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Stock price crash risk and CEO power: Firm-level analysis

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ABSTRACT

This study examines the impact of stock price crash risk on future CEO power. Using a large panel sample with 17,816 firm-year observations, we posit and find a significant negative impact of stock price crash risk on CEO power, suggesting that CEO power becomes smaller after stock price crashes. We also find that our results are stronger for firms with female CEOs and are largely driven by firms with shorter-tenure CEOs. In addition, we find that the significant negative impact of stock price crash risk on CEO power is diminished for firms with strong corporate governance. Our study responds to the call in Habib, Hasan, and Jiang (2018) by providing more empirical evidence on the consequences of stock price crash risk.

1. Introduction

A large body of finance literature (e.g., Hong and Stein, 2003) documents that stock returns often exhibit negative skewness (i.e., more negative stock price movements than positive price movements). One critical factor that causes the negative skewness is the managerial tendency to withhold bad news for an extended period of time (e.g., Jin and Myers, 2006). When the accumulation of bad news reaches a relatively high level, the manager has to release or disclose the bad news to the investors, leading to a large negative stock price movement (i.e., a large price drop). This type of price drop risk is known as stock market crash risk (hereafter crash risk), which has recently received tremendous attention in academic research. Habib et al. (2018) find that the majority of recent research has centered on the determinants of crash risk, but little research has been devoted to investigate the consequences of crash risk.[1] Hence, Habib et al. (2018) call for more empirical evidence to better understand the consequences of crash risk by stating that "we believe that there is immense potential for future research in the area of crash risk consequences (page 36)".

The purpose of this study is to respond to the call in Habib et al. (2018) by providing more empirical evidence on crash risk consequences. Specifically, we explore the relation between crash risk and future CEO power, an important managerial characteristic that has been extensively studied in accounting and finance literature. We hypothesize that crash risk is negatively related to future CEO power for two reasons. First, CEO power increases crash risk (Mamun et al., 2019). Habib et al. (2018) argue that rational firms should limit or eliminate certain factors that increase crash risk after stock price crashes. Hence, we expect that after price crashes, rational firms curtail CEO power. Second, CEO power is associated with negative firm outcomes including low market valuation, poor

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[1] Habib et al. (2018) review 48 published studies on stock price crash risk, and find 46 studies examining the determinants of crash risk and only 2 studies examining the consequences of crash risk.

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performance and low bond ratings (e.g., Liu and Jiraporn, 2010; Bebchuk et al., 2011). Additionally, too much CEO power suggests a high level of agency conflicts. Jin and Myers (2006) argue that shareholders take corrective actions to discipline managers (i.e., CEOs) when agency problems are severe. Hence, it is intuitive to expect that investors reduce the power of the CEO after stock price crashes.

Following Kim et al. (2011b), we use the likelihood of crash risk and the negative conditional stock price skewness to proxy for crash risk in our study. Using 17,816 firm-year observations and 1814 unique public firms in the United States from 2001 to 2014, we regress CEO power in the subsequent year on our crash risk measures and control for firm-level and CEO-specific variables. Our results reveal a significant negative relation between crash risk and future CEO power, suggesting that firms restrict their CEOs' power after stock price crashes. We perform a battery of robustness checks such as using alternative measures of CEO power and stock price crash risk and applying alternative empirical specifications, and still obtain consistent results, supporting our hypothesis.

In other additional tests, we find that our results are stronger for firms with female CEOs, suggesting that the power of female CEOs is reduced more than the power of male CEOs after stock price crashes. Additionally, we find that our results are largely driven by firms with shorter-tenure CEOs, which suggests that it may be difficult to restrict the power of a CEO with a longer tenure after stock price crashes. Prior research (e.g., Andreou et al., 2016; Chen et al., 2017a) suggests that effective corporate governance can reduce crash risk. Hence, we explore the impact of corporate governance on the relation between crash risk and CEO power, and find that the significant negative impact of stock price crash risk on CEO power is diminished for firms with strong governance mechanisms.

Our study makes several important contributions. First, we respond to the call in Habib et al. (2018) by providing more empirical evidence on crash risk consequences, an under-researched area with tremendous potential. Our study also contributes to the literature on CEO power by documenting that crash risk leads to reduced CEO power. To our knowledge, our study is the first study that directly explores the relation between crash risk and future CEO power. Second, Jin and Myers (2006) argue that stock price crash risk is mainly caused by agency problems (i.e., managers purposely withhold bad news from shareholders), and severe agency conflicts may cause investors to take some corrective actions. Our results document that crash risk leads to reduced CEO power, suggesting that shareholders discipline managers after stock price crashes. Hence, our findings strengthen the argument in Jin and Myers (2006). Third, we provide interesting findings regarding certain CEO characteristics. For instance, a female CEO's power can be influenced more by crash risk than a male CEO's power. Hence, our findings contribute to the growing literature suggesting that different managerial characteristics can have different impacts on firm behavior, performance and outcomes (e.g., Ali and Zhang, 2015; Faccio et al., 2016). Fourth, our findings are consistent with prior research that strong corporate governance and internal control can mitigate firm risks including stock price crash risk. Thus, our empirical results highlight the importance of having strong corporate governance mechanisms. Lastly, our study has several practical implications to different stakeholder groups, especially to shareholders. For example, our findings can help investors understand better crash risk consequences and correspondingly adjust their investing behavior after stock prices crash. For example, investors need to consider reducing the CEO's power after stock price crashes. Additionally, our results may encourage shareholders to invest in firms with strong corporate governance.

The remainder of our study is structured as follows. We review related literature and present the hypothesis development in Section 2. Section 3 describes our research design and we present the primary findings in Section 4. Section 5 and Section 6 present results of robustness checks and additional tests, respectively. Section 7 concludes our study.

2. Literature review and hypothesis development

2.1. CEO power

Prior research on CEO power largely focuses on the impact of having powerful CEOs. In their theoretical paper, Larcker and Tayan (2012) argue that it is still not clear whether having a powerful CEO has a positive or negative impact on an organization. However, many empirical studies suggest that CEO power may have a negative impact on firm behavior and performance. For example, Bebchuk et al. (2011) investigate the impact of CEO power on firm behavior, performance and market valuation, and find that CEO power is negatively associated with firm operating performance and market valuation, which suggests that more powerful CEOs cause more agency problems. Liu and Jiraporn (2010) find that firms with powerful CEOs receive lower bond credit ratings. Jiraporn et al. (2012) find that CEO power is negatively related to debt financing, leading to a negative impact on firm performance. Abernethy et al. (2015) find that more powerful CEOs are more likely to propose less challenging performance targets in their compensation contracts. Dikolli et al. (2016) find that more powerful CEOs are less likely to choose relative performance evaluation. Han et al. (2016) find that powerful CEOs perform worse than other CEOs when the external business environment becomes more risky or volatile. Korkeamaki et al. (2017) suggest that more powerful CEOs like to impose their personal leverage preferences on their firms. Taken together, the above studies suggest that more powerful CEOs cause more agency problems, leading to worse firm performance and more negative outcomes.

2.2. Stock price crash risk

A significant body of prior research on stock price crash risk has examined the factors or determinants that influence crash risk. In this study, we classify prior studies on the determinants of crash risk into four categories, namely firm behavior and characteristics, managerial incentives and characteristics, corporate governance, and institutional and other factors. From the firm behavior and characteristics perspective, Hutton et al. (2009) find that firms with more opaque financial reporting have a higher level of crash risk,

Francis et al. (2016) document a significant positive relation between real earnings management and crash risk, Chen et al. (2017b) also find earnings smoothing increase crash risk, Kim and Zhang (2015) find that conservative accounting practice reduce crash risk, and Kim et al. (2016b) find that financial statement comparability reduce crash risk. Other studies find that socially-responsible firms experience low crash risk (Kim et al., 2014), the adoption of International Financial Reporting Standards (IFRS) reduce crash risk (DeFond et al., 2015), and firms with larger 10-Ks and more uncertain words in 10-Ks are more likely to experience crash risk (Ertugrul et al., 2016).

From the managerial incentives and characteristics perspective, Kim et al. (2011a) find that CFO equity incentives lead to a high likelihood of crash risk. He finds that CEO's inside debt reduce subsequent crash risk. Habib and Hasan (2017) find that more capable managers increase crash risk. Kim et al. (2016a) find that over-confident CEOs increase crash risk. Similarly, Andreou et al. (2017) find that younger CEOs increase crash risk. Li and Chan (2016) and Lee and Wang (2017) find that better-connected directors can reduce crash risk. Yuan et al. (2016) find that directors' and officers' liability insurance (D&O insurance) can reduce stock price crash risk. Park (2017) finds that greater pay disparity among top executives increases crash risk.

From the corporate governance perspective, prior research documents that the independence of the audit committee and effective corporate governance can reduce crash risk (Andreou et al., 2016), and strong internal control can reduce crash risk (Chen et al., 2017a,b). Other studies suggest that external corporate governance mechanisms such as institutional monitoring can also reduce crash risk. For example, stock price crash risk can be reduced by effective institutional monitoring, by institutional investor stability (Callen and Fang, 2013), by auditor industry specialization (Robin and Zhang, 2015), by auditor tenure and client-specific knowledge (Callen and Fang, 2016), and by external takeover threats (Bhargava et al., 2017).

Some studies investigate the impact of institutional-level and other factors on stock crash risk. For example, Callen and Fang (2015) find that local religiosity can reduce firm crash risk. Cao et al. (2016) find that social trust can curtail crash risk. Aman (2013) finds that media coverage increases firm crash risk. Similarly, Xu et al. (2013) find that analyst coverage also increases crash risk. Kubick and Lockhart (2016) find that firms located closer to SEC headquarters experience lower crash risk.

Despite the above studies on the determinants of stock price crash risk, there is very limited empirical evidence on the consequences of crash risk. An and Yu (2015) document a negative relation between crash risk and future speed of leverage adjustment, suggesting that firms adjust their financial leverage towards targets after crash risk. Hackenbrack et al. (2014) find that audit fees increase after stock price crashes. Therefore, Habib et al. (2018) highlight the immense potential for future research on crash risk consequences and call for more empirical evidence.

2.3. Hypothesis development

Based on the above research, we posit a negative relation between stock price crash risk and CEO power for at least two reasons. First, prior research suggests that when a CEO becomes too powerful, he/she is more likely to engage in opportunistic behavior to maximize his/her own self-interest at the expense of shareholders. Crash risk is largely driven by managers' opportunistic behavior (i.e., withholding bad news), which reflects agency conflicts between managers and shareholders. Intuitively, CEO power is associated with crash risk. Further, Mamun et al. (2019) find empirical evidence to show that CEO power increases stock price crash risk. Hence, if CEO power leads to a higher likelihood of stock price crash risk, we expect that firms attempt to reduce the CEO's power after stock price crashes because Habib et al. (2018) suggest that rational firms should eliminate certain factors that increase crash risk. Second, Jin and Myers (2006) suggest that shareholders take corrective actions to discipline managers when shareholders discover managers' opportunistic behavior. Therefore, if shareholders take disciplinary actions to curtail managers' opportunistic behavior, it is very likely that shareholders limit or reduce the power of the CEO especially after stock price crashes because powerful CEOs are associated with many negative firm outcomes such as low market valuation and poor firm operating performance (Bebchuk et al., 2011). Taken together, we propose the following hypothesis.

H1. CEO power becomes smaller after stock price crashes.

3. Research design

3.1. Measuring CEO power

According to Finkelstein (1992), an individual's power includes four components: structural power component, ownership power component, expert power component, and prestige power component. 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 refers to an executive's knowledge and experience. Prestige power refers to power derived from an executive's reputation. Prestige power is the most intangible dimension and thus very difficult to measure (Larcker and Tayan, 2012). Consistent with prior studies (e.g., Brass, 1984; Adams et al., 2005), our study attempts to identify whether other individuals at the top of the hierarchy participate in decision making with the CEO. The structural power is the only component that reflects the power the CEO has over the board and other top executives because of his/her formal position and title in the organization (Adams et al., 2005). In addition, structural power has been extensively used in the literature (e.g., Hambrick, 1981; Brass, 1984; Tushman and Romanelli, 1985; Adams et al., 2005). Hence, we focus on the structural power of the CEO in our study.

Consistent with many prior studies on CEO power (e.g., Bebchuk et al., 2011), we use the ratio of CEO's compensation to the combined total compensation of the top five executives (including the CEO) to proxy for CEO power. This ratio is also known as CEO

pay slice. The total compensation is reported in the ExeuComp database for each executive, which includes base salary, other pay, total value of restricted stock, the Black-Scholes value of stock options, long-term incentive payouts, and other compensation (ExecuComp Item: TDC1).

Bebchuk et al. (2011) argue that CEO pay slice is an accurate measure of CEO power because this ratio captures the relative importance of the CEO in the top management team in the context of ability and power. Additionally, this measure can capture unobservable factors of a firm's top management. Second, Bebchuk et al. (2011) document that this measure (CEO pay slice) contains a substantial amount of information at the firm level, due to the broad scope of the total compensation. Hence, using CEO pay slice as a proxy for CEO power can control for many firm-specific characteristics. Third, this measure is associated with important corporate outcomes such as firm operating performance, market value, and stock returns, suggesting that it is a useful proxy in investigating the role of CEO power in a firm's performance and outcomes (Bebchuk et al., 2011). Lastly, CEO pay slice is a continuous measure, unlike prior research that often uses indicator variables to measure CEO power. Taken together, we use CEO pay slice in our study to measure CEO power.

3.2. Measuring stock price crash risk

We use two measures of firm-level stock price crash risk (namely, *CRASH_1* and *CRASH_2*) in our study. To calculate *CRASH_1*, we first estimate weekly returns by each firm year using the following equation.

$$\mathrm{RETURN}_{i,t} = \alpha_i + \alpha_{1,i}\mathrm{RETURN}_{c,t-2} + \alpha_{2,i}\mathrm{RETURN}_{c,t-1} + \alpha_{3,i}\mathrm{RETURN}_{c,t} + \alpha_{4,i}\mathrm{RETURN}_{c,t+1} + \alpha_{5,i}\mathrm{RETURN}_{c,t+2} + \varepsilon_{i,t} \quad (1)$$

where $RETURN_{i,t}$ is the return on stock i in week t; $RETURN_{c,t}$ is the return on the CRSP weighted-value market index in week t. The lag and lead terms for market index returns are included in Equation 1 to allow for nonsynchronous trading (Dimson, 1979).

We calculate the weekly return for firm i in week t (R) using the log of one plus the residual term ($\varepsilon_{i,t}$) in Eq. (1). Following Kim et al. (2011a), when a public company demonstrates weekly returns 3.2 standard deviations below the mean firm-specific returns over the entire year, these weeks are regarded as crash weeks. Hence, consistent with Hutton et al. (2009), our first crash measure (*CRASH_1*) is an indicator variable that equals one if a firm experiences at least one crash week in a given year and zero otherwise. A higher value of *CRASH_1* suggests a higher likelihood of stock price crash risk.

Our second measure, *CRASH_2*, is based on the stock price crash measure in Chen et al., which uses the negative conditional return skewness. Specifically, we follow Chen et al. to calculate *CRASH_2*, which is a ratio of the third moment of weekly returns for each firm year to the standard deviation of weekly returns raised to the third power and multiply that ratio by negative one. A higher value of *CRASH_2* suggests greater stock price crash risk. The equation is listed below.

$$CRASH\_2 = (-1)\frac{n(n-1)^{\frac{3}{2}}(\sum w_{i,t})^3}{(n-1)(n-2)((\sum w_{i,t})^2)^{\frac{3}{2}}} \quad (2)$$

3.3. Empirical specification

To test our hypothesis, we use the following equation.

$$CEO\_POWER_{t+1} = \beta_0 + \beta_1 CRASH_t + \beta_2 SIZE_t + \beta_3 MB_t + \beta_4 LEVERAGE_t + \beta_5 ROA_t + \beta_6 ZSCORE_t + \beta_7 CASHFLOW_t + \beta_8 FIRMAGE_t + \beta_9 BIG4_t + \beta_{10} CEO\_AGE_t + \beta_{11} CEO\_TENURE_t + \beta_{12} CEO\_GENDER_t + \beta_{13} CEO\_CHAIR_t + Year\ Dummy\ Variables + Industry\ Dummy\ Variables + \varepsilon_{t+1} \quad (3)$$

The dependent variable, *CEO_POWER*, is the CEO pay slice in year t + 1. The primary independent variable of interest, *CRASH*, alternatively represents one of the two stock price crash risk measures (*CRASH_1* and *CRASH_2*). If our hypothesis is valid, we expect a significant negative coefficient (β_1) on *CRASH*.

We also control for firm-specific and CEO-specific characteristics in Eq. (3). Specifically, we control for total firm assets (*SIZE*), market to book ratio (*MB*), leverage ratio (*LEVERAGE*), firm profitability (*ROA*), ALTMAN's Z score (*ZSCORE*), cash flow from operating activities (*CASHFLOW*), firm age (*FIRMAGE*), and whether the firm uses a BIG 4 auditor (*BIG4*). Additionally, we control for the age of CEO (*CEOAGE*), the tenure of CEO (*CEO_TENURE*), the gender of CEO (*CEO_GENDER*), and whether a CEO also chairs the board (*CEO_CHAIR*).

We use Tobit regression as the primary regression in our analysis because the values of *CEO_POWER* are between zero and one. We winsorize all continuous variables in Equation 3 at the first and ninety-ninth percentiles, and include year and industry dummy variables. We provide detailed variable descriptions in Appendix A.

3.4. Sample selection and descriptive statistics

Our initial sample is an intersection of data from the CRSP database for stock return data, the ExecuComp database for CEO's and other executives' data, and the Compustat database for financial statement variable data. We then calculate our stock price crash measures and CEO power measure, and delete observations with missing values for these variables. Next, we remove observations with missing information to calculate control variables. Our final sample consists of 17,816 firm-year observations from 2001 to

2014, which includes 1814 unique public firms in the United States.[2]

In Table 1, we present the sample distribution by year and distribution by industry in Panel A and Panel B, respectively. Panel A shows that there are 1061 observations in 2001 and 1505 observations in 2007. The number of firm-year increases (decreases) from 2001 (2007) to 2007 (2014). Panel B shows that the most represented industry in our sample is Business Services (SIC = 73; 1872 observations; 219 firms), followed by Electric Equipment (SIC = 36; 1640 observations; 155 firms) and Chemicals (SIC = 28; 1406 observations; 149 firms).

Table 2 presents the sample summary statistics. The average CEO power (*CEO_POWER*) is 0.382, which is fairly close to that (0.36) in Bebchuk et al. (2011) and that (0.39) in Liu and Jiraporn (2010). Our two stock price crash risk measures are also close to those in recent studies. For example, Table 2 shows that the mean value of *CRASH_2* is 0.04, which is very close to that (0.035) in Kim et al. (2014). Overall, our descriptive statistics are in line with recent studies on CEO power and stock price crash risk. In addition, Table 2 reports that the mean value of *ZSCORE* is 4.27, suggesting that on average our sample firms are financially healthy. The mean value of *BIG4* is 0.916, suggesting that the majority of our sample firms use BIG 4 auditors. The mean value of *CEO_GENDER* is 0.972, which suggests that the number of female CEOs is very limited in our sample.

Table 3 presents the Pearson (below the diagonal) and Spearman (above the diagonal) correlations. For example, the Pearson correlation coefficients between *CEO_POWER* and *CRASH_1* and *CRASH_2* are −0.034 (p-value < 0.0001) and −0.030 (p-value < 0.030), respectively. The Spearman correlation coefficients between *CEO_POWER* and *CRASH_1* and *CRASH_2* are −0.036 (p-value < 0.0001) and −0.033 (p-value < 0.030), respectively. Consistent with our hypothesis, both correlations in Table 3 show that stock price crash measures are significantly and negatively correlated with CEO power (*CEO_POWER*). Additionally, many correlation coefficients are reasonably small, suggesting that our study may not be sensitive to multicollinearity issues. For instance, the largest coefficient in Table 3 is 0.669 (i.e., correlation between *CRASH_1* and *CRASH_2*). Many variables are significantly correlated with *CEO_POWER* and both crash measures, highlighting the need to test our hypothesis in a multivariate setting.

4. Main results

Table 4 presents our primary results of testing H1 by regressing CEO power on stock price crash risk and other variables in Eq. (3). In Column 1 and Column 3, we exclude control variables. In Column 2 and Column 4, we include all variables in Eq. (3). Both Column 1 and Column 2 show that *CRASH_1* is significantly and negatively related to *CEO_POWER*. For example, the coefficient on *CRASH_1* in Column 2 is −0.014 (Chi-Square = 9.18; p-value = 0.002). Similarly, both Column 3 and Column 4 show that our second crash risk measure, *CRASH_2*, is significantly and negatively related to *CEO_POWER*. For instance, the coefficient on *CRASH_2* in Column 4 is −0.006 with a p-value of 0.011. Hence, our primary findings support our hypothesis that suggests a negative relation between stock price crash risk and subsequent CEO power. Our findings are also economically meaningful. For example, based on results in Column 2 and Column 4, a one unit increase in *CRASH_1* (*CRASH_2*) is associated with a 0.014 (0.006) unit decrease in the predicted value of *CEO_POWER*.

Column 2 and Column 4 show that *CEO_POWER* is positively related to *SIZE*, *LEVERAGE*, *FIRMAGE*, *CEO_TENRUE*, and *CEO_CHAIR*, and negatively related to *BIG4* and *CEO_AGE*. Overall, the above findings on the relations between the dependent variable and control variables are consistent with general expectations. For example, the significant positive relation between *CEO_POWER* and *CEO_TENURE* suggests that CEO power increases in CEO tenure. The significant negative relation between *CEO_POWER* and *BIG4* suggests that using BIG4 auditors may mitigate CEO power.

We perform some commonly used tests to check the robustness of the primary results. For example, to ensure the robustness of our main results across different periods, we investigate the extent to which changes in macroeconomic and firm level factors influence the relation between stock price crash risk and CEO power. Specifically, we re-perform the regression analysis after dividing our sample period into three periods: 2001–2005, 2006–2010, and 2011–2014, and still obtain consistent results showing a significant negative relation between crash risk and CEO power across different time periods. Additionally, we re-perform the regression after removing firms in highly regulated industries (SIC 4000–4999 and SIC 6000–6999) and find that our hypothesis is still strongly supported. Results of these two robustness checks are not tabulated due to brevity.

5. Robustness tests

5.1. Alternative CEO power measures

To further curtail concerns about the robustness of our primary findings, we use two alternative CEO power measures (e.g., Adams et al., 2005). The first measure (namely, *LOG_CEOPAY*) is the natural log of the CEO's total compensation (ExecuComp Item: TDC1). Using *LOG_CEOPAY* as the dependent variable, we re-estimate Equation 3 and report results in Table 5. As shown in Column 1 and Column 2 of Table 5, the coefficients on both crash risk measures are negative and significant, consistent with our hypothesis. The second measure, *LOG(CEOPAY – Median_VPPAY)*, is the natural log of the difference between the CEO's total compensation and the median VP's total compensation. We re-estimate Equation 3 using *LOG(CEOPAY – Median_VPPAY)* as the dependent variable, and report results in Column 3 and Column 4 of Table 5. As shown in Column 3 and Column 4, *LOG(CEOPAY – Median_VPPAY)* is significantly and negatively related to *CRASH_1* and *CRASH_2*, supporting our hypothesis. Taken together, Table 5 provides evidence

[2] Because the ExecuComp database provides data on executives since 1992, our sample starts in 1991.

Table 1
Stock price crash risk and CEO power sample distribution.

Panel A: sample distribution by fiscal year

Year	Number of observations	Percent	Cumulative percent
2001	1061	5.96%	5.96%
2002	1081	6.07%	12.02%
2003	1143	6.42%	18.44%
2004	1152	6.47%	24.90%
2005	1168	6.56%	31.46%
2006	1179	6.62%	38.08%
2007	1505	8.45%	46.53%
2008	1489	8.36%	54.88%
2009	1451	8.14%	63.03%
2010	1398	7.85%	70.87%
2011	1370	7.69%	78.56%
2012	1327	7.45%	86.01%
2013	1277	7.17%	93.18%
2014	1215	6.82%	100.00%
	17,816	100.00%	

Panel B: sample distribution by industry

2 SIC	Description	Obs.	Percent	Firms	Percent	2 SIC	Description	Obs.	Percent	Firms	Percent
01	Agricultural Crops	28	0.16%	3	0.17%	45	Air Transportation	183	1.03%	19	1.05%
02	Agricultural Livestock	8	0.04%	1	0.06%	47	Transportation Services	43	0.24%	6	0.33%
07	Agricultural Services	11	0.06%	1	0.06%	48	Communications	493	2.77%	56	3.09%
10	Metal Mining	67	0.38%	5	0.28%	49	Utilities Services	1,090	6.12%	94	5.18%
12	Coal Mining	54	0.30%	6	0.33%	50	Wholesale Durable	395	2.22%	38	2.09%
13	Oil & Gas Extraction	736	4.13%	75	4.13%	51	Wholesale Nondurable	248	1.39%	26	1.43%
14	Mining	58	0.33%	6	0.33%	52	Building Materials	68	0.38%	6	0.33%
16	Heavy Construction	122	0.68%	11	0.61%	53	General Stores	191	1.07%	16	0.88%
17	Special Construction	37	0.21%	3	0.17%	54	Food Stores	100	0.56%	10	0.55%
20	Food	518	2.91%	49	2.70%	55	Automotive Service	126	0.71%	11	0.61%
21	Tobacco	47	0.26%	5	0.28%	56	Apparel Stores	374	2.10%	36	1.98%
22	Textile	82	0.46%	7	0.39%	57	Furniture Stores	95	0.53%	11	0.61%
23	Apparel	202	1.13%	23	1.27%	58	Eating & Drinking	355	1.99%	36	1.98%
24	Lumber	125	0.70%	12	0.66%	59	Miscellaneous Retail	314	1.76%	35	1.93%
25	Furniture	151	0.85%	12	0.66%	60	Depository Institutions	27	0.15%	5	0.28%
26	Paper	247	1.39%	24	1.32%	61	Nondepository Institutions	7	0.04%	1	0.06%
27	Printing	197	1.11%	21	1.16%	62	Brokers	130	0.73%	18	0.99%
28	Chemicals	1406	7.89%	149	8.21%	63	Insurance Carriers	76	0.43%	10	0.55%
29	Petroleum	124	0.70%	13	0.72%	64	Insurance	89	0.50%	13	0.72%
30	Rubber	137	0.77%	13	0.72%	65	Real Estate	38	0.21%	6	0.33%
31	Leather	100	0.56%	10	0.55%	67	Investment Offices	211	1.18%	24	1.32%
32	Stone Clay Glass	125	0.70%	12	0.66%	70	Hotels	34	0.19%	3	0.17%
33	Primary Metal	259	1.45%	28	1.54%	72	Personal Services	91	0.51%	8	0.44%
34	Fabricated Metal	298	1.67%	25	1.38%	73	Business Services	1872	10.51%	219	12.07%
35	Industrial Machinery	1,253	7.03%	120	6.62%	75	Auto Repair	35	0.20%	4	0.22%
36	Electronic Equipment	1,604	9.00%	155	8.54%	78	Motion Pictures	48	0.27%	6	0.33%
37	Transportation Equipment	512	2.87%	47	2.59%	79	Amusement	140	0.79%	15	0.83%
38	Measuring Instruments	1,103	6.19%	114	6.28%	80	Health Services	344	1.93%	37	2.04%
39	Other Manufacturing	174	0.98%	17	0.94%	82	Educational Services	122	0.68%	12	0.66%
40	Railroad	56	0.31%	5	0.28%	83	Social Services	9	0.05%	1	0.06%
41	Local/Suburban Transit	17	0.10%	2	0.11%	87	Engineering & Accounting	268	1.50%	27	1.49%
42	Motor Freight	185	1.04%	16	0.88%	99	Nonclassified	55	0.31%	6	0.33%

This panel presents sample distribution by fiscal year. The sample consists of 17,816 firm-year observations, representing 1814 unique firms, from 2001 to 2014.
This panel presents sample distribution by industry, based on the first two digits of the Standard Industrial Classification (SIC) code. The sample consists of 17,816 firm-year observations (representing 1814 unique firms) from 2001 to 2014.

to show that our primary findings are robust using these two alternative CEO power measures.

5.2. Alternative stock price crash risk measure

Prior research (e.g., Chen et al., 2017b) uses the down-to-up volatility of firm-specific daily returns to measure the stock price crash risk. Consistent with Chen et al. (2017b), we use the following equation to calculate this variable (namely, *DUVOL*).

Table 2
Stock price crash risk and CEO power sample descriptive statistics.

Variable	Obs.	Mean	Std Dev	25th Pctl	Median	75th Pctl
CEO_POWER	17,816	0.382	0.117	0.313	0.386	0.452
CRASH_1	17,816	0.281	0.450	0.000	0.000	1.000
CRASH_2	17,816	0.040	0.893	−0.478	−0.025	0.462
SIZE	17,816	7.456	1.589	6.305	7.336	8.513
MB	17,816	2.980	3.852	1.435	2.198	3.573
LEVERAGE	17,816	0.190	0.175	0.014	0.170	0.294
ROA	17,816	0.037	0.110	0.017	0.049	0.087
ZSCORE	17,816	4.270	4.587	1.882	3.247	5.219
CASHFLOW	17,816	0.102	0.085	0.060	0.100	0.148
FIRMAGE	17,816	3.183	0.652	2.708	3.135	3.784
BIG4	17,816	0.916	0.278	1.000	1.000	1.000
CEO_AGE	17,816	55.654	7.316	51.000	56.000	60.000
CEO_TENURE	17,816	5.483	3.967	2.000	5.000	8.000
CEO_GENDER	17,816	0.972	0.165	1.000	1.000	1.000
CEO_CHAIR	17,816	0.418	0.466	0.000	0.000	1.000

This table presents the descriptive statistics of the sample variables, showing the number of observations, pooled means, standard deviations, 25th percentile, median, and 75th percentile of the dependent variable, independent variables of interest, and control variables. The sample consists of 17,816 firm-year observations from 2001 to 2014, which represents 1814 unique U.S. public firms. All continuous variables are winsorized at the 1% and 99% percentiles. Variable definitions are provided in Appendix A.

$$DUVOL = log\left[((n_{up} - 1)\sum_{down} R^2)/(n_{down} - 1)\sum_{up} R^2\right] \quad (4)$$

where n is the number of observations during the quarter t, and n_{up} and n_{down} are the numbers of ups and downs days over quarter t, respectively. R is the natural log of one plus the estimated residual returns of Eq. (1). A higher value of *DUVOL* suggests a higher likelihood of stock price crash risk.

Using this alternative measure as the independent variable of interest, we re-estimate Equation 3 and present results in Table 6. Column 2 shows that the coefficient on *DUVOL* is -0.008 with a p-value of 0.026, suggesting a significant negative relation between *DUVOL* and *CEO_POWER*. Thus, our hypothesis is still supported using this alternative measure.

5.3. Alternative empirical specifications

Following prior research (e.g., Petersen, 2009), we use three alternative empirical specifications (namely, clustered standard errors OLS, firm fixed effects regression, and Fama-MacBeth regression). As shown in Column 1 and Column 2 of Table 6, clustered standard errors OLS shows that coefficients on *CRASH_1* and *CRASH_2* are negative and significant. We perform firm fixed effects regression to estimate Equation 3 and still obtain consistent findings (reported in Column 3 and Column 4) to support a significant negative relation between stock price crash risk and CEO power. Column 5 and Column 6 also show that coefficients on *CRASH_1* and *CRASH_2* are negative and significant in Fama-MacBeth regression analysis. Taken together, results of Table 7 show that our primary findings are robust to alternative empirical specifications.

6. Additional tests

6.1. Female CEOs vs. Male CEOs

Prior research suggests that the gender of a CEO plays an important role in firm performance and behavior. For example, Khan and Vieito (2013) find that firms with female CEOs demonstrate better performance than firms with male CEOs. Faccio et al. (2016) find that firms with female CEOs have lower leverage, less volatile earnings and lower overall risk than firms with male CEOs. Together, prior research suggests that female CEOs are better managers, relative to male CEOs. We argue that female CEOs may be penalized more when their firms' stock price crashes because firms run by female CEOs are regarded as less risky and more stable firms. We explore whether our primary findings differ between firms run by female CEOs and firms run by male CEOs. Specifically, we divide our sample into two subsamples (female CEOs with 501 observations and male CEOs with 17,315 observations), re-estimate Eq. (3) separately for each subsample, and report results in Table 8. Using *CRASH_1* as the independent variable of interest, Column 1 and Column 2 show that the coefficient on *CRASH_1* is -0.048 with a p-value of 0.056 for female CEOs, and the coefficient on *CRASH_1* is −0.013 with a p-value of 0.005 for male CEOs. We perform a coefficient comparison test (−0.048 vs. −0.013) between these two coefficients and find that the difference is statistically significant (p-value = 0.027), suggesting that the negative impact of stock price crash risk on female CEOs is significantly stronger than the impact on male CEOs.

Using *CRASH_2*, Column 3 and Column 4 report similar findings. The coefficient on *CRASH_2* is −0.024 with a p-value of 0.051 for female CEOs, and −0.006 with a p-value of 0.013 for male CEOs. The difference between these two coefficients is statistically significant (p-value = 0.061). Taken together, findings in Table 8 indicate that our primary findings are stronger for firms with female CEOs, suggesting that a female CEO's power will be reduced more than a male CEO's power in the context of crash risk consequences.

Table 3
Stock price crash risk and CEO power correlation matrix.

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	CEO_POWER		−0.036	−0.033	0.115	0.037	0.079	0.044	−0.027	0.011	0.123	0.015	−0.012	0.042	−0.014	0.008
	p-value		*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*0.000*	*0.146*	*< .0001*	*0.049*	*0.097*	*< .0001*	*0.066*	*0.280*
2	CRASH_1	−0.034		0.669	−0.047	−0.057	−0.028	−0.025	0.008	0.001	−0.035	0.004	0.001	0.004	−0.001	−0.011
	p-value	*< .0001*		*< .0001*	*< .0001*	*< .0001*	*0.000*	*0.001*	*0.268*	*0.943*	*< .0001*	*0.597*	*0.925*	*0.560*	*0.911*	*0.154*
3	CRASH_2	−0.030	0.662		0.020	−0.086	0.010	−0.039	−0.023	−0.017	−0.002	0.006	0.003	−0.002	0.004	0.011
	p-value	*< .0001*	*< .0001*		*0.008*	*< .0001*	*0.177*	*< .0001*	*0.002*	*0.023*	*0.766*	*0.399*	*0.708*	*0.820*	*0.550*	*0.128*
4	SIZE	0.075	−0.048	0.007		0.028	0.417	0.031	−0.317	0.001	0.416	0.274	0.104	0.111	0.004	0.088
	p-value	*< .0001*	*< .0001*	*0.365*		*0.000*	*< .0001*	*< .0001*	*< .0001*	*0.940*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*0.557*	*< .0001*
5	MB	0.001	−0.037	−0.056	0.010		−0.116	0.488	0.424	0.399	−0.096	0.036	−0.058	0.017	0.008	0.025
	p-value	*0.912*	*< .0001*	*< .0001*	*0.169*		*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*0.024*	*0.264*	*0.001*
6	LEVERAGE	0.056	−0.024	0.001	0.313	−0.040		−0.249	−0.629	−0.185	0.195	0.143	0.063	0.020	0.018	0.045
	p-value	*< .0001*	*0.002*	*0.871*	*< .0001*	*< .0001*		*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*0.009*	*0.015*	*< .0001*
7	ROA	0.043	−0.039	−0.047	0.137	0.182	−0.134		0.624	0.647	−0.018	0.025	0.031	0.062	−0.006	0.024
	p-value	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*		*< .0001*	*< .0001*	*0.018*	*0.001*	*< .0001*	*< .0001*	*0.456*	*0.002*
8	ZSCORE	−0.046	−0.006	−0.030	−0.254	0.223	−0.472	0.420		0.472	−0.178	−0.056	−0.021	0.037	−0.007	−0.014
	p-value	*< .0001*	*0.434*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*		*< .0001*	*< .0001*	*< .0001*	*0.005*	*< .0001*	*0.331*	*0.071*
9	CASHFLOW	0.010	−0.004	−0.017	0.062	0.206	−0.134	0.607	0.378		−0.095	0.020	−0.011	0.041	−0.004	0.013
	p-value	*0.175*	*0.581*	*0.024*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*		*< .0001*	*0.008*	*0.156*	*< .0001*	*0.582*	*0.078*
10	FIRMAGE	0.109	−0.030	−0.014	0.405	−0.056	0.119	0.055	−0.197	−0.069		0.064	0.188	0.155	−0.011	0.052
	p-value	*< .0001*	*< .0001*	*0.069*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*		*< .0001*	*< .0001*	*< .0001*	*0.136*	*< .0001*
11	BIG4	−0.001	0.004	0.005	0.273	0.011	0.118	0.053	−0.067	0.045	0.061		−0.007	0.011	0.002	0.045
	p-value	*0.886*	*0.597*	*0.538*	*< .0001*	*0.158*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*		*0.363*	*0.137*	*0.767*	*< .0001*
12	CEO_AGE	−0.022	0.000	0.005	0.101	−0.048	0.041	0.045	−0.032	−0.007	0.187	−0.002		0.357	0.066	0.143
	p-value	*0.003*	*0.950*	*0.486*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*0.321*	*< .0001*	*0.820*		*< .0001*	*< .0001*	*< .0001*
13	CEO_TENURE	0.022	0.005	−0.002	0.105	0.009	0.005	0.064	0.014	0.037	0.182	0.001	0.379		0.043	0.095
	p-value	*0.003*	*0.530*	*0.817*	*< .0001*	*0.237*	*0.540*	*< .0001*	*0.056*	*< .0001*	*< .0001*	*0.899*	*< .0001*		*< .0001*	*< .0001*
14	CEO_GENDER	−0.012	−0.001	0.002	−0.004	−0.013	0.005	−0.009	−0.002	−0.012	−0.009	0.002	0.060	0.041		0.045
	p-value	*0.096*	*0.911*	*0.750*	*0.625*	*0.076*	*0.515*	*0.246*	*0.757*	*0.115*	*0.216*	*0.767*	*< .0001*	*< .0001*		*< .0001*
15	CEO_CHAIR	0.008	−0.011	0.010	0.086	−0.005	0.022	0.018	0.013	0.019	0.056	0.045	0.137	0.058	0.045	
	p-value	*0.293*	*0.154*	*0.165*	*< .0001*	*0.531*	*0.003*	*0.017*	*0.084*	*0.010*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	*< .0001*	

This table presents the Pearson and Spearman correlations for selected variables of the sample over the period of 2001–2014, representing 1814 individual firms in the U.S. and 17,816 firm-year observations. The Pearson (Spearman) correlations are provided below the diagonal (above the diagonal). For each pair of variables, the correlation coefficient and related (two-tailed) p-value are provided. All continuous variables are winsorized at the 1% and 99% percentiles before the correlation analysis. Variable definitions are provided in Appendix A.

Table 4
Stock Price Crash Risk and CEO Power Main Results.

	Dependent Variable = CEO_POWER											
	Column 1			Column 2			Column 3			Column 4		
Parameter	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq
Intercept	−0.868***	3867.04	< .0001	−0.831***	781.77	< .0001	−0.873***	3930.13	< .0001	−0.837***	792.59	< .0001
CRASH_1	−0.015***	10.12	0.002	−0.014***	9.18	0.002						
CRASH_2							−0.006***	6.75	0.009	−0.006**	6.53	0.011
SIZE				0.007***	16.50	< .0001				0.007***	17.30	< .0001
MB				0.000	0.24	0.622				0.000	0.24	0.624
LEVERAGE				0.029*	3.68	0.055				0.029*	3.66	0.056
ROA				0.028	1.15	0.283				0.029	1.24	0.265
ZSCORE				0.000	0.03	0.859				0.000	0.03	0.866
CASHFLOW				−0.017	0.24	0.624				−0.018	0.28	0.595
FIRMAGE				0.012***	9.69	0.002				0.012***	9.62	0.002
BIG4				−0.056***	49.08	< .0001				−0.056***	48.78	< .0001
CEO_AGE				−0.002***	24.83	< .0001				−0.002***	24.77	< .0001
CEO_TENURE				0.002***	12.86	0.000				0.002***	12.62	0.000
CEO_GENDER				−0.010	0.63	0.426				−0.010	0.64	0.425
CEO_CHAIR				0.019***	11.26	0.001				0.019***	11.32	0.001
Year	Included			Included			Included			Included		
Industry	Included			Included			Included			Included		
Observations	17,816			17,816			17,816			17,816		
Adj. R^2	0.026			0.040			0.025			0.040		

This table reports the results of the Tobit regression, which regresses CEO power in year t + 1 (CEO_POWER) on stock price crash risk (CRASH_1 & CRASH_2) and control variables over the period of 2001–2014 based on the following equation:
$CEO\_POWER = \beta_0 + \beta_1 \times CRASH + \beta_x \times Control\ Variables + Year\ \&\ Industry\ Dummies + \varepsilon$.
Continuous control variables are winsorized at the 1% and 99% percentiles each year before entering the regression tests. *, **, and *** represent significance at the 10, 5 and 1 percent (two-tailed) confidence levels, respectively. Refer to Appendix A for variable definitions.

Table 5
Stock price crash risk and CEO power alternative CEO power measures.

	Dependent Variable = LOG_CEOPAY						Dependent Variable = LOG(CEOPAY - Median_VPPAY)					
	Regression = OLS						Regression = OLS					
	Column 1			Column 2			Column 3			Column 4		
Parameter	Estimate	t Value	Pr > |t|	Estimate	t Value	Pr > |t|	Estimate	t Value	Pr > |t|	Estimate	t Value	Pr > |t|
Intercept	4.931***	68.01	< .0001	4.918***	67.92	< .0001	2.470***	20.52	< .0001	2.439***	20.30	< .0001
CRASH_1	−0.032***	−2.76	0.006				−0.075***	−4.00	< .0001			
CRASH_2				−0.020***	−3.39	0.001				−0.042***	−4.42	< .0001
SIZE	0.456***	109.53	< .0001	0.457***	109.67	< .0001	0.625***	90.50	< .0001	0.626***	90.71	< .0001
MB	0.016***	10.86	< .0001	0.015***	10.81	< .0001	0.017***	7.75	< .0001	0.017***	7.69	< .0001
LEVERAGE	−0.080**	−2.16	0.031	−0.080**	−2.17	0.030	−0.015	−0.25	0.803	−0.015	−0.24	0.809
ROA	−0.022	−0.33	0.742	−0.022	−0.34	0.733	−0.074	−0.66	0.507	−0.073	−0.66	0.512
ZSCORE	0.003**	2.21	0.027	0.003**	2.20	0.028	0.023***	8.57	< .0001	0.023***	8.56	< .0001
OCF	0.728***	8.79	< .0001	0.726***	8.77	< .0001	0.890***	6.42	< .0001	0.885***	6.38	< .0001
FIRMAGE	−0.020**	−2.05	0.041	−0.020**	−2.07	0.039	−0.084***	−5.40	< .0001	−0.084***	−5.43	< .0001
BIG4	0.109***	5.48	< .0001	0.108***	5.45	< .0001	0.076**	2.11	0.035	0.074**	2.07	0.039
CEO_AGE	−0.003***	−3.64	0.000	−0.003***	−3.62	0.000	−0.001	−1.07	0.284	−0.001	−1.04	0.296
CEO_TENURE	0.000	−0.18	0.860	0.000	−0.18	0.855	0.000	−0.14	0.887	0.000	−0.16	0.872
CEO_GENDER	0.013	0.40	0.687	0.013	0.40	0.687	0.053	1.03	0.301	0.054	1.05	0.294
CEO_CHAIR	0.112***	7.89	< .0001	0.112***	7.86	< .0001	0.122***	5.25	< .0001	0.122***	5.22	< .0001
Year	Included			Included			Included			Included		
Industry	Included			Included			Included			Included		
Observations	17,816			17,816			17,816			17,816		
Adj. R^2	0.5321			0.5322			0.4430			0.4431		

This table reports the results of estimating Equation 1 using two alternative CEO Power measures: LOG_CEOPAY and LOG(CEOPAY – Median_VPPAY). LOG_CEOPAY is the natural log of total CEO compensation (TDC1). LOG(CEOPAY – Median_VPPAY) is the natural log of the difference between the CEO's total compensation and the median VP's total compensation. Continuous control variables are winsorized at the 1% and 99% percentiles each year before entering the regression tests. *, **, and *** represent significance at the 10, 5 and 1 percent (two-tailed) confidence levels, respectively. Refer to Appendix A for variable definitions.

Table 6
Stock Price Crash Risk and CEO Power Alternative Stock Price Crash Risk Measure.

	Dependent Variable = CEOPOWER					
	Column 1			Column 2		
Parameter	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq
Intercept	−0.872***	3928.62	< .0001	−0.836***	791.67	< .0001
DUVOL	−0.008**	5.07	0.024	−0.008**	4.93	0.026
SIZE				0.007***	17.25	< .0001
MB				0.000	0.26	0.611
LEVERAGE				0.029*	3.67	0.056
ROA				0.030	1.28	0.258
ZSCORE				0.000	0.03	0.866
OCF				−0.018	0.29	0.592
FIRMAGE				0.012***	9.58	0.002
BIG4				−0.056***	48.80	< .0001
CEO_AGE				−0.002***	24.88	< .0001
CEO_TENURE				0.002***	12.64	0.000
CEO_GENDER				−0.010	0.64	0.422
CEO_CHAIR				0.020***	11.36	0.001
Year	Included			Included		
Industry	Included			Included		
Observations	17,816			17,816		
Adj. R^2	0.0251			0.0399		

This table reports the results of estimating Equation 1 using an alternative measure of stock price crash risk, namely DUVOL. DUVOL is the down-to-up volatility of the negative coefficient of skewness of firm-specific daily returns. Continuous control variables are winsorized at the 1% and 99% percentiles each year before entering the regression tests. *, **, and *** represent significance at the 10, 5 and 1 percent (two-tailed) confidence levels, respectively. Refer to Appendix A for variable definitions.

Table 7
Stock Price Crash Risk and CEO Power Alternative Empirical Specifications.

	Dependent Variable = CEO_POWER											
	Clustered Errors OLS				Firm Fixed Effects				Fama-MacBeth			
	Column 1		Column 2		Column 3		Column 4		Column 5		Column 6	
Parameter	Estimate	t Value	Estimate	t Value	Estimate	t Value	Estimate	t Value	Estimate	t Value	Estimate	t Value
Intercept	0.398***	32.06	0.395***	31.85					0.392***	20.74	0.389***	21.33
CRASH_1	−0.007***	−3.59			−0.007***	−3.91			−0.007**	−2.34		
CRASH_2			−0.003***	−3.12			−0.003***	−3.53			−0.003***	−4.26
SIZE	0.002***	3.28	0.002***	3.42	−0.009***	−4.31	−0.009***	−4.25	0.002*	2.05	0.002*	2.16
MB	0.000	0.03	0.000	0.03	0.000	−0.08	0.000	−0.10	0.000	0.84	0.000	0.80
LEVERAGE	0.017***	2.71	0.017***	2.71	−0.023***	−2.67	−0.023***	−2.67	0.021***	3.21	0.021***	3.19
ROA	0.041***	3.41	0.041***	3.43	0.026**	2.54	0.026**	2.56	0.057***	3.55	0.057***	3.65
ZSCORE	−0.001***	−3.19	−0.001***	−3.19	0.001**	2.02	0.001**	2.00	−0.001***	−3.85	−0.001***	−3.85
CASHFLOW	0.021	1.47	0.020	1.42	0.028**	1.93	0.027**	1.87	0.011	0.44	0.010	0.41
FIRMAGE	0.013***	8.41	0.013***	8.39	0.023***	3.02	0.022***	2.96	0.013***	12.50	0.013***	12.58
BIG4	−0.011***	−2.87	−0.011***	−2.91	−0.013***	−2.76	−0.013***	−2.78	−0.008***	−3.70	−0.008***	−4.03
CEO_AGE	−0.001***	−8.04	−0.001***	−8.03	−0.002***	−8.62	−0.002***	−8.66	−0.001***	−7.14	−0.001***	−7.03
CEO_TENURE	0.000*	1.86	0.000*	1.85	0.000	0.07	0.000	0.10	0.001**	2.28	0.001**	2.22
CEO_GENDER	−0.009*	−1.82	−0.009*	−1.82	−0.008	−1.10	−0.008	−1.09	−0.011**	−2.44	−0.011**	−2.37
CEO_CHAIR	0.010***	4.30	0.010***	4.27	0.002	0.80	0.002	0.77	0.002	0.32	0.002	0.31
Year	Included		Included		Included		Included		Included		Included	
Industry	Included		Included		Included		Included		Included		Included	
Observations	17,816		17,816		17,816		17,816		17,816		17,816	
Adj. R^2	0.044		0.044		0.407		0.407		0.039		0.036	

This table reports the results of regressing CEO power in year t + 1 (CEO_POWER) on stock price crash risk (CRASH_1 & CRASH_2) and control variables over the period of 2001–2014, using alternative empirical specifications, based on the following equation:
$\text{CEO\_POWER} = \beta_0 + \beta_1 \times \text{CRASH} + \beta_x \times \text{Control Variables} + \text{Year \& Industry Dummies} + \varepsilon$.
Continuous control variables are winsorized at the 1% and 99% percentiles each year before entering the regression tests. *, **, and *** represent significance at the 10, 5 and 1 percent (two-tailed) confidence levels, respectively. Refer to Appendix A for variable definitions.

6.2. CEOs with shorter tenure vs. CEOs with longer tenure

Prior research (e.g., Ali and Zhang, 2015) suggests that CEO's behavior and performance often vary with the CEO's tenure. Additionally, Ali and Zhang (2015) find that CEO power increases in CEO tenure. Hence, we argue that CEOs with longer tenure may possess more power than CEO with shorter tenure. When a CEO becomes more powerful, the impact of factors such as stock price crash risk on the CEO power may decrease because more powerful CEOs have more control and influence over other executives. In other words, we expect that our results are driven by CEOs with shorter tenure. We divide our sample into two subsamples: CEOs with shorter tenure (less than or equal to 5 years) and CEOs with longer tenure (greater than 5 years), and re-estimate Eq. (3) separately for these two subsamples. As shown in Table 9, Column 1 shows that the coefficient on *CRASH_1* is −0.018 with a p-value of 0.003 for CEOs with shorter tenure, and Column 2 shows that the coefficient on *CRASH_1* is −0.008 with a p-value of 0.267 for CEOs with longer tenure. Similarly, Column 3 and Column 4 show that the coefficients on *CRASH_2* is −0.007 with a p-value of 0.025 for CEOs with shorter tenure and −0.004 with a p-value of 0.254 for CEOs with longer tenure, respectively. Taken together, findings in Table 9 show that stock price crash risk is significantly related to CEO power for CEOs with shorter tenure and is not significantly related to CEOs power for CEOs with longer tenure, suggesting that our primary results are largely driven by CEOs with shorter tenure.

6.3. The effect of corporate governance

Prior research suggests that effective corporate governance can mitigate excessive CEO power and stock price crash risk. In this additional test, we investigate the influence of corporate governance on the relation between crash risk and CEO power. Following Kim et al. (2014), we obtain data on corporate governance from the MSCI's ESG database,[3] and merge the governance dataset with our sample. We use an indicator variable (GOV_H), which equals one if the value of corporate governance is above the median and zero otherwise, to divide our sample into two subsamples (firms with weak governance and firms with strong governance). We re-estimate Eq. (3) for each subsample and present results in Table 10. Column 1 shows that the coefficient on *CRASH_1* is -0.019 with a p-value of 0.002 for firms with weak governance, and Column 2 shows that the coefficient on *CRASH_1* is 0.002 with a p-value of 0.860 for firms with strong governance. Similarly, Column 3 and Column 4 show that the coefficients on *CRASH_2* is −0.010 with a p-value of 0.001 for firms with weak governance and 0.004 with a p-value of 0.386 for firms with strong governance, respectively. The above evidence suggests that the significant negative relation between stock price crash risk and CEO power is diminished for

[3] Morgan Stanley Capital International (MSCI) Environmental, Social and Governance (ESG) database.

Table 8
Stock Price Crash Risk and CEO Power Female CEOs vs. Male CEOs.

	Dependent Variable = CEO_POWER											
	Female CEOs			Male CEOs			Female CEOs			Male CEOs		
	Column 1			Column 2			Column 3			Column 4		
Parameter	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq
Intercept	−0.956***	47.81	< .0001	−0.832***	1427.73	< .0001	−0.942***	46.46	< .0001	−0.838***	1456.80	< .0001
CRASH_1	−0.048*	3.65	0.056	−0.013***	7.82	0.005						
CRASH_2							−0.024*	3.81	0.051	−0.006**	6.20	0.013
SIZE	0.0075	0.81	0.3686	0.003*	3.54	0.060	0.008	0.81	0.368	0.003**	4.07	0.044
MB	0.0048*	2.86	0.0907	0.000	0.23	0.635	0.005	2.59	0.1075	0.000	0.20	0.657
LEVERAGE	0.0314	0.2	0.6564	0.029**	4.14	0.042	0.041	0.34	0.5614	0.029**	4.13	0.042
ROA	0.3916***	8.03	0.0046	0.052**	3.96	0.047	0.384***	7.67	0.0056	0.052**	3.97	0.046
ZSCORE	−0.0014	0.13	0.7183	0.000	0.00	0.952	−0.001	0.09	0.7593	0.000	0.00	0.966
CASHFLOW	0.0765	0.18	0.6686	−0.037	1.22	0.269	0.053	0.09	0.7688	−0.037	1.24	0.266
FIRMAGE	−0.0317	2.2	0.1377	0.018***	23.15	< .0001	−0.032	2.18	0.1396	0.018***	23.00	< .0001
BIG4	−0.0872*	3.62	0.057	−0.051***	40.39	< .0001	−0.088*	3.71	0.0542	−0.051***	40.40	< .0001
CEO_AGE	0.0046**	3.85	0.0497	−0.002***	21.59	< .0001	0.004*	3.09	0.0786	−0.002***	21.37	< .0001
CEO_TENURE	−0.0094**	6.17	0.013	0.003***	25.65	< .0001	−0.010**	6.29	0.0121	0.003***	25.16	< .0001
CEO_GENDER	0.0393	1.78	0.1824	0.012**	6.23	0.013	0.045	2.31	0.1281	0.012**	6.52	0.011
CEO_CHAIR	−0.5431***	12.59	0.0004	−0.015	0.48	0.489	−0.534***	12.2	0.0005	−0.016	0.48	0.487
Observations	501			17,315			501			17,315		
Adj. R^2	0.050			0.020			0.047			0.020		
Coefficient Comparison: CRASH_1 of Female CEOs vs. CRASH_1 of Male CEOs							Coefficient Comparison: CRASH_2 of Female CEOs vs. CRASH_2 of Male CEOs					
p-value = 0.027							p-value = 0.061					

This table reports the results of the Tobit regression, which regresses CEO power in year t + 1 (CEO_POWER) on stock price crash risk (CRASH_1 & CRASH_2) and control variables over the period of 2001–2014 based on the following equation:

$CEO\_POWER = \beta_0 + \beta_1 \times CRASH + \beta_x \times Control\ Variables + Year\ \&\ Industry\ Dummies + \varepsilon.$

Continuous control variables are winsorized at the 1% and 99% percentiles each year before entering the regression tests. *, **, and *** represent significance at the 10, 5 and 1 percent (two-tailed) confidence levels, respectively. Refer to Appendix A for variable definitions.

Table 9
Stock Price Crash Risk and CEO Power CEOs with Shorter Tenure vs. CEOs with Longer Tenure.

	Dependent Variable = CEO_POWER											
	CEOs with Shorter Tenure			CEOs with Longer Tenure			CEOs with Shorter Tenure			CEOs with Longer Tenure		
	Column 1			Column 2			Column 3			Column 4		
Parameter	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq
Intercept	−0.827***	448.27	< .0001	−0.833***	298.63	< .0001	−0.833***	455.34	< .0001	−0.838***	301.94	< .0001
CRASH_1	−0.018***	9.01	0.003	−0.008	1.23	0.267						
CRASH_2							−0.007**	5.03	0.025	−0.004	1.30	0.254
SIZE	0.008***	12.84	0.000	0.005*	3.34	0.068	0.008***	13.71	0.000	0.005*	3.41	0.065
MB	0.001*	3.23	0.072	−0.002*	3.39	0.066	0.001*	3.2	0.074	−0.002*	3.35	0.067
LEVERAGE	0.009	0.24	0.626	0.068***	7.72	0.006	0.009	0.25	0.616	0.068***	7.72	0.006
ROA	−0.022	0.48	0.488	0.160***	10.28	0.001	−0.020	0.42	0.516	0.160***	10.29	0.001
ZSCORE	0.001	0.65	0.420	−0.001	1.62	0.203	0.001	0.68	0.410	−0.001	1.60	0.206
CASHFLOW	−0.007	0.03	0.873	−0.030	0.26	0.613	−0.009	0.05	0.827	−0.030	0.26	0.612
FIRMAGE	0.016***	11.97	0.001	0.006	0.62	0.433	0.016***	11.75	0.001	0.006	0.63	0.426
BIG4	−0.063***	36.98	< .0001	−0.050***	15.42	< .0001	−0.063***	36.87	< .0001	−0.050***	15.38	< .0001
CEO_AGE	−0.002***	18.27	< .0001	−0.002***	8.01	0.005	−0.002***	18.31	< .0001	−0.002***	7.92	0.005
CEO_TENURE	0.009***	19.01	< .0001	0.002	1.95	0.163	0.009***	19.34	< .0001	0.002	1.89	0.169
CEO_GENDER	−0.018	1.37	0.242	−0.004	0.03	0.874	−0.019	1.45	0.228	−0.003	0.02	0.895
CEO_CHAIR	0.016**	5.05	0.025	0.017*	2.72	0.099	0.016**	5.16	0.023	0.017	2.68	0.102
Year	Included			Included			Included			Included		
Industry	Included			Included			Included			Included		
Observations	10,526			7,290			10,526			7,290		
Adj. R^2	0.043			0.047			0.043			0.047		

This table reports the results of the Tobit regression, which regresses CEO power in year t + 1 (CEO_POWER) on stock price crash risk (CRASH_1 & CRASH_2) and control variables over the period of 2001–2014 based on the following equation:
$CEO\_POWER = \beta_0 + \beta_1 \times CRASH + \beta_x \times Control\ Variables + Year\ \&\ Industry\ Dummies + \varepsilon$.
Continuous control variables are winsorized at the 1% and 99% percentiles each year before entering the regression tests. *, **, and *** represent significance at the 10, 5 and 1 percent (two-tailed) confidence levels, respectively. Refer to Appendix A for variable definitions.

Table 10
Stock Price Crash Risk and CEO Power The Effect of Corporate Governance.

	Dependent Variable = CEO_POWER											
	Weak Governance			Strong Governance			Weak Governance			Strong Governance		
	Column 1			Column 2			Column 3			Column 4		
Parameter	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq	Estimate	Chi-Square	Pr > ChiSq
Intercept	−0.788***	352.84	< .0001	−0.873***	180.31	< .0001	−0.795***	360.00	< .0001	−0.871***	179.92	< .0001
CRASH_1	−0.019***	9.67	0.002	0.002	0.03	0.860						
CRASH_2							−0.010***	10.69	0.001	0.004	0.75	0.386
SIZE	0.004	1.88	0.170	−0.001	0.04	0.841	0.004	1.98	0.160	−0.001	0.05	0.825
MB	−0.001	0.46	0.498	0.000	0.02	0.877	−0.001	0.56	0.454	0.000	0.02	0.891
LEVERAGE	0.040*	3.51	0.061	0.050*	2.86	0.091	0.039*	3.32	0.068	0.050*	2.89	0.089
ROA	0.171***	13.47	0.000	0.000	0.00	0.997	0.172***	13.65	0.000	0.001	0.00	0.980
ZSCORE	−0.001	1.78	0.182	0.001	1.29	0.257	−0.001	2.05	0.152	0.001	1.33	0.249
CASHFLOW	−0.078	2.21	0.137	−0.016	0.05	0.822	−0.078	2.22	0.136	−0.018	0.06	0.802
FIRMAGE	0.011**	4.08	0.043	0.010	1.57	0.210	0.011**	4.15	0.042	0.010	1.62	0.203
BIG4	−0.045***	17.80	< .0001	−0.042**	4.95	0.026	−0.045***	17.83	< .0001	−0.041**	4.87	0.027
CEO_AGE	−0.002***	17.34	< .0001	0.000	0.32	0.571	−0.002***	17.17	< .0001	0.000	0.36	0.550
CEO_TENURE	0.002***	9.00	0.003	0.003***	8.87	0.003	0.002***	8.89	0.003	0.003***	8.97	0.003
CEO_GENDER	−0.014	0.65	0.421	−0.017	0.53	0.468	−0.014	0.61	0.433	−0.017	0.53	0.467
CEO_CHAIR	0.009	1.12	0.290	0.020**	3.96	0.047	0.008	1.00	0.316	0.020**	4.01	0.045
Observations	7,002			7,000			7,002			7,000		
Adj. R^2	0.066			0.044			0.066			0.044		

This table reports the results of the Tobit regression, which regresses CEO power in year t + 1 (CEO_POWER) on stock price crash risk (CRASH_1 & CRASH_2), and control variables over the period of 2001–2014 based on the following equation:
$CEO\_POWER = \beta_0 + \beta_1 \times CRASH + \beta_x \times Control\ Variables + Year\ \&\ Industry\ Dummies + \varepsilon$.
Continuous control variables are winsorized at the 1% and 99% percentiles each year before entering the regression tests. *, **, and *** represent significance at the 10, 5 and 1 percent (two-tailed) confidence levels, respectively. Refer to Appendix A for variable definitions.

firms with strong governance mechanisms, highlighting the important role of effective corporate governance in mitigating stock price crash risk and CEO power.

7. Conclusion

In this study, we explore the impact of stock price crash risk on future CEO power. Using a large panel sample from 2001 to 2014, we find that crash risk is negatively related to CEO power, suggesting that CEO power becomes smaller after a firm experiences stock price crashes. We also find that female CEOs' power is restricted more than male CEOs' power after stock prices crashes. In addition, we find that our results are largely driven by CEOs with shorter tenure. More importantly, our results suggest that corporate governance plays an important role in mitigating CEO power when crash risk is high. Our primary findings are still robust after a battery of robustness checks.

Our study makes important contributions. For instance, we provide empirical evidence on the consequences of stock price crash risk because recent studies (i.e., Habib et al., 2018) argue that the research on crash risk consequences is very limited and call for more evidence to understand better crash risk consequences. Therefore, because of the tremendous potential in research on stock price crash risk consequences (Habib et al., 2018), future studies should continue to explore the impact of crash risk on firm-level characteristics. Our study is subject to a few caveats. For example, our sample firms are large public firms. Whether our results hold for small or private firms still remains unknown. Additionally, our study may raise concerns about endogeneity such as reverse causality because recent research (e.g., Mamun et al., 2019) suggests that powerful CEOs may also increase future stock price crash risk. Due to the difficulty of selecting an instrumental variable of crash risk, we do not perform a two-stage OLS analysis (2SLS) in our study to mitigate concerns about reverse causality. Thus, caution should be exercised when readers attempt to generalize our results.

Data availability: Data are available from sources identified in this paper.

Appendix A. Variable definition

Variable		Definition
CEO_POWER	=	CEO power, measured as a ratio of CEO's compensation to the aggregate total of the top five executives' compensation, in year t + 1;
CRASH_1	=	an indicator variable that equals one if a firm experience at least one crash week in a given year and zero otherwise;
CRASH_2	=	the negative third moment of weekly returns for each firm year divided by the standard deviation of weekly returns raised to the third power;
SIZE	=	the natural log of total assets (AT);
MB	=	market value of common shares (CSHO) × (PRCC_F) divided by total book value of common shares (CEQ);
LEVERAGE	=	long-term liabilities (DLTT) divided by total assets (AT);
ROA	=	income before extraordinary items (IB) scaled by total assets (AT);
ZSCORE	=	3.3 × [net income (NI)/total assets (AT)] + sales (SALE)/total assets (AT) + 0.6 × {market value of common shares [(CSHO) × (PRCC_F)]/total liabilities (LT)} + 1.2 × working capital [current assets (ACT) – current liabilities (LCT)]/ total assets (AT) + 1.4 × retained earnings (RE)/total assets (AT);
CASHFLOW	=	operating cash flows (OANCF) scaled by total assets (AT);
FIRMAGE	=	the natural log of the number of years in Compustat database;
BIG4	=	the natural log of the number of years in Compustat database;
CEO_AGE	=	the age of CEO in a given year;
CEO_TENURE	=	the tenure of CEO in a given year;
CEO_GENDER	=	an indicator variable that equals one if a CEO is male and zero otherwise;
CEO_CHAIR	=	an indicator variable that equals one if a CEO is also the chair of the board and zero otherwise;
LOG_CEOPAY	=	the natural log of the CEO's total compensation;
LOG(CEOPAY – Median_VPPAY)	=	the natural log of the difference between the CEO's total compensation and the median VP's total compensation;
DUVOL	=	the log of the ratio of the standard deviation of firm-specific down weekly returns to the standard deviation of firm-specific up weekly returns during the fiscal year;
GOV_H	=	an indicator variable that equals one if the value of corporate governance is above the median and zero otherwise.

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