Firms' Environmental Uncertainty and Excessive CEO Pay

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Abstract

We investigate the relationship between environmental uncertainty and the power of Chief Executive Officer (CEO) at the firm level. We use the coefficient of variation of sales to measure environmental uncertainty (Ghosh and Olsen, 2009) and CEO excess pay as a proxy for CEO power (Bebchuk et al., 2011). Our multivariate regression analyses reveal a significant and negative relationship between environmental uncertainty and the excessive CEO pay, suggesting that CEO power decreases in the presence of a volatile operational environment. We perform various additional tests and obtain consistent results. In summary, our findings imply that uncertain corporate operational environments mitigate the power of CEOs.

Keywords: Environmental uncertainty; Sales volatility; CEO power

Data Availability: Data are available from sources identified in the paper.

1. Introduction

Environmental uncertainty (EU) is a core concept in management and organizational theory (Dill, 1958; Lawrence and Lorsch, 1967; Thompson, 1967; Kast and Rosenzweig, 1978). EU refers to the variability in external environmental activities relevant to an organization (Child, 1972; Tung, 1979; Dess and Beard, 1984; Drago, 1998). The most significant elements that affect a firm's environmental uncertainty include customers, competitors, and governmental regulations (Ghosh and Olsen, 2009). In response to environmental uncertainty, managers use their flexibility and discretion to better adapt to the external environment. Many prior studies (e.g., Cheng and Kesner, 1997; Dunk and Nouri, 1998; Davila and Wouters, 2005; Ghosh and Olsen, 2009) suggest that environmental uncertainty has a significant impact on the ability and power of managers. However, empirical work testing for a negative tradeoff between firm risk and management incentives, a cornerstone of agency theory, has not had much success.

The purpose of this study is to investigate the relationship between environmental uncertainty and the power of Chief Executive Officer (CEO). Following Ghosh and Olsen (2009) framework, we use the coefficient of variation of sales to measure environmental uncertainty. Following Bebchuk, Cremers and Peyer (2011), we use CEO Pay Slice (CPS) to capture CEO power. CEO Pay Slice (CPS) is defined as "the fraction of the aggregate compensation of the firm's top-five executive team captured by the CEO". Using 25,633 firm-year observations from 1992 to 2013, we find a negative and significant relationship between environmental uncertainty and the excessive CEO pay, suggesting that a volatile environment mitigates CEO power. We perform various additional tests, including using alternative environmental uncertainty measure, 'change' analysis, and fixed-effects regression analysis. Additional tests yield consistent results. Overall, our evidence suggests that CEO power decreases in the presence of a volatile environment.

Our study makes several contributions. First, it contributes to literature regarding CEO power and environmental uncertainty. To the best of our knowledge, this is the first study that performs a direct empirical test on the relationship between environmental uncertainty and CEO power. Second, although CEO power has recently received much attention, much of the research examines the impact of CEO power on firm performance and outcomes. For example, prior studies find that CEO power is negatively related to market value and accounting performance of a firm (Bebchuk et al., 2011), bond ratings (Liu and Jiraporn, 2010), and leverage (Jiraporn, Chintrakarn and Liu, 2012). Our study investigates the determinant of CEO power by showing that an uncertain environment mitigates the power of CEOs. Last, from a practical perspective, the results should interest stakeholders by showing a negative impact of uncertain environment on powerful CEOs. Our results should also provide practitioners with useful insights into what determines the CEO power.

2. Research Design

2.1 Measurement of the Dependent Variable – CEO power

According to Finkelstein (1992), power includes four dimensions: structural power, ownership power, expert power and prestige power. Structural power refers to the power from the position that an executive occupies in the hierarchy. Ownership power refers to voting interest that an executive holds in the organization. Expert power includes knowledge and experience. Prestige power refers to power derived from the top executive's reputation. Prestige power is the most intangible dimension and thus difficult to measure (Larcker and Tayan, 2012). Consistent with prior studies (e.g., Adams, Almeida and Ferreira, 2005), our focus is to identify whether other individuals at the top of the hierarchy participate in decision making with the CEO. Only the structural power indicates the power the CEO has over the board and other top executives as a consequence of his/her formal position and title (Adams et al., 2005). In addition, structural power is the most commonly cited in the literature (e.g., Brass, 1984; Hambrick, 1981; Tushman and Romanelli, 1985; Adams et al., 2005). Hence, we focus on the structural power of the CEO in our study.

However, it is possible that these four dimensions are not mutually exclusive, although we do not argue that all forms of CEO power affect employee performance. To mitigate the above concern, we control for CEO's ownership power and expert power in the regression analysis. Specifically, we use whether CEO chairs the board to control for ownership power and CEO's age and tenure to control for expert power.

Bebchuk et al. (2011) introduce a new measure (CEO Pay Slice) to capture CEO power. CEO Pay Slice (CPS) is defined as "the fraction of the aggregate compensation of the firm's top-five executive team captured by the CEO". Bebchuk et al. (2011) argue that the CPS is a good proxy for CEO power because CPS indicates the relative significance of the CEO in terms of ability, power or status. CPS also indicates the relative centrality of the CEO among the top executives. Following Bebchuk et al. (2011), we use CPS to measure the CEO power. Specifically, we calculate CPS as a fraction of the combined total compensation of the top five executives. Total compensation includes salary, bonus, other annual pay, the total value of restricted stock granted that year, the Black-Scholes value of stock options granted that year, long-term incentive payouts, and all other total compensation (ExecuComp Item # TDC1).

Previous studies (e.g., Adams et al., 2005) use a number of CEO power indicators such as whether the CEO also serves the chairman of broad. Bebchuk et al. (2011) argue that CPS is a better measure to capture CEO power for the following two reasons. First, CPS captures the product of many observable and unobservable dimensions of the firm's top executives. Second, CPS is calculated based on total compensation information from executives in the same firm, so it controls for any firm-specific characteristics. In addition, Jiraporn et al. (2012) also argue that CPS is a good proxy for CEO power because (1) it is a continuous variable, unlike other indicator; and (2) CPS is linked to firm profitability, market value, and stock returns. Thus, it contains a significant amount of information.

2.2 Measurement of the Independent Variable – Environmental Uncertainty

Tosi, Aldag and Storey (1973) examine three environmental uncertainty (EU) measures: sales volatility, earnings volatility, and technological volatility. They find that these measures are industry-specific, i.e., the correlations among the three measures vary significantly by industry types. For example, the EU measures are positively (negatively) correlated in manufacturing firms (marketing firms). Snyder and Glueck (1982) examine two EU measures in Tosi et al. (1973), namely, sales volatility and technological volatility, and find that both measures are objective measures to capture external environmental uncertainty. Ghosh and Olsen (2009) indicate that sales volatility is a better EU proxy, relative to technological volatility. They argue that technological components (such as R&D expenditures and capital expenditures) are often subject to management discretion. Managers often cut back R&D expenditures when the external environment becomes more uncertain. Hence, Ghosh and Olsen (2009) suggest that, unlike sales volatility, technological volatility is 'more of a response by management to the external environment as opposed to a direct measure of environmental uncertainty' (pg. 193). Prior management and accounting literature (e.g., Milliken, 1987; Kren, 1992) also suggest that sales volatility is the most appropriate proxy for firm's environment.

Following prior studies said above, we use the coefficient of variation (CV) of sales to capture sales volatility as our primary EU measure. The formula to calculate the raw sales volatility is expressed as below:

$$CV\ (S_i) = \frac{\sqrt{\sum_{i=1}^{5} \frac{(S_i - S_{mean})^2}{5}}}{S_{mean}}$$

where S_i is a firm's sales in year *i*, and S_{mean} is the mean of sales over a rolling five-year period. We calculate CV of sales by year and industry (using 2-digit SIC code). Following Ghosh and Olsen (2009), we normalize the raw firm-specific environmental uncertainty by dividing it by the average environmental uncertainty for that firm's industry for the same fiscal year to mitigate time and industry effects. A higher value of CV of sales indicates a higher level of environmental uncertainty.

2.3 Model Specification

We use the following model to test the influence of environmental uncertainty on the excessive CEO pay:

$$CPS = \beta_0 + \beta_1{*}\boldsymbol{EU} + \beta_2{*}SIZE + \beta_3{*}LEV + \beta_4{*}MTB + \beta_5{*}ROA + \beta_6{*}AGE + \beta_7{*}GENDER + \beta_8{*}TENURE + \beta_9{*}CHAIR + \beta_{10}{*}VP + \beta_{11}{*}EQCOMP + \varepsilon \qquad \text{[Model 1]}$$

In Model 1, the dependent variable (CPS) captures CEO power. All variables are defined in the Appendix. We analyze the coefficient β_1 on EU (environmental uncertainty). If a volatile environment mitigates CEO power, then we expect a significant and negative coefficient β_1 on EU. In addition to the variable of interest, we also control for factors associated with CEO power and environmental uncertainty established in prior literature. Specifically, following Ghosh and Olsen (2009), we control firm assets (SIZE), market-to-book ratio (MTB), and leverage ratio (LEV). Following Bebchuk et al. (2011), we control firm performance (ROA), age of CEO (AGE), tenure of CEO (TENURE), whether CEO is the chair of board (CHAIR), the number of vice presidents (VP), and the percentage of CEO's equity compensation (EQCOMP). Following Petersen (2009), we use clustered standard errors regression as the main regression analysis to better control for the firm and time effects in this study. We winsorize the variables at levels 1% and 99% and control for year and industry fixed effects (based on Fama-French 48 industry classifications) in the regression analysis.

2.4 Sample Selection and Descriptive Statistics

We begin our sample selection process by downloading CEO data from ExecuComp database during the period of 1992 to 2013. Next, we use Compustat to obtain financial statement data, which include total net sales (SALE), total assets (AT), income before extraordinary items (IB), long-term liabilities (DLTT), outstanding common shares (CSHO), fiscal year-end price (PRCC_F) and equity book value (CEQ). We delete observations that have missing values for any of our variables after merging the two samples. The final sample with completed data consists of 25,633 firm-year observations between 1992 and 2013.

Panel A of Table 1 presents the sample descriptive statistics. Specifically, Panel A reports the mean, standard deviation, median, 25th percentile and 75th percentile of the following variables: CPS, EU, SIZE, EU, SIZE, LEV, MTB, ROA, AGE, GENDER, TENURE, CHAIR, VP, and EQCOMP. The mean (median) value of CEO power (CPS) is 0.354 (0.371). The mean (median) value of environmental uncertainty (EU) is 0.759 (0.609). The mean (median) values of ROA and MTB are 0.032 (0.048) and 3.613 (2.174) respectively. Panel B of Table 1 reports the distribution of firm-year observations by year. For example, there are 230 firm-year observations in 1992 and there are 1,183 observations in 2013. 2007 has the largest number of observations (1,424). Panel C of Table 1 reports the distribution of firm-year observations by industry (first 2 SIC). For example, there are 997 firm-year observations in oil and gas extraction industries, and there are 2,103 observations in chemical industries. The most heavily represented industry is business (9.57%, SIC 73), followed by electronic equipment (8.47%, SIC 36) and chemical (8.20%, SIC 28).

Table 1. Sample Descriptive Statistics

Panel A: Sample Descriptive Statistics

Variable	Obs.	Mean	StdDev	Q1	Median	Q3
CPS	25,633	0.354	0.122	0.301	0.371	0.444
EU	25,633	0.759	0.567	0.362	0.609	0.981
SIZE	25,633	7.346	1.623	6.206	7.244	8.402
LEV	25,633	0.199	0.189	0.032	0.181	0.301
MTB	25,633	3.613	58.900	1.430	2.174	3.502
ROA	25,633	0.032	0.362	0.017	0.048	0.085
AGE	25,633	57.298	9.913	51.000	57.000	64.000
GENDER	25,633	0.978	0.146	1.000	1.000	1.000
TENURE	25,633	7.810	7.344	3.000	6.000	10.000
CHAIR	25,633	0.619	0.486	0.000	1.000	1.000
VP	25,633	3.000	1.336	2.000	3.000	4.000
EQCOMP	25,633	0.225	0.292	0.000	0.000	0.454

Panel B: Distribution by Year

Year	Obs.	% of Sample	Cumulative %	Year	Obs.	% of Sample	Cumulative %
1992	230	0.90%	0.90%	2003	1,279	4.99%	48.36%
1993	740	2.89%	3.78%	2004	1,309	5.11%	53.46%
1994	963	3.76%	7.54%	2005	1,272	4.96%	58.42%
1995	1,043	4.07%	11.61%	2006	1,319	5.15%	63.57%
1996	1,097	4.28%	15.89%	2007	1,424	5.56%	69.13%
1997	1,110	4.33%	20.22%	2008	1,369	5.34%	74.47%
1998	1,142	4.46%	24.68%	2009	1,372	5.35%	79.82%
1999	1,173	4.58%	29.25%	2010	1,372	5.35%	85.17%
2000	1,214	4.74%	33.99%	2011	1,330	5.19%	90.36%
2001	1,189	4.64%	38.63%	2012	1,288	5.02%	95.38%
2002	1,215	4.74%	43.37%	2013	1,183	4.62%	100.00%
				Total	25,633	100.00%	

Panel C: Distribution by Industry

2 SIC	Description	Obs.	%	2 SIC	Description	Obs.	%
01	Agricultural Crops	61	0.24%	44	Water Transportation	122	0.48%
02	Agricultural Livestock	5	0.02%	45	Air Transportation	253	0.99%
07	Agricultural Services	10	0.04%	47	Transportation Services	107	0.42%
10	Metal Mining	178	0.69%	48	Communications	695	2.71%
12	Coal Mining	47	0.18%	49	Utilities Services	1,807	7.05%
13	Oil & Gas Extraction	997	3.89%	50	Wholesale Durable	608	2.37%
14	Mining	67	0.26%	51	Wholesale Nondurable	277	1.08%
15	Building Construction	202	0.79%	52	Building Materials	100	0.39%
16	Heavy Construction	151	0.59%	53	General Stores	297	1.16%
17	Special Construction	34	0.13%	54	Food Stores	184	0.72%
20	Food	754	2.94%	55	Automotive Service	155	0.60%
21	Tobacco	47	0.18%	56	Apparel Stores	496	1.94%
22	Textile	192	0.75%	57	Furniture Stores	159	0.62%
23	Apparel	305	1.19%	58	Eating & Drinking	500	1.95%
24	Lumber	174	0.68%	59	Miscellaneous Retail	483	1.88%
25	Furniture	209	0.82%	60	Depository Institutions	16	0.06%
26	Paper	445	1.74%	61	Nondepository Institutions	19	0.07%
27	Printing	386	1.51%	62	Brokers	35	0.14%
28	Chemicals	2,103	8.20%	63	Insurance Carriers	121	0.47%
29	Petroleum	246	0.96%	64	Insurance	119	0.46%
30	Rubber	222	0.87%	65	Real Estate	3	0.01%
31	Leather	99	0.39%	67	Investment Offices	186	0.73%
32	Stone Clay Glass	168	0.66%	70	Hotels	52	0.20%
33	Primary Metal	524	2.04%	72	Personal Services	127	0.50%
34	Fabricated Metal	418	1.63%	73	Business Services	2,452	9.57%
35	Industrial Machinery	1,720	6.71%	75	Auto Repair	54	0.21%
36	Electronic Equipment	2,170	8.47%	78	Motion Pictures	82	0.32%
37	Transportation Equipment	816	3.18%	79	Amusement	220	0.86%
38	Measuring Instruments	1,486	5.80%	80	Health Services	455	1.78%
39	Other Manufacturing	248	0.97%	82	Educational Services	134	0.52%
40	Railroad	118	0.46%	83	Social Services	16	0.06%
41	Local/Suburban Transit	17	0.07%	87	Engineering & Accounting	364	1.42%
42	Motor Freight	229	0.89%	99	Nonclassified	87	0.34%

Table 2 provides the correlation matrices for selected variables for our sample firms. For each pair of variables, the Pearson and Spearman correlation coefficients and related p-values are provided. In Table 2, both Pearson and Spearman correlations report a significant (p-value < 0.0001) and negative relation between CPS and EU, suggesting that CEO power decreases when the environment becomes uncertain.

Table 2. Correlations among Selected Variables

	CPS	EU	SIZE	LEV	MTB	ROA	AGE	GENDER	TENURE	CHAIR	VP	EQCOMP
CPS		**-0.078**	-0.136	0.070	0.035	0.071	-0.064	-0.012	-0.001	0.066	0.000	0.146
p-value		***<.0001***	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.046*	*0.896*	*<.0001*	*0.965*	*<.0001*
EU	**-0.051**		-0.157	-0.067	0.011	-0.024	-0.092	-0.004	0.096	-0.044	-0.065	0.055
p-value	***<.0001***		*<.0001*	*<.0001*	*0.076*	*0.000*	*<.0001*	*0.539*	*<.0001*	*<.0001*	*<.0001*	*<.0001*
SIZE	-0.088	-0.151		0.369	0.037	0.004	0.096	0.026	-0.082	0.206	-0.004	0.002
p-value	*<.0001*	*<.0001*		*<.0001*	*<.0001*	*0.546*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.482*	*0.717*
LEV	0.045	-0.014	0.238		-0.166	-0.291	0.124	0.031	-0.049	0.094	0.023	0.019
p-value	*<.0001*	*0.027*	*<.0001*		*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.000*	*0.003*
MTB	-0.003	-0.005	-0.005	0.019		0.496	-0.022	0.018	0.036	0.025	-0.032	0.136
p-value	*0.585*	*0.412*	*0.437*	*0.003*		*<.0001*	*0.001*	*0.004*	*<.0001*	*<.0001*	*<.0001*	*<.0001*
ROA	0.027	-0.053	0.077	-0.055	0.006		-0.039	0.008	0.070	0.026	-0.056	-0.001
p-value	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.357*		*<.0001*	*0.180*	*<.0001*	*<.0001*	*<.0001*	*0.877*
AGE	-0.054	-0.070	0.091	0.075	-0.006	0.001		0.068	-0.376	0.123	0.014	0.334
p-value	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.334*	*0.914*		*<.0001*	*<.0001*	*<.0001*	*0.025*	*<.0001*
GENDER	-0.017	-0.004	0.020	0.020	0.003	0.001	0.062		0.045	0.020	0.004	0.041
p-value	*0.006*	*0.503*	*0.001*	*0.001*	*0.622*	*0.925*	*<.0001*		*<.0001*	*0.001*	*0.552*	*<.0001*
TENURE	-0.033	0.034	-0.099	-0.058	0.004	0.002	-0.433	0.034		0.277	-0.093	-0.061
p-value	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.502*	*0.722*	*<.0001*	*<.0001*		*<.0001*	*<.0001*	*<.0001*
CHAIR	0.053	-0.037	0.204	0.047	-0.003	0.006	0.111	0.020	0.241		-0.076	0.096
p-value	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.662*	*0.307*	*<.0001*	*0.001*	*<.0001*		*<.0001*	*<.0001*
VP	-0.027	-0.070	0.004	0.024	-0.005	-0.006	0.028	0.003	-0.085	-0.057		0.007
p-value	*<.0001*	*<.0001*	*0.472*	*0.000*	*0.425*	*0.371*	*<.0001*	*0.683*	*<.0001*	*<.0001*		*0.267*
EQCOMP	0.195	0.102	0.012	-0.019	0.004	-0.011	0.257	0.033	-0.069	0.078	0.009	
p-value	*<.0001*	*<.0001*	*0.049*	*0.003*	*0.507*	*0.087*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.139*	

Note 1: Pearson correlation is below the diagonal and Spearman correlation is above the diagonal.

Note 2: Please see the Appendix for variable definitions.

3. Main Results

Table 3 reports the clustered standard errors regression results. Using the full sample (obs. = 25,633), Table 3 reports coefficient on EU is -0.011 (t-stat = -7.33; p-value < 0.0001). The negative and significant coefficient suggests that high environmental uncertainty lead to reduced CEO power. In other words, a volatile environment mitigates CEO power. For the control variables, CPS is significantly and positively associated with LEV, ROA, CHAIR and EQCOMP, and is negatively associated with SIZE, GENDER and VP.

As a robustness check, we perform the same test after excluding finance and utility firms (SIC 4000-4999; SIC 6000-6999) and obtain consistent results. For example, using the sample excluding the above two industries (obs. = 21,786), we find coefficient on EU is -0.013 (t-stat = -7.53; p-value < 0.0001), consistent with our early findings.

Table 3. Environmental Uncertainty and CEO Power

Model: CPS = (EU, control variables)

	Full Sample		Excluding utility & finance industries	
Parameter	Estimate	t Value	Estimate	t Value
Intercept	0.436	40.18	0.440	36.88
EU	-0.011***	-7.33	-0.013***	-7.53
SIZE	-0.001**	-2.24	-0.001***	-2.15
LEV	0.020***	4.60	0.018***	3.89
MTB	0.000	-0.91	0.000	-0.85
ROA	0.007***	2.63	0.006**	2.33
AGE	0.000	-0.61	0.000	-0.31
GENDER	-0.012**	-2.34	-0.013**	-2.31
TENURE	-0.000*	-1.73	-0.000	-1.48
CHAIR	0.016***	9.75	0.017***	9.85
VP	-0.004***	-6.63	-0.003***	-5.03
EQCOMP	0.188***	14.91	0.191***	14.58
Year Effect	YES		YES	
Industry Effect	YES		YES	
Observations	25,633		21,786	
Adj. R^2	0.161		0.164	

***, **, and * denote the regression coefficient is statistically significant at the two-tailed 1%, 5%, and 10% level, respectively. Refer to the Appendix for variable descriptions.

4. Additional Tests

4.1 Alternative Environmental Uncertainty Measure

Prior studies (e.g., Tosi et al., 1973; Synder and Glueck, 1986) suggest that technology volatility be useful as an alternative measure of environment uncertainty. Technology input is measured as the ratio of the sum of research and development expenditures and capital expenditures to total assets at the firm level. We use the coefficient of variation (CV) of technology input to capture technology volatility. The formula to calculate CV of technology is expressed below:

$$CV(Ti) = \frac{\sqrt{\sum_{i=1}^{5} \frac{(T_i - T_{mean})^2}{5}}}{T_{mean}}$$

Where T_i is a firm's technology input in year *i*, and T_{mean} is the mean of technology input over a five-year period. A higher value of CV of technology indicates a higher level of environmental uncertainty.

We collect additional data on research and development expenditures (XRD) and capital expenditures (CAPX) to calculate the alternative EU measure (EU_tech). We set R&D expenditures to be zero when the data are missing. Table 4 reports the clustered standard errors regression results using EUTECH as an alternative environmental uncertainty measure. The coefficient on EU_tech is -0.002 (t-stat = -4.69; p-value < 0.0001). The negative and significant coefficient again suggest that environmental uncertainty is negatively related to CEO power. This evidence suggests that an uncertain environment mitigate CEO power.

Table 4. Environmental Uncertainty (EU) and CEO Power

Alternative EU Measure

Model: CPS = (EU_tech, control variables)

Parameter	Estimate	t Value	Pr > |t|
Intercept	0.418	26.03	<.0001
EU_tech	-0.002***	-4.69	<.0001
SIZE	0.000	-0.51	0.607
LEV	0.009	1.35	0.176
MTB	0.000*	-1.90	0.057
ROA	0.005*	1.74	0.081
AGE	0.000	-0.35	0.728
GENDER	-0.013*	-1.76	0.079
TENURE	-0.000*	-1.88	0.060
CHAIR	0.016***	7.19	<.0001
VP	-0.005***	-5.48	<.0001
EQCOMP	0.182***	13.56	<.0001
Year Effect	YES		
Industry Effect	YES		
Observations	14,008		
Adj. R^2	0.170		

***, **, and * denote the regression coefficient is statistically significant at the two-tailed 1%, 5%, and 10% level, respectively. Refer to the Appendix for variable descriptions.

4.2 Change Analysis

We employ a “change” analysis to provide additional evidence that differences in CEO power can be attributed to differences in environmental uncertainty. Specifically, we conduct a bivariate change analysis by regressing changes in CEO power (CHGCPS) from year t-1 to year t on the corresponding changes in environmental uncertainty (CHGEU) from year t-1 to year t. Table 5 presents the results of this change analysis of the relation between CHGCPS and CHGEU. We find that the changes in CEO power (CHGCPS) is negatively (-0.017) and significantly (t-stat = -7.16; p-value < 0.0001) related to changes in environmental uncertainty (CHGEU). These results suggest that an increase in environmental uncertainty can also lead to a decrease in CEO power, which is consistent with the primary results.

Table 5. Environmental Uncertainty and CEO Power

Change Analysis

Model: CHGCPS = (CHGEU, control variables)

Parameter	Estimate	t Value	Pr > |t|
Intercept	0.003	0.53	0.598
CHGEU	-0.017***	-7.16	<.0001
CHGSIZE	0.008***	5.53	<.0001
CHGLEV	0.004	0.50	0.615
CHGMTB	0.000	0.61	0.544
CHGROA	0.008***	2.95	0.003
CHGAGE	-0.003***	-13.34	<.0001
CHGGENDER	-0.012	-1.01	0.313
CHGTENURE	-0.002***	-7.27	<.0001
CHGCHAIR	0.005*	1.77	0.077
CHGVP	-0.012***	-14.25	<.0001
CHGEQCOMP	0.188***	14.75	<.0001
Year Effect	YES		
Industry Effect	YES		
Observations	23,574		
Adj. R^2	0.172		

***, **, and * denote the regression coefficient is statistically significant at the two-tailed 1%, 5%, and 10% level, respectively. Refer to the Appendix for variable descriptions.

4.3 Fixed-Effects Regression

Although we control for several variables that are possibly related to CEO power and/or environmental uncertainty, this procedure may not effectively address the omitted-variable bias induced by unknown firm characteristics. For example, some unknown variable may affect CEO power and environmental uncertainty simultaneously. To mitigate the omitted-variable concern, we use a fixed-effects regression, which removes the cross-sectional variation and analyzes only the variation over time within a firm. Because industry dummies are time-invariant, we exclude them in the fixed-effects regression.

Table 6 reports the coefficient on EU is -0.007 (t-stat = -4.70; p-value < 0.0001). The fixed-effect result suggests that, within firms, environmental uncertainty (EU) is negatively related to CEO power (CPS). Because the fixed-effects result is consistent with the primary results, it does not appear that our conclusion is affected by endogeneity due to the omitted-variable bias.

Table 6. Environmental Uncertainty and CEO Power

Fixed-Effects Regression

Model: CPS = (EU, control variables)

Parameter	Estimate	t Value	Pr > |t|
EU	-0.007***	-4.70	<.0001
SIZE	-0.008***	-5.81	<.0001
LEV	0.014**	2.57	0.010
MTB	0.000	-0.55	0.582
ROA	0.012***	6.18	<.0001
AGE	-0.001***	-5.91	<.0001
GENDER	0.001	0.11	0.916
TENURE	-0.001***	-5.70	<.0001
CHAIR	0.005***	2.68	0.007
VP	-0.010***	-15.08	<.0001
EQCOMP	0.185***	15.89	<.0001
Year Effect	YES		
Industry Effect	NO		
Observations	25,633		
Adj. R^2	0.478		

***, **, and * denote the regression coefficient is statistically significant at the two-tailed 1%, 5%, and 10% level, respectively. Refer to the Appendix for variable descriptions.

5. Conclusion

In this study, we investigate the relationship between environmental uncertainty and the excessive CEO pay using large panel data. We find a significant and negative relationship, suggesting that CEO power decreases when the external environment becomes volatile. We perform various additional tests including alternative environmental uncertainty measure, change analysis, and fixed-effects regression analysis, and obtain consistent results. The scope for CEO power in public corporations is vast. A promising area for future research could be to better understand the myriad behavioral biases that lie behind differential preferences for risk. Shedding light on these biases and the corporate policies associated with them will ultimately lead to better corporate governance and decision-making.

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Appendix

Variable Definitions

Variable		Definition
CPS	=	The fraction of the aggregate compensation of the firm's top-five executive team captured by the CEO.
EU	=	Environmental uncertainty, calculated as the coefficient of variation (CV) of sales to capture environmental uncertainty. The formula is expressed below: $CV\ (S_i) = \frac{\sqrt{\sum_{i=1}^{5} \frac{(S_i - S_{mean})^2}{5}}}{S_{mean}}$.
EU_tech	=	An alternative measure of environmental uncertainty, calculated as the coefficient of variation (CV) of the ratio of research and development expenditures (XRD) and capital expenditures (CAPX) to total assets (AT) to capture environmental uncertainty. The formula is expressed below: $CV\ (T_i) = \frac{\sqrt{\sum_{i=1}^{5} \frac{(T_i - T_{mean})^2}{5}}}{T_{mean}}$.
SIZE	=	Natural log of total assets (AT).
LEV	=	Long-term liabilities (DLTT) divided by total assets (AT).
MTB	=	Market value of common shares (CSHO*PRCC_F) divided by total book value of common shares (CEQ).
ROA	=	Income before extraordinary items (IB) scaled by total assets (AT).
AGE	=	The age of CEO.
GENDER	=	An indicator variable that takes a value of 1 if the CEO is male and 0 otherwise.
TENURE	=	The tenure of CEO in years.
CHAIR	=	An indicator variable that takes a value of 1 if the CEO chairs the board and 0 otherwise.
VP	=	The number of vice presidents.
EQCOMP	=	The fraction of equity compensation is defined as EBC/TDC1, where EBC is the equity-based compensation calculated as the sum of the value of the restricted shares granted plus the Black-Scholes value of options granted.