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CEO tenure, the risk of termination and firm value☆

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ABSTRACT

We examine CEOs' risk of termination, its determinants and its effect on firm value. Using survival analysis, we find that the risk of termination increases for about thirteen years before decreasing slightly with CEO tenure; 82% of CEOs have tenure of less than thirteen years. We also find that tenure increases with performance and compensation and decreases with monitoring by the board. Changes in the risk of termination do not have a significant effect on firm value. Taken as a whole, our results are consistent with the view that corporate governance functions reasonably well for the vast majority of firms.

1. Introduction

One of the most important and difficult decisions a corporate board of directors must make is whether to terminate the chief executive officer. This decision is especially difficult if a CEO has served for a long time. There are two fundamental reasons why a CEO may have a long tenure in office. First, a CEO might have a history of taking actions that increase firm value, resulting in superior past firm performance even if recent performance has suffered. Second, a CEO might have a history of taking actions that make replacement more difficult but do not increase firm value.

Whether CEO tenure is determined by performance or by other considerations is an important issue in corporate governance. If corporate governance structures function well, then CEOs will be retained when they perform well and replaced when they perform poorly. Conversely, if governance structures function poorly, CEOs will not be replaced due to poor performance. One approach to examining whether governance functions well is to analyze the CEO's risk of termination. Some researchers argue that the risk of CEO termination eventually decreases as CEO tenure increases because CEOs gain power through investment choices or board selection (e.g., Shleifer and Vishny, 1989; Hermalin and Weisbach, 1998). Another line of finance theory, based on matching theory, concludes that the risk of termination first increases, then decreases with tenure because poorly matched CEOs leave the firm quickly while well-matched CEOs stay (e.g., Jovanovic, 1979a; Allgood and Farrell, 2003).

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There is little empirical research on the risk of termination, that is, the probability that a CEO will be terminated at a point in time, given the CEO has thus far remained employed, and how the risk of termination changes with tenure.[2] To address this issue, we use survival analysis to estimate the hazard function for CEO tenure.[3] This allows us to determine whether the risk of CEO termination increases or decreases with tenure. We also analyze the determinants of CEO tenure. The CEO power theory and matching theory both imply that the CEO's risk of termination will eventually decrease. However, these theories have different implications for how the decreasing risk of termination affects firm value. CEO power theory suggests that decreases in the risk of termination have a negative effect on firm value, while matching theory suggests decreases in the risk of termination will have a positive effect on firm value. Consequently, we empirically investigate whether firm value is higher or lower when the CEO's risk of termination is a decreasing function of tenure.

Prior studies that have used CEO turnover to understand corporate governance have relied on logit analysis (e.g., Denis et al., 1997; Denis and Kruse, 2000; Parrino et al., 2004). Survival analysis offers important advantages over logit analysis in handling key features of the data, namely, right censoring, time at risk, and time-varying covariates or explanatory variables. Right censoring occurs because not all CEOs have completed their employment at the end of the sample period; we simply do not know whether they will be involuntarily terminated. Logit studies of forced CEO turnover treat CEOs still in office at the end of the sample period as if they will not be involuntarily terminated, while survival analysis is explicitly designed to take account of censoring. Time at risk is not accounted for with logit analysis. Logit analysis uses a dichotomous dependent variable for whether the CEO is involuntarily terminated at any point in the study period. A CEO terminated after, say, ten years, is at risk during the first nine years of tenure; the fact that the CEO was not terminated in the first nine years is informative about the risk of termination. Shumway (2001) shows that cross-sectional logit is an inconsistent estimator of the probability of termination because it does not account for time at risk. In contrast, time at risk (tenure) is the dependent variable in survival analysis. Survival analysis can incorporate time-varying covariates. Survival analysis utilizes each CEO's time series data by including, for example, annual observations on compensation, ownership, firm performance and other firm characteristics.

The main objective of this paper is to investigate the relation between changes in the risk of termination and firm value. Our estimates show that the risk of termination increases until the manager has about thirteen years of tenure. About 82% of CEOs have tenure of less than thirteen years. We find the decrease in the risk of termination is not large – the hazard falls by about 9% from its peak by the end of the CEO's twenty-fifth year of tenure. Once other factors affecting value are controlled for, we find that the risk of termination does not have a significant effect on firm value. We also find performance matters – current and prior year stock returns are positively related to tenure. Managers that run poorly performing firms are more likely to be terminated. However, the effect of performance on expected tenure diminishes over time. Our results imply that new CEOs expected tenure is affected by the prior CEOs performance; new CEOs do not start with a "clean slate". Greater CEO compensation, stock ownership, age and the number of years the CEO has credited to his or her retirement plan increase expected tenure, while greater firm size, greater use of leverage and more frequent meetings by the board of directors decrease expected tenure.

The next section discusses models of the CEO termination decision. Section 3 discusses the sample. Section 4 provides a brief description of survival analysis. Section 5 describes the results of the hazard function. Section 6 analyzes the implications for firm value. Section 7 provides brief concluding remarks.

2. CEO tenure

In this section we investigate what prior research implies about the risk of termination and about the relation between the risk of termination and firm value.

Prior research suggests that the hazard function will eventually be downward sloping. Shleifer and Vishny (1989) argue that CEOs choose investments that they have a comparative advantage in managing. These investments may or may not increase firm value; their purpose is to make the incumbent CEO more valuable to the firm than potential replacements, reducing the probability the CEO will be replaced. Since it may take the CEO some time to implement these investment decisions, Schliefer and Vishny's analysis implies that the hazard function is eventually decreasing. Hermalin and Weisbach (1998) suggest that CEO negotiating power increases with tenure because the CEO has input into board member selection, resulting in less diligent monitoring by the board. This implies that CEOs with longer tenure will have a lower probability of termination. Almazan and Suarez (2003) argue that for some firms, it may be less costly to allow the CEO to extract private benefits than to provide explicit incentive compensation, especially when incentive compensation is ineffective or control rents are small. For such firms, shareholders will prefer a weak board of directors and CEO tenure will be longer. Almazan and Suarez's model implies that the hazard function is eventually decreasing.

Matching theory (Jovanovic, 1979a,b, 1984) suggests that learning about the quality of the match between a CEO and a firm occurs early in employment and that bad matches do not last long while good matches do. The risk of termination rises initially as

[2] There is a substantial literature on CEO turnover going back to Coughlin and Schmidt (1985), Warner et al. (1988) and Weisbach (1988). The papers in this literature estimate the unconditional probability that the CEO will be terminated within a given period. See Brickley (2003) for a concise summary of the main empirical results and Murphy (1999) for a broader survey of the literature.

[3] Survival analysis has been extensively used to analyze bankruptcy; see LeClere (2000) for a survey and Shumway (2001) for a recent example. Other financial applications of survival analysis include business cycles (Sichel, 1991), bubbles (McQueen and Thorley, 1994), and limit order execution (Lo et al., 2003). Sebora (1996) and Allgood and Farrell (2003) estimate hazard functions for CEO tenure, however, neither study includes controls for the determinants of tenure.

bad CEO/firm matches are dissolved then eventually decreases since CEOs in good matches are less likely to find a better match and will have longer tenure. Thus, the matching model implies that the hazard function has an inverse-U shape.

While these theories suggest the hazard function will eventually decrease with tenure, the theories have different implications for how the decreasing risk of termination affects firm value. The "CEO power" hypothesis is based on the idea that CEOs gain power over time. When the risk of termination is decreasing, CEOs are not necessarily motivated to maximize shareholder value and firm value suffers. The models that suggest this scenario include Shleifer and Vishney (1989), Hermalin and Weisbach (1998), and Almazan and Suarez (2003). The "matching hypothesis" provides a contrasting view of the relation between CEO tenure and firm value. The matching model implies that the risk of termination eventually falls for CEOs that are well matched and that good firm performance is the result of good CEO/firm matches. Consequently, under the matching hypothesis we expect that a decreasing risk of termination has a positive effect on firm value.

A number of papers have examined the implications of the theoretical models. Rose and Shepard (1997) examine CEO compensation for diversified and undiversified firms and find that higher salaries for CEOs of diversified firms are more consistent with their ability or match. Similarly, Berry et al. (2006) find evidence that CEOs of diversified firms come from a more talented labor pool, suggesting that matching theory better explains CEO choice. Ang and Nagel (2005) find that a small percentage of CEO/firm pairs generate persistent superior performance, but breaking up the pair results in lower performance for both the CEO and the firm. Allgood and Farrell (2003) find that the hazard function for all CEO departures (forced and non-forced) peaks at about five years then decreases. They also find that good matches (lasting more than 3 years) have better firm performance than bad matches. They interpret these results as supporting matching theory.

Our approach differs from prior work in that we use the hazard function to indicate the likelihood a CEO will be terminated and to determine when the risk of termination decreases. We use our estimates of the hazard function to test for a relation between decreasing risk of termination and firm value. There is support for the CEO power hypothesis if a decreasing risk of termination is related to lower firm value. There is support for the CEO matching hypothesis if a decreasing risk of termination is related to higher firm value. Our approach also allows us to estimate the percent of CEOs that leave before the average risk of termination begins to decrease. Our approach also differs from prior work in that we use a structural model of tenure and firm value. We discuss estimation of the model, including estimation of the hazard function, in more detail below.

3. Methodological approach

3.1. Data

Our initial sample is from ExecuComp for 1993 through 2001. The firms in ExecuComp are mostly large publicly traded firms. We combine the ExecuComp data with financial data from Compustat and stock return data from the Center for Research and Security Prices (CRSP). We eliminate utilities (Standard Industrial Classification (SIC) codes 4800–4999) because they were in the process of deregulation during this time. We also eliminate financial firms (SIC codes 6000–6999) and firms for which the data is incomplete and for which there is only one observation. There are 1472 firms in our sample and 2325 different individuals who serve as CEOs in our sample. Of these, 379 firms have data for all nine years, and 113 CEOs are in the sample for all nine years. There are 8694 firm years of data.

The ExecuComp data contains the starting date for each CEO's tenure. This allows us to include CEOs with tenure beginning before 1993. However, covariates for these CEOs begin in 1993. Similarly, the sample construction allows CEOs that remain in their position after 2001 to be included; these are the right censored observations.

Table 1
Reasons for departures of CEOs under age of 65.

Reason	Number	Average tenure	Median tenure	Average age	Median age
Forced					
Ousted	21	6.38	4.00	54.76	55.00
Resigned	156	6.19	4.00	53.07	53.00
Retired LT 60 years old	25	7.08	7.00	57.04	57.00
No reason	244	7.76	7.00	55.36	56.00
Total	446	7.12	6.00	54.63	55.00
Voluntary					
Sick	7	10.86	10.00	56.43	59.00
Retired GE 60 years old	77	9.18	9.00	62.47	63.00
Died	5	7.80	5.00	59.20	58.00
Continued in the company	177	9.80	8.00	57.12	58.00
To join another company	28	6.00	5.50	53.36	55.00
Total	294	9.24	8.00	58.17	60.00
Grand total	740				

Table shows the reason for departure stated in the Wall Street Journal for CEOs under the age of 65.

3.2. Measurement and description of variables

3.2.1. Turnover and CEO tenure

We classify CEOs as either involuntarily terminated or not involuntarily terminated. We define an involuntary or forced termination as a departure that occurs before the retirement age of 65, where the stated reason in the Wall Street Journal is

Table 2
Summary statistics.

		Full sample (1)	Forced turnover year (2)	Remaining sample years (3)	Test for difference (4)
Panel A: CEO tenure					
Tenure (years)	Mean	8.139	6.743	8.471	(5.48)***
	Median	5.753	5.204	5.838	[0.011]
N (CEOs)		2,325	446	1,879	
Panel B: Firm performance					
Adjusted return (difference)	Mean	−0.111	−0.384	−0.097	(9.66)***
	Median	−0.139	−0.381	−0.131	[<.001]
Adjusted return (ratio)	Mean	0.930	0.738	0.941	(10.16)***
	Median	0.884	0.701	0.893	[<.001]
Adjusted return (difference)$_{t-1}$	Mean	−0.093	−0.242	−0.085	(5.04)***
	Median	−0.136	−0.253	−0.131	[<.001]
Adjusted return (ratio)$_{t-1}$	Mean	0.937	0.835	0.943	(4.85)***
	Median	0.891	0.792	0.896	[<.001]
Adjusted return (difference)$_{t-2}$	Mean	−0.058	−0.132	−0.054	(2.18)**
	Median	−0.115	−0.179	−0.111	[<.001]
Adjusted return (ratio)$_{t-2}$	Mean	0.962	0.906	0.965	(2.41)***
	Median	0.907	0.843	0.911	[<.001]
Panel C: CEO compensation					
ln(Salary + bonus + LTIP)	Mean	6.741	6.426	6.758	(7.71)***
	Median	6.722	6.356	6.744	[<.001]
ln(Option compensation)	Mean	5.104	3.967	5.166	(7.08)***
	Median	6.253	5.262	6.296	[<.001]
Panel D: Board governance characteristics					
Number of new CEOs		637	116	521	
Ownership (%)	Mean	2.994	1.992	3.048	(3.70)***
	Median	0.444	0.233	0.459	[<.001]
Number of board meetings	Mean	6.762	7.895	6.701	(−6.30)***
	Median	6.000	7.000	6.000	[<.001]
Panel E: Firm/industry characteristics					
Leverage	Mean	0.315	0.356	0.312	(−4.08)***
	Median	0.290	0.318	0.289	[<.001]
PPE/(sales)	Mean	0.757	0.613	0.765	(2.65)***
	Median	0.421	0.364	0.424	[0.004]
ln(assets)	Mean	7.600	7.264	7.618	(4.33)***
	Median	7.426	7.135	7.441	[<.001]
Herfindahl index	Mean	684	678	685	(0.23)
	Median	486	467	486	[0.345]
Panel F: CEO characteristics					
Age (years)	Mean	55.502	54.626	55.550	(3.11)***
	Median	56.000	55.000	56.000	[0.043]
Gender (number of obs)	Male	8,592	4440	8,152	
	Female	102	6	96	
Number of years credited to retirement	Mean	8.662	6.719	8.767	(3.58)***
	Median	0.000	0.000	0.000	[<.001]
N (CEO years)		8,694	446	8,248	

,* denote significance at the 5%, and 1% level.
Tenure is the number of days the CEO has held position as CEO in the firm, divided by 365. Adjusted return (difference) is the firm return less industry return, where return is the twelve-month holding period return beginning one month prior to termination for CEOs that departed from the firm and the twelve-month holding period return for the fiscal year if the CEO did not depart from the firm. Industry return is the value weighted return for all Compustat firms in the same two-digit SIC as the sample firm. Adjusted return (ratio) is one plus the firm return divided by one plus the industry return. Salary + bonus + LTIP (long-term incentive plan) and Options are for the current year. Number of new CEOs is the number of CEOs that have one year or less of tenure. Ownership is the percent of share ownership held by the CEO. Number of board meetings is the annual number of board meetings. Leverage is book value of liabilities divided by market value of assets. PPE/sales is the book value of property, plant and equipment divided by sales. Assets is book value of assets less common stock plus price times common shares outstanding. Herfindahl index is the sum of the squared market shares (in percent) of all firms in the industry. Age is for the current year. Gender is a dummy variable for the CEO's gender (Female = 1) . Number of years credited to retirement is the number of years the CEO has credited to his or her retirement plan. Test for difference is the t-test for the difference in the means (in parentheses) or Wilcoxon rank-sums test for difference in the medians (in brackets) between forced and the remaining firm-years.

"ousted, resigned, or no reason." This classification is consistent with prior literature (Denis et al., 1997; Denis and Kruse, 2000; Parrino et al., 2004). It is also consistent with literature showing a disproportionate number of CEOs leave office after the age of 64 (Weisbach, 1988). We also classify a departure as forced if the CEO is younger than 60 years old and the stated reason is retirement. We use 60 years as the cut off age because some retirement plans allow withdrawals without a penalty starting at age 59.5. We find a large increase in retirements at around age 60 and decide it is a reasonable age cutoff. We classify CEOs as not involuntarily terminated if the CEO departs and is over 65, or if the CEO departs, is over 60 years old and the reason given is "retirement," or if the CEO departs and the reason given is "sick, died, continued in the company, or joined another company." CEOs who do not depart are also classified as not involuntarily terminated.

Table 1 shows the number of CEOs younger than age 65 that leave the position classified by the reason stated in the Wall Street Journal. There are 2325 CEOs in the sample. This includes 32% (740 of 2325) who leave for any reason and 68% who either stay or are censored. There are 446 CEOs who are forced to leave or 19.2% of the sample. This is similar to the findings of Parrino et al. (2004), who classify about 20% of successions as forced. Of the 740 CEOs who leave, 60% (446 of 740) are forced to leave and 40% depart voluntarily.

Because we are ultimately interested in tenure, we report mean and median number of years of CEO tenure for the involuntarily terminated and non-involuntarily terminated groups in Panel A of Table 2. We measure tenure as the number of consecutive days a CEO has held that position as of the year end if the CEO has not departed from office. If the CEO leaves office then tenure is the number of days the CEO holds office until the departure date. However, for ease of reading, we report tenure as number of years. The mean number of years of tenure for CEOs who depart involuntarily is 6.74 years, a statistically significant decrease from the mean tenure of 8.47 years for CEOs who do not depart involuntarily. The median tenure for involuntarily terminated CEOs (5.20 years) is also significantly different from that of the remaining sample (5.84 years).

Mean tenure is lower for CEOs who are forced to depart, which suggests CEOs that are forced out leave in the first few years of their tenure. To investigate whether there is a trend in involuntary and voluntary departures, we examine the distribution of completed CEO tenure for CEOs who depart voluntarily and are forced to depart in Fig. 1. This figure shows CEOs who are forced to depart are most likely to do so in years two, three and four. Forced departures then fall until about year nine then drop off dramatically. CEO's that depart voluntarily are most likely to do so in their fifth and sixth years. The percent of CEOs that leave the firm voluntarily is more stable. Fig. 1 suggests that if a CEO is forced out it is likely to occur in the first four years of tenure, but this is not the case for CEOs that leave voluntarily.

3.2.2. Firm performance

Prior literature has shown poorly performing CEOs are more likely to be forced to leave (Coughlin and Schmidt, 1985; Warner et al., 1988; Weisbach, 1988). We predict that firm performance is positively related to CEO tenure. We measure current performance as the twelve-month holding period return for the fiscal year, unless the CEO departs during the fiscal year. If the CEO departs during the fiscal year, we measure current firm performance as the twelve-month holding period return beginning one month prior to the last month of employment. This measure allows us to estimate performance for the most current year for which the CEO has control.

For our sample period the stock market was increasing and most industries in the economy were growing. This positive environment could lead to "a rising tide lifts all ships" scenario, whereby poorly performing CEOs could retain tenure in firms with improving stock return performance simply because their industry was improving. To control for improving performance over the sample period we adjust firm performance by industry performance. Firm performance is adjusted for industry performance two ways. First, we measure adjusted performance as the difference between a firm's return and the median return of firms in the same

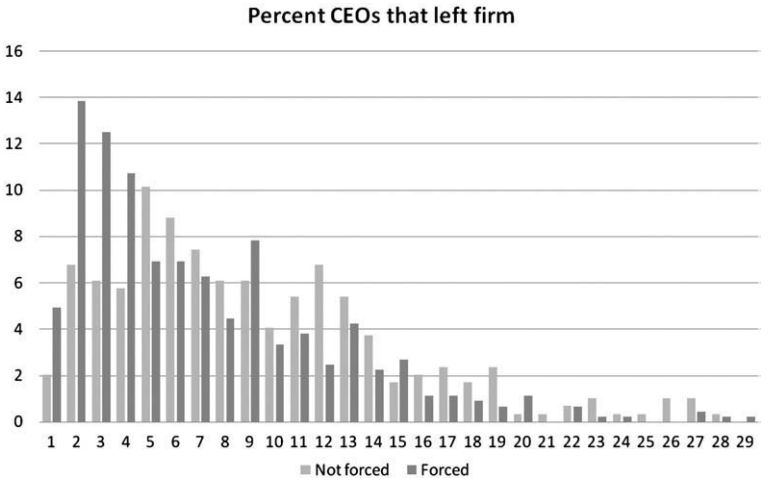

Fig. 1. Percent of CEOs that left the firm by number of years of tenure. Graph shows the number of CEOs that left the firm, for each tenure year, for forced and non-forced departures.

industry, where the industry consists of all firms in Compustat with the same two-digit SIC code. This measure is widely used in the literature. Second, we measure adjusted performance as the ratio of one plus the firm's return to one plus the median industry return. The second measure accounts for the fact that a 2% difference in returns may not have the same economic interpretation when the industry return is 3% as when it is 13%.

Panel B of Table 2 shows twelve-month adjusted returns for the firm-years where CEOs are forced from office and for the remaining sample. Using either the difference or ratio measure of relative performance, performance is much lower in firm-years in which CEOs are involuntarily terminated than in the remaining sample firm-years. CEO tenure could depend on prior performance as well as current performance. We measure prior performance using the one-year and two-year lagged values of the adjusted returns. Panel B shows mean and median one and two prior years performance for firm-years when CEOs are terminated is lower than for the remaining firm-years using either the difference or ratio adjusted returns.

3.2.3. CEO compensation

Better remuneration could reflect better managerial skill or a better CEO/firm match, which could ultimately reduce the chance of forced succession (Rose and Shepard, 1997). Better remuneration could also reflect managerial influence in shaping their compensation (Core, Holthausen and Larcker, 1999; Bebchuk and Fried, 2003; Bertrand and Mullainathan, 2001). We measure compensation in two ways. Our first measure includes components that reward for past performance (salary and bonus and long term incentive pay (LTIP)). Our second measure includes explicit incentives for future firm performance (option grants). We predict that both forms of compensation are positively associated with longer tenure. We use the log of compensation because of the wide dispersion and skewness in compensation.[4]

Panel C of Table 2 shows both the mean and median values of the natural log of fixed compensation is lower for firm-years when the CEO is terminated than for other firm-years. The mean (6.43) and median (6.36) fixed compensation for firm-years where the CEOs are terminated are lower than for the remaining firm years (6.76 and 6.74, respectively). Similarly, option compensation is lower for firm-years where the CEO is force to depart than for other firm-years. Option grants have a lot of variability. At one extreme, 26% of the firm years have a zero value for option grants. At the other extreme, Steve Jobs received roughly $500 million in option grants in 2000.

3.2.4. Corporate governance characteristics

One issue of interest is how the board of directors evaluates new CEOs. If new CEOs start with a "clean slate," then their expected tenure should be unaffected by prior year returns. Alternatively, there may be a carryover effect from the previous CEO, for example, if the new CEO is compared to the old CEO. We include new CEO indicator variables for first and second year CEOs and the interactions of these indicators with lagged performance. There are 637 new CEOs in the sample. Of these, 116 (18.2%) are forced to depart, a slightly lower rate than for the overall sample. The forced departures of new CEOs account for one-fourth of all forced CEO departures.

We include the CEO's share ownership as a measure of corporate governance. We expect top executive tenure to be positively related to CEO ownership for several reasons. First, greater ownership gives the CEO more bargaining power because of associated voting rights, reducing the chance the CEO is forced to leave (Morck et al., 1988; McConnell and Servaes, 1990). Second, managers having higher levels of ownership are more likely to act in shareholder interests because they share in stockholder cash flow rights (Jensen and Meckling, 1976; Jensen and Murphy, 1990). Third, it could be that longer tenured CEOs have had more time to acquire shares or have vested options. We measure managerial ownership as the percent of total common equity held by the CEO. Panel D shows mean (1.99%) and median (0.23%) ownership for firm-years when CEOs are terminated are lower than for the remaining firm-years (3.05% and 0.46%, respectively). Mean percentage share ownership is small, and we expect this is because these are mostly larger firms, making it difficult for CEOs to own a large percent of the firm (Hall and Liebman, 1998).

The role of the board of directors is to monitor the CEO and the performance of the firm more generally. We include the annual number of meetings of the board of directors as a measure of board monitoring. Vafeas (1999) reports that the frequency of boards meetings increases following declines in share prices, and that operating performance subsequently improves. Ryan and Wiggins (2004) report that directors' incentives to monitor decrease with CEO tenure. Boone et al. (2007) find empirical evidence that is consistent with the board playing a monitoring role. Ryan et al.'s (2007) results indicate the reason boards monitor is to obtain information for CEO retention and termination decisions. We expect CEO tenure to decrease with board monitoring. Both the mean (7.90) and median (7.0) number of board meetings is higher in firm-years with forced CEO turnover than in the remaining firm-years (6.70 and 6.0, respectively).

3.2.5. Financial variables

Several financial variables could also affect CEO tenure. We include leverage, asset tangibility, firm size and industry concentration. Firms with higher leverage are more likely to raise additional capital through external capital markets and therefore might be more closely monitored (Jensen, 1986). Prior literature has found evidence suggesting entrenched CEOs avoid debt (Berger et al., 1997). We expect leverage will be negatively related to CEO tenure. We measure leverage as the book value of liabilities divided by the market value of assets. The market value of assets is measured as the book value of assets minus the book value of common equity plus market price times common shares outstanding. Panel E of Table 2 shows leverage is slightly higher

[4] We add one to the value of all option grants to avoid taking the natural log of zero.

for firm-years in which there is forced CEO turnover (mean 0.36, median 0.32) than for the remaining sample (mean 0.31, median 0.29).

CEO tenure may also depend on the firm's asset tangibility. When the value of the firm is determined primarily by assets in place rather than by intangible assets such as human capital or growth options, the indirect costs of financial distress are lower (Williamson, 1988). Because less value is lost with financial distress, boards of such companies might be less diligent in their monitoring of the CEO and we expect CEOs of these firms to have longer tenure. We measure asset tangibility as property plant and equipment (PPE) divided by sales. Panel E shows the mean (0.61) and median (0.36) values for firm-years with forced CEO departure are lower than the mean (0.77) and median (0.42) values for the rest of the sample.

Larger firms have conceivably become larger because of their past performance. Moreover, larger firms have better name recognition and may attract more capable talent (Fama, 1980). Larger firms also have more complex operations and will demand high-quality managers. Higher quality managers should result in less possibility of forced management turnover. However, if firm size is reflective of superior past governance then poorly performing managers are more apt to be forced from their position. We measure firm size as the market value of assets, that is, as the book value of assets minus the book value of common equity plus share price times the number of common shares outstanding, in logarithms.[5] Panel E shows the mean (7.26) and median (7.14) values for firm-years with forced CEO departure is less than the mean (7.62) and median (7.44) for the remaining firm years.

More competitive industries could potentially have greater levels of turnover (DeFond and Park, 1999). We use the Herfindahl index to measure industry concentration. The Herfindahl index is defined as the sum of the squared values of the sales of all firms in the industry, measured as a percent of total industry sales; total industry sales is defined as the total sales by all firms in the same two-digit SIC code. The value of the Herfindahl index ranges from 0 to 10,000, with larger values representing greater concentration. The Herfindahl index is an industry characteristic and exogenous to the firm. There is no significant difference in the values of the Herfindahl index between the firm-years where CEOs are involuntarily terminated and the rest of the sample.

3.2.6. CEO characteristics

We also include several CEO personal characteristics as determinants of tenure. Panel F shows CEO age by firm year observation. Older CEOs will often have longer tenure. The panel shows that the mean (54.6) and median (55) age for involuntarily terminated CEOs is less than the mean (55.6) and median (56) age for the remaining sample. We include the CEO's gender. There are relatively few female CEO's, they comprise about 1.4% (32 of 2325) of the sample. We also include the years credited toward retirement, which we expect will be positively related to tenure. CEO's who are involuntarily terminated have lower mean years credit toward retirement (6.72) than the remainder of the sample (8.77); the medians are equal at zero. Unlike the firm's financial and governance characteristics, the CEO's personal characteristics do not determine, and are not determined by, firm value.

4. Survival analysis

Survival analysis is often used in measuring failure times or, in our case, time to termination. Survival analysis is particularly valuable in studying CEO tenure because it allows for both voluntary and involuntary departures, and because right censored observations can be easily and correctly accommodated, and because it incorporates time at risk. In this section we provide a brief overview of how survival analysis is incorporated in our study.[6]

There are two general approaches to estimating the hazard function: the proportional hazard model and the accelerated failure time (AFT) model.[7] The advantage of the proportional hazard model is that the coefficient vector can be estimated without specifying the baseline hazard function (although the estimators are less efficient). For our purposes, however, the AFT approach is more useful since we want to use the predicted hazard values to examine the relation between the risk of termination and firm value.

The AFT model can be viewed as a regression model:

$$ln(\tau_i) = \boldsymbol{x}_{1i}\alpha + ln(u_i), \tag{1}$$

where u_i has an appropriate (typically non-normal) distribution. This is the first equation of our structural model. For each individual in the sample, we have observations on tenure, τ_i, an indicator for whether the observation is censored, C_i and the covariates, $\boldsymbol{x}_{1i}$. The censoring indicator is $C_i = 0$ if the individual is censored (not involuntarily terminated) and $C_i = 1$ if the individual fails (is involuntarily terminated). The censoring indicator affects the estimation through the likelihood function.[8] We estimate the hazard function by maximum likelihood using the generalized gamma family of distributions with both the difference and ratio measures of relative performance. We estimate standard errors adjusted for clustering by individual CEO.

Since voluntary and involuntary termination is incorporated through the likelihood function, the coefficients β can be interpreted as the percentage change in expected tenure given a change in the covariates $\boldsymbol{x}_{1i}$. The covariates in the model include

[5] Many studies measure firm size as the market value of equity or as the book value of assets. We use the market value of assets because it is theoretically more appropriate. We note that our measure of firm size is the numerator of the market-to-book ratio as it is usually computed.

[6] Standard references on survival analysis include Cox and Oakes (1984), Kalbfleisch and Prentice (2002) and Miller (1981), to which readers are referred for more detailed discussions.

[7] Studies of CEO turnover typically estimate the unconditional probability that the CEO will be involuntarily terminated, that is, the distribution function $F(\tau|x)$. The hazard function, which we estimate here, is related to the distribution functions by $h(\tau|x) = f(\tau|x)/[1 - F(\tau|x)]$.

[8] For individuals who are censored, all we know is the probability their tenure exceeds τ_i so their contribution to the likelihood function is $S(\tau_i|\boldsymbol{x}_{1i}) = 1 - F(\tau_i|\boldsymbol{x}_{1i})$. Then the log-likelihood for the ith observation is $L_i = C_i \ln f(\tau_i|\boldsymbol{x}_{1i}) + (1 - C_i)\ln S(\tau_i|\boldsymbol{x}_{1i})$.

Table 3
Statistics for distribution choice.

	Using first difference returns		Using ratio of returns	
Null hypothesis	Chi square	*p*-value	Chi square	*p*-value
Exponential	121.48	<0.001	112.82	<0.001
Weibull	33.22	<0.001	27.16	<0.001
Log-normal	0.63	<0.427	2.23	<0.153

Log likelihood ratio test is the test of the restricted model (exponential, Weibull and log-normal) against the generalized gamma distribution.

the current year adjusted return, the first and second lags of the adjusted return, the indicators for first and second year CEOs and their interactions with lagged relative performance, compensation not including options, option compensation, ownership, the number of board of director meetings, leverage, property plant and equipment, firm size and the Herfindahl index and the CEO's age, gender and years credit toward retirement.

The error term in the regression (1) is $u_i = \exp(-\boldsymbol{x_{1i}}\beta)\tau_i$. The choice of the functional form for the distribution of the error term is important since it determines the shape of the hazard function. We use the generalized gamma distribution because it allows the greatest flexibility in the shape of the hazard function and because it includes the exponential, Weibull and log-normal distributions as special cases. The exponential distribution has a constant hazard function, so that the risk of termination does not depend on tenure. The Weibull distribution has a hazard function that is either strictly increasing or strictly decreasing. A strictly increasing hazard would be consistent with CEOs "wearing out their welcome". A strictly decreasing hazard would be consistent with the CEO gaining power over the board starting when the CEO is hired. The log-normal distribution has an inverse-U shaped hazard function. An inverse-U shape is implied by matching theory and is also consistent with a scenario where the CEO takes some time to gain influence over the board. In the next section we will test which of these distributions best describes the data.

5. Tenure and the risk of termination

In this section we examine the shape of the hazard function to determine whether the risk of termination decreases with tenure. We also examine the effects of the covariates on expected CEO tenure.

A potential problem in estimating the hazard function is that some of the variables, such as CEO compensation, governance characteristics and firm characteristics, may be endogenous within the model. We carry out Hausman (1978) tests for exogeneity for these variables. We do not reject the hypothesis that these variables are exogenous for tenure, with the exception of option compensation. For option compensation, exogenity is strongly rejected ($p<0.001$ for both return specifications). We use the predicted value from the reduced form equation as an instrumental variable for option compensation in estimating the hazard function.[9]

5.1. Choosing the distribution

The first step in analyzing the shape of the hazard function is to choose the distribution that best characterizes the data. Table 3 reports the results of the likelihood ratio tests of the exponential, Weibull and log-normal distributions against the alternative of the generalized gamma distribution. The exponential and Weibull distributions are rejected in favor of the generalized gamma; the *p*-values for the likelihood ratio test are 0.001. However, we cannot reject the hypothesis of the log-normal distribution ($p = 0.427$ and 0.153). Consequently, we report the results for the log-normal distribution in the following tests. The results for the generalized gamma distribution are qualitatively the same as those for the log-normal distribution.

5.2. Determinants of CEO tenure

We next examine the effects of the covariates on CEO tenure. The results for the duration model using the log-normal distribution are presented in Table 4. Model 1 uses the difference adjusted return measure of relative performance while Model 2 uses the ratio adjusted return measure. The results are qualitatively similar for both measures of relative performance.

For both performance measures, the coefficient for the adjusted return is positive and significant, implying better relative performance increases expected tenure. The coefficients for the one-year and two-year lagged values of the adjusted return are also positive and significant. This implies that the effect of relative performance lasts more than one year, and is consistent with the view that individuals who develop reputations as good CEOs have greater expected tenure. The coefficients on the lags suggest that the effect of prior performance diminishes over time.[10]

The indicators for first and second year CEOs are negative and significant for both return specifications. None of the coefficients for the interaction terms are significant. The sum of the coefficients for the new CEO indicator variables and their interactions with the lagged adjusted returns is statistically different from zero (Model 1: $\chi^2 = 32.42$, $p = <0.001$, Model 2: $\chi^2 = 78.39$, $p<0.001$). This implies that new CEOs' expected tenure is determined not only by their own performance, but is also affected by performance under the previous CEO.

[9] See Wooldridge (2002, pp. 118–122) for a discussion. We use the lagged values of adjusted returns, the Herfindahl index and CEO personal characteristics (age, gender, and years credit toward retirement), along with year and firm dummies in the reduced form regressions.

[10] We re-estimated the models with a three lags of relative performance, however, the third lag was never statistically significant.

Table 4
Survival models for log-normal distribution.

	Prediction	(1)	(2)
Intercept	+	7.151*** (17.48)	5.578*** (13.01)
Adjusted return (difference)	+	0.540*** (6.82)	
Adjusted return$_{t-1}$ (difference)	+	0.257*** (3.57)	
Adjusted return$_{t-2}$ (difference)	+	0.206** (2.24)	
Adjusted return (ratio)	+		0.813*** (5.88)
Adjusted return$_{t-1}$ (ratio)	+		0.369*** (3.29)
Adjusted return$_{t-2}$ (ratio)	+		0.343*** (2.54)
NewCEO 1	−	−0.931*** (−6.36)	−1.088*** (−3.97)
NewCEO 2	−	−0.757*** (−7.98)	−0.427** (−1.99)
Adjusted return$_{t-1}$ (difference) × newCEO 1	−	−0.040 (−0.22)	
Adjusted return$_{t-2}$ (difference) × newCEO 2	−	−0.195 (−1.27)	
Adjusted return$_{t-1}$ (ratio) × New CEO 1	−		0.211 (0.61)
Adjusted return$_{t-2}$ (ratio) × New CEO 2	−		−0.340 (−1.53)
ln(Salary + Bonus + LTIP)	+	0.251*** (5.97)	0.256*** (6.11)
ln(Option compensation)	+	−0.008 (−0.47)	−0.009 (−0.50)
Ownership (%)	+	0.031*** (3.12)	0.031*** (3.18)
Number of board meetings	−	−0.067*** (6.84)	−0.065*** (−6.67)
Leverage	−	−0.544*** (−3.10)	−0.451*** (−2.47)
PPE/Sales	+	0.042 (1.06)	0.050 (1.24)
D(PPE/Sales)	?	0.194 (1.59)	0.212* (1.73)
ln(Assets)	?	−0.066** (−2.32)	−0.071*** (−2.46)
Herfindahl Index	+	3.50×10^{-5} (0.71)	4.92×10^{-5} (0.99)
Age (years)	+	0.022*** (5.19)	0.022*** (5.15)
Gender	?	−0.011 (−0.05)	−0.017 (−0.08)
Number of years credited to retirement	+	0.012*** (2.80)	0.012*** (2.83)
D(Number of years credited to retirement)	?	0.047 (0.44)	0.040 (0.38)
Likelihood value		−1145.841	−1190.716
N		8694	8694

*, **,*** denote significance at the 10%, 5%, and 1% level.
Estimates of the accelerated failure time specification of CEO tenure for the log-normal distribution. Adjusted return (difference) is the firm return less industry return, where return is the twelve-month holding period return beginning one month prior to termination for CEOs that departed from the firm and the twelve-month holding period return for the fiscal year if the CEO did not depart from the firm. Industry return is the value weighted return for all Compustat firms in the same two-digit SIC code as the sample firm. Adjusted return (ratio) is one plus the firm return divided by one plus the industry return. New CEO 1 is an indicator for CEOs with one year or less of tenure, New CEO 2 is an indicator for CEOs with two years of less of tenure. Ownership is the percent of share ownership held by the CEO. Number of board meetings is the annual number of board meetings. Leverage is book value of liabilities divided by market value of assets. PPE/sales is the book value of property, plant and equipment divided by sales. D(PPE/Sales) is a dummy variable taking the value of 1 if PPE/Sales is 0 or missing. Assets is book value of assets less common stock plus price times common shares outstanding. Herfindahl index is the sales of a firm as a percent of its industry squared. Age is the CEO's age in the given year. Gender is a dummy variable for the CEO's gender (Female = 1). Number of years credited to retirement is the number of years the CEO has credited to his or her retirement plan. D(Number of years credited to retirement) is a dummy variable taking the value of 1 if the number of years credited to retirement is 0 or missing. *t*-statistics, based on standard errors adjusted for clustering by CEO, are provided in parentheses.

The coefficient for salary, bonus and LTIP compensation is positive and significant. The coefficient for option compensation is not significant in either model. Option compensation is endogenous, so that it is determined by the same exogenous firm, governance and CEO personal characteristics that determine tenure. Since these variables are controlled for in the tenure equation, option compensation provides no additional information about the determinants of tenure. Overall, the results are consistent with the view that increased compensation is a reward for better managerial skill or the result of a better match.

The results for the remaining control variables are mostly consistent across both equations. CEO stock ownership, is positive and significant as expected. Higher levels of ownership may align the CEO's and shareholders' incentives and may give the CEO more bargaining power with the board. The number of board meetings has a negative and significant effect on tenure. Leverage also has a negative and significant effect on tenure. The PPE/sales ratio does not have a significant effect. Firm size (assets) has a negative effect on tenure. Finally, the Herfindahl index does not affect tenure. CEO age and years credited toward retirement both have significant positive effects on tenure, while gender is not significant.[11]

5.3. Hazard functions

We need to examine the shape of the hazard function to determine if the risk of termination is an increasing or decreasing function of tenure. Fig. 2 plots the empirical hazard function for the log-normal model in Table 4, Column 1. The independent variables are evaluated at their sample means. Fig. 2 shows the hazard function is initially increasing, reaching a peak at 4700 days or 12.88 years of tenure. The maximum value of the hazard function is 0.0001134 per day or approximately 4.14% per year at an annualized rate. After

[11] As a robustness test to correct for possible outliers of CEO tenure, we delete the observations with tenure of greater than 38 years (72 of 8822 observations). The results are virtually identical to those reported in Table 4.

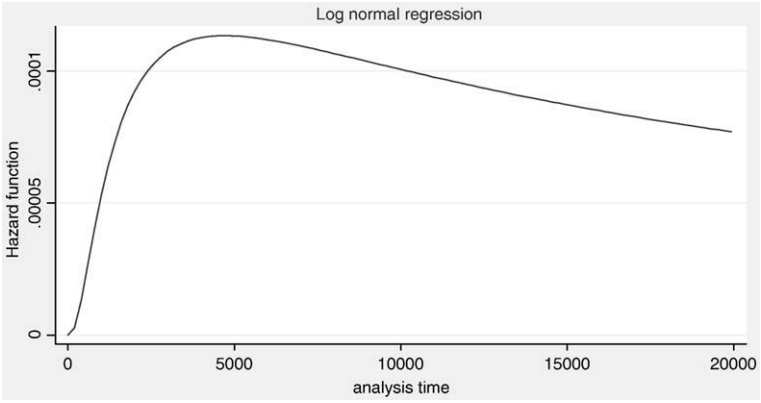

Fig. 2. Graph of lognormal distribution hazard. Graph shows the relation between the hazard value and the number of days of tenure.

twelve years and eleven months, the hazard decreases monotonically, reaching a value of 0.0001032 per day at twenty-five years (3.84% per year annualized). By the end of twenty-five years of tenure, the hazard has declined by about 9% from its peak.[12]

While we do not graph the hazard functions using the ratio measure of adjusted returns, the results are virtually identical. The hazard function increases to its peak at 4750 days or thirteen years of tenure. The maximum value of the hazard function is 0.0001132 per day or approximately 4.13% per year at an annualized rate. The hazard function then decreases to a value of 0.0001033 per day at the end of twenty-five years (3.84% per year annualized). By the end of twenty-five years of tenure, the hazard has declined by 8.75% from its peak.

The shape of the hazard is not consistent with models of CEO power in which the CEO continuously gains influence over the board. The majority of CEOs do not serve long enough for the risk of termination to begin to fall with tenure. Using the difference adjusted return measure of relative performance, the peak of the hazard is 4700 days or around twelve years and eleven months. Eighty-two percent of the CEOs have tenures that are less than this value. This result is not supportive of matching theory whereby poor matches leave early in the tenure process and good matches stay. Based on the ratio adjusted return, the peak of the hazard is 4750 days or thirteen years. Eighty-three percent of CEOs have tenure less than this value. In addition, once it begins to decline, the decrease in the risk of termination is not large. While these results are suggestive, determining their implications for corporate governance requires analyzing how the decreasing risk of termination affects firm value.

5.4. Robustness of the shape of the hazard

Since survival analysis has not been widely used in the literature, we need to determine whether the inverse-U shape of the hazard function is a robust empirical regularity. Therefore, we further investigate the shape of the hazard by examining different considerations that could affect its shape. We examine the effects of (a) CEO succession, (b) the type of departure, and (c) firm characteristics. In each case, we carry out tests to determine which distribution (exponential, Weibull, log-normal or generalized gamma) best characterizes the shape of the hazard function.

The results are summarized in Table 5. In every case, we reject the exponential distribution and in every case but one we reject the Weibull distribution. We fail to reject the log-normal distribution when the CEO is followed by an inside or outside successor. For the log-normal distribution and an inside successor, the peak of the hazard function is at 15.56 years; only 19% of the CEOs in this subsample have longer tenure. For a CEO followed by an outside successor, the peak is at 13.75 years; and only 14.20% of CEOs in this subsample have longer tenure. We re-estimated the hazard function for CEOs who departed for any reason and for CEOs that were forced to depart. In both cases, we also reject the log-normal distribution. For all departures, the generalized gamma hazard function has its peak at 23.43 years and for forced departures, the generalized gamma hazard peaks at 11.51 years; only 4.86 and 10.04% of CEOs, respectively, have longer tenure. We also fail to reject the log-normal distribution for single segment, multi-segment firms and for the Basic Industry/Mining/Export group. The peaks of the hazard functions are at 12.85, 14.27, and 13.84 years respectively, and only 19.27, 13.68, and 14.48% of CEOs in those types of firms have longer tenure. We fail to reject the Weibull distribution for Wholesale/Retail/Services; the hazard function is strictly increasing in this case. The results are broadly consistent with the results for the full sample.

6. Does a decreasing risk of termination affect firm value?

An important question we address in this paper is whether changes in a CEO's risk of termination affects firm value. The CEO power theory and matching theory both imply that a CEO's risk of termination will eventually decrease. However, CEO power

[12] Allgood and Farrell (2003) estimate the peak of the hazard for all CEO departures is about 5 years, considerably shorter that the approximate 13 years that we find. Allgood and Farrell use Forbes data for 1982–1993 while we use ExecuComp data for 1993–2001. The most important difference is the use of covariates. Allgood and Farrell do not include covariates in their analysis. When we estimate the hazard excluding covariates, we find that the peak of the hazard function is at about 3.7 years.

Table 5
Statistics for choice of distribution by selected characteristics.

	Exponential (1)	Weibull (2)	Log-normal (3)	*N* (4)
Panel A. Type of CEO				
Inside successor	51.73 (<.001)	18.34 (<.001)	0.62 (0.25)	1243
Outside successor	85.87 (<.001)	31.68 (<.001)	0.679 (0.17)	7451
Panel B. Type of departure				
All departures	259.82 (<.001)	62.15 (<.001)	31.66 (<.001)	8694
Forced departures	155.35 (<.001)	39.11 (<.001)	4.62 (0.032)	1444
Panel C. Firm characteristics				
Single segment firm	59.03 (<.001)	12.04 (<.001)	0.53 (0.469)	4683
Multi-segment firm	71.01 (<.001)	29.27 (<.001)	0.44 (0.506)	4011
Basic industry/ manufacturing/export	91.50 (<.001)	38.43 (<.001)	0.39 (0.532)	6021
Wholesale/retail/services	38.45 (<.001)	1.91 (0.166)	4.41 (0.036)	2673

Inside and outside successor examines the hazard function of the incumbent CEO. Inside successor is when the incumbent CEO is replaced by an internal candidate. Outside successor is when the incumbent CEO is replaced by an external replacement. All departures include both forced and voluntary terminations. Forced departures include only forced terminations. Single segment firms are those that report only one operating segment. Multi-segment firms are those that have more than one operating segment. Basic industry/ Manufacturing/ Export are firms in Standard Industrial Classification (SIC) code less than 5000. Wholesale/ Retail/ Services are firms in SIC code greater than or equal to 5000. Likelihood ratio tests of the restricted model (exponential, Weibull and log-normal) against the generalized gamma distribution. *p*-values in parentheses.

theory suggests that when the risk of termination is decreasing, firm value will suffer, while matching theory suggests firm value will not suffer when the risk of termination is decreasing.

6.1. Methodology

We construct a panel data set to test for the relation between firm value and the risk the CEO will be terminated. The equation for firm value is the second equation of the structural model:

$$V_{it} = \beta_0 + \Delta h_{it}\beta_1 + h_{it}\beta_2 + \boldsymbol{x}_{2it}\gamma + e_{it} \tag{2}$$

where V_{it} is the measure of firm value for firm i at time t, Δh_{it} is the change in the hazard function and h_{it} is the level of the hazard function at time t, respectively, $\boldsymbol{x}_{2it}$ is a vector of control variables at t, e_{it} is the error term and the βs and γ are the parameters to be estimated.[13]

Tobins' *Q* is defined as the ratio of the market value of the firm's assets to their replacement cost. We measure market value two ways, leading to two different measures of *Q*. First, we measure market value as the market value of equity plus the book value of debt plus the liquidating value of preferred stock. This measure is similar to that of Chung and Pruitt (1994). For the second measure of *Q*, we use the market value of equity plus the market value of debt plus the market value of preferred stock. We estimate the market value of debt as interest expense divided by the S&P interest rate for a long-term "A" corporate bond for the given year; this measure assumes debt is a perpetuity. Similar to Himmelberg et al. (1999), market value of preferred stock is approximated by preferred dividends divided by 0.10. For both measures we use the book value of assets to approximate replacement cost. As an additional measure of firm performance we use ROA, defined as operating income divided by total assets.

We use an indicator variable for the slope of the hazard function, letting it take the value of one if the estimated hazard function is downward sloping and zero otherwise. The change in the hazard function is measured at the beginning of the year. The CEO power theory implies that the coefficient for this variable will be negative, indicating a downward shift in firm value. Matching theory implies that the coefficient for this variable will be positive, since good CEO/firm matches are those that increase firm value. We include the estimated hazard to account for the effect of the risk of termination on firm value. The estimated hazard function is calculated from the maximum likelihood estimates in Column 1 of Table 4. The level of the hazard function is measured as of the end of the prior year.

The control variables are the same as those used by Himmelberg et al. (1999) in their estimation of *Q*. The control variables include ownership, ownership squared, sales, sales squared, property plant and equipment (PPE), property plant and equipment squared, standard deviation, operating income, research and development (R&D) expenditure, advertising expense, and capital expenditure. Because of missing and zero values for R&D (4121 out of 8083), advertising (6064 out of 8083), and PPE (443 out of 8083), we set missing observations equal to zero and use indicator variables equal to 1 if R&D, advertising or PPE has a zero value. The control variables, $\boldsymbol{x}_{2it}$, measured at time t may be correlated with the contemporaneous error. We use the lagged values, $\boldsymbol{x}_{2it-1}$, as instruments for the current values, that is, all of the explanatory variables are measured as of the end of the year preceding the

[13] Both the tenure equation, Eq. (1), and the value equation, Eq. (2), are identified by exclusion restrictions. We exclude the year and firm indicator variables from the tenure equation. The value equation contains two different nonlinear transformations of tenure. For analyzing identification, they can be treated "as if" they are two different additional endogenous variables (see Wooldridge, 2002, pp. 230–235.). We exclude CEO characteristics and compensation, performance and its lags and the Herfindahl index from the value equation.

Table 6
The effect of a decreasing hazard function on firm value.

	Q_1 (1)	Q_2 (2)	ROA (3)
Intercept	9.170*** (5.49)	9.174*** (5.60)	0.212 (1.43)
Decreasing risk	0.024 (0.42)	0.030 (0.52)	−0.002 (−0.77)
Hazard	−789.1*** (−3.84)	−725.4*** (−3.66)	−81.123*** (−4.78)
Ownership	0.001 (1.10)	0.001 (1.20)	-6.78×10^{-6} (−0.08)
Ownership squared	-1.42×10^{-6} (−0.69)	-1.72×10^{-6} (−0.84)	3.94×10^{-8} (0.22)
ln(sales)	−1.489*** (−3.59)	−1.374*** (−3.39)	0.023 (0.56)
ln(sales) squared	0.080*** (3.10)	0.073*** (2.92)	−0.003 (−1.02)
PPE/Sales	0.027 (0.56)	0.024 (0.53)	−0.015*** (−2.91)
PPE/Sales squared	2.62×10^{-4} (1.27)	2.66×10^{-4} (1.39)	4.65×10^{-5}** (2.25)
D(PPE/Sales)	−0.171* (−1.65)	−0.184* (−1.80)	−0.015** (−2.27)
Standard deviation	−3.217*** (−7.31)	−3.176*** (−7.26)	−0.129*** (−5.99)
Operating income	0.087*** (3.36)	0.086*** (3.38)	−0.002 (−0.57)
RD/Sales	0.087 (0.43)	0.125 (0.62)	−0.056 (−1.32)
D(RD/Sales)	−0.141 (−1.51)	−0.136 (−1.48)	−0.004 (−0.44)
Adv/PPE	1.197 (0.99)	1.217 (1.00)	−0.042*** (−2.66)
D(adv)	0.307** (2.16)	0.313** (2.21)	0.002 (0.31)
Cap expenditure	−0.901*** (−2.52)	−0.949*** (−2.62)	0.009 (0.07)
R^2	0.067	0.064	0.115
N	8,083	8,083	8,049

*, **,*** denote significance at the 10%, 5%, and 1% level.
Q_1 is measured as (price*shares + book value of debt + preferred stock liquidating value) / book value of assets. Q_2 is measured as (price*shares + market value of debt + market value of preferred stock) / book value of assets. ROA is measured as operating income/book value of assets. Decreasing Risk is a dummy variable taking the value of 1 if the slope of the hazard function for that firm year is negative. Hazard is the estimated hazard value for each firm year based on the coefficient estimates in Table 4 Column 1. Ownership is the percent of the firm owned by the CEO. Sales is the value of net sales. PPE/sales is the book value of property, plant and equipment divided by sales. D(PPE/Sales) is a dummy variable taking the value of 1 if PPE/Sales is 0 or missing. Standard deviation is the standard deviation of the firm's monthly stock returns for four years. Operating income is operating income/sales. RD/sales is R&D expense divided by sales, D(rd) is a dummy variable taking the value of 1 if R&D expense is 0 or missing. Adv/PPE is advertising expense divided by the book value property plant and equipment, D(adv) is a dummy variable taking the value of 1 if advertising expense is 0 or missing. Capital expenditure is the capital expenditure expense divided by book value of property plant and equipment. *t*-statistics using Huber–White robust standard errors are provided in parentheses.

year for which Q is measured. In addition, we use the firm fixed effects estimator to control for unobserved characteristics that may jointly determine the control variables and firm value. We use robust estimators of the standard errors.

6.2. Results

The results are provided in Table 6. The coefficient for the dummy variable is not significantly different from zero in the two Q regression models and the ROA regression. This implies that firm value is not affected by whether the CEO's risk of termination is decreasing. These results are not consistent with matching theory, which implies long tenure and good performance are both characteristics of good matches. The results are also not consistent with models of CEO power, where CEOs use their negotiating power to extract private benefits, including increased job security, to the detriment of shareholders.

The coefficient for the level of the hazard is negative and significant in all three specifications. We interpret this to mean that CEOs with a higher risk of termination are associated with lower firm value. The coefficient estimates imply an elasticity of about 0.0521 for Q_1 and 0.0366 for Q_2 evaluated at the sample mean, so that a 1% increases in the risk of termination leads to a decrease in Q of about four basis points. The elasticity for ROA is 0.0606 or six basis points. While the effect is statistically significant, it is not economically important.

The results for the control variables are consistent across the two Q models and are generally consistent for the model using ROA. There is a U-shaped relation between size, measured by the log of sales, and Q. Ownership, ownership squared, R&D, and the R&D dummy variable are not significant in the models. Zhou (2001) points out that firm fixed effects essentially remove the cross-sectional variation for slowly evolving variables, making it difficult to detect a relation even if one exists. Ownership varies cross-sectionally but has little within firm variation. Sales and its square, operating income, capital expenditures, and the dummy variable for advertising are significant across both Q models but not in the ROA model. Standard deviation, is significant across all models. The relation between Q and sales, sales squared, standard deviation, operating income and the dummy variable for advertising is consistent with findings in Himmelberg et al. (1999). Lastly, R&D and the dummy for PPE and advertising are significant in the ROA model, but not in the Q models.[14]

In sum, we do not find evidence that firm value either increases or decreases when the risk of termination is decreasing. Decreasing firm value would be consistent with CEOs using their negotiating power to gain increased tenure. Increasing firm value would be more consistent with evidence that good matches leads to better firm performance over time. We also find that the hazard is negative, implying that firms with a higher risk of termination have lower value, however, the size of the hazard is not

[14] In results not reported, we re-estimated all of the models in Table 6 using the hazard function estimates in Table 4, Column 2 (ratio measure of relative performance). The coefficient for advertising is consistently positive and significant in these models. Otherwise, the results are virtually identical to those reported in Table 6.

economically important. These results suggest that the slope and the value of the hazard function are not strongly associated with firm value.

7. Conclusions

We use survival analysis to examine CEOs' risk of termination, its determinants and the effect of the risk of termination on firm value. Different views of how well corporate governance functions have different implications for how the risk of termination changes with tenure. Matching theory implies that the risk of termination first increases, then decreases with tenure. Theories of CEO power imply that the risk of termination decreases with tenure. These theories have different implications for how the changes in the risk of termination affect firm value. Understanding the determinants of CEO tenure and the effect of tenure on firm value is an important issue in corporate governance.

We examine the effect of relative performance on tenure and find that better relative performance increases expected tenure. The effect of performance lasts more than one year, but diminishes over time. We also find that new CEOs do not start with a clean slate. New CEOs expected tenure initially depends on their predecessor's performance as well as their own performance. CEO compensation from salary, bonus and long-term incentive plans is positively related to expected tenure. This is consistent with the view that managers with more ability or in better matches have higher compensation and longer expected tenure. This is also consistent with the view that entrenched managers are able to extract higher compensation and more secure employment. Option compensation is endogenous and unrelated to CEO tenure. We also find greater CEO stock ownership increases expected tenure while more monitoring by the board of directors decreases expected tenure. Some of the results (e.g., for compensation) are also consistent with what we would expect if governance functions poorly. But overall, the results on the determinants of CEO tenure are consistent with what we would expect if corporate governance functions well.

When we examine the shape of the hazard function, we find that the risk of termination increases for the first thirteen years, then decreases with tenure. Only 18% of CEOs have more than thirteen years of tenure. This inverse-U shape of the hazard function is not inconsistent with the predictions of matching theory and with CEO power theories. However, we do not interpret the result as providing strong support for either of the theoretical models. While readers may have different views, thirteen years seems a very long time for the board to learn the quality of the CEO/firm match or for the CEO to be able to gain influence over the board.

Finally, we examine the effect of the risk of termination on firm value. Firm value, measured by Tobins' *Q* or by ROA, is not affected by changes in the CEO's risk of termination. This result is not consistent with the prediction of matching theory that good CEO/firm matches increase firm value. This result is not consistent with the view that CEOs use their influence over the board to obtain private benefits, such as increased compensation and more secure employment, at the expense of shareholders. However, about 82% of all CEOs have tenure less than thirteen years, the point at which the average risk of termination stops increasing. We conclude that CEOs typically do not become entrenched and, even if they did, it would not affect firm value. Taken as a whole, our results are consistent with the view that corporate governance, or at least the aspects of it studied here, functions reasonably well for the vast majority of firms.

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