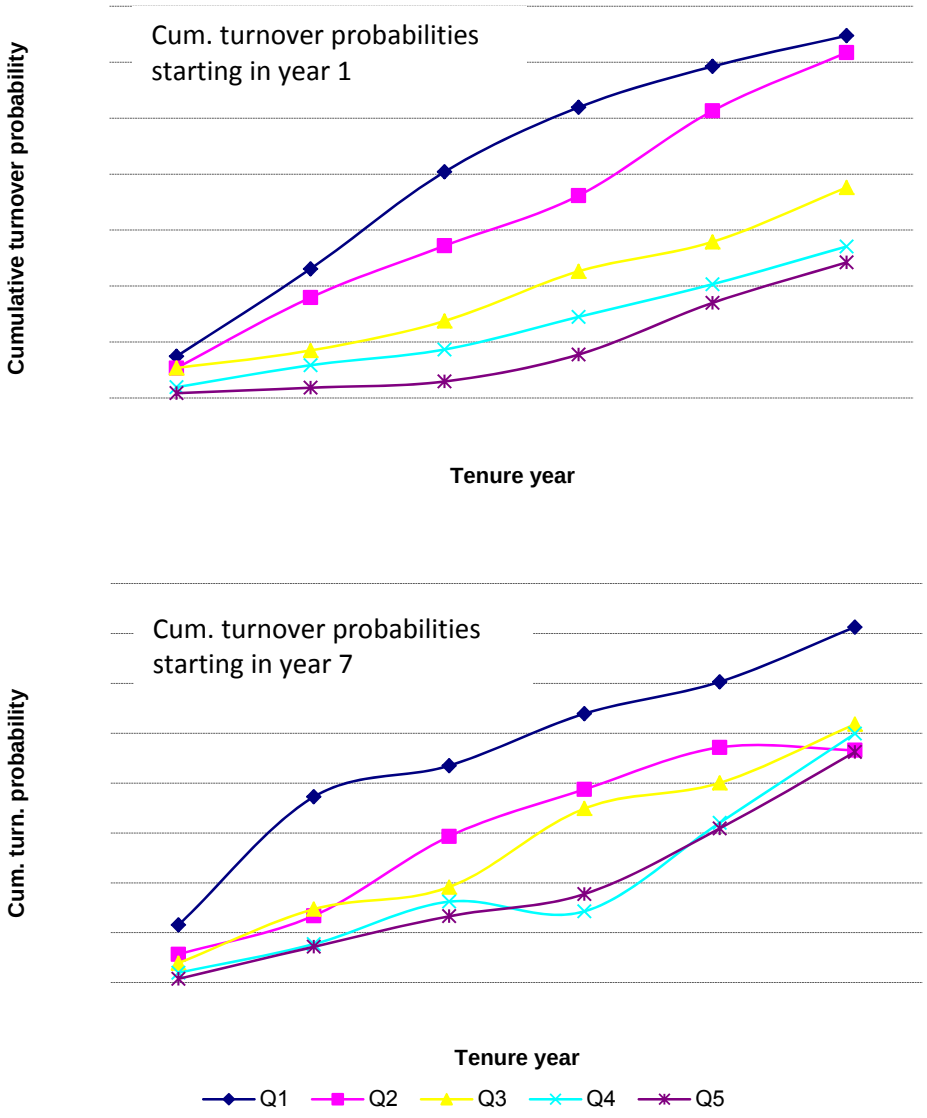


Fig. 3. Cumulative turnover probability for firms sorted by CEO tenure performance and board quality. The figure shows the implied cumulative probabilities of CEO turnover during tenure years 1-4, 1-5, and 1-6 by performance quintile for firms with weak and strong boards (the full regression results for years 1-5 are reported in Table 4). Firms are sorted into quintiles based on their abnormal stock return performance during tenure years 1-4, 1-5, and 1-6, respectively. See Table 4 for details of the estimation.

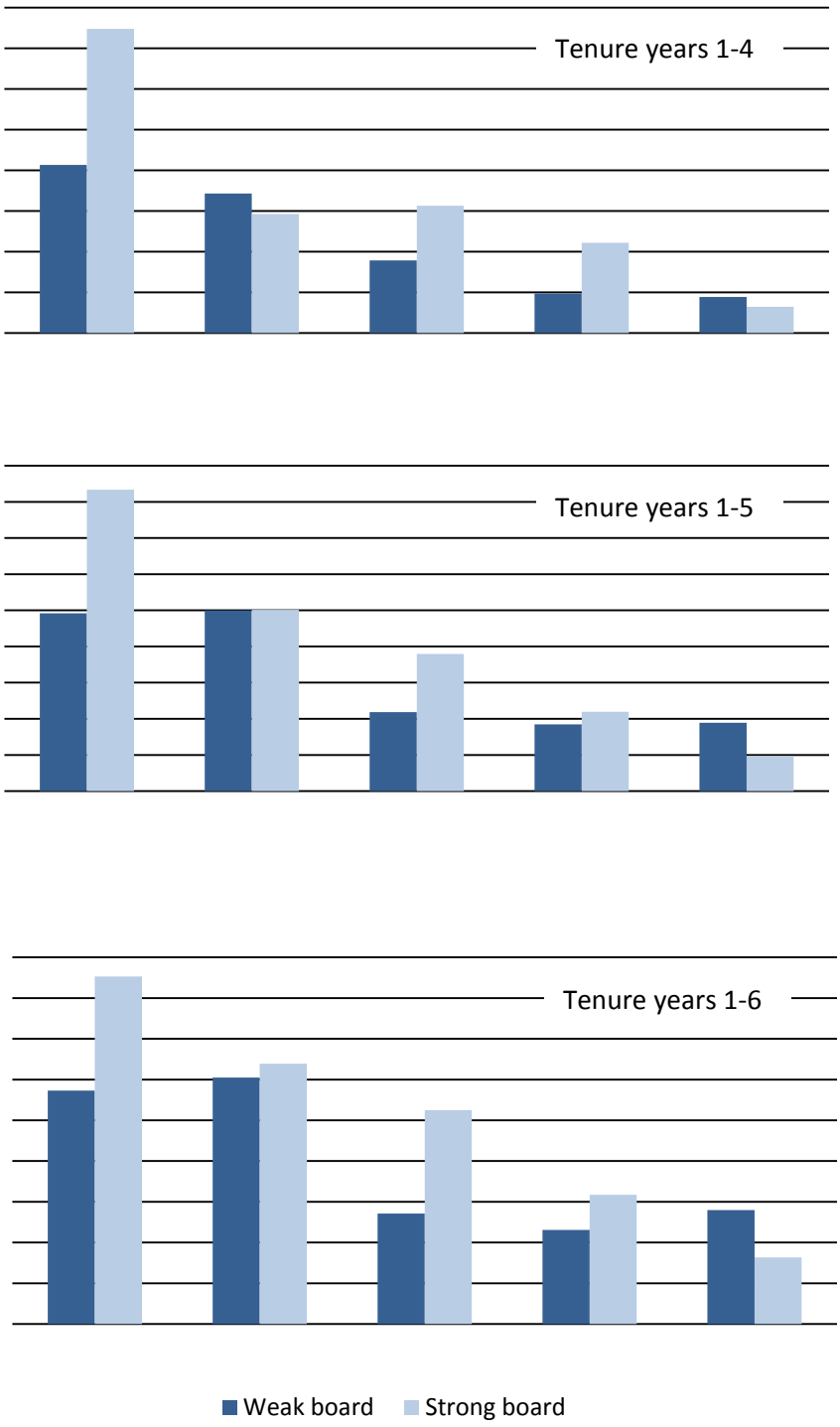


Table 1: Descriptive statistics. The sample consists of 2,569 firms on ExecuComp from 1992 to 2004 with 4,527 CEOs and 23,108 CEO-years. Total assets are in $ millions. B/M is the ratio of the book value to the market value of common stock. DIVIDEND is a dummy variable equal to one if the firm pays dividends. INSIDER is a dummy variable equal to one if the board is insider dominated, i.e., if at least 50% of directors are insiders. BOARD SIZE is the number of directors on the board. DIR OWN is the percentage of the firm's shares owned by non-executive directors. BOARD is a board quality index, with higher values for stronger boards. All variables are for the fiscal year two years before the CEO-year.

	Mean	Std	P1	Median	P99	N
Panel A: All firms						
Total assets	7,321	33,715	12	869	117,323	23,108
DIVIDEND	0.59	0.49	0.00	1.00	1.00	22,500
B/M	0.58	0.43	0.05	0.48	2.45	21,627
INSIDER	0.11	0.31	0.00	0.00	1.00	16,553
BOARD SIZE	8.96	2.92	4.00	9.00	17.00	16,553
DIR OWN	0.01	0.04	0.00	0.00	0.18	16,093
BOARD	1.70	0.68	0.00	2.00	3.00	16,093
Panel B: BOARD INDEX = 0 or 1[*]						
Total assets	7,338	24,411	33	1,663	87,560	6,435
DIVIDEND	0.71	0.45	0.00	1.00	1.00	6,345
B/M	0.55	0.41	0.05	0.45	2.18	6,309
INSIDER	0.22	0.42	0.00	0.00	1.00	6,439
BOARD SIZE	10.95	3.01	3.00	11.00	18.00	6,439
DIR-OWN	0.00	0.01	0.00	0.00	0.01	6,439
BOARD	0.97	0.17	0.00	1.00	1.00	6,439
Panel C: BOARD INDEX = 2						
Total assets	1,258	3,407	19	424	14,152	7,839
DIVIDEND	0.42	0.49	0.00	0.00	1.00	7,763
B/M	0.53	0.42	0.05	0.43	2.27	7,591
INSIDER	0.04	0.20	0.00	0.00	1.00	7,844
BOARD SIZE	7.78	2.09	4.00	8.00	14.00	7,844
DIR OWN	0.01	0.04	0.00	0.00	0.15	7,844
BOARD	2.00	0.00	2.00	2.00	2.00	7,844
Panel D: BOARD INDEX = 3						
Total assets	560	1,909	11	211	5,479	1,810
DIVIDEND	0.37	0.48	0.00	0.00	1.00	1,789
B/M	0.49	0.40	0.05	0.39	2.23	1,782
INSIDER	0.00	0.07	0.00	0.00	0.00	1,810
BOARD SIZE	7.32	1.41	4.00	7.00	9.00	1,810
DIR OWN	0.05	0.07	0.01	0.03	0.38	1,810
BOARD	3.00	0.00	3.00	3.00	3.00	1,810

[*] In this category, the vast majority of observations (6,232 out of 6,435) have BOARD INDEX = 1.

Table 2: Regressions of cumulative CEO turnover on performance. In Panel A, each column shows a probit model with the dependent variable equal to one if the CEO leaves office at any time during tenure years 1-2 (first column), tenure years 1-3 (second column), etc. Panel B shows similar regressions for tenure years 7-8 through 7-12. DIVIDEND, ASSETS, and B/M are measured two years before the start of the observation period, i.e. before tenure year 1 in Panel A and before tenure year 7 in Panel B. DIVIDEND is a dummy variable equal to one if the firm pays dividends. ASSETS is the natural logarithm of total book assets in $ million. B/M is the ratio of the book value to the market value of common stock. ROA is the average return on assets for the three years preceding the start of the observation period. PRIOR RET is the average industry-adjusted monthly return over the two years preceding the observation period. BOARD is a board quality index, with higher values indicating stronger boards. In Panel A, it is measured in tenure year -2 if available, and otherwise in tenure years -1 or -3 (in that order). In Panel B, it is measured in tenure year 5 if available, and otherwise in tenure years 6 or 4 (in that order). RETRANK is a set of quintile dummies for the CEO's stock return performance during the observation period. For example, for the observation period 1-2 in the first column, the return is computed as the average monthly industry-adjusted return from the beginning of tenure through the end of tenure year 2, or through the month preceding the departure month, whichever comes first. Each observation period return is scaled by its standard error. The regressions include two age dummy variables, one for CEOs who are 55-59 in tenure year 1 (7), and one for CEOs who are 50-54 in tenure year 1 (7). CEOs who are 60 or older in tenure year 1 (7) are excluded. P-values are in parentheses.

Table 2: Regressions of cumulative CEO turnover on performance.

		Panel A: Tenure years 1-6					Panel B: Tenure years 7-12				
		1-2	1-3	1-4	1-5	1-6	7-8	7-9	7-10	7-11	7-12
Intercept		-2.04	-2.09	-1.41	-1.40	-1.26	-1.81	-1.27	-1.25	-0.35	-0.36
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.01)	(0.47)	(0.46)
DIV		-0.30	-0.40	-0.37	-0.40	-0.40	-0.28	-0.18	-0.18	-0.17	-0.15
		(0.03)	(0.00)	(0.00)	(0.00)	(0.00)	(0.19)	(0.36)	(0.36)	(0.35)	(0.44)
B/M		-0.24	-0.22	-0.37	-0.05	0.11	-0.01	-0.05	-0.33	-0.39	-0.61
		(0.31)	(0.29)	(0.06)	(0.77)	(0.52)	(0.97)	(0.86)	(0.27)	(0.17)	(0.04)
ASSETS		-0.03	-0.01	-0.02	0.02	0.03	0.12	0.06	0.13	0.08	0.13
		(0.53)	(0.78)	(0.54)	(0.63)	(0.36)	(0.07)	(0.30)	(0.02)	(0.16)	(0.02)
ROA		0.96	0.81	0.69	1.15	0.96	-0.49	-0.05	-0.08	-0.01	-0.02
		(0.05)	(0.08)	(0.12)	(0.01)	(0.02)	(0.41)	(0.93)	(0.88)	(0.99)	(0.97)
PRIOR RET		-2.75	-4.84	-3.91	-4.24	-5.21	-7.18	-4.56	-6.45	-2.87	-2.46
		(0.27)	(0.04)	(0.07)	(0.04)	(0.01)	(0.06)	(0.17)	(0.05)	(0.36)	(0.45)
BOARD		0.17	0.25	0.19	0.15	0.12	-0.04	-0.08	-0.12	-0.24	-0.20
		(0.07)	(0.01)	(0.02)	(0.06)	(0.15)	(0.77)	(0.55)	(0.36)	(0.06)	(0.13)
RETRANK	1	1.35	1.65	1.47	1.19	1.08	1.14	0.95	1.02	0.76	0.66
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
RETRANK	2	1.17	1.28	1.07	0.99	1.00	0.35	0.57	0.64	0.43	0.01
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.28)	(0.05)	(0.02)	(0.10)	(0.97)
RETRANK	3	0.72	0.80	0.67	0.37	0.38	0.41	0.24	0.54	0.25	0.14
		(0.01)	(0.00)	(0.00)	(0.04)	(0.03)	(0.21)	(0.41)	(0.05)	(0.34)	(0.59)
RETRANK	4	0.52	0.53	0.36	0.12	0.09	0.04	0.13	-0.14	0.03	0.09
		(0.07)	(0.04)	(0.08)	(0.50)	(0.62)	(0.92)	(0.67)	(0.64)	(0.91)	(0.73)
N (Non-ev.)		667	587	504	432	370	263	229	197	163	132
N (Event)		97	144	195	245	292	56	80	103	126	149
Cumulative turnover probabilities in abnormal return quintile (RETRANK):											
1 (low)		0.23	0.40	0.52	0.59	0.65	0.37	0.43	0.54	0.60	0.71
2		0.18	0.27	0.36	0.51	0.62	0.13	0.29	0.39	0.47	0.47
3		0.08	0.14	0.23	0.28	0.38	0.15	0.19	0.35	0.40	0.52
4		0.06	0.09	0.14	0.20	0.27	0.08	0.16	0.14	0.32	0.50
5 (high)		0.02	0.03	0.08	0.17	0.24	0.07	0.13	0.18	0.31	0.46
Spread 1 – 5		0.21	0.37	0.44	0.42	0.41	0.30	0.30	0.36	0.29	0.25

Table 3: Implied performance-induced turnovers

Performance-induced turnovers are identified as turnovers in excess of the turnover rate for the best-performing CEOs. We first calculate the implied turnover rate for the best-performing (quintile 1) CEOs separately for every tenure year, based on the cumulative CEO turnover regressions in Table 2. We then use this year-by-year turnover rate as benchmark for all other CEOs in quintiles 2 to 5. Any *additional* turnovers observed at lower levels of performance are interpreted as *performance-induced*. The cumulative performance-induced turnovers are calculated by applying the annual performance-induced turnover rate to the percentage of CEOs still in office at the beginning of the respective year, and summing the resulting annual turnover probabilities across years. The procedure is explained in detail in Appendix 3.

	Panel A: Tenure years 1-6				
	1-2	1-3	1-4	1-5	1-6
Cumulative performance-induced turnover in abnormal return quintile:					
1 (low)	0.21	0.38	0.47	0.49	0.50
2	0.16	0.24	0.29	0.38	0.45
3	0.06	0.11	0.16	0.14	0.16
4	0.04	0.06	0.09	0.10	0.10
5 (high)	0	0	0	0	0

	Panel B: Tenure years 7-12				
	7-8	7-9	7-10	7-11	7-12
Cumulative performance-induced turnover in abnormal return quintile:					
1 (low)	0.30	0.33	0.41	0.41	0.52
2	0.07	0.16	0.23	0.19	0.15
3	0.08	0.09	0.18	0.14	0.18
4	0.01	0.05	0.02	0.07	0.10
5 (high)	0	0	0	0	0

Table 4: Regressions of cumulative CEO turnover on performance: the effect of board quality by performance quintile. The table shows probit regressions of cumulative CEO turnover on tenure performance for tenure years 1-5. The dependent variable is equal to one if the CEO leaves office during tenure years 1-5. Five separate regressions are shown, one for each quintile of performance. Tenure performance is measured as the average monthly industry-adjusted return from tenure year 1 through 5, or through the month preceding the departure, whichever comes first. Each return is scaled by its standard error. The control variables are defined in Table 2. P-values are in parentheses. At the bottom of the table, we report for each performance quintile the implied cumulative turnover probabilities over tenure years 1-5 for firms with high and low quality boards.

	Tenure Performance Quintile 1	Tenure Performance Quintile 2	Tenure Performance Quintile 3	Tenure Performance Quintile 4	Tenure Performance Quintile 5
Intercept	-1.25	0.46	-0.59	-1.05	-1.34
	(0.12)	(0.56)	(0.47)	(0.19)	(0.13)
DIVIDEND	-1.02	-0.16	-0.44	-0.22	0.12
	(0.00)	(0.54)	(0.11)	(0.46)	(0.71)
B/M	0.61	-0.32	-0.76	-0.61	0.48
	(0.24)	(0.45)	(0.15)	(0.28)	(0.18)
ASSETS	0.07	-0.05	-0.01	0.05	0.01
	(0.41)	(0.53)	(0.89)	(0.61)	(0.91)
ROA	1.70	0.68	1.42	1.35	-0.62
	(0.15)	(0.49)	(0.14)	(0.15)	(0.62)
PRIOR RET	-7.36	-5.48	0.53	-5.31	-7.45
	(0.17)	(0.24)	(0.90)	(0.33)	(0.18)
BOARD	0.49	0.00	0.23	0.06	-0.21
	(0.01)	(0.99)	(0.21)	(0.77)	(0.40)
N (Non-ev.)	57	74	97	101	103
N (Event)	80	74	40	28	23
Cumulative turnover probabilities for high and low quality boards:					
BOARD=1 (low)	0.49	0.50	0.22	0.18	0.19
BOARD=3 (high)	0.83	0.50	0.38	0.22	0.10
Spread 3–1	0.34	0.00	0.16	0.03	-0.09

Table 5: Year-by-year regressions of CEO turnover on firm performance: Comparison with the literature. The table shows year-by-year probit regressions of CEO turnover on prior firm performance. The unit of observation is a CEO-year, and the dependent variable equals one if the CEO departs in the given year. The regressions differ with respect to the definition of forced turnover and the performance measure: *Forced.* indicates that turnovers are classified as forced or voluntary using the Parrino (1997) algorithm, and the regression estimates the probability of a forced turnover. Voluntary turnovers are included as non-events. *P-induced.* indicates that the regression estimates the probability of any turnover event included in the panel, i.e. it treats all events as potentially performance-induced. We exclude interim CEOs, CEOs that die or depart for health reasons, and years in which the CEO is over 65. *One (3/5) year* indicates that performance is measured as the equal-weighted industry-adjusted monthly return over the 12 (36/60) months preceding the turnover decision. *Linear* indicates that the actual return (rather than return quintiles) is included in the regression. The implied turnover probabilities for different performance quintiles are then calculated at the average return for each quintile. *Nonlinear* indicates that return quintile dummies are included in the regressions. P-values are in parentheses.

Table 5: Regressions of CEO turnover on performance: Comparison with the literature

		Forced, 1 year, linear	Forced, 1 year, nonlinear	P-induced, 1 year, nonlinear	P-induced, 3 year, nonlinear	P-induced, 5 year, nonlinear
Intercept		-1.44	-1.72	-1.81	-1.79	-1.86
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
DIVIDEND		-0.25	-0.23	-0.12	-0.14	-0.17
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
B/M		0.05	0.04	-0.06	-0.13	-0.16
		[0.37]	[0.48]	[0.13]	[0.00]	[0.00]
LN(ASSETS)		0.06	0.06	0.07	0.06	0.07
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
ROA		-0.51	-0.55	-0.31	-0.23	-0.18
		[0.00]	[0.00]	[0.00]	[0.04]	[0.10]
BOARD		0.04	0.03	0.02	0.03	0.04
		[0.33]	[0.39]	[0.31]	[0.17]	[0.07]
LN(TENURE)		-0.18	-0.18	-0.03	-0.02	0.00
		[0.00]	[0.00]	[0.15]	[0.43]	[0.97]
RETRANK	1		0.77	0.55	0.56	0.56
			[0.00]	[0.00]	[0.00]	[0.00]
RETRANK	2		0.35	0.19	0.24	0.32
			[0.00]	[0.00]	[0.00]	[0.00]
RETRANK	3		0.03	0.10	0.18	0.17
			[0.77]	[0.06]	[0.00]	[0.00]
RETRANK	4		0.01	0.02	0.01	0.00
			[0.87]	[0.77]	[0.92]	[0.93]
RETURN		-8.15				
		[0.00]				
N (Non-event)		12,418	12,418	11,598	11,598	11,598
N (Event)		422	422	1,296	1,296	1,296
Yearly turnover probabilities in abnormal return quintile (RETRANK):						
1 (low)		0.053	0.069	0.168	0.168	0.166
2		0.030	0.028	0.094	0.099	0.113
3		0.024	0.013	0.080	0.088	0.087
4		0.018	0.012	0.068	0.064	0.063
5 (high)		0.008	0.012	0.066	0.064	0.063
Spread 1-5		0.045	0.057	0.102	0.105	0.103

Table 6: Year-by year regressions of CEO turnover on *optimally-weighted* past performance for different sub-periods of CEO tenure. The table shows year-by-year probit regressions of annual CEO turnover on prior firm performance. The unit of observation is a CEO-year, and the dependent variable equals one if the CEO departs in the given year. The sample includes CEOs who were in office between 1992 and 2005, and CEOs who started before 1992 are included. RETRANK is a set of quintile dummies for CEO performance. Performance is measured as the weighted-average industry-adjusted monthly return since the beginning of the CEO's tenure. Weighted-average performance is calculated using the weighting function described in Section 5.3 and Appendix 4, and the weighting parameter LAMBDA is estimated from the data. A higher LAMBDA means more weight on more recent performance and less weight on the more distant past. The other independent variables are constructed as in Table 2, except that DIVIDEND, B/M, ASSET, and BOARD are measured two years before the current year, and ROA is the average ROA for the three years preceding the current year. P-values are in parentheses.

		Tenure Years 1 and 2	Tenure Years 3, 4, and 5	Tenure Years 6, 7, 8, and 9	Tenure Years > 9
Intercept		0.29	2.49	2.74	0.90
		[0.43]	[0.00]	[0.00]	[0.23]
DIVIDEND		-0.44	-0.23	-0.03	-0.03
		[0.00]	[0.00]	[0.66]	[0.62]
B/M		-0.10	-0.09	-0.05	-0.21
		[0.32]	[0.27]	[0.51]	[0.03]
LN(ASSETS)		0.04	0.04	0.08	0.08
		[0.13]	[0.03]	[0.00]	[0.00]
ROA		0.28	-0.30	-0.28	-0.19
		[0.30]	[0.11]	[0.20]	[0.43]
BOARD		0.09	0.09	0.04	-0.10
		[0.13]	[0.08]	[0.46]	[0.04]
LN(TENURE)		-0.83	-1.17	-1.06	-0.5
		[0.00]	[0.00]	[0.00]	[0.00]
RETRANK	1	0.78	0.80	0.59	0.44
		[0.00]	[0.00]	[0.00]	[0.00]
RETRANK	2	0.21	0.41	0.04	0.22
		[0.12]	[0.00]	[0.67]	[0.03]
RETRANK	3	-0.09	0.33	0.13	0.19
		[0.55]	[0.00]	[0.23]	[0.06]
RETRANK	4	0.01	0.22	0.02	-0.19
		[0.91]	[0.04]	[0.83]	[0.07]
LAMBDA		0.902	1.353	1.952	1.962
N (Non-event)		2,425	3,341	2,871	2,972
N (Event)		209	347	391	350
Yearly turnover probabilities in abnormal return quintile (RETRANK):					
1 (low)		0.15	0.17	0.20	0.15
2		0.05	0.09	0.08	0.11
3		0.03	0.08	0.10	0.10
4		0.04	0.06	0.08	0.05
5 (high)		0.04	0.04	0.08	0.07
Spread 1-5		0.12	0.13	0.13	0.08

Table 7: Simulated turnover probabilities for homogenous and heterogeneous samples. The homogenous sample consists of 5000 CEOs in their first five years of tenure. The board fires a CEO at the end of each year with probability p=16% (or 20%) if the firm's average stock return over the preceding 12 months is in the bottom quintile. The heterogeneous sample consists of three groups of 5000 CEOs. Each group is associated with a different type of board. Type B1 board is the same as in the homogenous sample. Types B2 and B3 boards are similar except that they evaluate CEOs based on 24 and 36 months of return performance, respectively. The standard model estimates the annual probability of turnover for CEOs sorted into quintiles based on the average monthly return for the preceding 12 months. The cumulative model estimates the cumulative probability of turnover in years 1-5 for CEOs sorted into quintiles based on the average monthly return during the entire tenure (the mans as scaled by their standard errors to account for differences in tenure length across CEOs). The details of the simulation are in Appendix 1.

Performance quintile	Standard model				Cumulative model			
	Homogenous sample		Heterogeneous sample		Homogenous sample		Heterogeneous sample	
	16%	20%	16%	20%	16%	20%	16%	20%
1 (low)	0.16	0.21	0.09	0.12	0.39	0.46	0.36	0.43
2	0.00	0.00	0.02	0.02	0.19	0.25	0.15	0.19
3	0.00	0.00	0.01	0.01	0.12	0.15	0.06	0.08
4	0.00	0.00	0.00	0.00	0.05	0.07	0.03	0.04
5 (high)	0.00	0.00	0.00	0.00	0.03	0.03	0.01	0.01
Spread 1-5	0.16	0.21	0.09	0.12	0.36	0.43	0.35	0.42

Table 8: Differences in boards' use of historical returns in turnover decisions: The top panel shows implied probabilities of CEO turnover for quintiles 1-5 formed based on historical performance, RET(-2,-3), measured as the average industry adjusted monthly return for years t-2 and t-3. The probabilities are estimated using a probit model with the dependent variable equal to 1 if the CEO leaves office in year t. The model includes DIVIDEND, B/M, LN(ASSETS), ROA, LN(TENURE), BOARD, RET(-1), and three CEO age dummies as control variables, and the probabilities are estimated at the mean of all control variables. RET(-1) is the average industry-adjusted monthly return for year t-1. The table shows results for subsamples formed using four sorting variables. The BOARD subsamples LOW, MID, and HIGH are sets of firms with board index equal to 0 or 1, 2, and 3, respectively. For each of the remaining sorting variables, the LOW, MID, and HIGH subsamples are the first, the second and third (combined), and the fourth quartiles, respectively. PANEL B shows coefficients and t-statistics from a probit model similar to that in Panel A, but estimated on the HIGH and LOW subsamples combined. Each model includes two interaction terms of the return variables with an indicator equal to 1 if the sorting variable is HIGH, and equal to 0 if the sorting variable is LOW (high and low is defined as in Panel A). In addition to the variables shown in the table, the model also includes three CEO age dummies. T_marg are the t-statistics for the marginal interaction effects estimated at the mean of all control variables.

Panel A: Implied probabilities of CEO turnover for quintiles formed based on RET(-2,-3), estimated for different subsamples using a probit model

Sorting variable:	B/M			LN(ASSETS)			BOARD			RET(-1)		
RET(-2,-3) quintiles	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High
1 (low)	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.09	0.11	0.17	0.10	0.04
2	0.10	0.09	0.06	0.07	0.09	0.12	0.09	0.08	0.08	0.16	0.08	0.05
3	0.07	0.06	0.07	0.04	0.07	0.08	0.07	0.06	0.05	0.09	0.07	0.04
4	0.08	0.06	0.04	0.04	0.06	0.07	0.06	0.06	0.03	0.10	0.06	0.03
5 (high)	0.09	0.05	0.04	0.04	0.07	0.10	0.08	0.05	0.04	0.10	0.06	0.04
Spread 1-5	0.01	0.04	0.05	0.06	0.03	0.00	0.02	0.04	0.06	0.07	0.04	0.00

Panel B: Probit model of CEO turnover with interaction terms of returns with dummies for sorting variables in the top 25 percent

Sorting variable:	B/M			LN(ASSETS)			BOARD			RET(-1)		
Parameter	Coef.	T	T_marg	Coef.	T	T_marg	Coef.	T	T_marg	Coef.	T	T_marg
Intercept	-3.63	-11.04		-3.58	-8.38		-3.49	-11.81		-3.63	-10.13	
DIVIDEND	-0.33	-2.97		-0.46	-3.39		-0.37	-3.15		-0.47	-4.46	
B/M	0.06	0.31		-0.23	-1.64		-0.42	-3.01		-0.25	-1.95	
LN(ASSETS)	0.11	3.46		0.14	2.12		0.09	3.06		0.13	4.05	
ROA	-0.43	-1.43		-0.62	-1.92		-0.49	-1.22		-0.58	-1.67	
LN(TENURE)	-0.01	-0.14		0.03	0.40		0.04	0.57		-0.04	-0.57	
BOARD	0.05	0.68		-0.03	-0.36					0.11	1.39	
HIGH	-0.41	-1.89		-0.12	-0.37		-0.04	-0.27		-0.30	-1.23	
RET(-1)	-0.41	-7.66		-0.48	-7.24		-0.26	-5.32		-0.30	-3.47	
RET(-2,-3)	-0.06	-1.09		-0.31	-4.46		-0.13	-2.52		-0.26	-4.60	
HIGH *RET(-1)	0.11	1.18	1.42	0.26	2.82	3.00	-0.16	-1.44	-1.44	0.04	0.21	0.54
HIGH *RET(-2,-3)	-0.32	-3.08	-2.34	0.24	2.39	2.37	-0.25	-2.04	-1.88	0.18	1.80	2.15
N (Non-event)	5,263			4,951			5,376			5,463		
N (Event)	533			471			566			585		

Table 9: Cross-sectional regressions of stock returns on board quality. The dependent variable is the cumulative industry-adjusted stock return in fiscal year t, computed as the sum of monthly industry-adjusted stock returns. Industry returns are from the 49 equal-weighted industry portfolios on Ken French's website. STRONG BOARD is a dummy variable equal to 1 if the firm's governance index measured in t-2 (or t-1 or t-3 if the t-2 index is not available, in that order) is 3, and is equal to zero if the index is 1. CRISIS is a dummy variable equal to one if the firm's cumulative return in year t-2, defined at the top of each column, is in the lowest quintile for that year, and is equal to zero otherwise. SIZE is the market value of equity at the end of fiscal year t-1. BM is the book value of equity divided by the market value of equity at the end of fiscal year t-1. INV is the growth in assets in fiscal year t-1. ROA(-1) to ROA(-3) are the return on assets in fiscal years t-1 through t-3, where ROA is operating income before depreciation scaled by prior year assets. Fama and MacBeth (1973) t-statistics are in parentheses.

Dependent variable:	Cumulative industry adjusted return in year t		
CRISIS dummy formed using returns in t-2:	Raw returns	Industry adj. returns	Industry returns
Intercept	0.22	0.21	0.24
	(3.63)	(3.59)	(3.36)
STRONG BOARD	-0.01	0.00	-0.03
	(-0.53)	(-0.15)	(-1.09)
CRISIS	0.07	0.12	-0.03
	(0.57)	(1.08)	(-0.31)
CRISIS * STRONG BOARD	0.08	0.04	0.08
	(2.23)	(1.39)	(2.81)
CRISIS *SIZE	-0.01	-0.01	-0.01
	(-0.64)	(-0.71)	(-0.44)
CRISIS *BM	0.00	-0.02	0.04
	(-0.09)	(-0.25)	(1.33)
CRISIS *INV	-0.05	-0.08	0.05
	(-0.70)	(-1.11)	(0.71)
CRISIS *ROA(t-1)	-0.11	-0.20	0.04
	(-0.46)	(-1.08)	(0.18)
SIZE	-0.03	-0.03	-0.03
	(-3.87)	(-4.53)	(-3.97)
BM	0.02	0.05	0.06
	(1.02)	(1.51)	(1.93)
INV	-0.04	-0.05	-0.06
	(-2.37)	(-2.69)	(-3.61)
ROA(t-1)	0.38	0.45	0.43
	(3.99)	(3.72)	(5.88)
ROA(t-2)	-0.27	-0.21	-0.26
	(-2.35)	(-1.54)	(-2.24)
ROA(t-3)	-0.02	-0.11	-0.06
	(-0.28)	(-1.25)	(-0.66)
CUM. IND. ADJ. RETURN(t-1)	-0.02	-0.01	-0.01
	(-0.77)	(-0.37)	(-0.39)