CEO Tenure and Risk-Taking

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CEO Tenure and Risk-Taking

Dong Chen and Yudan Zheng*

This paper conducts a systematic analysis of the effect of CEO tenure on risk-taking. We document an overall positive effect of tenure on risk-taking, which is inconsistent with viewing tenure primarily as an indicator of human capital investment. Though we can not rule out the explanations based on the power and experience effects of tenure, our results are more consistent with interpreting tenure as the career concerns of a manager. Consistent with this interpretation and recent theoretical work, we show that the effect of CEO tenure on risk-taking depends on the information asymmetry about CEO ability.

I. Introduction

There is a long list of empirical studies examining the effect of "explicit" compensation incentives on managerial risk-taking (e.g., Guay, 1999; Coles et al., 2006; Chakraborty et al., 2007; Brick et al., 2012; Gormley et al., 2013). In contrast, the empirical work on the relationship between risk-taking and "implicit" incentives, in particular the incentives of managers to secure or advance their careers, is significantly less, despite the arguments that career concerns matter for risk-taking incentives (e.g., Hermalin, 1993; Holmstrom, 1999; Chen, 2013; Fu and Li, 2014). Because newly promoted CEOs may be more concerned about their career prospects than long-serving CEOs, prior studies have used the tenure of CEOs as a proxy for career concerns (e.g., Gibbons and Murphy, 1992; Hong et al., 2000; Milbourn, 2003; Cremers and Palia, 2010). In this study, we extend this line of work by studying the effect of CEO tenure on risk-taking.

It is notable that a number of studies already include CEO tenure in their risk-taking regressions (Bloom and Milkovich, 1998; Coles et al., 2006; Chakraborty et al., 2007; Simsek, 2007; Hirshleifer et al., 2012; Ryan and Wang, 2012; Muscarella and Zhao, 2013; Serfling, 2013; Cain and Mckeon, 2014). We differentiate from these studies in two ways. First, unlike these studies which merely include tenure as a control variable, we undertake a systematic analysis of the effect of tenure on risk-taking. To our knowledge, we are the first to examine tenure as a proxy for CEO career concerns in the risk-taking study, in addition to using tenure as a measure of managerial power, human capital investment and, less so, experiences, as in the extant studies. The dominant prediction in the literature is that, because longer tenure indicates higher risk-aversion due to either larger private benefits from control associated with higher managerial power or more undiversified human capital investment, tenure should be negatively associated

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* **Dong Chen** is an Assistant Professor of Finance at the Merrick School of Business at the University of Baltimore, Baltimore, MD, USA.

Yudan Zheng is an Associate Professor of Finance at the School of Business, Public Administration and Information Sciences at Long Island University, Brooklyn, NY, USA.

with risk-taking. In contrast, we argue that the impact of tenure on risk-taking is generally ambiguous.[1] We conduct a number of tests to examine four different hypotheses on CEO tenure and risk-taking. Second, our empirical methodology is different from most other related work. In addition to the commonly employed panel regressions, we also entertain CEO-firm fixed effects and system GMM models, to alleviate the concerns for endogeneity.[2] In addition, we follow Brick et al. (2012) and control for lagged dependent variables, which may further reduce the endogeneity concerns.

Based on a sample of S&P 1,500 firms between 1992 and 2006, we document a positive impact of CEO tenure on risk-taking. This result is inconsistent with viewing tenure primarily as a measure of human capital investment. In further differentiating among the other three effects of tenure, we find that the results are most consistent with interpreting tenure as a measure of career concerns. Consistent with recent theoretical work (Chen, 2013), we document a differential impact of CEO tenure on risk-taking conditional on the information asymmetry regarding the ability of the CEO.

Our work suggests the importance of career concerns in affecting managerial risk-taking, which has not received much attention in the literature. A significant number of studies examine the relationship between career concerns and herding (e.g., Hong et al., 2000; Lamont, 2002), which is a form of relative risk-taking, rather than risk-taking itself. A small strand of studies employ termination risk or CEO age to proxy for career concerns and find mixed evidence on their effects on risk-taking (Chevalier and Ellison, 1999; Chakraborty et al., 2007; Hu et al., 2011; Garfinkel et al., 2013; Serfling, 2013). We add to this line of work not only through the use of a new measure for career concerns, but also by demonstrating a differential effect of career concerns on risk-taking conditional on the information asymmetry about CEO ability. These results provide additional insight into the effect of career concerns on managerial behavior.

Our work also suggests the importance of empirical specifications in risk-taking studies. The positive effect of CEO tenure on risk-taking as we document is consistent with some studies (Bloom and Milkovich, 1998; Serfling, 2013) but in contrast with others (Coles et al., 2006; Chakraborty et al., 2007; Hirshleifer et al., 2012). We show that the difference between the results is at least partly driven by the difference in model specifications, in particular whether the regression controls for both CEO tenure and age, and the lagged dependent variable. The differential impact of CEO tenure on risk-taking contingent on the information asymmetry regarding CEO ability provides another explanation for the mixed results, because samples in different studies may be characterized by different degrees of information asymmetry on CEO ability.

Finally, we also aim to shed light on the balance of implicit risk-taking incentives associated with tenure with explicit compensation incentives. With regard to effort incentives, Gibbons and Murphy (1992) document increasing compensation incentives with the declining of career concerns. We extend their work by considering risk-taking in addition to effort incentives. We show that pay-performance sensitivity (delta) increases with CEO tenure, which is consistent

[1] This argument may explain the mixed empirical evidence on the relationship between CEO tenure and risk-taking as documented in the literature. Most studies do not detect a significant relation between tenure and risk-taking (Ryan and Wang, 2012; Muscarella and Zhao, 2013; Cain and Mckeon, 2014). Some find a negative relation (Coles et al., 2006; Chakraborty et al., 2007; Hirshleifer et al., 2012). A few find a positive and significant relation (Bloom and Milkovich, 1998; Serfling, 2013).

[2] The results with system GMM models are similar to those using the other two model specifications, and are not reported to save space. The advantage of GMM specification is that it considers the endogeneity of not only the primary variable of interest, but also other potentially endogenous control variables.

with the idea that delta balances the reduced effort incentives as a result of declining career concerns (Cremers and Palia, 2010). But given the risk-reducing effect of delta as documented in this paper, the positive association between delta and tenure is also consistent with the idea that delta offsets the risk-increasing effect of tenure. We further show that pay-volatility sensitivity (vega), which also reduces the risk-taking incentives of a CEO, is negatively associated with tenure. This result may suggest a complementary role vega plays in providing optimal risk-taking incentives. The significant relationship between vega and tenure contradicts the exclusion condition used by some studies in their simultaneous-equation models (e.g., Coles et al., 2006).

The rest of the paper is structured as follows. Section II develops four hypotheses relating tenure to risk-taking. Section III describes the data and major variables, and reports the summary statistics. Section IV conducts the empirical analysis. Finally, Section V concludes.

II. Hypothesis Development

As mentioned above, there can be at least four different effects associated with the increase of tenure. First, longer tenure may increase managerial power (Hermalin and Weisbach, 1998). Second, as tenure increases, managers also have more undiversified human capital invested in the firm (Berger et al., 1997). Third, the experiences of a manager may also accumulate with tenure (Simsek, 2007). Finally, the increase of tenure also implies declining career concerns of a manager (Gibbons and Murphy, 1992). Among these effects, the impact of human capital investment on managerial risk-taking is unambiguously negative (Amihud and Lev, 1981; Bloom and Milkovich, 1998; Chakraborty et al., 2007), which results in the following:

Human Capital Hypothesis: *CEO tenure is negatively related to risk-taking.*

However, the relationship between tenure and risk-taking is uncertain based on the other three effects of tenure. First, it is not clear how managerial power affects risk-taking. Hermalin and Weisbach (1998) develop a model on board composition based on the bargaining between the CEO and the board. The turnover of the CEO is determined by his or her perceived ability, which is inferred from firm performance. If retained, the incumbent CEO bargains for a less independent board. Therefore, longer tenure of the CEO suggests greater managerial power and entrenchment. Entrenched managers may take fewer risks to protect their private benefits from control (Bertrand and Mullainathan, 2003). This suggests that CEO tenure should be negatively associated with risk-taking, as commonly assumed in the literature.

On the other hand, Adams et al. (2005) show that founder CEOs, who are presumably very powerful people, are nevertheless associated with greater variability in firm performance. The rationale is that the risk arising from the judgment errors of a powerful CEO is not well diversified because the CEO dictates the decision-making process (Sah and Stiglitz, 1986, 1991). This leads to extreme corporate actions. Similarly, Cheng (2008) documents that a larger board is associated with less volatile firm performance, because the decision errors of individual directors are dissipated over their colleagues. Social psychology also suggests that an elevated power may increase (decrease) an individual's sensitivity to rewards (threat) (Keltner et al., 2003). This "approach-related" behavior often results in risk-taking (Lewellyn and Muller-Kahle, 2012). Therefore, the relationship between managerial power and risk-taking is ambiguous.

The effect of experiences on risk-taking is also uncertain. On the one hand, some studies suggest that inexperienced individuals tend to be more overconfident, and therefore experiences may lower the level of overconfidence (Locke and Mann, 2003). If overconfidence is associated with more risk-taking (Gervais et al., 2011), the accumulation of experiences should lead to less

risk-taking. On the other hand, an experienced manager may possess sufficient skills that are necessary to take strategic risks (Simsek, 2007).[3] Glaser et al. (2010) also suggest that experiences may increase the degree of overconfidence, and therefore promote risk-taking.

The ambiguity of the power and experience effects of tenure on risk-taking implies that a direct test of the relationship between tenure and risk-taking can not differentiate these two effects. However, if power drives the effect of tenure on risk-taking, it is expected that such an effect would be more pronounced if, in addition to being powerful as suggested by tenure, the CEO is also powerful by other means. We therefore state our power hypothesis as the following:

Power Hypothesis: *The effect of CEO tenure on risk-taking is more pronounced if the CEO is also powerful as suggested by other mechanisms besides tenure.*

Similarly, if managerial experiences drive the effect of tenure on risk-taking, it is expected that this effect should be more significant if a CEO is abler as well as experienced.[4]

Experience Hypothesis: *The effect of CEO tenure on risk-taking is more pronounced if the CEO is abler.*

Finally, if tenure proxies for career concerns, the relationship between CEO tenure and risk-taking is also ambiguous. Holmstrom (1999) argues that managers underinvest relative to the optimal level, because risky investment may reveal their true ability, which may compromise their future compensations. Similarly, Hirshleifer and Thakor (1992) argue that career concerns may incentivize managers to favor safe projects in an attempt to delay the resolution of the uncertainty about their ability. In contrast, Hermalin (1993) argues that managers may take the riskiest project, because doing so forces the market to rely more on the prior estimate of their ability, which decreases the uncertainty on their wages. However, this result hinges on the somewhat unrealistic assumption of the observability of project risk.

In a more general setting, Chen (2013) argues that managerial risk-aversion in Holmstrom (1999) depends critically on the assumption of information symmetry regarding the ability of the manager. If managers are privately informed of their abilities, Chen (2013) shows that they always take risks. The intuition is that because it is more likely for an able manager to succeed with a risky project, taking risks would signal to the market that a manager is talented. Therefore, managers choose risky projects regardless of their abilities. Similarly, in the context of political reform, Fu and Li (2014) argue that a privately informed politician has the incentive to engage in a risky reform to be perceived as capable, even if such an action is detrimental to the society. The results in Chen (2013) and Fu and Li (2014) suggest that career concerns should increase risk-taking if managers possess private information about their own ability. In other words, tenure should be negatively associated with risk-taking under such a scenario. Combining the results in Holmstrom (1999), Chen (2013), and Fu and Li (2014), a differential impact of CEO tenure on risk-taking is expected conditional on the level of information asymmetry about CEO ability. Because the hiring and firing decisions of a CEO are made by the board of directors, the information asymmetry should be between the CEO and the board rather than the market in our context. We therefore state our career concern hypothesis in the following form:

[3] Though both this argument and the human capital hypothesis depend on firm-specific skills, the difference between these two hypotheses is that while the former stresses the necessity of these skills for a manager to take strategic risks, the latter stresses the undiversified nature of these skills which results in the risk-aversion of a manager.

[4] We do not examine the experience hypothesis by testing the interaction of CEO tenure and other measures of experiences, because measures of experiences are harder to come by than abilities. But it should be natural to expect that the effects of experiences and abilities on risk-taking are similar.

Career Concern Hypothesis: *The effect of CEO tenure on risk-taking is more negative or less positive if the information asymmetry between the board and the CEO regarding the CEO ability is higher.*

Two notes are in order on the four hypotheses on CEO tenure and risk-taking as developed in this section. First, it is possible that multiple effects of tenure may be at work. As a result, the four hypotheses may not be mutually exclusive. Therefore, our test on the different hypotheses should be understood as examining the dominant channel(s) through which tenure may affect risk-taking. Second and related, the declining of career concerns with longer tenure is based on the notion that newly-appointed CEOs care more about their future careers because they have more years to work. This follows the convention in the literature (e.g., Hong et al., 2000; Cremers and Palia, 2010). Theoretically speaking, however, the sources of career concerns may be beyond this "mechanical" mechanism. In particular, powerful or experienced CEOs may be harder or undesirable to be replaced, and hence these CEOs may have less career concerns. Considering this possibility, a test of the power and experience hypotheses is also a test of whether the source of career concerns of a CEO is managerial power, experiences, or other mechanisms such as the "mechanical" mechanism.

III. Sample, Variables, and Summary Statistics

A. Data and Sample

We merge several databases to form our sample. The data for CEO tenure, age, and compensation are taken from EXECUCOMP. Stock returns to calculate equity volatility and firm age are from CRSP. The calculation of systematic and idiosyncratic volatilities requires data on market factor, which are obtained from Professor Kenneth French's website. Financial data are from COMPUSTAT. Some data used in the tests of power and experience hypotheses are obtained from RiskMetrics and Thomson Reuters. After merging the databases, our primary sample to examine the relationship between CEO tenure and risk-taking includes 11,526 firm-year observations and 2,072 unique firms. The sample mainly covers S&P 1,500 firms from 1992 to 2006.[5] The primary sample includes financial (one-digit SIC code equals 6) and utility firms (two-digit SIC code equals 49). In an unreported robustness check we exclude these firms and obtain similar results.

B. Variables

We describe the major variables used in the empirical analysis in this subsection. The detailed definitions are in the Appendix. To consider the influence of outliers, we either winsorize a variable at the 1st and 99th percentiles, or take the log of that variable. In unreported

[5] Our sample period precedes the "great recession" starting at 2007 due to two reasons. First, we lack some recent data needed in testing the hypotheses in our study. Second and more importantly, because we are interested in examining the "clean" effects of CEO tenure on risk-taking, including the sample period with extraordinary events such as the financial crisis may introduce some unnecessary complications. For example, as argued in our paper, longer tenure may indicate higher managerial power. Whether this is still true in the event of financial crisis is uncertain. On the one hand, crises may be the time when a longer-tenured manager enjoys the benefit of entrenchment. On the other hand, crises may also change the balance of power between various constituents of a firm, and reduce the relevance of tenure in empowering a manager. Therefore, tests of the power and experience hypotheses during the financial crisis are not only a test of the tenure effects, but also a test of whether the financial crisis makes tenure more or less relevant to proxy for power or experiences, thus complicating the matters.

analysis, we also obtain qualitatively similar results using the raw data without winsorizing, or winsorizing the variables at the 5th and 95th percentiles.

1. Risk-Taking Variables

We follow many others (e.g., Bloom and Milkovich, 1998; Guay, 1999; Chakraborty et al., 2007) and use the volatility of stock returns rather than specific corporate policies as a proxy for managerial risk-taking, to avoid the ambiguity of the interpretations for these policies. For example, financial leverage may indicate managerial risk taking (Cain and Mckeon, 2014). But leverage may also discipline managers from consuming excessive cash flows (Jensen, 1986). Similarly, R&D expenditure is frequently used as a risk-taking proxy (e.g., Ryan and Wiggins, 2002). But R&D may also represent a long-term investment (e.g., Dechow and Sloan, 1991).

We estimate total equity volatility (Volat), as well as decomposing this variable into the systematic volatility (Sys_mkt) and idiosyncratic volatility (Idio_mkt) based on the market model with a constant term.[6]

2. CEO Tenure

CEO tenure in a given year is the length of time between the date when the person became the CEO ("becameceo" in EXECUCOMP) and the current fiscal year end. Figure 1 shows that while the distribution of CEO tenure is skewed, the distribution of the log of tenure is much more symmetric. Therefore, we take the log of CEO tenure in our regressions, which separates our work from most other risk-taking studies. This may provide one explanation for the difference in results. In contrast to the distribution of CEO tenure, we find that the distribution of the log of CEO age is even more skewed than its raw data. Therefore, we control for CEO age in its raw format, rather than taking logs.

3. Compensation Incentives

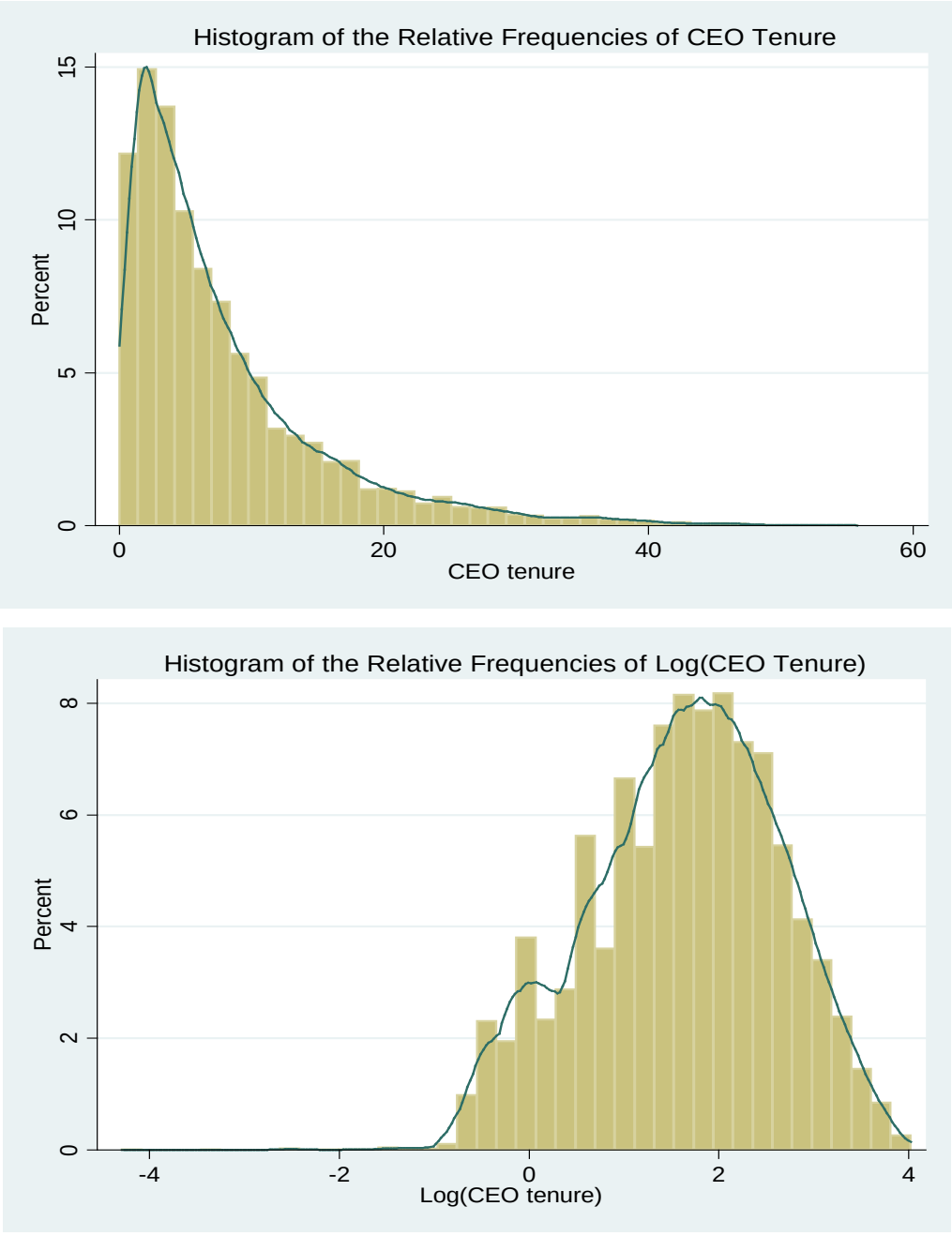
Explicit compensation incentives, including delta and vega, have been shown to affect managerial risk-taking. We use the "one-year approximation" method in Core and Guay (2002) to estimate these two sensitivities. The estimation of delta is based on CEO total portfolio wealth, which includes newly granted and outstanding options, and stocks. However, Guay (1999) shows that option vega is several orders of magnitude higher than stock vega. Therefore, we use option vega to approximate the vega of CEO total wealth.

4. Control Variables

In the risk-taking regressions we also control for several CEO and firm characteristics. For CEO characteristics, we include CEO age together with tenure, since these two variables are significantly correlated with each other. Age has been used as another proxy for career concerns (Chevalier and Ellison, 1999), and hence has an uncertain impact on risk-taking based on our arguments above. However, older CEOs are expected to be more conservative in setting corporate policies (Tufano, 1996; Bertrand and Mullainathan, 2003). If this demographic effect dominates, CEO age is expected to be negatively associated with risk-taking. We also include CEO cash compensation, which may increase risk-taking (Guay, 1999). The firm-level characteristics include (inflation-adjusted) firm size, market-to-book ratio, return on assets

[6] In unreported analysis we also use the Fama-French-Carhart four factor model to calculate the idiosyncratic volatility, and obtain substantially similar results as those based on the market model.

Figure 1. Histograms of the Relative Frequencies of CEO Tenure and the Log of CEO Tenure



(ROA), capital expenditures, R&D expenses, financial leverage, and firm age (Guay, 1999; Coles et al., 2006; Ryan and Wang, 2012; Cain and Mckeon, 2014). We also control for corporate diversification using the (log of) number of business segments.[7]

[7] These control variables follow the literature on risk-taking and do not include corporate hedging. To the extent that hedging is correlated with CEO tenure, this may result in an omitted variable bias. In our specific context, however,

In the delta and vega regression models, we also control for the inflation-adjusted cash balance as a proxy for the liquidity of the firm, in addition to the control variables in the risk-taking regressions. Yermack (1995) documents that liquidity-constrained firms may be more inclined to pay their CEOs with options.

C. Summary Statistics

Table 1 presents summary statistics and correlations of the variables in our primary analyses. Panel A shows that the average (median) CEO in our sample is 55.63 (56) years old with a tenure of 7.95 (5.42) years. As expected, Panel B shows that tenure is significantly correlated with age (0.35). Except for the correlation between CEO tenure and delta, the correlations between tenure and other variables, including the equity volatilities and vega are low. With the inclusion of the control variables, however, we show subsequently that the effects of CEO tenure on these variables are significant.

IV. Empirical Analysis

In this section we examine the four hypotheses in Section II on CEO tenure and risk-taking. We then examine the relationship between CEO tenure and delta and vega, to gauge the balance of explicit risk-taking compensation incentives with implicit incentives.

A. CEO Tenure and Risk-Taking

We use two model specifications to examine the relationship between CEO tenure and risk-taking. We first employ OLS models, which is common in the literature. But this specification is subject to the endogeneity concerns in the form of reverse causality or omitted variable bias.

Reverse causality may not be a serious problem in our context, because CEO tenure is a "state" variable. We adopt several strategies to alleviate the potential omitted variable bias. First, in addition to the extensive list of controls as described above, we also follow Brick et al. (2012) and control for lagged dependent variables.[8] Second, we control for the two-digit SIC industry and year effects. Recent studies also suggest that innate attributes of managers matter for corporate risk-taking (e.g., Hilary and Hui, 2009; Cain and Mckeon, 2014). To account for this effect, our second specification employs models with CEO-firm fixed effects, similar to Cremers and Palia (2010). In both model specifications, standard errors are adjusted for heteroskedasticity and clustered at the firm level.[9]

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this bias may be less relevant because we focus on identifying the dominant channel through which CEO tenure affects risk-taking, and in testing the hypotheses we examine a differential impact of tenure on risk-taking, conditional on different levels of CEO power or ability, or information asymmetry regarding CEO ability. We believe the direct effect of CEO tenure on risk-taking may be subject more to this omitted variable bias. In this case, because the correlation between CEO tenure and hedging is uncertain based on the evidence in the literature (Tufano, 1996; Kumar and Rabinovitch, 2013), the direction of the bias is also ambiguous.

[8] The dependent variables for the risk-taking regressions are lagged at the firm level. In contrast, the dependent variables for the delta and vega regressions in Section C are lagged with respect to the CEO-firm matched pair. This is because while volatilities may be firm specific, delta and vega should be both firm and CEO specific.

[9] For the delta and vega regressions, standard errors are clustered at the CEO-firm level. Our results remain similar if standard errors are generated from bootstrapping with clustering.

Table 1. Summary Statistics

Panel A: Summary Statistics

Variable	Observations	P25	Mean	Median	P75	Std
Tenure	11,526	2.59	7.95	5.42	10.59	7.80
Volat	11,526	0.02	0.03	0.02	0.03	0.01
Sys_mkt	11,526	0.01	0.01	0.01	0.01	0.01
Idio_mkt	11,526	0.02	0.02	0.02	0.03	0.01
Delta (10^3)	11,526	58.84	1,569.31	182.40	568.35	16,104.72
Vega (10^3)	11,526	3.53	113.14	32.59	107.26	278.81
CEO age	11,526	51.00	55.63	56.00	60.00	7.51
CEO cash (10^6)	11,526	0.46	1.03	0.75	1.27	0.94
Size	11,526	5.93	7.11	6.93	8.14	1.66
Mb	11,526	1.19	2.00	1.54	2.25	1.32
ROA	11,526	0.09	0.13	0.13	0.19	0.10
Capexp	11,526	0.00	0.04	0.02	0.06	0.05
R&D	11,526	0.00	0.03	0.00	0.03	0.05
Leverage	11,526	0.07	0.23	0.22	0.35	0.18
Segment	11,526	3.00	5.01	4.00	7.00	2.97
Firm age	11,526	9.84	24.96	19.85	33.53	19.11
Cash bal (10^6)	11,523	18.50	463.34	64.11	210.53	1,804.73

Table 1. Summary Statistics (continued)

Panel B: Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Tenure (1)	1.00																
Volat (2)	0.00	1.00															
Sys_mkt (3)	0.02	0.48	1.00														
Idio_mkt (4)	0.00	0.99	0.36	1.00													
Delta (5)	0.36	-0.07	0.24	-0.12	1.00												
Vega (6)	0.00	-0.03	0.23	-0.08	0.46	1.00											
CEO age (7)	0.35	-0.19	-0.10	-0.19	0.11	-0.06	1.00										
CEO cash (8)	0.06	-0.23	0.05	-0.27	0.37	0.35	0.14	1.00									
Size (9)	-0.06	-0.46	0.00	-0.50	0.34	0.32	0.13	0.58	1.00								
Mb (10)	0.07	0.14	0.21	0.12	0.37	0.12	-0.09	0.03	-0.17	1.00							
ROA (11)	0.09	-0.27	-0.09	-0.27	0.26	0.09	0.05	0.14	0.05	0.37	1.00						
Capexp (12)	0.08	0.08	-0.02	0.10	0.01	-0.08	-0.05	-0.12	-0.18	0.14	0.21	1.00					
R&D (13)	-0.03	0.38	0.29	0.36	0.00	0.05	-0.13	-0.12	-0.28	0.35	-0.26	-0.01	1.00				
Leverage (14)	-0.07	-0.12	-0.15	-0.10	-0.11	0.02	0.06	0.13	0.29	-0.27	-0.11	-0.05	-0.24	1.00			
Segment (15)	-0.04	-0.10	0.10	-0.14	0.09	0.17	0.10	0.20	0.32	-0.09	-0.06	-0.21	0.03	0.07	1.00		
Firm age (16)	-0.05	-0.45	-0.18	-0.45	-0.04	0.08	0.21	0.24	0.41	-0.18	0.05	-0.14	-0.20	0.14	0.32	1.00	
Cash bal (17)	-0.01	-0.07	0.10	-0.12	0.26	0.15	0.05	0.41	0.48	0.00	-0.06	-0.11	-0.01	0.11	0.13	0.06	1.00

This table reports the summary statistics and correlations of the major variables used in the empirical analysis. Panel A lists the summary statistics. Panel B reports the correlation matrix for the variables. Volat, Sys_mkt, Idio_mkt, Tenure, Delta, Vega, Segment, Firm age are in their raw format in Panel A, but they are transformed into the logged format in Panel B and onward. CEO cash, Mb, ROA, Capexp, R&D, Leverage, and Cash bal have been winsorized at the 1st and 99th percentiles. See the Appendix for the definitions of all variables.

Table 2 reports the OLS regression results on the three risk-taking measures. Model 1 shows a positive and highly significant effect of CEO tenure on total volatility. In contrast, the effect of CEO age on risk-taking is negative and significant. Therefore, the results suggest that though both tenure and age may proxy for career concerns of the CEO, they have directly opposite effects on risk-taking. The risk-reducing effect of age may be explained by the demographic effect of aging. The positive effect of CEO tenure on risk-taking is consistent with Bloom and Milkovich (1998) and Serfling (2013), but in contrast with many others (Coles et al., 2006; Chakraborty et al., 2007; Hirshleifer et al., 2012). We note four possible explanations for the difference in results. First, our sample covers a larger set of firms with a longer time span than these studies. Second, none of these studies control for the lagged dependent variable as we do. Third, most of these papers do not include CEO age together with tenure, despite their significant correlation (Coles et al., 2006; Chakraborty et al., 2007; Hirshleifer et al., 2012). The omission of CEO age may generate a bias on the coefficient of tenure.[10] Fourth, our career concern hypothesis suggests a potentially differential effect of CEO tenure on risk-taking conditional on the information asymmetry regarding CEO ability. Because different studies may employ samples with different degrees of information asymmetry, the effects of CEO tenure on risk-taking may also be different. We examine the second and third possible explanations in Models 2 and 3, and the fourth explanation in the next subsection when we test the career concern hypothesis.

Consistent with the evidence in Brick et al. (2012), Model 1 shows that both delta and vega are negatively associated with risk-taking. The negative effect of delta on risk-taking may reflect the reluctance of a CEO to take risks when her portfolio wealth is sensitive to the fluctuation of stock price (e.g., Coles et al., 2006; Gormley et al., 2013). The risk-reducing effect of vega, however, is harder to reconcile. In contrast, most empirical studies document a positive effect of vega on risk-taking (e.g., Coles et al., 2006; Chakraborty et al., 2007; Gormley et al., 2013). Subsequently we show the importance of controlling the lagged dependent variable in the effect of vega on risk-taking. Here we note one possible explanation for our results. Hjortshoj (2007) demonstrates that the sensitivity of option value to volatility (vega) may not be equivalent to the sensitivity of the certainty equivalent option cash flow to volatility, especially for an undiversified CEO with significant in-the-money options. Because the latter sensitivity is a better indicator of the risk-taking incentives of a CEO, a higher vega does not necessarily induce a CEO to take more risks. We also note that though the coefficients on delta and vega are both negative, the magnitude on vega is about half of that on delta. In an unreported *F*-test, we confirm the statistical difference between the two coefficients. These results suggest a stronger risk-reducing effect of pay-performance sensitivity relative to pay-volatility sensitivity.

In Model 2 we examine whether the results in Model 1 change with the exclusion of the lagged dependent variable and CEO age. To be consistent with the specification in Coles et al. (2006), we also exclude the year dummies. Interestingly, once CEO age and the lagged dependent variable are omitted, CEO tenure becomes *negative* and weakly significant at the 10% level. The contrast between the results in Models 1 and 2 demonstrates that the negative effect of tenure on risk-taking as documented in prior studies may be at least partly due to their omission

[10] Because CEO tenure and age are positively correlated, and CEO age is negatively associated with risk-taking, the bias on CEO tenure due to the omission of age is negative, which may explain why some papers obtain insignificant or negative coefficient on CEO tenure.

Table 2. CEO Tenure and Risk-Taking (OLS Models)

Dependent variable	(1) Votal	(2) Votal	(3) Votal	(4) Sys_mkt	(5) Idio_mkt
Tenure	0.008***	-0.009*	-0.002	0.012**	0.007***
	(3.178)	(-1.716)	(-0.307)	(2.044)	(2.892)
Delta	-0.008***	-0.001	-0.001	0.009*	-0.009***
	(-3.988)	(-0.254)	(-0.137)	(1.830)	(-4.298)
Vega	-0.004***	0.011***	0.010***	0.003	-0.005***
	(-3.506)	(4.104)	(3.534)	(0.892)	(-3.956)
CEO age	-0.001***		-0.003***	-0.003***	-0.001**
	(-2.722)		(-3.556)	(-3.351)	(-2.353)
CEO cash	-0.004	-0.001	0.001	-0.018***	-0.004
	(-1.446)	(-0.111)	(0.158)	(-2.627)	(-1.290)
Size	-0.018***	-0.083***	-0.082***	0.048***	-0.024***
	(-7.525)	(-15.484)	(-15.379)	(7.925)	(-9.471)
Mb	0.009***	0.027***	0.026***	0.061***	0.004*
	(4.146)	(5.257)	(5.021)	(10.954)	(1.682)
ROA	-0.442***	-1.186***	-1.182***	-0.321***	-0.444***
	(-14.208)	(-18.132)	(-18.187)	(-4.226)	(-14.186)
Capexp	0.186***	0.291***	0.277***	0.407***	0.181***
	(4.134)	(2.826)	(2.693)	(3.416)	(3.976)
R&D	0.338***	1.180***	1.159***	0.752***	0.398***
	(6.191)	(9.369)	(9.204)	(5.527)	(7.115)
Leverage	0.068***	0.224***	0.225***	-0.079**	0.077***
	(4.200)	(6.019)	(6.028)	(-2.201)	(4.642)
Segment	0.010***	0.065***	0.066***	0.028***	0.008**
	(2.584)	(7.033)	(7.111)	(2.670)	(2.066)
Firm age	-0.025***	-0.121***	-0.117***	-0.042***	-0.027***
	(-8.055)	(-15.344)	(-14.745)	(-5.277)	(-8.189)
Lagged Volat	0.670***				
	(75.542)				
Lagged Sys_volat				0.402***	
				(33.747)	
Lagged Idio_volat					0.669***
					(75.553)
Observations	11,526	11,526	11,526	11,526	11,526
Number of firms	2,072	2,072	2,072	2,072	2,072
Adjusted R^2	0.81	0.48	0.49	0.54	0.81

These models use OLS regressions to examine the relation between CEO tenure and risk-taking. The sample consists of S&P 1,500 firms from 1992 to 2006. See the Appendix for the definitions of all variables. All models include dummies for two-digit SIC code and a constant term. Except for Models 2 and 3, all models also include year dummies. These coefficients are not reported to save space. Standard errors are adjusted for heteroskedasticity and clustered at the firm level. *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

of age.[11] Indeed, once we control for CEO age but still leave the lagged dependent variable out of the regression in Model 3, the age variable picks up all the significance of tenure.

[11] Coles et al. (2006) state that their major results on the relation between vega (delta) and risk-taking remain when CEO age is controlled for, but do not discuss whether the inclusion of age changes the coefficient on tenure.

The results in Models 2 and 3 also show that if we exclude the lagged dependent variable, vega becomes *positive* and significant. Since the lagged dependent variable is highly significant as shown in Model 1, and it is reasonable to expect that lagged firm risk should affect the risk-taking incentives of a CEO, the results in these two models suggest a possible omitted variable bias on vega with the exclusion of lagged dependent variable.

In Models 4 and 5, we use the systematic and idiosyncratic volatilities to further examine the relation between CEO tenure and risk-taking. The positive and significant effect of tenure on risk-taking persists across these models. The results also show a consistently negative impact of CEO age on risk-taking. The negative effects of delta and vega on risk-taking still hold for the model with respect to idiosyncratic volatility. However, for the model on systematic volatility, both delta and vega are positive and the coefficient on delta is significant at the 10% level. Nonetheless, we show subsequently that once the CEO-firm fixed effects are controlled for, the positive coefficient on delta is no longer significant.

The control variables generally have their expected signs. In contrast with Coles et al. (2006) but similar to Ryan and Wang (2012) and Muscarella and Zhao (2013), we document a positive effect of capital expenditures on equity volatility. We also note that firm size and leverage have opposite effects on systematic volatility as on idiosyncratic volatility.

In Table 3 we examine the robustness of the positive effect of CEO tenure on risk-taking using CEO-firm fixed effects models. The results are qualitatively similar, albeit statistically weaker.[12] Table 3 also shows that delta and vega continue to be negative and significantly associated with risk-taking in most of the models.

Overall, the results in Tables 2 and 3 document a consistently positive impact of CEO tenure on risk-taking. The evidence is inconsistent with the human capital hypothesis. However, the other three hypotheses (power, experience, and career concern) may all explain this result. In the next subsection we further test the three hypotheses. We employ the fixed effects specifications as in Table 3 for these tests. To save space, we only report the results using total volatility as the risk-taking variable. Results with respect to the other risk-taking proxies are qualitatively similar.

B. Hypothesis Test

1. Power Hypothesis

The power hypothesis predicts that the effect of tenure on risk-taking should be more pronounced if the CEO is also powerful as suggested by other means besides tenure. To test this hypothesis, we examine the interaction of tenure and mechanisms indicating weak corporate governance hence stronger CEO power on risk-taking. The power hypothesis would predict a positive effect of the interaction term.

We entertain several governance mechanisms based on the literature. First, independent directors may have strong incentives to monitor management and reduce its power (see, e.g., the survey evidence in Hermalin and Weisbach, 2003). We define a dummy variable that equals one if a firm has less than a majority of independent directors on its board, and zero otherwise (No majority ind). Following Bebchuk et al. (2011), our second measure of CEO power is the fraction of the aggregate compensation of the top five executives captured by the CEO – the CEO Pay Slice (CPS). CPS is an indicator of the extent to which a CEO is able to extract

[12] One potential explanation for the weaker results is the inclusion of a large number of dummy variables in the fixed effect specifications (3,378 CEO-firms), which may decrease the power of the test. As evidence for this argument, we note that the coefficients on CEO tenure and age based on the fixed effects models in Table 3 are comparable to those based on the OLS models in Table 2.

Table 3. CEO Tenure and Risk-Taking (CEO-Firm Fixed Effects Models)

	(1)	(2)	(3)
Dependent variable	Votal	Sys_mkt	Idio_mkt
Tenure	0.017**	0.013	0.013*
	(2.246)	(0.634)	(1.678)
Delta	-0.022***	0.013	-0.024***
	(-4.231)	(0.963)	(-4.635)
Vega	-0.005**	-0.004	-0.006**
	(-2.151)	(-0.721)	(-2.375)
CEO age	-0.002	-0.007	-0.002
	(-0.246)	(-0.395)	(-0.267)
CEO cash	-0.028***	-0.038***	-0.030***
	(-4.621)	(-3.058)	(-5.060)
Size	-0.013	0.087***	-0.027**
	(-1.289)	(2.986)	(-2.530)
Mb	0.014***	0.091***	0.005
	(3.432)	(8.765)	(1.172)
ROA	-0.382***	-0.243*	-0.338***
	(-6.940)	(-1.820)	(-6.085)
Capexp	-0.038	0.436**	-0.063
	(-0.472)	(2.134)	(-0.771)
R&D	0.150	-0.233	0.240
	(1.050)	(-0.771)	(1.634)
Leverage	0.075**	-0.094	0.099***
	(2.211)	(-1.187)	(2.792)
Segment	0.035***	0.025	0.036***
	(3.986)	(0.898)	(3.883)
Firm age	-0.151***	-0.127**	-0.143***
	(-6.939)	(-2.243)	(-6.319)
Lagged Volat	0.202***		
	(13.214)		
Lagged Sys_volat		0.053***	
		(3.262)	
Lagged Idio_volat			0.199***
			(12.871)
Observations	11,526	11,526	11,526
Number of CEO-firms	3,378	3,378	3,378
Adjusted R^2	0.54	0.27	0.54

These models use CEO-firm fixed effects regressions to examine the relation between CEO tenure and risk-taking. The sample consists of S&P 1,500 firms from 1992 to 2006. See the Appendix for the definitions of all variables. All models include year dummies and a constant term. These coefficients are not reported to save space. Standard errors are adjusted for heteroskedasticity and clustered at the firm level. *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

rents. We define a dummy variable that equals one if the CPS of the firm is above the sample median, and zero otherwise (High CPS). Another important governance mechanism is blockholding. Blockholders may spend the necessary efforts to monitor management to overcome the "free-riding" problem. Due to the difficulty of collecting data for all blockholders, we follow Cremers et al. (2007) and use the percentage of shares held by institutional blockholders with at least 5% ownership. We define a dummy variable that equals one if the

fraction of the institutional blockholdings of the firm is at or below the sample median, and zero otherwise (Low inst block).[13] Our fourth measure of corporate governance follows Agrawal and Nasser (2012), who show that independent directors who are also blockholders have both a strong incentive and the ability to monitor management. We define a dummy variable to equal to one if the firm does not have an independent director with at least 5% ownership, and zero otherwise (No ind block). Finally, we use the G-index as in Gompers et al. (2003), which indicates the number of antitakeover provisions in the firm's charter, bylaw, and the state where the firm is incorporated. Based on this measure, we define a dummy variable that equals one if the G-index is above the sample median, and zero otherwise (High G-index).[14]

We then interact these governance variables suggesting high CEO power with tenure in the risk-taking regressions. Table 4 reports the results. Because the data for independent directors and independent blockholders are not available prior to 1996 and 1998, respectively, the sample sizes based on these two measures of CEO power are significantly smaller.

The results in Table 4 show that all of the interaction terms are insignificant.[15] The insignificant results suggest that even though we may not be able to rule out the power effect of CEO tenure, the primary channel through which tenure matters for risk-taking may not be power.

2. Experience Hypothesis

It is natural to expect that if experiences drive the positive effect of CEO tenure on risk-taking, such an effect would be stronger if the CEO is also abler besides being experienced. We examine several indicators of CEO ability and interact them with tenure to test the experience hypothesis. Positive interactions should be consistent with this hypothesis.

Our first proxy for ability is the number of external boards a CEO sits on. An abler CEO is expected to sit on more boards (Padmanabhan and Ghosh, 2009). We create a dummy variable that equals one if the number of boards a CEO sits on is more than the sample median, and zero otherwise (More CEO boards). Since the data for external directorships are not available before 1998, the sample size with this measure of CEO ability is significantly reduced. We follow Milbourn (2003) and define our second and third proxies for CEO ability as the industry-adjusted ROA and stock return, respectively. We use the two-digit SIC code to define industries.[16] Better performance relative to industry peers may suggest that the CEO is abler. We also create dummy variables by comparing these ability measures with their respective sample medians (High ind-adj ROA and High ind-adj stkret). The three proxies of CEO ability are then interacted with CEO tenure respectively in the risk-taking regressions. Table 5 reports the results.

Most of the interaction terms are insignificant in the table. Model 1 even shows that the interaction is *negative* and weakly significant, which is opposite to the prediction of the

[13] Results are similar using a more conventional measure of institutional blockholdings based on whether a firm has at least one institutional blockholder with at least 5% ownership.

[14] Results are similar if we define the high entrenchment dummy based on the E-index, which measures the number of the six most important antitakeover provisions at the firm level (Bebchuk et al., 2009). The results are also similar if we use the presence of a classified board as an indicator of managerial power (Bebchuk and Cohen, 2005).

[15] In an unreported analysis, we also entertain two more proxies of CEO power. We follow Ashbaugh-Skaife et al. (2006) and measure power as the number of positions a CEO holds inside the firm, including chairman of the board and memberships of the three major committees (audit, compensation, and nomination). We also use whether a CEO is also the chairman as an indicator of CEO power. Results with these proxies of power are insignificant either.

[16] Specifically, industry-adjusted ROA (stock return) is the ratio of the difference between firm ROA (stock return) and median industry ROA (stock return) to the standard deviation of ROAs (stock returns) for all the firms in the same industry in a given year.

Table 4. Test of Power Hypothesis

	(1)	(2)	(3)	(4)	(5)
Dependent variable	Votal	Votal	Votal	Votal	Votal
Tenure	0.012	0.018**	0.008	0.003	0.021**
	(1.280)	(2.015)	(0.972)	(0.158)	(2.062)
Tenure * No majority ind	-0.016				
	(-1.443)				
No majority ind	0.051**				
	(2.151)				
Tenure * High CPS		0.004			
		(0.638)			
High CPS		-0.003			
		(-0.299)			
Tenure * Low inst block			0.006		
			(0.902)		
Low inst block			0.002		
			(0.135)		
Tenure * No ind block				-0.002	
				(-0.095)	
No ind block				-0.009	
				(-0.229)	
Tenure * High G-index					-0.012
					(-1.362)
High G-index					0.013
					(0.625)
Observations	8,733	10,735	10,518	7,179	9,822
Number of CEO-firms	2,757	3,262	3,166	2,414	2,992
Adjusted R^2	0.58	0.55	0.55	0.57	0.55

These models use CEO-firm fixed effects regressions to test the power hypothesis, which states that the positive effect of CEO tenure on risk taking is due to longer tenure proxying for higher CEO power, which may either drive the CEO to take extreme actions as a result of non-diversified decision errors, or activate the approach-related behavioral tendencies leading to risk-taking. The sample consists of S&P 1,500 firms from 1992 to 2006. No majority ind is a dummy variable that equals one if the firm has less than a majority of independent directors on its board, and zero otherwise. High CPS is a dummy variable that equals one if the fraction of the aggregate compensation of the top five executives captured by the CEO – the CEO Pay Slice (CPS), is above the sample median, and zero otherwise. Low inst block is a dummy variable that equals one if the percentage of shares held by institutional blockholders with at least 5% ownership is at or below the sample median, and zero otherwise. No ind block is a dummy variable that equals one if the firm does not have an independent director with at least 5% stock ownership, and zero otherwise. High G-index is a dummy variable that equals one if the G-index of the firm is above the sample median, and zero otherwise. All models also include the control variables as in Model 1 of Table 3. These variables are omitted to save space. Standard errors are adjusted for heteroskedasticity and clustered at the firm level. *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

experience hypothesis. One may argue that this evidence is also inconsistent with viewing experiences as a source of career concerns, based on our discussions in Section II. This is plausible if an abler CEO with more directorships is less concerned about her future career. However, a counter argument may also hold according to Fama (1980), as managers with outside directorships care about their reputation and hence future careers. Therefore, the evidence in

Table 5. Test of Experience Hypothesis

Dependent variable	(1) Votal	(3) Votal	(4) Votal
Tenure	0.008	0.020**	0.017**
	(0.693)	(2.444)	(2.001)
Tenure * More CEO boards	-0.017*		
	(-1.798)		
More CEO boards	0.027		
	(1.562)		
Tenure * High ind-adj ROA		-0.006	
		(-1.044)	
High ind-adj ROA		0.001	
		(0.055)	
Tenure * High ind-adj stkret			-0.002
			(-0.510)
High ind-adj stkret			-0.026***
			(-2.983)
Observations	6,980	11,515	11,467
Number of CEO-firms	2,360	3,375	3,347
Adjusted R^2	0.57	0.54	0.55

These models use CEO-firm fixed effects regressions to test the experience hypothesis, which states that the positive effect of CEO tenure on risk taking is either due to the accumulation of experiences which are necessary for the CEO to take strategic risks, or due to overconfidence as a result of the expertise associated with longer tenure. The sample consists of S&P 1,500 firms from 1992 to 2006. More CEO boards is a dummy variable that equals one if the number of external boards the incumbent CEO sits on is more than the sample median, and zero otherwise. High ind-adj ROA is a dummy variable that equals one if the industry-adjusted ROA (the ratio of the difference between firm ROA and the median industry ROA to the standard deviation of ROAs for all the firms in the same two-digit SIC industry in a given year) is above the sample median, and zero otherwise. High ind-adj stkret is a dummy variable that equals one if the industry-adjusted annual stock return (equals the ratio of the difference between firm stock return and median industry stock return to the standard deviation of stock returns for all the firms in the same two-digit SIC industry in a given year) is above the sample median, and zero otherwise. All models also include the control variables as in Model 1 of Table 3. These variables are omitted to save space. Standard errors are adjusted for heteroskedasticity and clustered at the firm level. *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 5 can not rule out the possibility that experiences are a source of career concerns, and therefore should not serve as the evidence against the career concern hypothesis.

3. Career Concern Hypothesis

Our results so far suggest that the primary channel through which CEO tenure matters for risk-taking may not be human capital investment, power, or experiences as commonly suggested in the literature. Despite the fact that none of the risk-taking studies employ tenure as a proxy for career concerns, our arguments in Section II suggest that declining career concerns may also lead to increased incentives for risk-taking. To examine this, we test whether the effect of tenure on risk-taking is more negative or less positive (i.e., increasingly negative) if there is a higher level of information asymmetry regarding CEO ability.

We use three proxies for this information asymmetry. Because a CEO hired from outside the firm does not have a proven record in managing the firm compared to an inside CEO, we expect outside CEOs to possess more private information about their abilities (Holmstrom, 1999;

Zhang, 2008). We create a dummy variable that equals one for an externally hired CEO, and zero for an inside CEO (CEO outsider). In our sample, 27.3% of the CEOs are hired from outside. For the inside CEOs, the degree of information asymmetry for their abilities may further depend on the length of time they had worked for the firm before they became CEOs. For outside CEOs, this length is zero. Our second measure of the information asymmetry is a dummy variable that equals one if the time a person had worked for the firm before he or she was promoted as CEO is at or below the sample median, and zero otherwise (Low firm tenure). Finally, we consider the possibility that among the outside CEOs, those who have served as executives in similar firms may have lower information asymmetry than otherwise. Specifically, we define a dummy variable that equals one if the outside CEO has served as one of the top five executives in another firm in the EXECUCOMP database, and that firm is in the same industry as classified by two-digit SIC code (Same industry). By this definition, Same industry dummy equals one for all inside CEOs. We then define a Different industry dummy as one minus this variable, to measure the level of information asymmetry on CEO ability.[17] A drawback of this definition is that, because the data are limited to EXECUCOMP, outside CEOs are considered to have higher information asymmetry for their abilities even if these CEOs have served as executives in similar firms but the information is not in the database, either because those firms are not covered by the database, or because the years of these CEOs' prior services were before 1992, the starting year of EXECUCOMP database. Because EXECUCOMP covers the largest firms in the U.S., this sample selection bias mostly affects earlier years or smaller firms. To consider this issue, we examine the robustness of our results using a sub-sample with the largest firms and excluding the observations in early years of the sample. In testing the career concern hypothesis, we interact CEO tenure with the three dummy variables on information asymmetry of CEO ability. If career concerns drive the positive effect of tenure on risk-taking, it is expected that the interaction terms are negative and significant, since a privately-informed CEO has less incentive to take risks with the declining of career concerns.[18]

The results reported in Table 6 conform to these predictions. The coefficients on the interaction terms all have their expected signs and are significant. To examine the influence of sample selection bias on the results with respect to the Different industry dummy, we test the robustness of the results based on the sub-sample of firms which are larger than the median firm in the sample, with the observations after 1995.[19] The results in Model 4 show that with presumably smaller magnitude of the bias, the interaction term is still negative and significant. Therefore, the results in Table 6 provide support to the career concern hypothesis.[20]

[17] Our results are not sensitive to the classification of industries. The results are similar if we define industries according to one-digit, three-digit, or four-digit SIC code. The results are also similar if we exclude the consideration of industries in defining the outside CEO's past executive function. Finally, our results are robust to limiting whether the outside CEO has served as a CEO of another firm.

[18] Since there is a large number of missing observations for "joined_co" in EXECUCOMP, which is necessary to identify outside CEOs, the sample sizes in the tests of career concern hypothesis are reduced significantly.

[19] The year 1995 is chosen to reach a balance between the reduction of sample size due to time restrictions, and the alleviation of the sample selection bias. We also entertain other cutoff years for the sub-sample with the largest firms. Though the interaction terms are negative for all these cutoff years, some of the results are not significant.

[20] One may be concerned that because the Different industry dummy is defined based on whether a CEO has served as a top executive in a firm within the EXECUCOMP database, this variable may also represent the ability of the CEO, since EXECUCOMP covers the largest firms in the U.S. and a manager who is capable of managing a larger firm is presumably abler. From this perspective, the interaction of this variable with CEO tenure may also be interpreted as a test of the experience hypothesis. However, we note that if the dummy equals one, the CEOs by definition are outsiders. So if a dummy variable equaling one suggests that the CEO is abler, it implies that outside

Table 6. Test of Career Concern Hypothesis

	(1)	(2)	(3)	(4)
Dependent variable	Votal	Votal	Votal	Votal
Sample	Full	Full	Full	Large firms after 1995
Tenure	0.024**	0.026**	0.023**	0.034**
	(2.232)	(2.334)	(2.172)	(2.158)
Tenure * CEO outsider	-0.025**			
	(-2.066)			
CEO outsider	0.057			
	(0.675)			
Tenure * Low firm tenure		-0.029**		
		(-2.340)		
Low firm tenure		0.099		
		(1.263)		
Tenure * Different industry			-0.033**	-0.044**
			(-2.430)	(-2.041)
Different industry			0.027	0.332***
			(0.264)	(2.740)
Observations	6,586	6,583	6,586	2,651
Number of CEO-firms	1,864	1,863	1,864	830
Adjusted R^2	0.57	0.57	0.57	0.66

These models use CEO-firm fixed effects regressions to test the career concern hypothesis, which states that the positive effect of CEO tenure on risk taking is due to the declining career concerns associated with longer tenure. The sample consists of S&P 1,500 firms from 1992 to 2006. CEO outsider is a dummy variable that equals one if the CEO was hired from outside the firm, and zero otherwise. We determine a CEO as an outside hire if she has been with the firm for less than two years at the time of succession and if she is not a founder. Low firm tenure is a dummy variable that equals one if the CEO's job tenure within the firm before she was promoted as the CEO is at or below the sample median, and zero otherwise. Different industry is a dummy variable that equals one if an externally hired CEO's previous appointment as one of the top five executives in a firm in the EXECUCOMP database was from a different industry as classified by two-digit SIC code, and zero otherwise. Large firms after 1995 refers to the sub-sample of firms which are larger than the median firm in the sample, with the observations after 1995. All models also include the control variables as in Model 1 of Table 3. These variables are omitted to save space. Standard errors are adjusted for heteroskedasticity and clustered at the firm level. *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Overall, our empirical tests in this subsection suggest that, although we may not rule out the power and experience effects of tenure to explain its positive impact on risk-taking, the evidence is more consistent with viewing tenure primarily as a measure of career concerns.

C. The Balance of Explicit and Implicit Risk-Taking Incentives

The evidence in this paper suggests that the declining career concerns associated with tenure increase managerial risk-taking. In the context of effort incentives, Gibbons and Murphy (1992) document that CEO pay is more sensitive to firm performance as the CEO approaches retirement, to compensate his or her declining implicit effort incentives. Recent work suggests that the provision of risk-taking incentives is important besides effort incentives (Dittmann and Yu,

CEOs are abler than inside CEOs. But intuition suggests that this may not be true, nor does the evidence support this proposition. Therefore, this dummy variable is more appropriately interpreted as indicating whether a CEO has served as an executive in a similar capacity in the past, rather than measuring his or her ability.

2011). Therefore, it is informative to examine the relationship between compensation incentives and CEO tenure, to gauge the optimal provision of effort as well as risk-taking incentives. A rigorous treatment of this issue requires parsimonious theoretical modeling, which is beyond the scope of this paper. Consequently, our analysis is meant to be suggestive.

The provision of effort incentives via compensation is mainly through delta. Consistent with many others, our evidence suggests that delta also induces CEOs to take fewer risks. Because the decline of career concerns associated with longer tenure decreases the effort incentive of CEOs (Holmstrom, 1999), and at the same time increases their incentive to take risks as our results suggest, delta should be positively associated with tenure, since higher pay-performance sensitivity is needed to balance both the effort-reducing and risk-inducing effects of tenure.

However, without a rigorous model, it is hard to predict the specific relationship between vega and tenure. Our results show that, similar to delta, vega also decreases risk-taking. The evidence also suggests that, compared with delta, the risk-reducing effect of vega is smaller. Therefore, vega may potentially serve as a finer means to fill the gap between the optimal risk-taking incentives and the incentives provided through tenure and delta. However, it is theoretically hard to predict whether the provision of delta is insufficient or excessive to balance the risk-taking effect of tenure, given the other role of delta to balance the decreasing effort incentives associated with tenure. Therefore, it is also hard to predict the relationship between vega and tenure. Nevertheless, since delta plays a dual role of balancing the effort and risk-taking incentives of tenure, it is reasonable to expect that delta alone may not cover the necessary adjustment of risk-taking incentives. Therefore, vega should step in and is expected to be significantly associated with tenure, despite the uncertain direction between their relationship.

We examine the relations between CEO tenure and delta and vega in Table 7. Similar to the risk-taking regressions, we employ the CEO-firm fixed effects models with a control of the lagged dependent variables as well as the lagged total volatility. Besides, we follow Coles et al. (2006) and control for vega in the delta regression and vice versa.

Consistent with the evidence in Cremers and Palia (2010), Model 1 shows that CEO tenure is positively and highly significantly associated with delta. However, expanding their interpretation of this result based solely on the provision of optimal effort incentives, the positive relation between tenure and delta is also consistent with the idea that the risk-reducing effect of delta balances the risk-inducing effect of tenure. Also consistent with the prediction of a significant relation between tenure and vega, Model 2 shows that the effect of tenure on vega is negative and weakly significant at the 10% level.[21] Given the risk-reducing effect of vega, this result suggests that as delta increases with tenure to provide an optimal level of effort incentives for a CEO, its risk-reducing effect may have outweighed the risk-inducing effect of tenure. Therefore, vega is decreased with tenure to provide the CEO with sufficient risk-taking incentives.

V. Conclusion

We conduct a systematic analysis of the relationship between CEO tenure and risk-taking. Our work is motivated by the observation that implicit incentives, in particular the career

[21] This result is in contrast with the positive relation between vega and tenure as documented in Belkhir and Chazi (2010) with a sample of bank holding companies and industrial firms. We note that it is essential to control for the lagged vega to obtain our result. If we omit this variable, the relation between vega and CEO tenure becomes positive and significant. Belkhir and Chazi (2010) do not control for the lagged dependent variable.

Table 7. CEO Tenure and Compensation Delta and Vega

Dependent variable	(1) Delta	(2) Vega
Tenure	0.191***	-0.161*
	(3.621)	(-1.845)
Vega	0.273***	
	(23.442)	
Delta		0.926***
		(16.217)
CEO age	-0.015	0.021
	(-1.391)	(1.079)
CEO cash	0.053*	-0.031
	(1.808)	(-0.719)
Size	0.371***	-0.173**
	(7.462)	(-2.252)
Mb	0.331***	-0.263***
	(21.698)	(-8.310)
Capexp	-0.030	0.201
	(-0.093)	(0.404)
R&D	-1.462**	0.990
	(-1.988)	(1.171)
Leverage	-0.292*	0.095
	(-1.933)	(0.436)
Segment	-0.016	0.100**
	(-0.521)	(1.965)
ROA	0.887***	-0.354
	(3.774)	(-1.076)
Cash bal	0.000	0.000
	(0.069)	(0.469)
Lagged Vega		0.129***
		(8.513)
Lagged Delta	0.170***	
	(6.633)	
Lagged Volat	0.031	-0.074
	(0.710)	(-1.012)
Observations	8,398	8,553
Number of CEO-firms	2,745	2,779
Adjusted R^2	0.57	0.50

These models use CEO-firm fixed effects regressions to examine the balance of implicit risk-taking incentives associated with tenure with the explicit compensation incentives. The sample consists of S&P 1,500 firms from 1992 to 2006. See the Appendix for the definitions of all variables. All models include year dummies and a constant term. These coefficients are not reported to save space. Standard errors are adjusted for heteroskedasticity and clustered at the CEO-firm level. *t*-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

concerns of managers may affect their risk-taking incentives besides the explicit compensation incentives. Though CEO tenure has been employed as a proxy for career concerns in other studies, no risk-taking studies include tenure to indicate career concerns. Three commonly recognized effects associated with tenure are power, human capital investment, and experiences. Although risk-taking studies often predict that longer tenure implies risk-aversion, our analysis

suggests that, except for the effect with respect to human capital investment, the relationship between tenure and risk-taking is ambiguous based on the other three effects of tenure. Our work intends to shed light on the dominant mechanism(s) through which tenure may affect risk-taking.

Our empirical analysis reveals a positive relationship between CEO tenure and risk-taking, which is opposite to the prediction of the human capital hypothesis. We also show that the career concerns of a CEO, rather than her power or experiences, may be the dominant effect of tenure in its positive relation with risk-taking.

Finally, we provide some insight into an optimal provision of risk-taking as well as effort incentives through a balance between implicit incentives associated with tenure and explicit compensation incentives. We document a positive (negative) relation between delta (vega) and CEO tenure. The positive relation between delta and tenure is consistent with the notion that the provision of delta is to balance not only the decreasing effort incentives, but also the increasing risk-taking incentives of tenure. The negative relation between vega and tenure suggests that the dual role that delta plays in balancing these two types of incentives may make the risk-taking incentives of the CEO to be insufficient, and therefore vega is decreased to fine-tune the balance for an optimal provision of risk-taking incentives.

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Appendix. Variable Definitions

Variable	Definitions
Volat	The log of the standard deviation of daily stock returns for at least 100 days over the year.
Sys_mkt	The log of the standard deviation of the predicted values of the stock return from the market model (with a constant term) using daily returns over the year.
Idio_mkt	The log of the standard deviation of the residuals of the stock return from the market model (with a constant term) using daily returns over the year.
Tenure	The log of CEO tenure in years. CEO tenure in a given year is determined as the length of time between the date when the person became the CEO ("becameceo" in EXECUCOMP) and the current fiscal year end. In two situations where this variable is not conveniently available, we further make the following assumptions: (1) For those observations with missing values, if the CEO is hired from outside the firm and the date when the person joined the company ("joined_co" in EXECUCOMP) is available, CEO tenure in a given year is calculated as the time between "joined_co" and the current fiscal year end. A CEO is determined as an outside hire if she has been with the firm for less than two years at the time of succession and if she is not a founder; (2) For those CEOs who held the position multiple times, EXECUCOMP only has the data for "becameceo" for either the first time or the most recent time the person became the CEO. Therefore, we manually check these cases and use the information that the previous CEO left the company to determine the starting date for the incumbent CEO.
Delta	The log of one plus the sensitivity of CEO option and stock portfolio value to a 1% change in stock price, where the estimation of the average exercise price and remaining time-to-maturity for outstanding options follows Core and Guay (2002)'s "one-year approximation" (OA) method. Specifically, for the inputs for stock return volatility, dividend yield, and risk-free rate, we use the annualized standard deviation of monthly stock returns over the past 60 months, the average dividend yield over the past three years, and the yield-to-maturity of Treasury bonds matched by the maturities closest to options', respectively.
Vega	The log of one plus the sensitivity of CEO option portfolio value to a 0.01 change in the annualized standard deviation of stock returns. We follow Core and Guay (2002)'s OA method for the estimation of the average exercise price and remaining time-to-maturity for outstanding options. Specifically, for the inputs for stock return volatility, dividend yield, and risk-free rate, we use the annualized standard deviation of monthly stock returns over the past 60 months, the average dividend yield over the past three years, and the yield-to-maturity of Treasury bonds matched by the maturities closest to options', respectively.
CEO age	CEO age in years.
CEO cash	Inflation-adjusted CEO salary plus bonus (with year 1992 as the basis year).
Size	The log of the inflation-adjusted total assets (with year 1992 as the basis year).
Mb	Market-to-book ratio.
ROA	Operating income before depreciation divided by total assets.
Capexp	Net capital expenditure scaled by total assets, with missing values coded as zeros.
R&D	R&D expenses scaled by total assets, with missing values coded as zeros.
Leverage	Debt in current liabilities plus long-term debt scaled by total assets.
Segment	The log of the number of business segments.
Firm age	The log of the number of years since the firm went public.
Cash bal	Inflation-adjusted firm cash balance (with year 1992 as the basis year).