Lesson from stock price crash: CEO overconfidence and the crash experience

by

Hyeong Joon Kim[1], Seongjae Mun[2], Seung Hun Han[3]

[1] School of Business and Technology Management, College of Business, Korea Advanced Institute of Science and Technology, 291, Daehak-ro, Yuseong-gu, Daejeon, Republic of Korea, e-mail: creatinghj@kaist.ac.kr

[2] Department of Economics and Finance, Soonchunhyang University, 22, Soonchunhyang-ro, Sinchang-myeon, Asan-si, Chungcheongnam-do, Republic of Korea, e-mail: forbelld@sch.ac.kr

[3] School of Business and Technology Management, College of Business, Korea Advanced Institute of Science and Technology, 291, Daehak-ro, Yuseong-gu, Daejeon, Republic of Korea, e-mail: synosia@kaist.ac.kr

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All remaining errors are our own.

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Abstract

The literature posits that overconfident CEOs are more likely to hoard bad news, resulting in higher stock price crash risk than non-overconfident CEOs. However, what if a CEO experiences an extreme market crash of their firm's stock price during their tenure? We provide evidence that overconfident CEOs appear to moderate their behavior after their stock price crash experience. We find that the positive effect of CEO overconfidence on a firm's future stock price crash risk is less pronounced after a crash experience. We propose three possible reasons. First, a CEO's crash experience, particularly the first one, reduces their confidence level. Second, firms that experience a crash tend to change their CEO, typically from an overconfident to a non-overconfident CEO. Finally, firms seek to adjust their CEO compensation structure after a crash experience. Our results similarly hold for executives in firms. Overall, we suggest that both the CEO and the firm may learn from their crash experiences.

Keywords: CEO overconfidence, Stock price crash, CEO experience

JEL Classification: G30, G41

1. Introduction

Overconfident CEOs tend to overestimate future returns on investment and their managerial abilities (Malmendier and Tate, 2005). By this definition, firms with overconfident CEOs are expected to have the following situations, as suggested in prior literature. First, overconfident CEOs may misperceive their chosen project as having a positive net present value (NPV) when there is, in fact, a negative NPV. Second, such CEOs who have bullish views on their firms' future performance, are more likely to fail to disclose negative information in a timely manner, either intentionally or otherwise. Finally, they may not believe (or simply ignore) the negative feedback about the status quo of their firms. Collectively, overconfidence thus leads a CEO to hoard the firm's bad news (Kim, Wang and Zhang, 2016).

Although managers have an incentive to withhold bad information from the investors (Graham, Harvey and Rajgopal, 2005; Kothari, Shu and Wysocki, 2009), however, they cannot continue to do so for a substantial period of time. If such information is revealed in the market, it leads to a significant change of investors' expectations about the future prospects of the firm and can lead to a crash of the firms' stock price (Hutton, Marcus and Tehranian, 2009; Jin and Myers, 2006). The literature posits this manifestation and provides empirical evidence. In particular, Kim, Wang and Zhang (2016) show that overconfident CEOs lead to a higher risk of their firm's stock price crash on average, compared to non-overconfident CEOs. Banerjee et al. (2018) similarly find that overconfident managers are more likely to engage in manipulative actions such as making excessively optimistic public statements of the firm, resulting in a higher risk of securities class actions.

A number of natural questions arise in the above context. First, if overconfident CEOs observe a market crash of their firms' stock price during their tenure (hereafter, the crash experience), would they still retain their over-optimistic views that might bring about a future crash? Second, from the firm's perspective, after the crash experience, would a firm fire their CEO who has posed this high

crash risk? In particular, would they hire an overconfident CEO again, even though this overconfidence resulted in a crash in the firm's stock price before? Finally, if a firm does not fire its CEO after the crash experience, how can they convince the CEO to behave in a way that avoids future crashes? These questions are in line with the call of Habib, Hasan and Jiang (2018) that emphasizes a necessity for more research about the consequences of stock price crashes.

Extending the aforementioned questions, we hypothesize that overconfident CEOs modify their behavior after they experience a stock price crash. According to a large body of literature, an impactful experience for a CEO can influence their decision-making in corporate policy (Bernile, Bhagwat and Rau, 2017; Bertrand and Schoar, 2003; Billett and Qian, 2008; Custódio, Ferreira and Matos, 2013; Dittmar and Duchin, 2016; Kolasinski and Li, 2013; Lewis, Walls and Dowell, 2014). Note that our study focuses on the stock price crash experience as an impactful experience for a CEO (or a firm). In particular, Banerjee et al. (2018) find that for firms that have already been sued once, the effect of an overconfident CEO on the likelihood of future litigation is mitigated, which is consistent with our hypothesis.

Following the methodologies of prior literature (e.g., Chen, Hong and Stein (2001), and Kim, Li and Zhang (2011a)), we calculate two measures of assessing a firm's stock price crash risk: the negative conditional return skewness and the down-to-up volatility. We use the option-based measure of CEO overconfidence, as in Campbell et al. (2011), which identifies CEOs who postpone the exercise of vested options that are deep-in-the-money (specifically, 67% or 100%). Using a sample from the U.S. between 1993 and 2015, we first confirm the main finding in Kim, Wang and Zhang (2016), that is a positive relationship between firms with overconfident CEOs and their future stock price crash risks. In line with our expectation, we then find that after a CEO experiences an extreme stock price downside shock (i.e., the stock price crash), the positive influence of CEO overconfidence on the future crash risk is significantly reduced. We construct the firm's (yearly) stock price crash experience as suggested in Hutton, Marcus and Tehranian (2009) if the firm has at least one crash week in the year,

where a crash week indicates the firm's weekly return drops to a 3.20 standard deviation below its annual average. Specifically, we identify the crash experience of the CEO (during their tenure at the firm). Our findings are also consistent with Banerjee et al. (2018)'s argument that an overconfident CEO's behavior is moderated after a firm's prior litigation experience, as a stock price crash and the firm's litigation (such as a security class action) could be positively correlated.

We investigate the possible reasons to support our main hypothesis. Using an exercisable option value as a continuous measure of the CEO's confidence level, we find that it significantly decreases after the first crash experience during their tenure at the firm. In particular, overconfident CEOs who have higher confidence levels (due to the given nature of the definition), more substantially have their confidence levels reduced after experiencing a crash, compared to non-overconfident CEOs. The results are robust for controlling the lagged value of the CEO's confidence level (a continuous measure) and replacing the dependent variable with the change of this value. These results suggest that CEOs who are overconfident may learn from their crash experience and, thus, they tend to revise their belief about the firm's prospects. We also suggest that the firm's stock price crash, per se, can be an impactful shock to the CEO.

Next, we analyze the likelihood of CEO turnover. As we expected, a firm's stock price crash experience is strongly and positively associated with the turnover of its current CEO. We also find that a firm that experiences more crash weeks (under its prior CEO) is more likely to hire a new CEO. Moreover, a firm that experiences a crash under an overconfident CEO tends to hire non-overconfident individual as its new CEO. In the same way, when a firm's prior CEO experiences several crash weeks during their tenure, the turnover from a non-overconfident CEO to an overconfident CEO is less likely to occur. In other words, a post-crashed firm is likely to avoid hiring yet another overconfident CEO. Therefore, we argue that the firm also learns from the crash experience in this way, and seeks to prevent future stock price crashes.

We further assess whether firms seek to adjust their CEO's compensation structure after their crash experience. First, we find that the total pay for a CEO is decreased after a crash, indicating a possible punishment for the crash. Second, a firm is more likely to compensate its CEO with restricted stock after the crash experience, as is the case for a newly hired CEO. Finally, if a firm decides to not replace its CEO after the crash experience, the firm tends to avoid giving stock options to its CEO. Instead, it seems that a firm replaces a CEO's option awards with restricted stock grants and salary after a crash experience. Since a CEO's cash compensation and restricted stock do not increase with respect to the firm's stock price volatility while a stock option does (Coles, Daniel and Naveen, 2006; Core and Guay, 1999; Guay, 1999), this adjustment would diminish a CEO's incentive to engage in high-risk behavior. As a result, it may lessen the motivation to hoard bad news and eventually lower the risk of future stock price crashes. Overall, we find some evidence that firms who have experienced a crash adjust their CEOs' compensation structure to make them more cautious, also indicating that the firm learns from the crash experience.

Executives in the firm could also be overconfident. Thus, our conjecture is also testable for the executives of a firm. We find that overconfident executives are positively related to their firm's future stock price crash risk. This result is an extension of the results of Kim, Wang and Zhang (2016) that focuses on CEOs. In particular, our results show that senior executives, such as "chief" officers, are more likely to have a significant effect on future stock price crash risk compared to junior executives, in line with the results of Banerjee et al. (2018). Furthermore, we find that the average level of executives' confidence is reduced when they observe their firm's stock price crash during their CEO's tenure. Firms also seek to adjust their executives' components of equity-based compensation after the crash experience by replacing stock options with restricted stock grants. As a result, the positive effect of executives' overconfidence on future stock price crash risk is also mitigated after the crash experience, in the same manner as that of CEOs.

Since executives can play a significant role in terms of their firm's future stock price crash

risk, we further examine whether an exogenous improvement for corporate governance affects the relation between CEO overconfidence and the future crash risk. Specifically, we focus on the passage of the Sarbanes-Oxley Act (SOX) to examine whether it improves the behavior of overconfident CEOs (Banerjee, Humphery-Jenner and Nanda, 2015). We find that SOX moderates the positive effect of CEO overconfidence on future stock price crash risk. This impact of SOX is typically pronounced for CEOs who already experienced a crash which suggests the following implications. First, the CEO's own experience—in our study, the stock price crash during their tenure at the firm—is significantly impactful even relative to SOX. Second, for CEOs who have had a crash experience, the difference in stock price crash risk between overconfident and non-overconfident CEOs is still significantly positive for the pre-SOX period. In other words, if there is no effective monitoring in the firm, overconfident CEOs are less likely to moderate their behaviors even after the crash experience. Similarly, for CEOs without any crash experience, the stock price crash risk for overconfident CEOs is still higher than that for non-overconfident CEOs for the post-SOX period. Finally, these results overall suggest that a better monitoring mechanism in the firm might facilitate the learning of a CEO (as well as of the firm) from the crash experience. Thus, the improvement of corporate governance and the CEO's (or the firm's) self-adjustment could be complementary.

To address potential endogeneity concerns as much as possible, this study performs the following analyses. First, we additionally control the variables for corporate governance that are omitted in our main analysis. Specifically, we re-estimate our baseline and CEO turnover analysis and find consistent results. Second, we re-estimate our previous regressions with the firm or firm-CEO fixed effects, whereas our main analysis basically controls for the industry level. Using the alternative fixed effects, our results remain statistically significant. Third, to rule out an alternative explanation, we show that our results are not mainly driven by the firm's poor performance. Fourth, as pointed out by Hutton, Marcus and Tehranian (2009), we measure the firm's upside risk of stock price (i.e., the stock price jump) in line with downside risk (i.e., the stock price crash). Then, we find that CEO

overconfidence does not lead to a higher probability of the stock price jump, and confirm that the jump experience does not drive our results as well. Fifth, as a robustness test, we alternatively define the firm's stock price crash experience based on 3.09, 3.50, and 4.00 standard deviation, whereas our main results use 3.20 as a criterion. Overall, we find that the results in our baseline regressions are unchanged. Sixth, our main hypothesis, in which we argue that the positive effect of CEO overconfidence on the future crash risk is mitigated after a CEO experiences a crash, still holds for alternative measures of CEO overconfidence by using media-based measures (Hirshleifer, Low and Teoh, 2012; Humphery-Jenner et al., 2016; Malmendier and Tate, 2008). As a final empirical test in this study, we extend our conjecture to the relation between CEO overconfidence, investment, and the value of the investment. Interestingly, we find that, in the post-crash period, overconfident CEOs reduce their capital expenditure compared to the pre-crash period. The value of the investment by overconfident CEOs is also improved for the post-crash period, while it is significantly lower than one by non-overconfident CEOs for the pre-crash period. These results indicate that overconfident CEOs may learn from the crash experience, and thus create more shareholder value by moderating their overconfident behavior.

Our study contributes to the literature in several ways. First, we add empirical evidence to the literature on managerial overconfidence (e.g., Campbell et al. (2011), Kim, Wang and Zhang (2016), and Malmendier and Tate (2005)). To the best of our knowledge, this study is the first attempt at examining the possibility of the moderating impact a CEO's stock price crash experience has on their overconfident behavior. Second, we expand on the CEO literature by highlighting the impactful effects of a crash experience, particularly that of a firm's stock price crash during a CEO's tenure. Third, we argue that both the CEO and the firm learn from their crash experience as the conclusion of this study. Thus, the lesson from the crash experience can moderate CEO's excessively optimistic views and it may eventually lead to creating more shareholder value. Fourth, we also highlight the role of governance. Overconfidence of the board (particularly for senior executives) as well as of the CEO induces a higher risk of future stock price crashes. Furthermore, improved governance can moderate

the effect of CEO overconfidence on future stock price crash risk. Finally, by investigating the consequence of a stock price crash, this study contributes to the finance and accounting literature on stock price crash risk (Hutton, Marcus and Tehranian, 2009; Kim, Li and Zhang, 2011b; Kim, Wang and Zhang, 2016). In doing so, we also believe that our study can be a response to the call from recent literature (Habib, Hasan and Jiang, 2018).

The remainder of this paper is organized as follows: Section 2 reviews related literature and develops the hypotheses. Section 3 describes our data and sample selection. Section 4 presents our empirical analysis that examines the impact of the crash experience. Section 5 discusses robustness tests and additional analyses that aim to address alternative explanations of the results. Section 6 finally concludes the paper and provides suggestions for future studies.

2. Literature review and hypotheses development

2.1. The relationship between an overconfident CEO and stock price crash risk

This study starts to build on the relationship between CEO overconfidence and a firm's future stock price crash risk. Before we begin reviewing the literature related to our study, we note that there is a growing body of research that focuses on the effect of CEO overconfidence on a variety of firm characteristics, following the spirit of Malmendier and Tate (2005).[1] For instance, an overconfident CEO tends to invest more in the firm's innovation (Galasso and Simcoe, 2011; Hirshleifer, Low and Teoh, 2012), and makes more acquisitions, but this can diminish value (Kolasinski and Li, 2013;

[1] See, Goel and Thakor (2008) for the well-documented theoretical prediction about CEO overconfidence. Meanwhile, recent empirical studies on CEO overconfidence reveal its effect on, for example, bank loan contracts (Lin et al., 2020) and corporate cash holdings (Deshmukh, Goel and Howe, 2021). We also note that overconfidence or overoptimism is more relevant among CEOs than in the general population (Ben-David, Graham and Harvey, 2013; Graham, Harvey and Puri, 2013).

Malmendier and Tate, 2008) and affect external financing with a different preference (Graham, Harvey and Puri, 2013; Malmendier, Tate and Yan, 2011) compared to non-overconfident (or rational) CEOs.

As stated in the introduction, we expect that the effect of CEO overconfidence on future crash risk would be positive based on the following literature reviews. First, an overconfident CEO is more likely to misperceive that the firm's projects have positive NPVs even they in fact have negative. This is due to the CEO, who is overconfident, typically overestimating their chosen projects' future return on investments (Campbell et al., 2011; Malmendier and Tate, 2005). Second, an overconfident CEO has a bullish view of the firm's future prospects by definition, thus they tend to fail to disclose negative information from the market (in a timely manner). This argument is also empirically evident: firms with overconfident CEOs are more likely to have a higher incidence of accounting misstatements or securities class actions (Banerjee et al., 2018; Schrand and Zechman, 2012).[2] Finally, overconfident CEOs tend to have a miscalibrated perception of the firm's performance and their managerial abilities (Ben-David, Graham and Harvey, 2013). Thus, similar to the second argument, they may not believe (or may ignore) the negative feedback about their firms, as also suggested by Schumacher, Keck and Tang (2020).

The aforementioned tendencies of overconfident CEOs can result in negative information being disclosed too late (hereafter called "bad news hoarding") or a falsely positive statement; this is also empirically supported (Banerjee et al., 2018; Kim, Wang and Zhang, 2016). According to the finance and accounting literature, such bad news hoarding can provoke a firm's stock price crash (Chen, Hong and Stein, 2001; Hutton, Marcus and Tehranian, 2009; Jin and Myers, 2006). In particular, Kim,

[2] We note that our study can be extended compared to the literature focusing on accounting fraud or litigation, which is a more serious consequence of such overconfident CEOs' tendencies. Additionally, the main focus of our study is not the impact of CEO overconfidence on stock price crash risk (in fact, it is already well-documented in Kim, Wang and Zhang (2016)); rather, we focus on the impact of the CEO's experience from the firm's stock price crash.

Wang and Zhang (2016), which is our study's most related literature, find the positive influence of CEO overconfidence on a firm's stock price crash risk.

We further note the literature on CEO characteristics that might affect stock price crash risk. Kim, Li and Zhang (2011a) find that the CEO's equity compensation structure affects the firm's stock price crash risk.[3] Andreou, Louca and Petrou (2017) argue that younger CEOs have relatively strong incentives to hoard bad news earlier in their career, thus such CEOs are more likely to experience stock price crashes. Al Mamun, Balachandran and Duong (2020) find that powerful CEOs are more likely to increase their firm's stock price crash risk, compared to other CEOs.[4] Recently, Chen et al. (2021) suggest that the early-life disaster experience affects a CEO's risk-tolerance and bad news hoarding behavior, leading to higher crash risk.

2.2. The impact of CEO's prior experiences

The literature posits that a CEO's characteristics, personality traits, and lifetime experience influence corporate policies (see, e.g., Bertrand and Schoar (2003), Custódio, Ferreira and Matos (2013), Dittmar and Duchin (2016), and Lewis, Walls and Dowell (2014)). In particular, the effect an impactful experience can have on a CEO's decision-making behavior is evident in prior studies, particularly regarding their education (Malmendier and Tate, 2005), early-life exposure to natural disasters (Bernile, Bhagwat and Rau, 2017), early-life experiences such as of the Great Depression and military experience (Malmendier, Tate and Yan, 2011), prior work experience such as being a financial

[3] Specifically, Kim, Li and Zhang (2011a) focus on the CEO and CFO's equity incentives from their option compensation. Although authors highlight a more significant CFO's effect (compared to CEO) as their key finding, their results still show a significantly positive effect of a CEO's on the stock price crash risk.

[4] In the empirical analysis by Al Mamun, Balachandran and Duong (2020), the authors also include a CEO overconfidence variable (which is equivalent to *CEO HOLDER100* in our study) as one of the control variables, and confirm its positive effect on stock price crash risk.

expert, and general managerial skills (Custódio, Ferreira and Matos, 2013; Custódio and Metzger, 2014). Furthermore, Chen et al. (2021) recently found the impact of a CEO's early-life disaster experience on stock price crash risk.

However, beyond the aforementioned the CEO's early-life, early-career, or education experiences, we expect that a CEO's relatively recent experience can also shape their managerial traits. Although the literature posits that the effect of CEO overconfidence is persistent (e.g., Malmendier and Tate (2005, 2008)), there is some literature highlighting the effect a CEO's recent experience may have on their overconfidence. On the one hand, Billett and Qian (2008) suggest that a CEO's positive experience from previous acquisitions leads them to become overconfident. As a result, such CEOs tend to make more frequent acquisitions, but the subsequent acquisitions are value-destroying on average. The evidence in Billett and Qian (2008) is generally consistent with the argument that CEO overconfidence can lead to over-acquisitions and thus destroy shareholder value (Malmendier and Tate, 2008). On the other hand, according to Kolasinski and Li (2013), a CEO's negative experience may lead them to be less overconfident. In their study, CEO overconfidence positively influences acquisition decisions, which is also consistent with the findings by Malmendier and Tate (2008). However, authors find that after a CEO experiences inside trading losses at their current firm, overconfident CEOs become less acquisitive on average, indicating less confidence.[5] This implies that overconfident CEOs learn from their negative experiences, and then cautiously decide on future acquisitions. The results of Kolasinski and Li (2013) also show that acquisitions by CEOs with such trading-loss experiences no longer tend to be value-destroying, indicating the consequences of more cautious (and better) acquisitions by post-learned CEOs.

[5] Kolasinski and Li (2013) identify a CEO as being "overconfident" ("postoverconfident" or "once-overconfident") if they make insider purchases and then loses money on them on average within the next (past) two years. Authors find that a positive effect comes from "overconfidence," but a negative one from "postoverconfidence" on the firm's likelihood of acquisition.

In addition to those two studies on acquisitions and overconfident CEOs, Banerjee et al. (2018) focus on the firm's litigation experience (in specific securities class actions). Authors find that while CEO overconfidence generally leads to higher litigation risk, the effect of CEO overconfidence on the future litigation risk is reduced for firms that have previously been sued. Hence, the authors suggest that an impactful event such as litigation can make an overconfident CEO question the validity of their over-optimistic beliefs. In sum, the key finding by Banerjee et al. (2018) (as well as Kolasinski and Li (2013)) is that CEO overconfidence may be overcome if they directly experience negative consequences in a timely manner.

Extending this view, we thus expect that a CEO's crash experience during their tenure at a firm reduces the influence of CEO overconfidence on the future stock price crash risk. Facing a crash of the firm's stock price can be an impactful experience for the CEO and might lead them to modify their behavior. Even though a large number of prior studies have investigated determinants of stock price crashes,[6] the effect of stock price crashes is far less clear. In fact, Habib, Hasan and Jiang (2018) highlight a scarceness of research for the consequence of firms' stock price crashes.[7] Overall, we hypothesize the main conjecture as follows:

H1. *Crash experience reduces the effect of overconfident CEOs on future stock price crash risk.*

2.3. Channels for moderating an overconfident CEO's behavior after the crash experience

We develop empirically testable hypotheses to explore the consequences of crash experiences. We first focus on the CEO's option exercising (that is, a basis of proxy for CEO overconfidence),

[6] Additionally, for the review for the determinants of a stock price crash, see, Habib, Hasan and Jiang (2018).

[7] Therefore, our study seeks to contribute to the literature by adding new evidence on the consequence of stock price crashes. Similar to our research motivation, recently, Harper, Johnson and Sun (2020) find that the power of CEOs becomes weaker after their firm's stock price crashes.

which generally depends on their own decision. Malmendier and Tate (2005) suggest that both the CEO's personal wealth and career concern are bounded to the firm. In addition, as we stated in previous subsection (Section 2.2), the CEO's prior experience can affect their decision-making in several aspects. For instance, CEOs who observe a crash of their firm's stock price in the market may be concerned about their career, and thus question the validity of their managerial style. Therefore, from the CEO's perspective, such an impactful experience can affect their confidence regarding their option exercising.

Similar to our expectation, Banerjee et al. (2018) find that a CEO's confidence decreases after a litigation experience. In other words, a CEO may learn from an impactful shock. Collectively, the learning from the crash experience can make a CEO more cautious and less overconfident.[8] This logic can explain the reason why the positive effect of CEOs who are classified as overconfident on future stock price crash risk is mitigated after a crash experience. Thus, we state the following hypothesis as the first possible channel:

H2. ***(Channel 1)*** *Crash experience reduces the CEO's confidence.*

Prior literature posits that the key mechanism of stock price crashes is a firm's faulty information management, particularly, bad news hoarding (Hutton, Marcus and Tehranian, 2009; Jin and Myers, 2006). Since releasing accumulated bad news affects the stock market investors' prospects (thus, a crash of stock price occurs), the crash may indicate not only a fall in value but also a loss of trust in the stock market. In addition, the crash can worsen future access to capital. Although such a loss of trust (that also crashes with the stock price) is hard to recover in a short period of time, existing

[8] Therefore, we construct a continuous measure of a CEO's confidence level to examine H2, whereas our baseline analysis used it as an indicator variable for overconfident CEOs following the literature (Campbell et al., 2011; Kim, Wang and Zhang, 2016).

shareholders of the firm (or the board) are likely to send a signal of their willingness to recover the firm's trust in the stock market. From the firm's perspective, one possible way to quickly send this signal could be a replacement of the current CEO who is held responsible for that crash. If the post-crash firm seeks to fire its current CEO, then CEO may perceive the threat of turnover after experiencing a stock price crash. Thus, the post-crash CEO may spontaneously modify their behavior to preserve their careers.

We further note that after the crash experience, firms may seek to effectively prevent their future stock price crashes by ameliorating their CEO hiring decisions. For instance, after observing a crash, a firm may realize the fact that overconfident CEOs are likely to hoard bad news (as described in Section 2.1), leading to a higher likelihood of the crash compared to non-overconfident CEOs. As a result, if such post-crash firms decide to replace their CEO, then they may prefer non-overconfident individuals as their new CEO.[9] Collectively, we expect the following hypothesis as the second possible channel:

H3. ***(Channel 2)*** *Firms with a crash experience are more likely to turnover their CEOs.*

To align the interests of shareholders and management, the executive compensation structure plays a significant role (Jensen and Meckling, 1976). In particular, Kim, Li and Zhang (2011a) find that the executive's equity incentives, particularly from stock options, induce bad news hoarding and eventually a higher risk of stock price crash. Therefore, shareholders (or the board) who observe a crash of their firm's stock price may realize that their CEO's compensation is suboptimal in terms of the crash risk. In particular, if the firm decides to not fire its CEO after the crash experience, then the firm would rather adjust its CEO compensation structure to prevent future crashes. We expect a similar

[9] Thus, we further classify the CEO turnovers based on a prior and a newly-hired CEO's overconfidence. The results in Table 5 support our expectations.

(or less significant) effect from the newly-hired CEO compensation. This logic can explain the moderating impact of the CEO's crash experience on the positive relationship between CEO overconfidence and the stock price crash risk.

Consistent with this line of thought, Kamiya et al. (2020) recently found that firms adjust their CEOs' compensation structure after they experience an impactful shock (in their study, cyber-attacks). Authors suggest that the firms may learn from an actual shock whether their risk of shock (in their study, cyber-risk was the focus and indicated how well their firm prevented a potential cyber-attack) is higher than they expected. If we assume that a crash of the firm's stock price is an impactful shock, from the firm's perspective as well as the CEO's, we expect the following hypothesis as the third possible channel:

H4. ***(Channel 3)*** *Firms with a crash experience seek to adjust their CEO compensation.*

2.4. Governance

Our hypotheses can extend to the executives at the firm. This is because executives on the board may also withhold bad news, even though the CEO is generally the most responsible for the firm's management. Kim, Li and Zhang (2011a) find that the CFO's equity incentives are a significant determinant of the stock price crash risk (in fact, authors argue that the CFO's effect is stronger than the CEO, as their key finding). Banerjee et al. (2018) suggest that the board with more overconfident executives is more likely to (recklessly or intentionally) make a false statement, leading to a higher likelihood of the firm's litigation. Thus, we expect that overconfident executives are more likely to engage in actions that increase the future crash risk. Consistent with our main hypothesis (H1), a positive effect of executives' overconfidence is expected to be less significant after the crash experience. Moreover, similar to H2, the executives' confidence also may reduce if they learn from experiencing their firm's stock price crash. Finally, since the executive's compensation structure (as

well as the CEO's) can affect the stock price crash risk, as suggested by Kim, Li and Zhang (2011a), a post-crashed firm may also seek to adjust its executives' compensation structure to reduce the future crash risk. Collectively, we state the following hypotheses for the executive level:

H5. ***(Executive-level)*** *A firm with overconfident executives tends to have a higher stock price crash risk. However, the crash experience reduces the effect of overconfident executives on future stock price crash risk.*

H5a. ***(Executive-level)*** *Crash experience reduces the executives' confidence.*

H5b. ***(Executive-level)*** *Firms with a crash experience seek to adjust their executives' compensation.*

In general, monitoring by independent directors can prevent accounting fraud (Khanna, Kim and Lu, 2015). Thus, improving governance in the firm might reduce stock price crash risk. We use the Sarbanes-Oxley Act (SOX),[10] which was a response to corporate scandals in 2002, to examine this effect. Specifically, after SOX, firms are imposed to reform internal governance, such as requiring a majority-independent board and a completely independent audit committee. In addition, SOX increased the penalties for firms' manipulation. Thus, as shown in Graham, Harvey and Rajgopal (2005), SOX exogenously decreases the incidence of earnings management. Hutton, Marcus and Tehranian (2009) also find empirical evidence that SOX improves the quality of accounting reports, suggesting that firms are unable to hide information like before.

Meanwhile, in terms of CEO overconfidence, Campbell et al. (2011) theoretically and empirically show that well-governed firms are more likely to turnover their overconfident CEOs (who

[10] Note that the passage of SOX was along with contemporaneous changes to the NYSE/NASDAQ listing rules in 2002, although we simply state SOX alone in this paper. These concurrent events represent an exogenous shock to internal governance for U.S. public firms (e.g., Coates and John (2007)).

might be detrimental to their value) compared to firms with poor governance. Furthermore, in line with Goel and Thakor (2008), prior empirical studies find that SOX can mitigate CEOs' overconfidence, and lead them to behaviors that enhance shareholder value (Banerjee, Humphery-Jenner and Nanda, 2015; Banerjee et al., 2018). Collectively, since SOX substantially increased the firm's monitoring mechanism and the penalties for manipulation, we expect the positive influence of CEO overconfidence on the future crash risk to be moderated after the passage of SOX.

Overconfident CEOs with crash experience might be aware of the negative consequences from poor information management, such as bad news hoarding (if our H1 is supported). Thus, we expect that such overconfident and crash-experienced CEOs refrain more from their behavior that leads to a higher risk of their firm's stock price crash after SOX. In other words, improved governance may encourage better post-crash learnings for both the CEO and the firm.[11] Combining the expected effect of SOX and our H1, we state the following hypothesis:

H6*. *(Governance improvement) *The passage of SOX reduces the effect of overconfident CEOs on future stock price crash risk, particularly for CEOs who already experienced a stock price crash.*

3. Data

3.1. Stock price crash risk measures

In this study, we calculate two measures of stock price crash risk, as suggested in the literature

[11] Thus, we expect the relation between internal governance and the CEO's learning from their crash experience to be complementary. Contrastingly, if improved governance (by SOX) and the lesson from the CEO's crash experience are a relation of substitution, we should observe the more significant effect of SOX on the firm's stock price crash risk for CEOs who never experienced the crash, compared to the crash-experienced CEOs. We also note that, if we observe no difference between these two CEO groups, then governance improvement and the CEO's experience are neither substitutes nor complementary.

(Chen, Hong and Stein, 2001; Kim, Li and Zhang, 2011a; Kim, Li and Zhang, 2011b). Specifically, we employ the negative conditional firm-specific return skewness (*NCSKEW*) and down-to-up volatility (*DUVOL*). We first estimate the firm-specific weekly returns for each firm and each year using the following expanded market model regression in Eq. (1):

$$r_{i,\tau} = \beta_{0i} + \beta_{1i} r_{m,\tau-2} + \beta_{2i} r_{m,\tau-1} + \beta_{3i} r_{m,t} + \beta_{4i} r_{m,\tau+1} + \beta_{5i} r_{m,\tau+2} + \varepsilon_{i,\tau} \quad (1)$$

where $r_{i,\tau}$ is the return on the firm (stock) *i* in week τ, and *m* denotes the value-weighted market index from the Center for Research in Security Prices (CRSP). Then, we derive the firm-specific weekly return ($W_{i,\tau}$) by taking the natural logarithm of one plus the residual return ($\varepsilon_{i,\tau}$).

We calculate *NCSKEW* as the negative of the ratio of the third moment of firm-specific weekly returns normalized by the standard deviation of firm-specific weekly daily returns raised to the third power (Chen, Hong and Stein, 2001). In sum, the following Eq. (2) describes *NCSKEW* for each firm *i* in year *t (n* is the number of weekly returns for each firm *i* in year *t*):

$$NCSKEW_{i,t} = \frac{-[n(n-1)^{\frac{3}{2}} \sum W_{i,\tau}^3]}{(n-1)(n-2)(\sum W_{i,\tau}^2)^{3/2}} \quad (2)$$

To calculate *DUVOL* as a second measure of stock price crash risk, we separate all the weeks with firm-specific weekly returns below the annual average as "down" weeks and those above the annual average as "up" weeks. n_{UP} and n_{DOWN} refer to the number of "up" weeks and "down" weeks for firm *i* during year *t*, respectively. *DUVOL* is the natural logarithm of the ratio of the standard deviation of firm-specific weekly returns over down weeks to its standard deviation over up weeks (Chen, Hong and Stein, 2001). A higher *DUVOL* implicates more left-skewed weekly return distribution, which corresponds to the higher crash risk. In sum, the following Eq. (3) describes *DUVOL* for each firm *i* in year *t*:

$$DUVOL_{i,t} = \log\left[\frac{(n_{UP}-1)\sum_{DOWN} W_{i,\tau}^2}{(n_{DOWN}-1)\sum_{UP} W_{i,\tau}^2}\right] \quad (3)$$

Following Hutton, Marcus and Tehranian (2009) and Kim, Li and Zhang (2011a), we identify crash weeks in a given fiscal year *t* for a given firm *i* as firm-specific weekly returns that fall more than 3.20 standard deviations below the mean firm-specific weekly returns over the entire fiscal year. Then, we construct an indicator for such an extreme crash of the firm's stock price (*CRASH*), which equals one for a firm-year observation that has at least one crash week during the fiscal year and zero otherwise.[12]

To examine our hypotheses, we further construct "the CEO's crash experience," denoted as *POST_CRASH*, whereas *CRASH* represents "the crash experience per se" (or simply the firm's crash experience). Specifically, we sort the firm-CEO observations in our primary sample and identify the CEO's first crash experience during their tenure at the firm (i.e., the first occurrence of *CRASH* for a firm-CEO observation). After the CEO's first crash experience, we set *POST_CRASH* as one; otherwise, it is zero. If the post-crashed CEO (i.e., a CEO with one of *POST_CRASH*) is fired and a new CEO is appointed, then *POST_CRASH* is again set to zero.

3.2. CEO overconfidence

We use the option-based measure of CEO overconfidence by using Execucomp which provides detailed information on executives from 1992. The literature posits that a rational CEO would sufficiently exercise their options in moneyness under the assumption that a CEO's personal wealth is less-diversified (e.g., Hirshleifer, Low and Teoh (2012), and Malmendier and Tate (2005)). Specifically, we follow Campbell et al. (2011) to compute the average moneyness of the CEO's option for each year. The average (realized) value per option is the total value of the CEO's exercisable option holdings divided by the number of the CEO's exercisable option holdings. The average exercise price is the

[12] We also construct a positive jump of the firm's stock price following Hutton, Marcus and Tehranian (2009), and examine its effect in Section 5.4.

firm's stock price at the end of the fiscal year less the average (realized) value per option. Finally, we calculate average moneyness as the firm's stock price divided by the average exercise price minus one.[13]

Following Campbell et al. (2011) and Malmendier and Tate (2005), we then identify an overconfident CEO (*CEO HOLDER67* or *100*) if a CEO holds vested options that are above 67% or 100% moneyness at least twice in the sample period. Similar to the literature on CEO overconfidence, we set these indicators for overconfident CEOs to one from the first time the CEO exhibits such behavior (e.g., Banerjee et al. (2018)).[14]

3.3. Sample selection

We obtain financial information from Compustat and CRSP, and CEO information from Execucomp. Specifically, for our primary variables, we measure stock price crash risk and CEO overconfidence from CRSP and Execucomp, respectively. We exclude firms in regulated industries (i.e., utilities and financial industries), which are Standard Industrial Classification (SIC) code 4900–4999 and 6000–6999.

We include a set of characteristics for both firm and CEO levels. As suggested by prior studies on stock price crash risk (Chen, Hong and Stein, 2001; Hutton, Marcus and Tehranian, 2009), we first

[13] The average moneyness of the CEO's option holdings can be used as a continuous measure of the option-based CEO overconfidence (*CONFIDENCE*), as in Banerjee, Humphery-Jenner and Nanda (2015). In unreported results, we find a positive relationship between the future stock price crash risk measures (*NCSKEW* and *DUVOL*) and *CONFIDENCE (t–1)*. Nevertheless, to examine the effect of the CEO's crash experience on the CEO's confidence (which is our H2), we use this continuous measure as the dependent variable in Table 4 of Section 4.2.

[14] As a robustness test, we further construct the media-based measure of CEO overconfidence. We describe in detail in Section 5.6.

account for a lagged value of the negative skewness of the firm's stock returns (*NCSKEW*) to address the concern from the persistency of the third moment of stock returns. We also include the following firm characteristics: firm size (*SIZE*), the market-to-book ratio (*MTB*), leverage (*LEV*), return on assets (*ROA*), tangibility (*PPE*), the research and development expense (*RD*), and the institutional ownership (*INST OWNERSHIP*). To capture differences of opinion among investors, we control for the detrended stock trading volume (*DTURNOVER*). The firm's stock return volatility (*SIGMA*) and average return (*RET*) are also included. Furthermore, we control for the firm's financial reporting opacity measure (*OPAQUE*) and its square term (*OPAQUE SQUARE*).

For the CEO level, we control for the CEO's total compensation (*CEO TOTALPAY*) and their tenure at the firm and age (*CEO TENURE* and *AGE*), as is generally done in CEO literature. We also construct an indicator of CEOs who are also the chair of the board (*CEO-CHAIRMAN*) from Execucomp, which can control for the potential effect of CEO power (Al Mamun, Balachandran and Duong, 2020). Finally, to distinguish the effect of the CEO's equity incentives on the stock price crash risk (Benmelech, Kandel and Veronesi, 2010; Kim, Li and Zhang, 2011a), we include the sensitivity of CEO's equity compensation with respect to the firm's stock price and volatility (*CEO DELTA* and *VEGA*).[15]

All the continuous variables are winsorized at the 1st and 99th levels, to avoid the potential impact of outliers. Table 1 presents the descriptive statistics for our primary sample during 1993–2015. The control variables in the multivariate regressions are measured at the year *t*–1. Detailed definitions of variables are in Appendix A.

[15] We obtain the data for the executives' delta and vega from Prof. Naveen's personal website. These two measures (*DELTA* and *VEGA*) are the change of the CEO's equity value for a one-percent increase in the firm's stock price and return volatility, respectively, based on the methodology of Core and Guay (2002). We also use the average delta and vega for all the executives at the firm in Section 4.3.

[Insert Table 1 here]

4. Empirical results

4.1. CEO overconfidence and future stock price crash risk

To investigate our main hypothesis (H1), we begin by performing the univariate analysis in Table 2. We use *NCSKEW* and *DUVOL* as the measure of stock price crash risk in Panels A and B, respectively. Specifically, we divide the subsample into two groups based on the CEO's crash experience in Models (2) and (3) and examine the difference between these two in Model (4). We first confirm the finding from Kim, Wang and Zhang (2016) that overconfident CEOs are more likely to associate with higher stock price crash risk compared to non-overconfident CEOs. This suggests the fact that CEO overconfidence tends to lead to bad news hoarding, which in turn leads to a higher risk of future stock price crashes. Consistently, we also find that about 58% of the total crash experience in our sample has occurred in firms with overconfident CEOs.[16]

The important finding in Table 2 is that the positive effect of CEO overconfidence on future stock price crash risk is generally more significant for CEOs who never experience stock price crash (Model (2)), compared to CEOs with such a crash experience (Model (3)). In other words, overconfident CEOs typically adjust (decrease) their future stock price crash risk on average if they have experienced a stock price crash, whereas there is no such tendency for non-overconfident CEOs, as shown in Model (4).

[Insert Table 2 here]

[16] We describe this statistic in Appendix Table B.1. Therefore, naturally, about 50% of the overconfident CEOs had at least one crash experience at the firm during their tenure, while had 34% for non-overconfident CEOs (see, Panel B of Appendix Table B.1).

Table 3 reports the results from the multivariate test for H1. To control potential effects from the year- and industry-specific time-invariant characteristics, Table 3 and subsequent tables basically control for fiscal year and Standard Industrial Classification (SIC) two-digit industry fixed effects, as in Banerjee et al. (2018). However, we check whether our results are robust to controlling firm fixed effects. All the independent variables are one-year lagged.

In Panel A of Table 3, we divide the subsample into two groups based on the CEO's crash experience in Models (1)–(4) and (5)–(8). Consistent with our univariate analysis (Table 2), we find that estimated coefficients of CEO overconfidence indicator (*CEO_HOLDER67* or *100*) are positively significant only for CEOs who never experienced their firm's stock price crash (Models (1)–(4)), whereas these are insignificant for CEOs who already have at least one crash experience (Models (5)–(8)). Instead of subsample analysis, we perform the baseline regressions with an interaction term of CEO overconfidence and the post-crash experience indicator (*POST_CRASH*) in Panel B. Most importantly, the sum of CEO overconfidence and interaction terms are not significantly different from zero (see *coefficient test* below in Panel B), while the indicators of CEO overconfidence are strongly positive alone. In untabulated results, we further find that the positive effect of CEO overconfidence on the likelihood of stock price crash per se (as well as the measures of stock price crash) is also reduced if the CEO has prior crash experience.[17] We also find that our baseline results are unchanged in an unreported test where we account for the influence of financial crisis, suggesting that the CEO's

[17] In Appendix Tables B.2 and B.3, we report the correlation matrix and additional regression analysis. Appendix Table B.2 shows that, regardless of the CEO's crash experience, the Pearson correlation coefficients between *CRASH*, *NCSKEW*, and *DUVOL* are strongly positive. However, the coefficient between CEO overconfidence and *CRASH* (as well as, *NCSKEW* and *DUVOL*) becomes less positive and significant if the CEO experienced the crash. In particular, we perform the linear probability model (LPM) and the logit regression for the likelihood of future stock price crashes per se with the industry or firm fixed effects in Appendix Table B.3. We note that the results in Appendix Table B.3 are generally consistent with our hypothesis H2.

crash experience is separate and distinct from their experience of the financial crisis.[18]

In sum, Tables 2 and 3 support our H1 that the positive effect of CEO overconfidence on future stock price crash risk is moderated after the CEO experienced an actual crash of stock price. On the one hand, since the firm's stock price crash and its litigation (such as security class actions) can be positively correlated, we argue that our finding is consistent with Banerjee et al. (2018) that an overconfident CEO's behavior is mitigated after the firm's lawsuit case.[19] On the other hand, if CEOs lose money on their own purchased stock in the firm (which might be due to their overconfidence), our argument that overconfident CEOs may learn from their negative experience can also be in line with Kolasinski and Li (2013).

[Insert Table 3 here]

4.2. Possible channels: CEO confidence, CEO turnover, and CEO compensation

We expect that our main finding in the previous section is driven by the lessons from the crash experience. In other words, the CEO and/or firm may learn from observing a crash of stock price.

[18] We perform the following tests (but unreported for brevity): (1) including an indicator of the financial crisis period and its interaction term with our variables or interest, (2) in addition to (1), including triple-interaction term of the financial crisis indicator, the crash experience indicator, and CEO overconfidence indicator, and (3) excluding observations of the financial crisis period. We find that the results are qualitatively similar to our reported results. We also note that defining the crisis period as either 2008-2009 or 2008-2010 does not largely affect the results.

[19] In general, the securities class actions (SCAs) are raised by the firm's false statements (Banerjee et al., 2018). Compared with "bad news hoarding", a false statement would be a more serious situation. Thus, the stock price crash experience might be a more comprehensive set including the firm's situations that were deemed illegal (e.g., the false statement and fraud), illegal but non-detected cases, and legal but detrimental to shareholder value cases. Meanwhile, it is also possible that the firm's litigation per se (e.g., SCA) causes a crash of its stock price. Either way, our paper could be considered an extension of prior literature (e.g., Banerjee et al. (2018)) by using the stock price crash risk.

Therefore, we hypothesize and examine the three possible channels in this subsection.

First, we assess the effect of the crash experience on the CEO's confidence level (H2). Specifically, we construct a continuous measure of managerial confidence as the average realized value per option divided by the average exercise price per option.[20] This continuous and option-based measure, *CEO CONFIDENCE*, is calculated by the data from Execucomp following the literature on managerial confidence (e.g., Banerjee, Humphery-Jenner and Nanda (2018)). The average realized value per option is the estimated value of unexercised exercisable options scaled by the number of such options. The average exercise price per option is the given current stock price minus the average realized value per option.

Table 4 reports the results for H2. We exclude firm-year observations with CEO turnovers (at the year *t*) to clearly examine the (same) CEO's response after the crash experience.[21] In Panel A, we compare the effect of the CEO's first (Model (1)) and subsequent crash experience (Model (2)). The coefficient of *CRASH* is only significantly negative in Model (1), and the difference between Models (1) and (2) is significant at the 5% level, suggesting that the impact of the crash experience especially occurs for the first time during a CEO's tenure at the firm. This result is also consistent with the argument by Banerjee et al. (2018) that the firm's first lawsuit negatively impacts the CEO's confidence.

In Panel B, we find that the impact of a CEO's crash experience on their confidence level is more pronounced for overconfident CEOs.[22] If overconfident CEOs adhere to their over-optimistic

[20] This continuous measure is more appropriate to examine the effect of the CEO's crash experience on the change of their confidence, compared to the indicators of CEO overconfidence (*CEO HOLDER67* or *100*).

[21] Nevertheless, we obtain qualitatively similar results (unreported) if we include observations with CEO turnovers.

[22] We find that the impact of the first crash on the CEO's confidence level is significantly negative at the 1% level both for overconfident and non-overconfident CEOs. Although the coefficient of the first crash for

view even after the crash experience, then we should observe that they are less likely to reduce their confidence compared to non-overconfident CEOs. However, we find the opposite results; thus, we suggest that the CEO's crash experience is an influential shock, particularly for overconfident CEOs. As robustness tests show (Panel C), we control for a lagged continuous measure of the CEO's confidence level in Models (1) and (2) and replace the dependent variable with the change of the CEO's confidence level in Models (3) and (4). The estimated coefficients of the crash experience indicators (*CRASH* and *POST_CRASH*) are still significantly negative in Panel C. We also find that our results in Table 4 remain statistically significant if we account for the financial crisis.[23]

[Insert Table 4 here]

Next, we conduct the CEO turnover analysis to examine the second channel (H3). We perform logit regressions with the year and industry fixed effects, and the control variables.[24] Moreover, in this analysis, we construct the variable, *Total number of CRASH by prior CEO*, which is the number of experiences of crash weeks during the CEO's tenure. This variable enables us to examine the effect of several crash experiences and account for those that occurred more than one year ago.

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overconfident CEOs is more negative than for non-overconfident CEOs, the difference between these two CEO subsamples is not significant. These results are untabulated for brevity.

[23] These results are unreported for brevity. Specifically, we find that our variable of interest, coefficient of *CEO HOLDER67* × *CRASH* (or *POST_CRASH*), is still significantly negative in these unreported results. Although overconfident CEOs tend to reduce their confidence level during the crisis (relative to the non-crisis period), the triple interaction term, *CEO HOLDER67* × *CRASH* (or *POST_CRASH*) × *Crisis*, is statistically insignificant. Thus, our results for H2 are not driven by the impact of the financial crisis, indicating that the CEO's crash experience is distinct and significant compared to the financial crisis.

[24] We include a set of the control variables except for the CEO compensation-related variables (*CEO TOTALPAY*, *CEO DELTA*, and *CEO VEGA*). Thus, our sample period in the CEO turnover analysis is slightly extended; we identify "CEO turnover" during 1993–2016 (as we can identify overconfident CEOs from 1992, and we measure the stock price crash during 1992–2015) if a firm-year observation's CEO is different from the prior year from Execucomp. However, we find qualitatively similar results (unreported) if we include those CEO compensation-related variables in the CEO turnover analysis.

Table 5 reports the results of CEO turnover analysis. Panel A overall shows that firms with crash experience are more likely to change their CEOs, supporting H3. Specifically, Model (1) of Panel A implies that the crash experience (at the year t–1) has about 1.1% of the marginal effect at the sample mean for all other variables. Given that an unconditional probability of CEO turnover in Panel A is approximately 8.9%, we note that this result supports the economic significance.

We further classify CEO turnovers into four types based on a prior and a newly-hired CEO's overconfidence to assess whether the firm's CEO hiring practice is affected by the crash experience in Panels B and C. We find that the firm's crash experience is mostly (and positively) associated with the first type — from an overconfident to a non-overconfident — of CEO turnover, as shown in Models (1) and (2) in both Panels. Moreover, Model (8) of Panel B indicates the opposite type — from a non-overconfident to an overconfident — of CEO turnover is less likely to arise if the firm experienced several crash weeks under its prior CEO, although Model (8) of Panel C does not support this argument statistically. These results in Panels B and C are also in line with the argument by Banerjee et al. (2018) that a firm's CEO hiring practice is affected by its prior litigation.

We note a concern that may arise from the way we classify CEO turnovers. Following the literature (e.g., Campbell et al. (2011) and Malmendier and Tate (2005)), CEOs are classified as overconfident if they hold exercisable options above 67% moneyness at least twice. However, *CEO HOLDER67* (or *100*) is set to one from the first year such CEOs exhibit this behavior. If a CEO who is newly appointed at the year t begins to postpone the exercise of vested options (that are above 67% or 100% moneyness) from the second year of their tenure, a CEO is classified as an overconfident CEO from the year t+1, but a non-overconfident CEO at the year t. Thus, such cases are classified as *Type 1* or *Type 2* in Panels B and C of Table 5; however, it would make more sense to be classified as *Type 3* or *Type 4*. To address this concern, we re-classify CEO turnovers in Panels B and C of Table 5 based on the newly-hired CEOs' overconfidence indicator at the year t+1 or t+2 (e.g., *CEO*

HOLDER67 (t+1 or t+2)).[25] However, we obtain qualitatively similar results (unreported). We also confirm that the results in Table 5 are not affected by the financial crisis period.

[Insert Table 5 here]

The third channel (H4) that we propose is about CEO compensation structure. In addition to considering the CEO's total compensation, we decompose it into salary, bonus, and equity-based compensation. Note that equity-based compensation is further divided into option- and stock-based compensation. As we argue that CEO turnover is significantly affected by the firm's crash experience (as in Table 5), we separately analyze the non-turnover sample, and the sample focusing on the newly hired CEO.[26]

The results of the aforementioned subsample analysis are reported in Panels A and B of Table 6, respectively. Note that we control for a lagged value of the CEO's total compensation (*CEO TOTALPAY* at the year t–1) in Table 6. We find that a crash of the firm's stock price leads to a drop in CEO compensation in Model (1) of Panel A. This suggests that shareholders (or the board) of the firm with the crash experience hold their CEO responsible for the crash, and thus give them a punishment

[25] Alternatively, we conduct a cross-sectional analysis (but untabulated) by regressing the CEO overconfidence indicator at the year t+1 or t+2. Specifically, for CEOs who are newly appointed at the year t, we perform logit regressions with the control variables as seen in Table 5, and the year and industry fixed effects. If the dependent variable is *CEO HOLDER67 (CEO HOLDER100)* at t+1 or t+2, estimated coefficients of *Total number of CRASH by prior CEO* are still negative and significant at the 10% (5%) level, except a model for *CEO HOLDER67* at t+2 with 0.15 of p-value. We also find the same results using a linear probability model, instead of logit regressions.

[26] As Humphery-Jenner et al. (2016) argue how the difference in compensation structure lies between overconfident and non-overconfident CEOs, we further examine the different effect of the firm's crash experience on their adjustment of the CEO's compensation structure between firms with overconfident and non-overconfident CEOs. We include *CEO HOLDER67* and an interaction term between *CEO HOLDER67* and *CRASH* in the non-turnover sample (Panel A of Table 6). However, we find that the interaction terms are insignificant, suggesting that the firm with the crash experience seeks to adjust its CEO compensation structure regardless of CEO overconfidence. These results are untabulated.

by reducing the total payment. The reduction in the CEO's total compensation is also economically significant since it represents an approximately 7.4% decrease at the sample mean.[27] We also find the opposite coefficients of *CRASH* on different components of CEO compensation in Panel A, suggesting that the firm with the crash experience seeks to adjust its existing CEO's compensation structure. Specifically, it seems that the firm replaces option awards with restricted stock grants and fixed cash pays (salary). Furthermore, the results in Panel A remain qualitatively unchanged if we replace the dependent variables with the ratios scaled by the CEO's total compensation.[28]

Prior studies posit that CEO's equity incentives could encourage more bad news hoardings and thus a higher stock price crash risk (Chen et al., 2021; Kim, Li and Zhang, 2011a). The results in Table 6 can be consistent with this line of thought, suggesting that a firm with the prior year's crash experience seeks to prevent a future crash by adjusting their CEO's compensation structure. In particular, the CEO's cash compensation and restricted stock grants do not increase with the stock volatility whereas a stock option does (Coles, Daniel and Naveen, 2006; Core and Guay, 1999; Guay, 1999). Therefore, we cautiously interpret that the adjustment after the firm's crash experience (the results in Panel A) would decrease the CEO's incentive to take a high-risk behavior, such as bad news hoarding. Meanwhile, Panel B shows that, for the newly-hired CEOs, firms with the crash experience are likely to give them more restricted stock grants as compensation compared to firms without the

[27] If we re-estimate Model (1) in Panel A with the raw data of the CEO's total payment as the dependent variable (instead of the natural logarithm value), we find that the crash experience at the year t–1 reduces the total compensation by approximately $0.36 million. Given $4.86 million as the unconditional sample mean of the total compensation (at the year t), this reduction indicates about a 7.4% (= 0.36/4.86) decrease at the sample mean, relative to firms with no such prior crash experience.

[28] In these untabulated tests, we find 0.95%, –1.32%, and 0.81% significant changes of the ratios of the CEO's salary, option awards, and restricted stock grants to the total payment, respectively, after the firm's crash experience. Given the unconditional sample mean (29.31%, 36.09%, and 17.37%, respectively), these estimates represent about 3.24%, –5.06%, and 4.66% proportional changes in salary, option, and stock intensity in the compensation structure, respectively.

crash experience.[29] Overall, we argue that our findings in Table 6 indicate the firm's learning in compensation practice toward its CEO from the crash experience.

On the one hand, according to Kim, Li and Zhang (2011a), the option-induced managerial risk-taking incentive (i.e., vega) per se does not increase the stock price crash risk. On the other hand, Chen et al. (2021) argue that the CEO's vega can induce bad news hoarding, thus lead to higher crash risk. Furthermore, as suggested by Hayes, Lemmon and Qiu (2012), the accounting rule change significantly influences the CEO compensation structure.[30] Since we are aware of these findings, we further discuss as follows: First, in our baseline analysis (Table 3), we find that the coefficients of *CEO VEGA* are insignificant, which are generally consistent with the results in Kim, Li and Zhang (2011a). Next, we examine the direct effect of the firm's crash experience on the change of equity incentives. In this unreported test, we find that the crash experience has no direct effect, after controlling firm characteristics, neither on the change of CEO's (or the average of executives) delta nor vega per se. Finally, although we do not tabulate the results for brevity, we also find that the accounting rule change does not mainly drive our results in Table 6.[31] Overall, we argue that the results in Table 6 might be

[29] We include the prior CEO's total pay (*CEO TOTALPAY* at the year t–1) in the cross-sectional analysis of Panel B of Table 6, to control the firm-level persistency on the CEO's total compensation. Nevertheless, we find qualitatively the same results if we do not include the prior CEO's total pay.

[30] Several prior empirical studies use the adoption of Financial Accounting Standards 123R (FAS 123R) following in the spirit of Hayes, Lemmon and Qiu (2012). Nevertheless, we additionally test an (exogenous) event that might have a potential effect on the CEO compensation structure: The financial crisis. However, we find that our results in Table 6 remain statistically significant (untabulated) if we include the financial crisis indicator and its interaction term with the firm's crash experience indicator.

[31] Following Hayes, Lemmon and Qiu (2012), we use the adoption of FAS 123R which took effect in 2005, as an exogenous event that significantly (and exogenously) affects the CEO compensation structure. In this unreported test, we confirm that in our sample, an indicator for the post-FAS 123R period has a significant estimate (and that is generally consistent with the literature on FAS 123R) for each component of CEO compensation. Furthermore, we find as follows: First, the overall reduction of total compensation by the crash is only pronounced after the FAS 123R (below 0.01 of p-value). Second, for the pre-FAS 123R period, firms with the crash experience tend to replace their CEO's bonus with salary (both effects are significant with

(partial but supportive) evidence indicating the firm's effort to prevent its future crash after the crash experience by replacing the CEO's incentives from stock options with restricted stock grants.

To summarize this subsection, the results from Tables 4–6 can indicate the lesson learned from the stock price crash experience. First, CEOs (particularly those who are overconfident) may self-adjust their confidence on the future prospect of the firm after their crash experience. Second, firms are more likely to turnover their CEOs after the crash of their stock price. It can also suggest that from the CEO's perspective, they may perceive a higher threat of turnover after the crash experience, and thus seek to reduce future crash risk. Finally, firms may try to adjust their CEO's compensation structure after the crash of their stock price. Collectively, both the CEO and the firm may learn from the crash experience, leading to a reduction of the effect of managerial confidence on future stock price crash risk. We further conduct a placebo test to assess the causality of the CEO's (or firm's) crash experience in our previous hypotheses (H1–4) and find supporting evidence.[32]

[Insert Table 6 here]

4.3. Executive level and governance improvement

The stock price crash arises from the management's bad news hoarding (Hutton, Marcus and Tehranian, 2009), which can be done not only by the CEO but also the executives on the board.

below 0.01 of *p*-value). Third, for the post-FAS 123R period, firms tend to reduce their CEO's stock options after the crash experience (below 0.01 of *p*-value), and rather give them restricted stock grants (with 0.11 of *p*-value). Collectively, our results in Table 6 are a mixture of results before and after the passage of FAS 123R.

[32] We report the results of this placebo test in Appendix Table B.4. Specifically, as suggested by Bernile, Bhagwat and Rau (2017), we randomly re-assign the variable (of interest) based on the primary sample distribution and calculate the mean values of coefficients and *t*-statistics over 1,000 repetitions. Overall, the results in Appendix Table B.4 indicate that our main results for H2–4 (Tables 3–6) are unlikely to be the results of spurious correlations.

Therefore, we examine the effect of overconfident executives on future stock price crash risk, and whether the crash experience also mitigates this influence in the same manner as for the CEO.

Table 7 reports the results for H5. Panel A shows that the average number of overconfident executives in the firm is positively related to the future stock price crash risk. In addition, this positive effect (almost) disappears after the board observes a crash of the firm's stock price during the CEO's tenure. Banerjee et al. (2018) find that a board with more overconfident senior executives is more likely to be associated with the risk of litigation. Similar to their study, we also expect that compared to junior executives, seniors' overconfidence is more relevant. We find consistent results in Panel B of Table 7, suggesting that senior executives can hoard bad news through their relatively strong influence within the board (as the title "senior" suggests), while this is less likely to be the case for juniors.

Meanwhile, Kim, Li and Zhang (2011a) find that the CFO's equity incentive is a significant determinant of the firm's stock price crash risk. The authors suggest that the effect of the CFO's equity incentive on future crash risk is stronger than the effect of the CEO's (even the CEO's effect is also significant). Thus, we examine the effect of a CFO's overconfidence in Panel C of Table 7. Models (1) and (2) show the positive effect of *CFO HOLDER67* on future stock price crash risk, which is consistent with the argument of Kim, Li and Zhang (2011a). However, after we include the CEO's overconfidence indicator in Models (3) and (4), we find that the effect of CFO overconfidence disappears. These results suggest that contrary to the results of Kim, Li and Zhang (2011a), which examine the effect of equity incentive, the effect of overconfidence is more powerful for the CEO relative to the CFO. Furthermore, Models (5)–(8) show that the positive effect of overconfident CFOs and/or CEOs appear to be moderated for the post-crash period, which is generally consistent with our H1 and H5.

[Insert Table 7 here]

Next, to examine the effect of the crash experience on the executives' confidence level (H5a),

we construct the average value of a continuous confidence measure for the executives at the firm. Table 8 reports the results for H5a. In Panel A, we find that the first crash experience during the CEO's tenure is more impactful to the executives' confidence compared to the subsequent crashes (with 0.076 of *p*-value in the difference), consistent with our previous results for the CEO's confidence. However, the executives' confidence is reduced on average also by the subsequent crash experiences at the 5% level, in contrast to the previous results (Panel A of Table 4). We cautiously interpret this result as follows: First, the executives may have less charge, on average, relative to the CEO in the management of the firm (i.e., the CEO is the most representative person on the board). Second, the executives may face a lesser threat of turnover relative to the CEO even if a crash of the firm's stock price occurs. Collectively, the executives may learn from the crash experience more slowly than the CEO. Thus, after subsequent crashes, the executives are still likely to behave confident while CEOs do not (since CEOs tend to modify their confidence level instantly after their first crash experience). We further note that any subsequent crashes might be the first experience for some executives, as we classify the first crash based on the CEO's tenure. Panel B shows similar results as in Table 4 that overconfident executives tend to reduce their confidence more after the crash experience compared to non-overconfident individuals.

[Insert Table 8 here]

Further, we assess whether the crash experienced firm adjusts the compensation structure of their executives on the board (H5b). Table 9 reports the results. As we argue that the effect of executives' overconfidence on future stock price crashes seem different between senior and junior executives, we divide the subsample into Models (4)–(6) and (7)–(9), as well as all the executives in Models (1)–(3). The results in Table 9 are generally consistent with our previous results on the CEO compensation structure. We note that the reduction in the executives' total payment by the firm's crash experience is typically pronounced for senior executives at the firm. This indicates that shareholders with crash experience may punish their senior executives (by reducing the total payment) to prevent a future crash.

Thus, senior executives seem to be more responsible for hoardings bad news (thus, the stock price crash risk) compared to junior executives, consistent with our previous results in Panel B of Table 7. Overall, we find evidence that firms with the prior year's crash experience also adjust their executives' compensation structures by replacing stock options with restricted stock grants.[33]

In sum, Tables 7–9 support that our hypotheses can expand to the executive level as well as the CEO. These results also suggest that the executives' crash experience (during the CEO's tenure) could also be impactful shocks and thus, lead them to reduce their own confidence about the firm's prospects. Further, the post-crashed firms seek to adjust not only their CEO's but also their executives' compensation structure.

[Insert Table 9 here]

After the passage of SOX, Hutton, Marcus and Tehranian (2009) argue that firms cannot hide information as much as they could before (in the context of our study, bad news hoarding) because SOX substantially increased firms' monitoring mechanisms and the penalties for manipulation. In addition, SOX can improve the decision-making of overconfident CEOs (Banerjee, Humphery-Jenner and Nanda, 2015). Extending these two views, we examine whether improved governance moderates the effect of overconfident CEOs on future crash risk (H6).

Table 10 reports the results for H6. We begin by testing the univariate analyses for NCSKEW and DUVOL in Panels A and B, respectively. We summarize the findings as follows: First, we confirm that the effect of SOX on the firm's stock price crash risk is overall negative, as suggested by Hutton, Marcus and Tehranian (2009). Second, the negative effect of SOX on the future crash risk is more pronounced for firms with overconfident CEOs (see the results in the second row) compared to non-

[33] In unreported results (for brevity), we also find that, after the firm's crash experience, junior executives' bonus payment slightly decreases on average, whereas senior executives' salary payment slightly increases on average.

overconfident CEOs. It also implies that SOX can help mitigate an overconfident CEO's behavior, such as bad news hoarding, which is consistent with the findings of Banerjee, Humphery-Jenner and Nanda (2015). Finally, for both the pre and post-SOX periods, overconfident CEOs tend to reduce their firm's future crash risk if they have prior crash experience, suggesting that the CEO's personal experience (in our study, the crash experience) could also be impactful even relative to SOX.

Furthermore, we find some interesting results in Model (2) in Panels A and B: Even for the post-SOX period, if CEOs never experienced a crash before, the stock price crash risk for overconfident CEOs is still significantly higher than that for non-overconfident CEOs (see the results in the third row). Similarly, Model (4) in Panels A and B indicate that for the pre-SOX period, the difference of the stock price crash risk between overconfident and non-overconfident CEOs is significantly positive even if CEOs already experienced the crash before. However, if the governance improves and this is combined with the CEO's crash experience, then there is no difference in the crash risk between overconfident and non-overconfident CEOs, as shown in the third row of Model (5). In unreported univariate tests (for brevity), we find qualitatively similar results using *CEO HOLDER100*.

In the multivariate tests (Panels C and D), we construct an indicator for the post-SOX period that equals to one for observations in 2003 or later, and zero otherwise, and its interaction term with CEO overconfidence indicators (*CEO HOLDER67* or *100*). Consistent with the results in Panels A and B, we find that the effect of improved governance (by SOX) on the relation between CEO overconfidence and future stock price crash risk is particularly pronounced for firms with CEOs who already have at least one crash experience (Models (5) and (6)).[34]

[34] As suggested in the literature on the effect of SOX (e.g., Coles, Daniel and Naveen (2014)), some firms were compliant with the requirements of SOX before the passage. Thus, we focus on highly-non-compliant firms with a relatively high independence gap between their own independence and SOX requirement (a majority independent board). In this unreported subsample analysis (similar to Table 10), we find that our results overall hold for both highly-non-compliant firms and other firms.

Collectively, the results in Table 10 provide the following implications. First, an enhanced monitoring role can be more effective for CEOs (or firms) who learn from the crash experience, compared to CEOs (or firms) without such an impactful experience. Second, if there is no effective monitoring in the firm (e.g., firms in the pre-SOX period), overconfident CEOs are less likely to moderate their behaviors even if they observe a crash of their firm's stock price that they might have caused. In other words, a better monitoring mechanism in the firm might lead to better learning for the CEO (as well as the firm) from the crash experience. Combining these two implications, we suggest that improving corporate governance and the CEO's (or firm's) self-adjustment could be complementary.

[Insert Table 10 here]

5. Additional analysis

5.1. Omitted variable bias concern: control variables for corporate governance

The literature highlights the role of corporate governance (e.g., Bebchuk, Cohen and Ferrell (2009), and Gompers, Ishii and Metrick (2003)). For instance, entrenched CEOs or executives may prefer to hoard bad news for private benefits. Managerial entrenchment (by its meaning) also lowers the threat of CEO turnover. In particular, Campbell et al. (2011) suggest that poorly governed firms are unlikely to change their overconfident CEOs even when their behavior is detrimental to firm value. In sum, managerial entrenchment can affect the firm's stock price crash risk, as well as monitoring by independent directors.

While our previous estimations control for institutional ownership *(INST OWNERSHIP*) and we perform an empirical test on the effect of SOX (Table 10), we additionally include the following variables in our main results: *E-INDEX*, as an entrenchment index that comprises six provisions (Bebchuk, Cohen and Ferrell, 2009), *BOARD INDEPENDENCE*, as an internal monitoring instrument,

and *BOARD SIZE*, as a control for the total number of executives on the board. We obtain the related data from Institutional Shareholder Services (ISS, formerly RiskMetrics).[35] We specifically focus on our baseline and CEO turnover analysis that might be affected by the fact that we omit the governance variables. However, the results in Table 11 show that our previous expectations are still supported statistically, indicating that omitted corporate governance factors do not drive our main results.

[Insert Table 11 here]

5.2. Omitted variable bias concern: alternative fixed effect regressions

To alleviate the bias concern from (time-invariant) omitted variables, we perform our regressions with alternative fixed effects. Table 12 reports the results that re-examine our previous hypotheses from 1 to 4. Our results are robust to control for firm fixed effects which account for (unobserved) firm-level time-invariant characteristics. In particular, for the baseline and the analysis for the effect of the crash experience on the CEO's confidence level (Panels A and B of Table 12), we further use the firm-CEO fixed effects,[36] which control for the time-invariant firm attributes during a CEO's tenure. These two alternative fixed effects may include, for instance, a persistent corporate culture and CEO's inherent characteristics during their tenure at the firm, which might be unobservable. For the CEO turnover analysis (Panel C of Table 12), our sample size is smaller than Table 5 since we perform logit regressions with the firm fixed effect, instead of industry fixed effect. In sum, the results in Table 12 suggest that unobserved (and thus omitted) variables do not drive the results of our main analyses.

[35] Due to the data availability of ISS, the observations in Table 11 are relatively small compared to our primary sample.

[36] Thus, we do not include the indicator variable for CEO overconfidence (*CEO HOLDER67* or *CEO HOLDER100*) in Models (5) and (6) of Panels A and B of Table 12.

[Insert Table 12 here]

5.3. Does the crash experience simply represent poor firm performance?

An alternative explanation for our results is the effect of the firm's poor accounting performance. For instance, if CEOs observe their firm's negative net income, they may realize that their over-optimistic view on the firm's future prospects should be (slightly) adjusted. Similarly, a firm may fire its CEO because of poor performance, rather than due to a stock price crash that year. Then, it is possible that our results merely reflect poor firm performance. Therefore, we examine whether the firm's negative returns drive our results (instead of the crash experience per se) in this subsection.

Table 13 reports the results. Specifically, we examine the effect of poor performance on the CEO's confidence level (Panel A), the likelihood of CEO turnover (Panel B), and the CEO compensation structure (Panel C). We construct an indicator for firms with negative net income at the year t–1 and interact it with the crash experience indicators. Most importantly, all the interaction terms of *Negative ROA firms* in Table 13 are insignificant. Panel A shows that, although the effect of poor performance on the CEO's confidence level is generally negative, the results still maintain that the CEO's crash experience reduces their confidence level. We find that the negative effect of the crash experience is more pronounced for overconfident CEOs (Models (3) and (4)), compared to non-overconfident CEOs (Models (5) and (6)), which is consistent with our previous finding. Our previous results are also robust in Panels B and C. Taking a closer look at the results, we find that firms with poor performance in the prior year are generally associated with a higher threat of CEO turnover, and lower CEO (total) compensation.

Furthermore, we examine the effect of the CEO's first crash experience and poor performance. Thus, similar to Panel A of Table 4, we divide the subsamples for the first crash and subsequent crashes and include *Negative ROA firms* and its interaction with *CRASH* in the analysis. In this test, unreported

for brevity, we find that the effect of the first crash is still substantially negative relative to subsequent crashes.[37] In another untabulated (for brevity) result similar to Table 13, we interact the firm's average return in the stock market (*RET*) and the crash experience indicators (*CRASH* and *POST_CRASH*) and find that the firm's poor market performance at the year *t*–1 also does not drive our previous results. Collectively, additional analyses in this subsection suggest that our main results do not merely reflect neither (negative) accounting nor market performances.

[Insert Table 13 here]

5.4. Does CEO overconfidence relate to stock price jump experience?

The accounting and finance literature measures an upside risk of the firm's stock price as well as a downside risk (Hutton, Marcus and Tehranian, 2009). We identify a positive stock price jump (hereafter, the jump experience) if the firm has at least one jump week in the year—a jump week indicates the firm's weekly return rises 3.20 standard deviation above its annual average. Consistent with our definition of the CEO's crash experience, we construct the CEO's jump experience during their tenure at the firm.

There are some alternative explanations for our main findings in terms of the jump experience. First, an overconfident CEO may have more jump experience (upside risk), as well as crash experience (downside risk), compared to a non-overconfident CEO. Second, those two extreme stock price shocks, crash and jump experiences, can be correlated positively,[38] for instance, due to a large stock return volatility. According to these alternative views, our results could merely indicate that CEO overconfidence predicts fat tails in stock return distribution. In particular, as the crash experience

[37] *Chi2* statistic of the difference between the effect of the first crash and subsequent crashes on the CEO's confidence is higher than one in Panel A of Table 4. It is 6.98 with 0.0082 of *p*-value.

[38] However, the Pearson correlation coefficient between *CRASH* and *JUMP* is –0.15 with *p*-values of 0.00.

influences both CEO and firm, the jump experience could also affect. Moreover, from the abovementioned second alternative, our results in Table 4 (for H2) could be a consequence of the CEO's better option-exercising at a higher stock price (not reducing confidence because of a crash).

Table 14 reports the results on stock price jump experience. First, Panel A shows no evidence of a relationship between CEO overconfidence and the likelihood of a positive jump. Therefore, CEO overconfidence only relates to the firm's stock price crash. Since Kim, Wang and Zhang (2016) do not examine this relation, our results support and strengthen the argument that CEO overconfidence leads to future stock price crash risk. Second, we also find that the CEO's jump experience does not affect our baseline results (Panel B). Finally, in Panel C, our main variables such as *CEO HOLDER67* × *CRASH* and *CEO HOLDER67* × *POST_CRASH* remain statistically significant and negative, even when we include indicators of the jump experience (*JUMP* and *POST_JUMP*) and its interaction terms with *CEO HOLDER67*. In addition, the significance of the coefficients *CEO HOLDER67* × *POST_JUMP* (in Model (3)) and *JUMP* (in Model (5)) disappear after we include the crash experience variables. Overall, the results in this subsection suggest that alternative explanations from the jump experience are unlikely to explain our main findings. The results also suggest that while the crash experience is an impactful shock to the CEO, the jump experience may not be.

[Insert Table 14 here]

5.5. Alternative criteria of the stock price crash experience

In this study, the stock price crash experience is defined if the firm has at least one crash week in the year, and the crash week is based on 3.20 times the standard deviation of the firm's return, following Hutton, Marcus and Tehranian (2009). Nevertheless, one still might cast a doubt on the appropriateness of this 3.20 standard deviation as the cutoff criterion of the crash experience. Therefore, we use alternative criteria in this subsection.

Table 15 reports the results. Naturally, as we set a higher criterion for the crash experience, the number of firm-year observations for the pre-crash period increases. If we define "the crash" with a smaller decrease in stock return (i.e., from Panel C to A), the estimated coefficients of *CEO HOLDER 67* or *100* become more positive in Models (5)–(8), and one of those appears significant at the 10% level (Model (7) of Panel A). Nevertheless, *CEO HOLDER67* or *100* is generally insignificant for the post-crash period, and positively significant for the pre-crash period. Furthermore, we re-estimate our main results in Tables 2–10 with these alternative criteria as in Table 15. In these untabulated (for brevity) results, we overall find the results that are qualitatively similar to the reported results, so that our previous hypotheses are still supported. Therefore, our main findings are robust to the alternative criteria of the crash experience.

[Insert Table 15 here]

5.6. Alternative measures of CEO overconfidence

Our main results use the option-based measure of CEO overconfidence following the literature (Banerjee, Humphery-Jenner and Nanda, 2015; Campbell et al., 2011; Malmendier and Tate, 2005; Malmendier, Tate and Yan, 2011).[39] In this subsection, we use alternative methods to measure CEO overconfidence through media-based measures, as suggested by Hirshleifer, Low and Teoh (2012) and

[39] Given the nature of this option-based measurement, one possible explanation is that giving intensive option-based compensation to the CEO might be related to both CEO overconfidence and a higher risk of future stock price crash. However, we argue that it is unlikely to drive our main results because of the following two reasons: First, the option-based measures of CEO overconfidence (*CEO HOLDER67* or *100*) are not derived from the option-based compensation per se, as pointed out by the literature on managerial confidence (e.g., Banerjee et al. (2018) and Malmendier and Tate (2005)). Second, we control the CEO's vega as a direct proxy for risk-taking incentive in our baseline analysis, and find its insignificant effect on the future stock price crash risk, consistent with the results in Kim, Li and Zhang (2011a). Nevertheless, we perform a robustness test in this subsection using the hand-collected data from Factiva.

Malmendier and Tate (2008). Specifically, we hand-collect the news articles for our sample period in Factiva.[40] We require that the firm have at least one article in Factiva during our sample period because thinly reported firms or difficult-to-find firms may cause potential bias (Humphery-Jenner et al., 2016). Using the available company codes in Factiva, we then count the total number of articles, and the number of confident or pessimistic articles for each CEO and year.[41]

Table 16 reports the results of three alternative media-based measures. First, following Hirshleifer, Low and Teoh (2012), we construct an indicator variable for confident CEOs, which equals to one if the CEO has a more cumulative number of confident articles than one of the pessimistic articles, and zero otherwise in Panel A. Second, in Panel B, we construct another indicator variable, *Confident news indicator*, which equals one for firm-year observations that have a greater number of confident articles than the number of pessimism articles during that year, and zero otherwise. Finally, we construct a continuous measure in Panel C, similar to Humphery-Jenner et al. (2016). This continuous measure is defined as the net news (which is the number of confident articles minus the number of pessimistic articles) scaled by the total number of articles.[42] Given the nature of these three

[40] Additionally, we require that the firm have at least one article in Factiva during our sample period because thinly reported firms or difficult-to-find firms may cause potential bias (Humphery-Jenner et al., 2016).

[41] As suggested in Hirshleifer, Low and Teoh (2012), we manually search Factiva for articles referring to the CEO between 1992 and 2014 (as the year t–1 for our sample period), in The New York Times, Business Week, Financial Times, The Economist, Forbes Magazine, Fortune Magazine, and The Wall Street Journal. Then, we count a news article as a confident (pessimistic) one if it contains the following words: "confident," "confidence," "overconfidence," "overconfident," "optimistic," "optimism," "overoptimistic," or "overoptimism," ("pessimistic," "pessimism," "overpessimistic," "overpessimism," "reliable," "steady," "practical," "conservative," "frugal," "cautious," or "gloomy"). During our hand-collection process, we also account for whether a news article contains the word "CEO" and/or the last name of the CEO for each firm-year.

[42] Therefore, it has a maximum value of one and a minimum value of negative one. Since we count the total number of articles including ones that are not classified as confident or pessimistic, the advantage of this continuous media-based measure of CEO overconfidence is that it ensures that we are analyzing how the degree of confidence is based on the exposure to media influences.

alternative measures, our sample size shrinks. Nevertheless, controlling for the industry (Models (1) and (2)) and firm fixed effects (Models (3) and (4)), we find partial but supportive evidence, that is, all the interaction terms of media-based measures of CEO overconfidence and the post-crash period indicator are generally negative. Although four models among twelves in Table 16 are not statistically significant with negative estimates, these results can support our main hypothesis. Overall, we argue that our main findings are robust to the alternative measures of CEO overconfidence.

[Insert Table 16 here]

5.7. Does the crash experience affect the relationship between CEO overconfidence and corporate investment?

The results of this study so far argue that the stock price crash experience significantly impacts an overconfident CEO's behavior. If so, a crash experience may affect an overconfident CEO's investment decision as well. The literature posits that CEO overconfidence leads to overinvestment in the firm, so it may harm shareholders' wealth (Malmendier and Tate, 2005). According to our hypothesis, overconfident CEOs who learn from their firms' crash experience are expected to adjust their behavior of overinvestment. To examine this extension of our hypothesis, we perform an additional analysis about investment and the value of investment following Banerjee, Humphery-Jenner and Nanda (2015).

Table 17 reports the results. In Panel A where we use the firm's capital expenditure divided by its beginning-of-year capital as the dependent variable, we confirm that overconfident CEOs generally overinvest compared to non-overconfident CEOs for both pre- and post-crash periods. However, if such CEOs experienced their firm's stock price crash, we find that this relation becomes weak, indicating that the tendency toward overinvestment by CEO overconfidence (due to its definition of excessively optimistic view on the future return of investment) is mitigated after an

impactful shock—which is the firm's stock price crash in our study.

Furthermore, Panel B shows that the crash experience positively influences the effect of CEO overconfidence on the value of investments. In Model (2), the value of investments is not significantly different between firms with overconfident and non-overconfident CEOs in the post-crash period, while CEO overconfidence affects negatively (and significantly) the value of investments in the pre-crash period in Model (1). After controlling for the industry and firm fixed effects (Models (3) and (4)), the triple interaction terms (*CEO HOLDER67* × *CAPEX / SALES* × *POST_CRASH*) are positively significant at the 10% level. These results suggest that the lesson from the crash experience may encourage overconfident CEOs to reduce relatively wasteful investment (thus, that might be value-destroying) and to enhance shareholder value. Overall, the evidence from Table 17 supports our main hypothesis that the crash experience moderates overconfident CEOs' behaviors that might be detrimental to shareholder value.

[Insert Table 17 here]

6. Conclusion

In this study, we investigate the relation between CEO overconfidence and firm-specific stock price crash risk, and the impact of the CEO's crash experience. Using a large sample between 1993–2015, we find that the crash experience appears to offer some lessons to both the CEO and the firm. Given the definition of CEO overconfidence, such overconfident CEOs are likely to bring a higher risk of the stock price crash, but this (positive) effect is reduced after they experience an extreme crash. We further propose three possible channels of how the crash experience moderates the positive influence of CEO overconfidence on future crash risk, by examining the impact of the crash experience on the CEO's confidence level, the likelihood of CEO turnover, and CEO compensation structure.

Taken as a whole, we argue that a CEO's relatively recent experience at the firm, beyond early-

life or career experience (e.g., Custódio, Ferreira and Matos (2013)), can affect managerial decisions regarding the firm's stock price crash. While the literature generally argues that CEO overconfidence is often persistent, our argument is consistent with some literature that focuses on the effect of managerial self-attribution (Banerjee et al., 2018; Billett and Qian, 2008; Kolasinski and Li, 2013). Overall, our study provides evidence that, if a CEO feels the negative consequences of their optimistic belief by experiencing an impactful shock (such as, a stock price crash), CEO overconfidence can be moderated.

Finally, our hypothesis and empirical evidence also can contribute to the literature by making potential suggestions for future studies. Following the most representative literature on managerial confidence (Malmendier and Tate, 2005), we examine whether the relation between CEO overconfidence and corporate investment (and its value) is affected by the CEO's crash experience in the last subsection. Similarly, for instance, if our hypothesis extends to the effect of managerial confidence on dividend policy (Banerjee, Humphery-Jenner and Nanda, 2018; Deshmukh, Goel and Howe, 2013), overconfident CEOs who have the crash experience could pay dividends differently compared to before the crash experience. Besides, there exist several testable arguments in terms of the effect of managerial traits (in our study, overconfidence) on corporate policies, such as capital structure, and innovative activities (Galasso and Simcoe, 2011; Hirshleifer, Low and Teoh, 2012; Malmendier, Tate and Yan, 2011).

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Table 1. Sample summary

This table presents the descriptive statistics of our sample from 1993 to 2015. We winsorize all continuous variables at the 1st and 99th percentiles. SD, P25, and P75 denote the standard deviations, and 25th and 75th percentiles, respectively. Variables definitions are in Appendix A.

	Mean	SD	P25	Median	P75
Stock price crash risk measures					
NCSKEW	0.1146	0.8015	-0.3486	0.0581	0.5128
DUVOL	0.0337	0.2522	-0.1355	0.0242	0.1905
Stock price crash experience indicator					
CRASH	0.2225	0.4159	0.0000	0.0000	0.0000
CEO and executives variables					
CEO HOLDER67	0.5751	0.4943	0.0000	1.0000	1.0000
CEO HOLDER100	0.4506	0.4976	0.0000	0.0000	1.0000
CEO CONFIDENCE	0.8890	1.5349	0.0685	0.3868	1.0118
CEO TOTALPAY	7.8700	1.0671	7.1124	7.8775	8.6292
CEO TENURE	1.7797	0.8830	1.0986	1.7918	2.3979
CEO AGE	4.0123	0.1328	3.9318	4.0254	4.1109
CEO-CHAIRMAN	0.5437	0.4981	0.0000	1.0000	1.0000
CEO DELTA	0.6545	1.5348	0.0763	0.2005	0.5535
CEO VEGA	0.1154	0.1988	0.0110	0.0416	0.1240
CEO TURNOVER (t+1)	0.1125	0.3160	0.0000	0.0000	0.0000
EXECUTIVES HOLDER67	0.3858	0.3204	0.0000	0.3333	0.6250
EXECUTIVES CONFIDENCE	0.8799	1.6301	0.0938	0.3875	0.9698
EXECUTIVES TOTALPAY	8.9637	0.9164	8.3074	8.9365	9.5903
EXECUTIVES DELTA	0.2330	0.4737	0.0336	0.0836	0.2182
EXECUTIVES VEGA	0.0424	0.0705	0.0053	0.0164	0.0461
Firm variables					
SIZE	7.1686	1.5563	6.0573	7.0325	8.1777
MTB	3.1123	6.2603	1.4854	2.3240	3.7262
LEV	0.1863	0.1831	0.0157	0.1597	0.2857
ROA	0.0313	0.1858	0.0152	0.0533	0.0913
PPE	0.2724	0.2152	0.1056	0.2100	0.3843
RD	0.0375	0.0745	0.0000	0.0045	0.0478
INST OWNERSHIP	0.0060	0.0033	0.0041	0.0069	0.0086
DTURNOVER	0.0328	0.9106	-0.2657	0.0183	0.3051
SIGMA	0.0490	0.0270	0.0306	0.0424	0.0596
RET	-0.1534	0.2153	-0.1740	-0.0879	-0.0459
OPAQUE	0.2386	0.2281	0.1034	0.1744	0.2966

Table 2. CEO overconfidence, future stock price crash risk, and the crash experience: univariate test

This table presents the results of univariate analysis. In Panels A and B, we use *NCSKEW* and *DUVOL* as the measure of stock price crash risk. Median values are reported in brackets. *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *Pre-CRASH experience* indicates that the CEO has no *CRASH experience* during their tenure at the firm that year. *Post-CRASH experience* indicates that the CEO has at least one *CRASH experience* during their tenure at the firm that year. We test the difference based on the null hypothesis that the difference is equal to zero. We use *t*-tests and *Wilcoxon*-tests for the means and medians, respectively. Variables definitions are in Appendix A. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: NCSKEW as the measure of stock price crash risk

Mean [Median]	Pooled (1)	Pre-CRASH experience (2)	Post-CRASH experience (3)	Difference ((3)-(2)) (4)
Pooled (*N*=20,404)	0.1188	0.2229	0.1935	-0.0294
	[0.0642]	[0.0675]	[0.0592]	[-0.0083]
CEO HOLDER67 (t-1) = 0 (*N*=8,339)	0.0811	0.0760	0.0910	0.0150
	[0.0326]	[0.0284]	[0.0411]	[0.0127]
CEO HOLDER67 (t-1) = 1 (*N*=12,065)	0.1448	0.1613	0.1288	-0.0325**
	[0.0843]	[0.1017]	[0.0653]	[-0.0364]***
Difference (b/w CEO HOLDER67)	0.0637***	0.0853***	0.0378**	
	[0.0517]***	[0.0733]***	[0.0242]	
CEO HOLDER100 (t-1) = 0 (*N*=10,934)	0.0861	0.0797	0.0970	0.0173
	[0.0394]	[0.0335]	[0.0496]	[0.0161]
CEO HOLDER100 (t-1) = 1 (*N*=9,470)	0.1565	0.1828	0.1327	-0.0501***
	[0.0914]	[0.1207]	[0.0641]	[-0.0566]***
Difference (b/w CEO HOLDER100)	0.0704***	0.1031***	0.0357**	
	[0.0520]***	[0.0872]***	[0.0145]	

Panel B: DUVOL as the measure of stock price crash risk

Mean [Median]	Pooled (1)	Pre-CRASH experience (2)	Post-CRASH experience (3)	Difference ((3)-(2)) (4)
Pooled (*N*=20,404)	0.0355	0.0378	0.0325	-0.0053
	[0.0263]	[0.0286]	[0.0237]	[-0.0049]*
CEO HOLDER67 (t-1) = 0 (*N*=8,339)	0.0249	0.0242	0.0262	0.0020
	[0.0151]	[0.0132]	[0.0205]	[0.0073]
CEO HOLDER67 (t-1) = 1 (*N*=12,065)	0.0428	0.0503	0.0354	-0.0149***
	[0.0356]	[0.0434]	[0.0255]	[-0.0179]***
Difference (b/w CEO HOLDER67)	0.0179***	0.0261***	0.0092	
	[0.0205]***	[0.0302]***	[0.0050]	
CEO HOLDER100 (t-1) = 0 (*N*=10,934)	0.0264	0.0253	0.0283	0.0030
	[0.0185]	[0.0168]	[0.0233]	[0.0065]
CEO HOLDER100 (t-1) = 1 (*N*=9,470)	0.0459	0.0570	0.0359	-0.0211***
	[0.0361]	[0.0460]	[0.0240]	[-0.0220]***
Difference (b/w CEO HOLDER100)	0.0195***	0.0317***	0.0076	
	[0.0176]***	[0.0292]***	[0.0007]	

Table 3. CEO overconfidence, future stock price crash risk, and the crash experience: multivariate test

This table presents the results of baseline regressions. The dependent variables are *NCSKEW* and *DUVOL* as the measures of stock price crash risk. *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *Pre-CRASH experience* indicates that the CEO has no *CRASH experience* during their tenure at the firm that year. *Post-CRASH experience* indicates that the CEO has at least one *CRASH experience* during their tenure at the firm that year. Panel B includes the control variables as in Panel A. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Baseline regressions

	Pre-CRASH experience				Post-CRASH experience			
Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO HOLDER67 (t-1)	0.0441**	0.0134**			0.0242	0.0052		
	(0.017)	(0.005)			(0.019)	(0.006)		
CEO HOLDER100 (t-1)			0.0501***	0.0156***			0.0236	0.0040
			(0.018)	(0.006)			(0.018)	(0.006)
NCSKEW (t-1)	0.0321*	0.0105**	0.0322*	0.0105**	0.0098	0.0025	0.0097	0.0025
	(0.017)	(0.005)	(0.017)	(0.005)	(0.010)	(0.003)	(0.010)	(0.003)
SIZE (t-1)	0.0042	0.0020	0.0044	0.0020	0.0060	0.0006	0.0058	0.0006
	(0.009)	(0.003)	(0.009)	(0.003)	(0.009)	(0.003)	(0.009)	(0.003)
MTB (t-1)	0.0007	0.0004	0.0006	0.0004	0.0025*	0.0008*	0.0025*	0.0008*
	(0.002)	(0.000)	(0.002)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
LEV (t-1)	-0.0834	-0.0265	-0.0825	-0.0262	-0.0007	0.0043	0.0002	0.0044
	(0.066)	(0.019)	(0.066)	(0.019)	(0.051)	(0.017)	(0.051)	(0.017)
ROA (t-1)	0.2414***	0.0826***	0.2391***	0.0818***	0.3291***	0.1003***	0.3293***	0.1006***
	(0.058)	(0.019)	(0.058)	(0.019)	(0.072)	(0.023)	(0.072)	(0.023)
PPE (t-1)	-0.0495	0.0034	-0.0482	0.0038	-0.0679	-0.0207	-0.0673	-0.0206
	(0.058)	(0.018)	(0.058)	(0.018)	(0.060)	(0.019)	(0.060)	(0.019)
RD (t-1)	0.0563	0.0066	0.0503	0.0047	0.0740	-0.0035	0.0745	-0.0031
	(0.162)	(0.047)	(0.161)	(0.047)	(0.182)	(0.054)	(0.182)	(0.054)
INST OWNERSHIP (t-1)	-0.3184	0.9450	-0.3438	0.9336	0.8254	0.7595	0.8555	0.7795

	(2.951)	(0.935)	(2.959)	(0.937)	(2.755)	(0.850)	(2.746)	(0.847)
DTURNOVER (t-1)	0.0120	0.0029	0.0121	0.0029	0.0141	0.0045	0.0141	0.0045
	(0.010)	(0.003)	(0.010)	(0.003)	(0.009)	(0.003)	(0.009)	(0.003)
SIGMA (t-1)	5.8647***	2.0098***	5.8223***	1.9958***	1.9598*	0.8259**	1.9172*	0.8196**
	(1.147)	(0.344)	(1.147)	(0.344)	(1.049)	(0.345)	(1.052)	(0.346)
RET (t-1)	0.6239***	0.1921***	0.6217***	0.1913***	0.2682**	0.0794**	0.2649**	0.0789**
	(0.124)	(0.036)	(0.124)	(0.036)	(0.114)	(0.040)	(0.115)	(0.040)
OPAQUE (t-1)	0.1757**	0.0573***	0.1725**	0.0563***	0.1941***	0.0619***	0.1941***	0.0618***
	(0.069)	(0.021)	(0.069)	(0.021)	(0.072)	(0.022)	(0.072)	(0.022)
OPAQUE SQUARE (t-1)	-0.0740**	-0.0222**	-0.0736**	-0.0221**	-0.1013**	-0.0317**	-0.1015**	-0.0317**
	(0.034)	(0.011)	(0.034)	(0.011)	(0.040)	(0.014)	(0.040)	(0.014)
CEO TOTALPAY (t-1)	0.0307**	0.0077**	0.0309**	0.0077**	0.0277**	0.0101***	0.0282**	0.0102***
	(0.012)	(0.004)	(0.012)	(0.004)	(0.011)	(0.004)	(0.011)	(0.004)
CEO TENURE (t-1)	0.0005	-0.0011	0.0006	-0.0011	0.0005	-0.0037	0.0004	-0.0036
	(0.010)	(0.003)	(0.010)	(0.003)	(0.012)	(0.004)	(0.012)	(0.004)
CEO AGE (t-1)	0.0464	0.0127	0.0449	0.0123	0.0537	0.0193	0.0540	0.0193
	(0.070)	(0.022)	(0.070)	(0.022)	(0.072)	(0.022)	(0.072)	(0.022)
CEO-CHAIRMAN (t-1)	-0.0200	-0.0094*	-0.0189	-0.0090	-0.0431**	-0.0115**	-0.0422**	-0.0113**
	(0.018)	(0.006)	(0.018)	(0.006)	(0.018)	(0.005)	(0.018)	(0.005)
CEO DELTA (t-1)	0.0017	0.0017	0.0010	0.0015	0.0049	0.0026	0.0045	0.0025
	(0.006)	(0.002)	(0.006)	(0.002)	(0.005)	(0.002)	(0.005)	(0.002)
CEO VEGA (t-1)	-0.0046	0.0041	-0.0043	0.0042	-0.0535	-0.0221	-0.0524	-0.0218
	(0.063)	(0.020)	(0.063)	(0.020)	(0.050)	(0.016)	(0.050)	(0.016)
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	9,005	9,005	9,005	9,005	11,399	11,399	11,399	11,399
Adj R2	0.0249	0.0318	0.0251	0.0320	0.0156	0.0187	0.0156	0.0187

Panel B: Baseline regressions with interaction term

Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO HOLDER67 (t-1)	0.0364***	0.0098**			0.0527***	0.0155***		
	(0.013)	(0.004)			(0.016)	(0.005)		
CEO HOLDER100 (t-1)			0.0374***	0.0094**			0.0627***	0.0180***
			(0.013)	(0.004)			(0.016)	(0.005)
POST_CRASH (indicator)					0.0106	0.0025	0.0133	0.0033
					(0.020)	(0.006)	(0.017)	(0.005)
CEO HOLDER67 × POST_CRASH					-0.0385	-0.0132*		
					(0.025)	(0.008)		
CEO HOLDER100 × POST_CRASH							-0.0545**	-0.0184**
							(0.024)	(0.007)
Coefficient test								
CEO HOLDER67 + CEO HOLDER67 × POST_CRASH					0.0142	0.0023		
[*p*-value]					[0.491]	[0.726]		
CEO HOLDER100 + CEO HOLDER100 × POST_CRASH							0.0082	-0.0004
[*p*-value]							[0.675]	[0.948]
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	20,404	20,404	20,404	20,404	20,404	20,404	20,404	20,404
Adj R2	0.0188	0.0235	0.0189	0.0235	0.0189	0.0237	0.0191	0.0238

Table 4. Effect of the crash experience on CEO confidence level

This table presents the results of the effect of the crash experience on CEO confidence level. The dependent variable is *CEO CONFIDENCE*, a continuous measure for CEO confidence level. In Models (3) and (4) of Panel C, the dependent variable is *ΔCEO CONFIDENCE* that equals *CEO CONFIDENCE* at the year *t* minus *CEO CONFIDENCE* at the year *t–1*. *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *Pre-CRASH experience* indicates that the CEO has no *CRASH experience* during their tenure at the firm that year. *Post-CRASH experience* indicates that the CEO has at least one *CRASH experience* during their tenure at the firm that year. *FIRST CRASH* indicates the first year of *CRASH experience* during the CEO's tenure at the firm. *CRASH* is an indicator variable for *CRASH experience*. The control variables are the same as in Table 3 except *NCSKEW*. We exclude firm-year observations that experience the CEO turnover at the year *t*. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The effect of CRASH experience on CEO confidence level

	FIRST CRASH	Subsequent CRASH
Dependent variable	CEO CONFIDENCE	
Model	(1)	(2)
CRASH (t-1)	-0.1418***	-0.0310
	(0.020)	(0.036)
Difference in CRASH (*Chi2*)	5.57**	
Difference in CRASH [*p*-value]	[0.018]	
Control variables	Yes	Yes
Year Fixed Effect	Yes	Yes
Industry Fixed Effect	Yes	Yes
N	12,706	3,819
Adj R2	0.140	0.178

Panel B: The effect of CRASH experience for overconfident CEOs

Dependent variable	CEO CONFIDENCE			
Model	(1)	(2)	(3)	(4)
CRASH (t-1)	-0.1047***	-0.0960***		
	(0.021)	(0.019)		
POST_CRASH (indicator)			0.0077	0.0207
			(0.027)	(0.024)
CEO HOLDER67 (t-1)	0.7449***		0.8751***	
	(0.029)		(0.036)	
CEO HOLDER100 (t-1)		0.8358***		1.0251***
		(0.033)		(0.043)
CEO HOLDER67 × CRASH	-0.0779**			
	(0.037)			
CEO HOLDER100 × CRASH		-0.1200***		
		(0.043)		
CEO HOLDER67 × POST_CRASH			-0.3579***	
			(0.045)	
CEO HOLDER100 × POST_CRASH				-0.4793***
				(0.053)
Control variables	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes
N	16,525	16,525	16,525	16,525
Adj R2	0.189	0.195	0.206	0.215

Panel C: Controlling prior CEO confidence level

Dependent variable	CEO CONFIDENCE		ΔCEO CONFIDENCE	
Model	(1)	(2)	(3)	(4)
CRASH (t-1)	-0.0598***		-0.0484***	
	(0.019)		(0.018)	
POST_CRASH (indicator)		-0.0421**		-0.0352**
		(0.019)		(0.017)
CEO CONFIDENCE (t-1)	0.6102***	0.6099***	-0.3508***	-0.3511***
	(0.020)	(0.020)	(0.017)	(0.018)
Control variables	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes
N	15,977	15,977	15,977	15,977
Adj R2	0.478	0.478	0.234	0.234

Table 5. Effect of the crash experience on the likelihood of CEO turnover

This table presents the results of the effect of the crash experience on the likelihood of CEO turnover. In Panel A, the dependent variable is CEO turnover that equals 1 if the CEO is newly hired at the fiscal year *t*, and 0 otherwise. In Panel B, we classify the CEO turnover types based on a newly hired and a prior CEO's overconfidence. *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *CRASH* is an indicator variable for *CRASH experience*. *Total number of CRASH by prior CEO* is the firm's total number of crash weeks during a prior CEO's tenure at the year *t*–1. All Panels include the control variables (at the year *t–1*) as follows: *SIZE, MTB, LEV, ROA, PPE, RD, INST OWNERSHIP, DTURNOVER, SIGMA, RET, OPAQUE, OPAQUE SQUARE, CEO TENURE, CEO AGE,* and *CEO-CHAIRMAN*. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The effect of CRASH experience on CEO turnover

Dependent variable	CEO turnover	CEO turnover
Model	(1)	(2)
CRASH (t-1)	0.1545***	
	(0.054)	
Total number of CRASH by prior CEO		0.0440**
		(0.020)
Control variables	Yes	Yes
Year Fixed Effect	Yes	Yes
Industry Fixed Effect	Yes	Yes
N	25,766	25,766
Pseudo R2	0.0626	0.0624

Panel B: CEO turnover type based on CEO HOLDER67

Dependent variable	Type 1 (CEO HOLDER67: from 1 to 0)	Type 1 (CEO HOLDER67: from 1 to 0)	Type 2 (CEO HOLDER67: from 0 to 0)	Type 2 (CEO HOLDER67: from 0 to 0)	Type 3 (CEO HOLDER67: from 1 to 1)	Type 3 (CEO HOLDER67: from 1 to 1)	Type 4 (CEO HOLDER67: from 0 to 1)	Type 4 (CEO HOLDER67: from 0 to 1)
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CRASH (t-1)	0.2274**		0.1742**		0.0321		0.1593	
	(0.091)		(0.087)		(0.109)		(0.154)	
Total number of CRASH by prior CEO		0.1546***		-0.0249		0.0132		-0.1437**
		(0.031)		(0.033)		(0.037)		(0.066)

Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	23,859	23,859	23,998	23,998	23,710	23,710	22,851	22,851
Pseudo R2	0.0731	0.0765	0.0734	0.0729	0.102	0.102	0.0694	0.0710

Panel C: CEO turnover type based on CEO HOLDER100

Dependent variable	Type 1 (CEO HOLDER100: from 1 to 0)	Type 1 (CEO HOLDER100: from 1 to 0)	Type 2 (CEO HOLDER100: from 0 to 0)	Type 2 (CEO HOLDER100: from 0 to 0)	Type 3 (CEO HOLDER100: from 1 to 1)	Type 3 (CEO HOLDER100: from 1 to 1)	Type 4 (CEO HOLDER100: from 0 to 1)	Type 4 (CEO HOLDER100: from 0 to 1)
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CRASH (t-1)	0.2732***		0.1446*		0.0565		-0.0175	
	(0.097)		(0.075)		(0.131)		(0.178)	
Total number of CRASH by prior CEO		0.1843***		-0.0214		-0.0132		-0.1132
		(0.033)		(0.028)		(0.046)		(0.072)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	23,666	23,666	24,465	24,465	23,488	23,488	21,501	21,501
Pseudo R2	0.0798	0.0847	0.0642	0.0638	0.112	0.112	0.0720	0.0733

Table 6. Effect of the crash experience on CEO compensation

This table presents the results of the effect of the crash experience on CEO compensation. The dependent variables are *CEO TOTALPAY, SALARY, BONUS, EQUITY, OPTION*, and *STOCK*. *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *CRASH* is an indicator variable for *CRASH experience*. In Panel A, we exclude firm-year observations that experience the CEO turnover at the year *t*. In Panel B, we only account for the sample consists of the CEO turnover at the year *t*, and control for a prior CEO's total pay at the year *t*–1. In Panel A, the control variables are the same as in Table 3 except *NCSKEW*. Panel B includes the control variables (at the year *t–1*) as follows: *SIZE, MTB, LEV, ROA, PPE, RD, INST OWNERSHIP, DTURNOVER, SIGMA, RET, OPAQUE,* and *OPAQUE SQUARE*. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The effect of CRASH experience on CEO compensation (excluding CEO turnover cases)						
Dependent variable	TOTALPAY	SALARY	BONUS	EQUITY	OPTION	STOCK
Model	(1)	(2)	(3)	(4)	(5)	(6)
CRASH (t-1)	-0.0351***	0.0241**	-0.0662	-0.0396	-0.1399**	0.0964*
	(0.012)	(0.010)	(0.046)	(0.047)	(0.061)	(0.053)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	18,481	18,481	18,481	18,481	18,481	18,481
Adj R2	0.620	0.330	0.399	0.264	0.185	0.382

Panel B: The effect of CRASH experience on newly hired CEO compensation						
Dependent variable	TOTALPAY	SALARY	BONUS	EQUITY	OPTION	STOCK
Model	(1)	(2)	(3)	(4)	(5)	(6)
CRASH (t-1)	0.0043	0.0313	0.0168	0.1576	0.0968	0.2996**
	(0.038)	(0.033)	(0.113)	(0.116)	(0.140)	(0.126)
Prior CEO's TOTALPAY	0.2500***	0.0896***	0.1193*	0.5828***	0.3492***	0.4614***
	(0.025)	(0.022)	(0.061)	(0.075)	(0.086)	(0.079)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	3,170	3,170	3,170	3,170	3,170	3,170
Adj R2	0.464	0.242	0.287	0.192	0.183	0.324

Table 7. Executives overconfidence, future stock price crash risk, and the crash experience

This table presents the results for the executive level. The dependent variables are *NCSKEW* and *DUVOL* as the measures of stock price crash risk *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *Pre-CRASH experience* indicates that the CEO has no *CRASH experience* during their tenure at the firm that year. *Post-CRASH experience* indicates that the CEO has at least one *CRASH experience* during their tenure at the firm that year. *CRASH* is an indicator variable for *CRASH experience*. All Panels include the control variables (at the year *t–1*) as follows: *NCSKEW, SIZE, MTB, LEV, ROA, PPE, RD, INST OWNERSHIP, DTURNOVER, SIGMA, RET, OPAQUE,* and *OPAQUE SQUARE*. In addition, each Model includes *TOTALPAY, DELTA,* and *VEGA* of its corresponding executive level (*EXECUTIVES*, *SENIOR*, *JUNIOR, CEO,* or *CFO*). Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: All executives

	Pre-CRASH experience		Post-CRASH experience		Pooled			
Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EXECUTIVES HOLDER67 (t-1)	0.0757***	0.0242***	0.0288	0.0091	0.0542***	0.0168***	0.0928***	0.0292***
	(0.025)	(0.008)	(0.026)	(0.008)	(0.018)	(0.006)	(0.023)	(0.007)
POST_CRASH (indicator)							0.0298*	0.0057
							(0.018)	(0.006)
EXECUTIVES HOLDER67 × POST_CRASH							-0.0902***	-0.0282***
							(0.034)	(0.011)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	10,573	10,573	12,780	12,780	23,353	23,353	23,353	23,353
Adj R2	0.0250	0.0321	0.0160	0.0190	0.0190	0.0238	0.0192	0.0241

Panel B: The effect of senior versus junior executives

	Pre-CRASH experience				Post-CRASH experience			
Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SENIOR HOLDER67 (t-1)	0.0645***	0.0174**	0.0600**	0.0125	0.0362	0.0098	0.0380	0.0077
	(0.022)	(0.007)	(0.026)	(0.008)	(0.022)	(0.007)	(0.026)	(0.008)
JUNIOR HOLDER67 (t-1)			-0.0007	0.0056			-0.0148	-0.0015
			(0.024)	(0.008)			(0.025)	(0.008)

Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	10,513	10,513	9,425	9,425	12,718	12,718	11,209	11,209
Adj R2	0.0253	0.0322	0.0246	0.0317	0.0163	0.0191	0.0171	0.0201

Panel C: The effect of CEO versus CFO versus junior executives

	Pre-CRASH experience				Post-CRASH experience			
Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO HOLDER67 (t-1)			0.0713***	0.0190**			0.0009	-0.0051
			(0.024)	(0.007)			(0.023)	(0.007)
CFO HOLDER67 (t-1)	0.0495**	0.0128*	0.0084	-0.0005	0.0238	0.0081	0.0187	0.0072
	(0.021)	(0.007)	(0.026)	(0.008)	(0.020)	(0.006)	(0.024)	(0.007)
JUNIOR HOLDER67 (t-1)			-0.0263	-0.0016			0.0029	0.0035
			(0.030)	(0.010)			(0.029)	(0.009)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	7,177	7,177	6,216	6,216	10,073	10,073	8,562	8,562
Adj R2	0.0240	0.0316	0.0231	0.0312	0.0178	0.0201	0.0181	0.0200

Table 8. Effect of the crash experience on executives' confidence level

This table presents the results of the effect of the crash experience on executives' confidence level. The dependent variable is *EXECUTIVES CONFIDENCE*, a continuous measure for executives' average confidence level. *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *Pre-CRASH experience* indicates that the CEO has no *CRASH experience* during their tenure at the firm that year. *Post-CRASH experience* indicates that the CEO has at least one *CRASH experience* during their tenure at the firm that year. *FIRST CRASH* indicates the first year of *CRASH experience* during the CEO's tenure at the firm. *CRASH* is an indicator variable for *CRASH experience*. All Panels include the control variables (at the year *t–1*) as follows: *SIZE, MTB, LEV, ROA, PPE, RD, INST OWNERSHIP, DTURNOVER, SIGMA, RET, OPAQUE, OPAQUE SQUARE, EXECUTIVES TOTALPAY, EXECUTIVES DELTA,* and *EXECUTIVES VEGA.* Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The effect of CRASH experience on executives' confidence level

	FIRST CRASH	Subsequent CRASH
Dependent variable	EXECUTIVES CONFIDENCE	
Model	(1)	(2)
CRASH (t-1)	-0.1827***	-0.0946**
	(0.030)	(0.041)
Difference in CRASH (*Chi2*)	3.15*	
Difference in CRASH [*p*-value]	[0.076]	
Control variables	Yes	Yes
Year Fixed Effect	Yes	Yes
Industry Fixed Effect	Yes	Yes
N	17,039	5,086
Adj R2	0.118	0.113

Panel B: The effect of CRASH experience for overconfident executives

Dependent variable	EXECUTIVES CONFIDENCE			
Model	(1)	(2)	(3)	(4)
CRASH (t-1)	-0.0398	-0.0445**		
	(0.026)	(0.023)		
POST_CRASH (indicator)			-0.0069	-0.0042
			(0.031)	(0.027)
EXECUTIVES HOLDER67 (t-1)	1.3910***		1.5446***	
	(0.058)		(0.072)	
EXECUTIVES HOLDER100 (t-1)		1.6766***		1.8919***
		(0.071)		(0.089)
EXECUTIVES HOLDER67 × CRASH	-0.3295***			
	(0.069)			
EXECUTIVES HOLDER100 × CRASH		-0.4248***		
		(0.085)		
EXECUTIVES HOLDER67 × POST_CRASH			-0.4784***	
			(0.097)	
EXECUTIVES HOLDER100 × POST_CRASH				-0.6564***
				(0.120)
Control variables	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes
N	22,125	22,125	22,125	22,125
Adj R2	0.180	0.199	0.183	0.204

Table 9. Effect of the crash experience on executives' compensation

This table presents the results of the effect of the crash experience on executives' compensation. The dependent variables are compensations that are calculated for all executives, senior executives, junior executives in Models (1)–(3), (4)–(6), and (7)–(9), respectively. *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *CRASH* is an indicator variable for *CRASH experience*. All Models include the control variables (at the year *t–1*) as follows: *SIZE, MTB, LEV, ROA, PPE, RD, INST OWNERSHIP, DTURNOVER, SIGMA, RET, OPAQUE,* and *OPAQUE SQUARE.* In addition, each Model includes *TOTALPAY, DELTA,* and *VEGA* of its corresponding executive level (*EXECUTIVES*, *SENIOR,* or *JUNIOR*). Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Executives		ALL			SENIOR			JUNIOR	
Dependent variable	TOTALPAY	OPTION	STOCK	TOTALPAY	OPTION	STOCK	TOTALPAY	OPTION	STOCK
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CRASH (t-1)	-0.0316***	-0.1144**	0.1955***	-0.0240**	-0.1161**	0.1703***	-0.0171	-0.0878*	0.1570***
	(0.008)	(0.053)	(0.052)	(0.009)	(0.053)	(0.051)	(0.012)	(0.051)	(0.049)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	23,162	23,162	23,162	23,039	23,039	23,039	20,130	20,130	20,129
Adj R2	0.735	0.241	0.393	0.700	0.226	0.394	0.584	0.223	0.375

Table 10. Effect of SOX on the relation between CEO overconfidence and future stock price crash risk

This table presents the results of the effect of the Sarbanes-Oxley Act (SOX) on the relation between CEO overconfidence and stock price crash risk. In Panels A and C (B and D), the dependent variable is *NCSKEW* (*DUVOL*) as the measure of stock price crash risk. In Panels A and B, we use *t*-tests and test the difference based on the null hypothesis that the mean difference is equal to zero. *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *Pre-CRASH experience* indicates that the CEO has no *CRASH experience* during their tenure at the firm that year. *Post-CRASH experience* indicates that the CEO has at least one *CRASH experience* during their tenure at the firm that year. We define the fiscal year less than (equal or greater) than 2003 as the pre (post) -SOX period. *SOX* is an indicator variable for the post-SOX period. Panels C and D include the control variables as in Table 3. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Univariate analysis for NCSKEW

	Pre-CRASH experience			Post-CRASH experience		
	Pre-SOX	Post-SOX	Difference ((2)-(1))	Pre-SOX	Post-SOX	Difference ((5)-(4))
Mean	(1)	(2)	(3)	(4)	(5)	(6)
CEO HOLDER67 (t-1) = 0	0.0594	0.0932	0.0338	0.0652	0.1031	0.0379
CEO HOLDER67 (t-1) = 1	0.1828	0.1404	-0.0423**	0.1717	0.1148	-0.0569**
Difference (b/w HOLDER67)	0.1234***	0.0472**		0.1065***	0.0117	

Panel B: Univariate analysis for DUVOL

	Pre-CRASH experience			Post-CRASH experience		
	Pre-SOX	Post-SOX	Difference ((2)-(1))	Pre-SOX	Post-SOX	Difference ((5)-(4))
Mean	(1)	(2)	(3)	(4)	(5)	(6)
CEO HOLDER67 (t-1) = 0	0.0196	0.0289	0.0093	0.0173	0.0305	0.0132
CEO HOLDER67 (t-1) = 1	0.0579	0.0429	-0.0150**	0.0535	0.0295	-0.0240***
Difference (b/w HOLDER67)	0.0383***	0.014**		0.0362***	-0.001	

Panel C: Multivariate analysis for NCSKEW

	Pooled		Pre-CRASH experience		Post-CRASH experience	
Model	(1)	(2)	(3)	(4)	(5)	(6)
CEO HOLDER67 (t-1)	0.0674***		0.0533**		0.0782***	
	(0.017)		(0.023)		(0.027)	
CEO HOLDER100 (t-1)		0.0895***		0.0777***		0.0996***
		(0.018)		(0.024)		(0.028)
SOX (indicator)	0.2383***	0.2461***	0.2674***	0.2781***	0.2275***	0.2326***
	(0.037)	(0.036)	(0.055)	(0.054)	(0.049)	(0.048)

CEO HOLDER67 × SOX	-0.0524**		-0.0188		-0.0794**	
	(0.024)		(0.034)		(0.034)	
CEO HOLDER100 × SOX		-0.0845***		-0.0546		-0.1091***
		(0.024)		(0.034)		(0.034)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	20,404	20,404	9,005	9,005	11,399	11,399
Adj R2	0.0190	0.0194	0.0249	0.0253	0.0159	0.0163

Panel D: Multivariate analysis for DUVOL

	Pooled		Pre-CRASH experience		Post-CRASH experience	
Model	(1)	(2)	(3)	(4)	(5)	(6)
CEO HOLDER67 (t-1)	0.0208***		0.0158**		0.0248***	
	(0.006)		(0.007)		(0.009)	
CEO HOLDER100 (t-1)		0.0279***		0.0263***		0.0286***
		(0.006)		(0.008)		(0.009)
SOX (indicator)	0.0960***	0.0989***	0.1007***	0.1062***	0.0959***	0.0954***
	(0.012)	(0.012)	(0.018)	(0.018)	(0.016)	(0.015)
CEO HOLDER67 × SOX	-0.0185**		-0.0048		-0.0289***	
	(0.007)		(0.011)		(0.011)	
CEO HOLDER100 × SOX		-0.0300***		-0.0212*		-0.0352***
		(0.007)		(0.011)		(0.011)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	20,404	20,404	9,005	9,005	11,399	11,399
Adj R2	0.0237	0.0242	0.0317	0.0323	0.0192	0.0195

Table 11. Additional control variables for corporate governance

This table presents the results of additional tests including corporate governance variables. In Panel A, the dependent variables are *NCSKEW* and *DUVOL* as the measures of stock price crash risk. In Panel B, the dependent variables are CEO turnover indicators. *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *Pre-CRASH experience* indicates that the CEO has no *CRASH experience* during their tenure at the firm that year. *Post-CRASH experience* indicates that the CEO has at least one *CRASH experience* during their tenure at the firm that year. Panel A includes the control variables as in Table 3. Panel B includes the control variables as in Table 5. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Baseline regressions controlling corporate governance

	Pre-CRASH experience		Post-CRASH experience		Pooled	
Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)	(5)	(6)
CEO HOLDER67 (t-1)	0.0791***	0.0207***	-0.0084	-0.0019	0.0594***	0.0162**
	(0.023)	(0.007)	(0.023)	(0.007)	(0.020)	(0.006)
POST_CRASH (indicator)					0.0247	0.0050
					(0.026)	(0.008)
CEO HOLDER67 × POST_CRASH					-0.0627**	-0.0174*
					(0.031)	(0.010)
E-INDEX	0.0139	0.0061**	0.0039	0.0031	0.0083	0.0042**
	(0.011)	(0.003)	(0.009)	(0.003)	(0.007)	(0.002)
BOARD INDEPENDENCE	-0.0650	-0.0058	-0.0711	-0.0323	-0.0550	-0.0167
	(0.085)	(0.026)	(0.078)	(0.023)	(0.058)	(0.017)
BOARD SIZE	-0.0327	-0.0166	-0.1046**	-0.0307**	-0.0827**	-0.0262**
	(0.059)	(0.018)	(0.050)	(0.015)	(0.039)	(0.012)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	5,099	5,099	8,191	8,191	13,290	13,290
Adj R2	0.0200	0.0246	0.0110	0.0139	0.0132	0.0177

Panel B: CEO turnover analysis controlling corporate governance

Dependent variable	CEO turnover	CEO turnover	Type 1 (CEO HOLDER67: from 1 to 0)	Type 1 (CEO HOLDER67: from 1 to 0)	Type 2 (CEO HOLDER67: from 0 to 0)	Type 2 (CEO HOLDER67: from 0 to 0)
Model	(1)	(2)	(3)	(4)	(5)	(6)
CRASH (t-1)	0.1661**		0.2733**		0.1879	
	(0.071)		(0.118)		(0.125)	
Total number of CRASH by prior CEO		0.0267		0.1149***		-0.0140
		(0.026)		(0.040)		(0.046)
E-INDEX	0.0293	0.0281	0.1119**	0.1067**	-0.0546	-0.0539
	(0.029)	(0.029)	(0.051)	(0.051)	(0.050)	(0.050)
BOARD INDEPENDENCE	0.4015	0.4066	1.2035***	1.2098***	1.0044**	1.0149**
	(0.247)	(0.248)	(0.465)	(0.468)	(0.407)	(0.408)
BOARD SIZE	0.1404	0.1419	-0.6207**	-0.6367**	0.3688	0.3751
	(0.164)	(0.164)	(0.279)	(0.280)	(0.296)	(0.296)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	14,277	14,277	13,101	13,101	12,949	12,949
Pseudo R2	0.0756	0.0751	0.0873	0.0880	0.0919	0.0913

Table 12. Alternative fixed effects

This table presents the re-estimation of our previous results with alternative fixed effects. We replace the industry fixed effects based on Standard Industrial Classification (SIC) 2-digit with the firm or the firm-CEO fixed effects. Panels A, B, C, and D follow our previous Tables 3, 4, 5, and 6. Panels A and D include the control variables as in Table 3. Panel B includes the control variables as in Table 4. Panel C includes the control variables as in Table 5. In Panels B and D, we exclude firm-year observations that experience the CEO turnover at the year *t*. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Baseline regressions						
Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)	(5)	(6)
POST_CRASH (indicator)	-0.1252***	-0.0298***	-0.1288***	-0.0319***	-0.3004***	-0.0770***
	(0.027)	(0.008)	(0.023)	(0.007)	(0.023)	(0.007)
CEO HOLDER67 (t-1)	0.0985***	0.0279***				
	(0.023)	(0.007)				
CEO HOLDER100 (t-1)			0.1270***	0.0355***		
			(0.025)	(0.008)		
CEO HOLDER67 × POST_CRASH	-0.0689**	-0.0241**				
	(0.032)	(0.010)				
CEO HOLDER100 × POST_CRASH			-0.0836***	-0.0272***		
			(0.031)	(0.010)		
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effect	Firm	Firm	Firm	Firm	Firm-CEO	Firm-CEO
N	20,404	20,404	20,404	20,404	20,404	20,404
Adj R2	0.0588	0.0559	0.0594	0.0563	0.0930	0.0818

Panel B: The effect of CRASH experience on CEO confidence level						
Dependent variable	CEO CONFIDENCE					
Model	(1)	(2)	(3)	(4)	(5)	(6)
CRASH (t-1)	-0.0493*	-0.0333			-0.0456**	
	(0.026)	(0.022)			(0.023)	
POST_CRASH (indicator)			0.0094	0.0346		-0.0615*
			(0.036)	(0.032)		(0.032)
CEO HOLDER67 (t-1)	0.6614***		0.7383***			
	(0.045)		(0.048)			

CEO HOLDER100 (t-1)		0.7623***		0.8974***		
		(0.050)		(0.056)		
CEO HOLDER67 × CRASH	-0.0679*					
	(0.039)					
CEO HOLDER100 × CRASH		-0.1200***				
		(0.043)				
CEO HOLDER67 × POST_CRASH			-0.2468***			
			(0.057)			
CEO HOLDER100 × POST_CRASH				-0.3867***		
				(0.064)		
CEO CONFIDENCE (t-1)					0.3487***	0.3483***
					(0.031)	(0.031)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effect	Firm	Firm	Firm	Firm	Firm-CEO	Firm-CEO
N	16,525	16,525	16,525	16,525	15,977	15,977
Adj R2	0.417	0.422	0.419	0.426	0.548	0.548

Panel C: The effect of CRASH experience on CEO turnover

Dependent variable	CEO turnover	CEO turnover	Type 1 (CEO HOLDER67: from 1 to 0)	Type 1 (CEO HOLDER67: from 1 to 0)	Type 2 (CEO HOLDER67: from 0 to 0)	Type 2 (CEO HOLDER67: from 0 to 0)
Model	(1)	(2)	(3)	(4)	(5)	(6)
CRASH (t-1)	0.1253**		0.1707		0.1798*	
	(0.059)		(0.106)		(0.094)	
Total number of CRASH by prior CEO		0.1879***		0.5323***		0.0999*
		(0.030)		(0.064)		(0.051)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effect	Firm	Firm	Firm	Firm	Firm	Firm
N	18,886	18,886	8,543	8,543	8,118	8,118
Pseudo R2	0.181	0.184	0.270	0.293	0.132	0.132

Panel D: The effect of CRASH experience on CEO compensation

Dependent variable	TOTALPAY	SALARY	BONUS	EQUITY	OPTION	STOCK
Model	(1)	(2)	(3)	(4)	(5)	(6)
CRASH (t-1)	-0.0374***	0.0107	0.0168	-0.0488	-0.1429**	0.0067
	(0.013)	(0.009)	(0.047)	(0.047)	(0.058)	(0.051)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effect	Firm	Firm	Firm	Firm	Firm	Firm
N	18,481	18,481	18,481	18,481	18,481	18,481
Adj R2	0.698	0.610	0.559	0.403	0.398	0.545

Table 13. Effect of the firm's negative performance

This table presents the results of the effect of the firm's negative return on assets. Panels A, B, and C follow our previous Tables 4, 5, and 6, including an indicator variable for negative ROA firm-years and its interaction terms. Panels A and C include the control variables as in Table 3. Panel B includes the control variables as in Table 5. In Panels A and C, we exclude firm-year observations that experience the CEO turnover at the year *t*. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The effect of negative return on CEO confidence level

	Pooled		CEO HOLDER67 (t-1) = 1		CEO HOLDER67 (t-1) = 0	
Dependent variable			CEO CONFIDENCE			
Model	(1)	(2)	(3)	(4)	(5)	(6)
CRASH (t-1)	-0.0578**		-0.0625**		-0.0597***	
	(0.022)		(0.032)		(0.015)	
POST_CRASH (indicator)		-0.0408*		-0.0734**		0.0101
		(0.021)		(0.031)		(0.018)
Negative ROA firms (t-1)	-0.1067***	-0.1088***	-0.1048**	-0.0867	-0.0768***	-0.0824***
	(0.028)	(0.031)	(0.050)	(0.062)	(0.027)	(0.026)
Negative ROA firms × CRASH	-0.0239		-0.0706		0.0129	
	(0.038)		(0.065)		(0.027)	
Negative ROA firms × POST_CRASH		-0.0005		-0.0560		0.0295
		(0.037)		(0.065)		(0.038)
CEO CONFIDENCE (t-1)	0.6079***	0.6078***	0.5905***	0.5891***	0.1749***	0.1786***
	(0.020)	(0.020)	(0.022)	(0.022)	(0.042)	(0.042)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	15,977	15,977	10,253	10,253	5,724	5,724
Adj R2	0.479	0.479	0.465	0.465	0.083	0.081

Panel B: The effect of negative return on CEO turnover

Dependent variable	CEO turnover	CEO turnover	Type 1 (CEO HOLDER67: from 1 to 0)	Type 1 (CEO HOLDER67: from 1 to 0)	Type 4 (CEO HOLDER67: from 0 to 1)	Type 4 (CEO HOLDER67: from 0 to 1)

Model	(1)	(2)	(3)	(4)	(5)	(6)
CRASH (t-1)	0.1345**		0.2969***		0.1183	
	(0.062)		(0.105)		(0.184)	
Total number of CRASH by prior CEO		0.0401*		0.1351***		-0.1431**
		(0.022)		(0.033)		(0.073)
Negative ROA firms (t-1)	0.4382***	0.4564***	0.7335***	0.5639***	0.2692	0.3348
	(0.081)	(0.086)	(0.125)	(0.140)	(0.226)	(0.228)
Negative ROA firms × CRASH	0.1089		-0.1734		0.1689	
	(0.117)		(0.192)		(0.356)	
Negative ROA firms × Total number of CRASH by prior CEO		0.0037		0.0569		-0.0117
		(0.037)		(0.051)		(0.123)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	25,766	25,766	23,859	23,859	22,851	22,851
Pseudo R2	0.0659	0.0655	0.0793	0.0823	0.0705	0.0721

Panel C: The effect of negative return on CEO compensation

Dependent variable	TOTALPAY	SALARY	BONUS	EQUITY	OPTION	STOCK
Model	(1)	(2)	(3)	(4)	(5)	(6)
CRASH (t-1)	-0.0285**	0.0278**	-0.0940*	-0.0161	-0.1271*	0.1162**
	(0.013)	(0.011)	(0.050)	(0.050)	(0.067)	(0.058)
Negative ROA firms (t-1)	-0.0558***	-0.0105	-0.3806***	-0.2514***	-0.1118	-0.1495*
	(0.021)	(0.023)	(0.078)	(0.081)	(0.095)	(0.085)
Negative ROA firms × CRASH	-0.0412	-0.0210	0.1152	-0.1508	-0.0797	-0.1215
	(0.037)	(0.029)	(0.121)	(0.131)	(0.151)	(0.129)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	18,481	18,481	18,481	18,481	18,481	18,481
Adj R2	0.641	0.345	0.413	0.276	0.189	0.387

Table 14. Stock price jump experience

This table presents the results for the stock price jump experience. *JUMP experience* indicates at least one jump week during the fiscal year, where we define jump weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations above its annual average returns. *Pre-JUMP experience* indicates that the CEO has no *JUMP experience* during their tenure at the firm that year. *Post-JUMP experience* indicates that the CEO has at least one *JUMP experience* during their tenure at the firm that year. In Panel A, the dependent variable is an indicator variable for *JUMP experience*. In Panel B, the dependent variables are *NCSKEW* and *DUVOL* as the measures of stock price crash risk. In Panel C, the dependent variable is *CEO CONFIDENCE.* Panels A and C include the control variables as in Table 3 except *NCSKEW*. Panel B includes the control variables as in Table 3. In Panel C, we exclude firm-year observations that experience the CEO turnover at the year *t*. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The effect of overconfident CEO on stock price jump

Dependent variable	JUMP	
Model	(1)	(2)
CEO HOLDER67 (t-1)	-0.0537	
	(0.060)	
CEO HOLDER100 (t-1)		-0.0587
		(0.058)
Control variables	Yes	Yes
Year Fixed Effect	Yes	Yes
Industry Fixed Effect	Yes	Yes
N	21,326	21,326
Pseudo R2	0.506	0.506

Panel B: The effect of JUMP experience on future stock price crash risk

	Pre-JUMP experience		Post-JUMP experience		Pooled			
Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO HOLDER67 (t-1)	0.0343**	0.0106**	0.0438**	0.0109*	0.0284*	0.0088*		
	(0.016)	(0.005)	(0.021)	(0.006)	(0.015)	(0.005)		
CEO HOLDER100 (t-1)							0.0353**	0.0102**
							(0.015)	(0.005)
POST_JUMP (indicator)					-0.0701***	-0.0217***	-0.0525***	-0.0172***
					(0.022)	(0.007)	(0.018)	(0.006)
CEO HOLDER67 × POST_JUMP					0.0310	0.0050		
					(0.026)	(0.008)		
CEO HOLDER100 × POST_JUMP							0.0070	-0.0020
							(0.025)	(0.008)

Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	11,531	11,531	8,873	8,873	20,404	20,404	20,404	20,404
Adj R2	0.0202	0.0240	0.0167	0.0231	0.0195	0.0243	0.0194	0.0243

Panel C: The effect of JUMP experience on CEO confidence level

Dependent variable				CEO CONFIDENCE				
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
JUMP (t-1)	0.0164	-0.0050			0.0422*	0.0315		
	(0.027)	(0.028)			(0.022)	(0.023)		
CRASH (t-1)		-0.1054***				-0.0548***		
		(0.022)				(0.020)		
POST_JUMP (indicator)			0.0181	-0.0253			0.0141	0.0180
			(0.028)	(0.028)			(0.020)	(0.019)
POST_CRASH (indicator)				0.0066				-0.0436**
				(0.026)				(0.019)
CEO HOLDER67 (t-1)	0.7260***	0.7430***	0.7699***	0.8814***				
	(0.029)	(0.031)	(0.032)	(0.037)				
CEO HOLDER67 × JUMP	0.0234	0.0102						
	(0.049)	(0.049)						
CEO HOLDER67 × CRASH		-0.0766**						
		(0.037)						
CEO HOLDER67 × POST_JUMP			-0.1273**	-0.0268				
			(0.049)	(0.050)				
CEO HOLDER67 × POST_CRASH				-0.3499***				
				(0.046)				
CEO CONFIDENCE (t-1)					0.6113***	0.6104***	0.6112***	0.6100***
					(0.020)	(0.020)	(0.020)	(0.020)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	16,525	16,525	16,525	16,525	15,977	15,977	15,977	15,977
Adj R2	0.187	0.189	0.188	0.195	0.478	0.479	0.478	0.478

Table 15. Robustness test using alternative criteria of the crash experience

This table presents the results of robustness test with alternative cutoff criteria for the crash experience. *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.09, 3.50, and 4.00 standard deviations below its annual average returns, in Panels A, B, and C, respectively. All our previous results are based on 3.20 standard deviation. Control variables that are the same as in Table 3, and year and industry fixed effects are included. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: CRASH cutoff criterion = 3.09 standard deviation								
	Pre-CRASH experience				Post-CRASH experience			
Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO HOLDER67 (t-1)	0.0506***	0.0150***			0.0214	0.0043		
	(0.019)	(0.006)			(0.018)	(0.005)		
CEO HOLDER100 (t-1)			0.0459**	0.0151**			0.0282*	0.0047
			(0.019)	(0.006)			(0.017)	(0.005)
N	8,009	8,009	8,009	8,009	12,395	12,395	12,395	12,395
Adj R2	0.0272	0.0328	0.0270	0.0327	0.0160	0.0198	0.0161	0.0198
Panel B: CRASH cutoff criterion = 3.50 standard deviation								
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO HOLDER67 (t-1)	0.0432***	0.0131***			0.0154	0.0011		
	(0.015)	(0.005)			(0.023)	(0.007)		
CEO HOLDER100 (t-1)			0.0478***	0.0154***			0.0137	-0.0015
			(0.016)	(0.005)			(0.022)	(0.007)
N	11,804	11,804	11,804	11,804	8,600	8,600	8,600	8,600
Adj R2	0.0214	0.0273	0.0215	0.0275	0.0162	0.0199	0.0162	0.0199
Panel C: CRASH cutoff criterion = 4.00 standard deviation								
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO HOLDER67 (t-1)	0.0460***	0.0133***			-0.0094	-0.0052		
	(0.014)	(0.004)			(0.032)	(0.010)		
CEO HOLDER100 (t-1)			0.0470***	0.0128***			-0.0059	-0.0039
			(0.014)	(0.004)			(0.030)	(0.009)
N	15,481	15,481	15,481	15,481	4,923	4,923	4,923	4,923
Adj R2	0.0226	0.0288	0.0226	0.0288	0.0121	0.0148	0.0121	0.0148

Table 16. Robustness test using media-based measures

This table presents the results of robustness test with alternative CEO overconfidence measures. The dependent variables are *NCSKEW* and *DUVOL* as the measures of stock price crash risk. Control variables are the same as in Table 3. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Confident CEO indicator following Hirshleifer et al. (2012)				
Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)
Confident CEO (t-1)	0.0189	0.0182**	0.0037	0.0147
	(0.028)	(0.009)	(0.043)	(0.013)
POST_CRASH (indicator)	0.0686**	0.0211**	-0.0933**	-0.0193
	(0.030)	(0.009)	(0.045)	(0.014)
Confident CEO × POST_CRASH	-0.0712*	-0.0294**	-0.0684	-0.0319*
	(0.040)	(0.012)	(0.058)	(0.018)
Control variables	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Fixed Effect	Industry	Industry	Firm	Firm
N	6,683	6,683	6,683	6,683
Adj R2	0.0115	0.0149	0.0634	0.0551
Panel B: Media-based indicator measure				
Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)
Confident news indicator (t-1)	0.0394	0.0191**	-0.0003	0.0062
	(0.029)	(0.009)	(0.033)	(0.010)
POST_CRASH (indicator)	0.0642**	0.0168**	-0.1127***	-0.0294**
	(0.025)	(0.008)	(0.038)	(0.012)
Confident news indicator × POST_CRASH	-0.1168***	-0.0386***	-0.0477	-0.0188
	(0.041)	(0.013)	(0.048)	(0.015)
Control variables	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Fixed Effect	Industry	Industry	Firm	Firm
N	6,683	6,683	6,683	6,683
Adj R2	0.0121	0.0152	0.0632	0.0547
Panel C: Media-based continuous measure				
Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)
Net news ratio (t-1)	0.0321	0.0150	0.0253	0.0167
	(0.050)	(0.015)	(0.066)	(0.020)
POST_CRASH (indicator)	0.0089	-0.0000	-0.1166***	-0.0343***
	(0.025)	(0.008)	(0.038)	(0.012)
Net news ratio × POST_CRASH	-0.1387**	-0.0457**	-0.1464	-0.0568**
	(0.069)	(0.021)	(0.093)	(0.029)
Control variables	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Fixed Effect	Industry	Industry	Firm	Firm
N	5,198	5,198	5,198	5,198
Adj R2	0.0158	0.0180	0.0521	0.0487

Table 17. CEO overconfidence, investment, and the value of investment: effect of the crash experience

This table presents the results of the effect of the crash experience on the relation between CEO overconfidence and corporate investment (Panel A), and the value of investment (Panel B). *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *Pre-CRASH experience* indicates that the CEO has no *CRASH experience* during their tenure at the firm that year. *Post-CRASH experience* indicates that the CEO has at least one *CRASH experience* during their tenure at the firm that year. Control variables are the same as in Table 3. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Dependent variable = CAPEX (t) / PPENT (t-1)

Model	Pre-CRASH experience (1)	Post-CRASH experience (2)	Pooled (3)	Pooled (4)
CEO HOLDER67 (t-1)	0.0450***	0.0249***	0.0482***	0.0352***
	(0.008)	(0.007)	(0.007)	(0.009)
POST_CRASH (indicator)			-0.0056	-0.0031
			(0.008)	(0.009)
CEO HOLDER67 × POST_CRASH			-0.0314***	-0.0184*
			(0.010)	(0.010)
Control variables	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Fixed Effect	Industry	Industry	Industry	Firm
N	9,054	11,461	20,515	20,515
Adj R2	0.220	0.180	0.194	0.326

Panel B: Dependent variable = Industry adjusted Tobin's Q (t)

Model	Pre-CRASH experience (1)	Post-CRASH experience (2)	Pooled (3)	Pooled (4)
CEO HOLDER67 (t-1)	2.5600**	1.0496	2.8165***	1.8898
	(1.029)	(1.220)	(0.960)	(1.488)
CAPEX (t-1) / SALES (t-1)	6.0318**	-3.0219	5.9953**	5.6183
	(2.958)	(9.213)	(2.817)	(3.812)
CEO HOLDER67 × CAPEX / SALES	-8.4471**	6.0791	-9.1528**	-3.8940
	(3.528)	(8.832)	(3.577)	(5.026)
POST_CRASH (indicator)			1.1812	1.1119
			(1.411)	(1.756)
CEO HOLDER67 × CAPEX / SALES × POST_CRASH			23.4100*	26.8929*
			(12.529)	(15.396)
CEO HOLDER67 × POST_CRASH			-2.5829	-2.5642
			(1.704)	(2.152)
CAPEX / SALES × POST_CRASH			-14.6022	-15.7296
			(11.689)	(13.890)
Control variables	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Fixed Effect	Industry	Industry	Industry	Firm
N	9,041	11,444	20,485	20,485
Adj R2	0.270	0.311	0.293	0.287

Appendix A. Variables definitions

Stock price crash risk measures

NCSKEW: Negative skewness of the firm's (weekly) returns over the fiscal year.

DUVOL: Natural logarithm of the ratio of the standard deviation of the firm's (weekly) returns for down weeks to the standard deviation of the firm's (weekly) returns for up weeks. We define down and up weeks as all the weeks with the firm's (weekly) returns below and above its annual average returns, respectively.

Stock price crash experience variables (indicators)

CRASH: Indicator variable that equals 1 for a firm-year observation that experiences at least one crash week during the fiscal year and 0 otherwise. We define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns.

FIRST CRASH: Indicator variable that equals 1 for the CEO's first year of crash experience (at least one crash week) during their tenure at the firm and 0 otherwise.

POST_CRASH: Indicator variable that equals 1 for the CEO after their first crash experience at the firm and 0 otherwise.

CEO and executives variables

CEO HOLDER67: Indicator variable that equals 1 from the first time the CEO holds vested options that are at least 67% in the money, and if such CEO does so at least twice during our sample period.

CEO HOLDER100: Indicator variable that equals 1 from the first time the CEO holds vested options that are at least 100% in the money, and if such CEO does so at least twice during our sample period.

CEO CONFIDENCE: Ratio of the CEO's average value per vested option to the average exercise price of the options.

CEO TENURE: Natural logarithm of one plus the CEO's tenure (year-based).

CEO AGE: Natural logarithm of the CEO's age.

CEO-CHAIRMAN: Indicator variable that equals 1 if the CEO is the chair of the firm's board of directors and 0 otherwise.

CEO TOTALPAY: Natural logarithm of one plus the CEO's total compensation (*tdc1* in ExecuComp).

CEO SALARY: Natural logarithm of one plus the CEO's salary.

CEO BONUS: Natural logarithm of one plus the CEO's bonus.

CEO EQUITY: Natural logarithm of one plus the CEO's total value of stock and option awards.

CEO OPTION: Natural logarithm of one plus the CEO's value of option awards.

CEO STOCK: Natural logarithm of one plus the CEO's value of stock awards.

CEO DELTA: Sensitivity of CEO's granted stock and option value (in millions $) for the firm's stock price.

CEO VEGA: Sensitivity of CEO's option value (in millions $) for the firm's stock return volatility.

EXECUTIVES HOLDER67: Average HOLDER67 measures for all executives.

SENIOR HOLDER67: Average HOLDER67 measures for all senior executives. Following Banerjee et al. (2018), we define senior executives as executives with the title in ExecuComp of chief executive officer (CEO), chief financial officer (CFO), chief operating officer (COO), president, chairman, and any executives whose title includes the word "chief".

JUNIOR HOLDER67: Average HOLDER67 measures for all junior executives. Following Banerjee et al. (2018), we define junior executives as any non-senior executives.

CFO HOLDER67: HOLDER67 measure for the CFO (if there are two or more CFOs at the firm, we calculate the average value). We first define CFO as executives using *Annual CFO Flag* variable in Execucomp. Additionally, we account executives as CFO if they have the title in Execucomp as follows: CFO, chief financial (or finance) officer, chief financial (or finance) advisor, treasurer, and VP-finance.

EXECUTIVES CONFIDENCE: Average CONFIDENCE for all executives.

EXECUTIVES TOTALPAY: Natural logarithm of one plus the sum of all executives' total compensations.

EXECUTIVES SALARY: Natural logarithm of one plus the sum of all executives' salaries.

EXECUTIVES BONUS: Natural logarithm of one plus the sum of all executives' bonuses.

EXECUTIVES EQUITY: Natural logarithm of one plus the sum of all executives' total value of stock and option awards.

EXECUTIVES OPTION: Natural logarithm of one plus the sum of all executives' value of option awards.

EXECUTIVES STOCK: Natural logarithm of one plus the sum of all executives' value of stock awards.

EXECUTIVES DELTA: Average DELTA measures for all executives.

EXECUTIVES VEGA: Average VEGA measures for all executives.

CEO turnover variables

CEO TURNOVER: Indicator variable that equals 1 if the CEO is newly hired at the fiscal year *t*, and 0 otherwise.

Type 1 (CEO HOLDER67 or 100: from 1 to 0): Indicator variable that equals 1 if the CEO is newly hired at the fiscal year *t* and a newly hired CEO is not HOLDER67 or 100, while a prior CEO (at *t–1*) is HOLDER67 or 100, and 0 for observations with no CEO turnover (i.e., other types of CEO turnover are excluded).

Type 2 (CEO HOLDER67 or 100: from 0 to 0): Indicator variable that equals 1 if the CEO is newly hired at the fiscal year *t* and both a newly hired CEO and a prior CEO (at *t–1*) are not HOLDER67 or 100, and 0 for observations with no CEO turnover (i.e., other types of CEO turnover are excluded).

Type 3 (CEO HOLDER67 or 100: from 1 to 1): Indicator variable that equals 1 if the CEO is newly hired at the fiscal year *t* and both a newly hired CEO and a prior CEO (at *t–1*) are HOLDER67 or 100, and 0 for observations with no CEO turnover (i.e., other types of CEO turnover are excluded).

Type 4 (CEO HOLDER67 or 100: from 0 to 1): Indicator variable that equals 1 if the CEO is newly hired at the fiscal year *t* and a newly hired CEO is HOLDER67 or 100, while a prior CEO (at *t–1*) is not HOLDER67 or 100, and 0 for observations with no CEO turnover (i.e., other types of CEO turnover are excluded).

Total number of CRASH by prior CEO: Total number of the crash weeks during a prior CEO's tenure period at the firm.

Firm variables

SIZE: Natural logarithm of the firm's total assets.

MTB: Ratio of the firm's market value of equity to book value of equity.

LEV: Ratio of the firm's total long-term debt to total assets.

ROA: Ratio of the firm's net income to total assets.

PPE: Ratio of the firm's property, plant, and equipment to total assets.

RD: Ratio of the firm's research and development expense to total assets.

INST OWNERSHIP: Aggregated ownership that institutional investors hold. This data is obtained from Thomson 13-F filings.

DTURNOVER: Average monthly share turnover over the fiscal year minus average monthly share turnover over the previous fiscal year, where monthly share turnover is the ratio of monthly trading volume to the total number of outstanding shares during the month.

SIGMA: Standard deviation of the firm's (weekly) returns in the fiscal year.

RET: Percentage of the firm's average (weekly) returns in the fiscal year.

OPAQUE: Last three years' moving sum of the absolute value of discretionary accruals (Hutton, Marcus and Tehranian, 2009; Kim, Wang and Zhang, 2016).

OPAQUE SQUARE: Square term of OPAQUE.

SOX: Indicator variable that equals 1 if the fiscal year is equal or greater than 2003 and 0 otherwise.

Variables in additional analysis (Section 5)

E-INDEX: Firm-level corporate governance index (six anti-takeover provisions) of Bebchuk, Cohen and Ferrell (2009).

BOARD INDEPENDENCE: Ratio of the firm's number of independent directors to the total number of directors.

BOARD SIZE: Natural logarithm of the firm's total number of directors.

Negative ROA firms: Indicator variable that equals 1 if a firm-year observation has negative ROA and 0 otherwise.

JUMP: Indicator variable that equals 1 for a firm-year observation that experiences at least one jump week during the fiscal year and 0 otherwise. We define jump weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations above its annual average returns.

POST_JUMP: Indicator variable that equals 1 for the CEO who had at least one jump experience during their tenure at the firm and 0 otherwise.

Confident CEO (media-based): Indicator variable that equals 1 if the CEO's cumulative number of confident news is greater than the number of cumulative pessimism news and 0 otherwise, following Hirshleifer, Low and Teoh (2012).

Confident news indicator: Indicator variable that equals 1 if a firm-year observation's number of confident news is greater than the number of pessimism news during the fiscal year and 0 otherwise.

Net news ratio: Ratio of the difference between the number of confident and pessimistic news to the total number of news.

Industry adjusted Tobin's Q: Tobin's Q minus the annual average Tobin's Q within an industry, where Tobin's Q is the firm's total assets plus the market value of equity minus book value of equity scaled by total assets.

Appendix B. Appendix Tables

Appendix Table B.1. Additional sample summary

This table presents summary statistics for the sample that available to calculate the stock price crash risk. CEO NON_HOLDER67 indicates CEOs with zero value of CEO HOLDER67 (i.e., non-overconfident CEOs).

Panel A: Distribution of CRASH

Year	N	# CEO HOLDER67	# CRASH	# CRASH by CEO HOLDER67	% CRASH by CEO HOLDER67
1993	711	242	113	40	35.40%
1994	957	370	146	60	41.10%
1995	1,042	468	173	70	40.46%
1996	1,098	549	190	88	46.32%
1997	1,111	615	206	109	52.91%
1998	1,143	673	196	117	59.69%
1999	1,199	711	215	139	64.65%
2000	1,186	733	285	186	65.26%
2001	1,139	699	275	167	60.73%
2002	1,156	695	262	159	60.69%
2003	1,203	753	260	171	65.77%
2004	1,204	783	268	174	64.93%
2005	1,193	782	290	178	61.38%
2006	1,221	790	320	199	62.19%
2007	1,364	791	347	197	56.77%
2008	1,351	750	358	193	53.91%
2009	1,340	737	276	155	56.16%
2010	1,337	771	273	152	55.68%
2011	1,322	768	271	155	57.20%
2012	1,300	760	349	209	59.89%
2013	1,271	779	329	200	60.79%
2014	1,257	775	342	196	57.31%
2015	1,215	718	335	205	61.19%
Total	27,320	15,712	6,079	3,519	57.89%

Panel B: CEO distribution with CRASH experience

Year	N	# CEO HOLDER67	% post-CRASH CEOs among HOLDER67	# CEO NON_HOLDER67	% post-CRASH CEOs among NON_HOLDER67
1993	711	242	3.31%	469	3.41%
1994	957	370	12.16%	587	11.75%
1995	1,042	468	19.66%	574	17.42%
1996	1,098	549	25.32%	549	25.87%
1997	1,111	615	28.94%	496	31.45%
1998	1,143	673	33.58%	470	31.91%
1999	1,199	711	35.58%	488	32.79%
2000	1,186	733	38.47%	453	29.80%
2001	1,139	699	47.35%	440	30.91%
2002	1,156	695	53.96%	461	35.36%

2003	1,203	753	53.65%	450	36.22%
2004	1,204	783	54.02%	421	40.14%
2005	1,193	782	52.56%	411	36.98%
2006	1,221	790	53.29%	431	37.82%
2007	1,364	791	53.98%	573	30.19%
2008	1,351	750	58.00%	601	35.77%
2009	1,340	737	62.82%	603	42.79%
2010	1,337	771	63.42%	566	45.94%
2011	1,322	768	64.06%	554	46.21%
2012	1,300	760	64.47%	540	47.78%
2013	1,271	779	66.62%	492	47.97%
2014	1,257	775	67.74%	482	46.68%
2015	1,215	718	69.36%	497	43.06%
Total	27,320	15,712	50.45%	11,608	34.19%

Appendix Table B.2. Correlation matrix

This table presents the correlation matrix between stock price crash risk measures, crash experience indicator, and overconfident CEOs. *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *Pre-CRASH experience* indicates that the CEO has no *CRASH experience* during their tenure at the firm that year. *Post-CRASH* experience indicates that the CEO has at least one *CRASH experience* during their tenure at the firm that year. *CRASH* is an indicator variable for *CRASH experience*. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Variables	CRASH	NCSKEW	DUVOL	CEO HOLDER67 (t-1)	CEO HOLDER100 (t-1)
Panel A: Pooled					
CRASH	1.0000				
NCSKEW	0.6569***	1.0000			
DUVOL	0.5328***	0.8961***	1.0000		
CEO HOLDER67 (t-1)	0.0228***	0.0384***	0.0345***	1.0000	
CEO HOLDER100 (t-1)	0.0329***	0.0431***	0.0383***	0.7737***	1.0000
Panel B: Pre-CRASH experience					
CRASH	1.0000				
NCSKEW	0.6423***	1.0000			
DUVOL	0.5087***	0.8898***	1.0000		
CEO HOLDER67 (t-1)	0.0247**	0.0526***	0.0530***	1.0000	
CEO HOLDER100 (t-1)	0.0363***	0.0588***	0.0599***	0.7700***	1.0000
Panel C: Post-CRASH experience					
CRASH	1.0000				
NCSKEW	0.6679***	1.0000			
DUVOL	0.5510***	0.9008***	1.0000		
CEO HOLDER67 (t-1)	0.0125	0.0283***	0.0217**	1.0000	
CEO HOLDER100 (t-1)	0.0218**	0.0326***	0.0242***	0.07707***	1.0000

Appendix Table B.3. CEO overconfidence, likelihood of future stock price crash, and the crash experience

This table presents the results of likelihood of future stock price crash. *CRASH experience* indicates at least one crash week during the fiscal year, where we define crash weeks as those weeks during which the firm experiences its (weekly) returns 3.20 standard deviations below its annual average returns. *Pre-CRASH experience* indicates that the CEO has no *CRASH experience* during their tenure at the firm that year. *Post-CRASH* experience indicates that the CEO has at least one *CRASH experience* during their tenure at the firm that year. *CRASH* is an indicator variable for *CRASH experience*. The dependent variable is *CRASH*, and we perform linear probability model (LPM) and logit regressions in Models (1)–(4) and (5)–(8), respectively. Variables definitions are in Appendix A. The robust standard errors adjusted for heteroscedasticity and clustered by firm level are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	LPM				Logit			
Dependent variable	CRASH							
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO HOLDER67 (t-1)	0.0093	0.0228**			0.0591	0.1625**		
	(0.008)	(0.011)			(0.049)	(0.066)		
CEO HOLDER100 (t-1)			0.0192**	0.0393***			0.1148**	0.2687***
			(0.008)	(0.012)			(0.049)	(0.069)
POST_CRASH (indicator)	0.0178*	-0.0917***	0.0185**	-0.0946***	0.1075*	-0.5431***	0.1119**	-0.5628***
	(0.011)	(0.014)	(0.009)	(0.012)	(0.061)	(0.071)	(0.053)	(0.064)
CEO HOLDER67 × POST_CRASH	-0.0109	-0.0275*			-0.0718	-0.1861**		
	(0.013)	(0.016)			(0.074)	(0.084)		
CEO HOLDER100 × POST_CRASH			-0.0159	-0.0305*			-0.1017	-0.2048**
			(0.012)	(0.016)			(0.070)	(0.083)
NCSKEW (t-1)	0.0064*	-0.0338***	0.0063	-0.0339***	0.0329	-0.1874***	0.0326	-0.1883***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.021)	(0.023)	(0.021)	(0.023)
SIZE (t-1)	-0.0029	0.0549***	-0.0027	0.0542***	-0.0139	0.3631***	-0.0130	0.3619***
	(0.003)	(0.009)	(0.003)	(0.009)	(0.020)	(0.052)	(0.020)	(0.052)
MTB (t-1)	0.0005	0.0009	0.0004	0.0008	0.0022	0.0049	0.0020	0.0045
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)
LEV (t-1)	0.0044	-0.0196	0.0049	-0.0172	0.0292	-0.1527	0.0318	-0.1370
	(0.019)	(0.034)	(0.019)	(0.034)	(0.110)	(0.181)	(0.110)	(0.181)
ROA (t-1)	0.1054***	0.0746***	0.1028***	0.0719***	0.7386***	0.5666***	0.7185***	0.5442***
	(0.021)	(0.027)	(0.020)	(0.027)	(0.168)	(0.196)	(0.167)	(0.195)
PPE (t-1)	-0.0629***	-0.0271	-0.0628***	-0.0283	-0.3825***	-0.0956	-0.3810***	-0.0958
	(0.022)	(0.056)	(0.021)	(0.055)	(0.132)	(0.323)	(0.132)	(0.323)
RD (t-1)	0.0564	0.0848	0.0538	0.0784	0.3644	0.7032	0.3506	0.6619
	(0.059)	(0.100)	(0.059)	(0.100)	(0.358)	(0.635)	(0.357)	(0.635)

INST OWNERSHIP (t-1)	-1.0975	1.7996	-1.1752	1.6749	-7.0261	9.7615	-7.4067	9.2440
	(1.056)	(2.355)	(1.057)	(2.352)	(5.930)	(12.516)	(5.936)	(12.508)
DTURNOVER (t-1)	0.0060*	0.0073*	0.0060*	0.0073*	0.0323	0.0392*	0.0320	0.0390*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.020)	(0.021)	(0.020)	(0.021)
SIGMA (t-1)	1.5030***	-0.3327	1.4781***	-0.3657	10.2772***	-0.0398	10.1280***	-0.2889
	(0.388)	(0.514)	(0.388)	(0.513)	(2.683)	(3.229)	(2.682)	(3.227)
RET (t-1)	0.1865***	0.0427	0.1849***	0.0403	1.3174***	0.5292	1.3077***	0.5072
	(0.041)	(0.050)	(0.041)	(0.050)	(0.340)	(0.381)	(0.340)	(0.381)
OPAQUE (t-1)	0.0574**	0.0576	0.0568**	0.0562	0.3327**	0.3611*	0.3292**	0.3539*
	(0.026)	(0.035)	(0.026)	(0.035)	(0.152)	(0.192)	(0.152)	(0.192)
OPAQUE SQUARE (t-1)	-0.0187	-0.0381**	-0.0186	-0.0382**	-0.1114	-0.2278**	-0.1115	-0.2300**
	(0.014)	(0.018)	(0.014)	(0.018)	(0.089)	(0.112)	(0.089)	(0.113)
CEO TOTALPAY (t-1)	0.0089**	0.0035	0.0085**	0.0030	0.0501**	0.0159	0.0481*	0.0122
	(0.004)	(0.006)	(0.004)	(0.006)	(0.025)	(0.032)	(0.025)	(0.032)
CEO TENURE (t-1)	-0.0039	0.0199***	-0.0049	0.0189***	-0.0232	0.1434***	-0.0284	0.1369***
	(0.004)	(0.007)	(0.004)	(0.007)	(0.024)	(0.036)	(0.024)	(0.036)
CEO AGE (t-1)	0.0366	0.0820*	0.0377	0.0822*	0.2061	0.4409*	0.2115	0.4411*
	(0.026)	(0.045)	(0.026)	(0.045)	(0.149)	(0.238)	(0.149)	(0.238)
CEO-CHAIRMAN (t-1)	-0.0087	0.0061	-0.0086	0.0060	-0.0469	0.0340	-0.0465	0.0326
	(0.007)	(0.013)	(0.007)	(0.013)	(0.038)	(0.067)	(0.038)	(0.067)
CEO DELTA (t-1)	-0.0003	0.0053	-0.0005	0.0047	-0.0012	0.0319	-0.0020	0.0289
	(0.002)	(0.004)	(0.002)	(0.004)	(0.011)	(0.021)	(0.011)	(0.021)
CEO VEGA (t-1)	-0.0142	0.0385	-0.0147	0.0384	-0.0850	0.2990*	-0.0889	0.2928*
	(0.019)	(0.030)	(0.019)	(0.030)	(0.113)	(0.159)	(0.114)	(0.159)
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effect	Industry	Firm	Industry	Firm	Industry	Firm	Industry	Firm
N	20,404	20,404	20,404	20,404	20,404	18,388	20,404	18,388
Adj / Pseudo R2	0.0183	0.0497	0.0185	0.0500	0.0223	0.0319	0.0225	0.0324

Appendix Table B.4. Placebo test

This table presents the results of the placebo test. We randomly assign *CRASH experience* based on the sample distribution. We re-estimate our main results with *PseudoCRASH experience*. Panels A, B, C, and D follow our previous Tables 3, 4, 5, and 6, respectively. Panels A and D include the control variables as in Table 3. Panel B includes the control variables as in Table 4. Panel C includes the control variables as in Table 5. In Panels B and D, we exclude firm-year observations that experience the CEO turnover at the year *t*. Year and industry fixed effects are included. The indicator for *Post-PseudoCRASH experience* is included in Models (5) and (6) of Panel A (but its estimated coefficients are not reported for brevity). Variables definitions are in Appendix A. We calculate the mean of the estimated coefficients and corresponding *t*-statistics over 1,000 repetitions. Parentheses report the absolute value of average *t*-statistics adjusted for heteroscedasticity and clustered by firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels based on the absolute value of average *t*-statistics over 1,000 repetitions, respectively.

Panel A: Baseline regressions (Table 3)

	Pre-*Pseudo*CRASH experience		Post-*Pseudo*CRASH experience		Pooled	
Dependent variable	NCSKEW	DUVOL	NCSKEW	DUVOL	NCSKEW	DUVOL
Model	(1)	(2)	(3)	(4)	(5)	(6)
CEO HOLDER67 (t-1)	0.0381**	0.0103*	0.0350*	0.0091	0.0401**	0.0115**
	(2.068)	(1.811)	(1.953)	(1.644)	(2.526)	(2.330)
CEO HOLDER67 × POST_*Pseudo*CRASH					-0.0084	-0.0038
					(0.345)	(0.498)
N	N/A	N/A	N/A	N/A	20,404	20,404

Panel B: The effect of *Pseudo*CRASH experience on CEO confidence level (Table 4)

	FIRST *Pseudo*CRASH	Subsequent *Pseudo*CRASH	Pooled	Pooled	Pooled	Pooled
Dependent variable	CEO CONFIDENCE	CEO CONFIDENCE	CEO CONFIDENCE	CEO CONFIDENCE	ΔCEO CONFIDENCE	ΔCEO CONFIDENCE
Model	(1)	(2)	(3)	(4)	(5)	(6)
*Pseudo*CRASH (t-1)	0.0246	0.0208	0.0006		0.0016	
	(0.756)	(0.527)	(0.015)		(0.069)	
POST_*Pseudo*CRASH				-0.0160		-0.0095
				(0.814)		(0.535)
CEO CONFIDENCE (t-1)			0.6111***	0.6108***	-0.3501***	-0.3503***
			(31.058)	(30.954)	(20.091)	(20.053)
N	N/A	N/A	15,977	15,977	15,977	15,977

Panel C: The effect of *PseudoCRASH* experience on CEO turnover (Table 5)

Dependent variable	CEO turnover	Type 1 (CEO HOLDER67: from 1 to 0)	Type 2 (CEO HOLDER67: from 0 to 0)	Type 3 (CEO HOLDER67: from 1 to 1)	Type 4 (CEO HOLDER67: from 0 to 1)
Model	(1)	(2)	(3)	(4)	(5)
*Pseudo*CRASH (t-1)	-0.0013	-0.0041	-0.0017	-0.0015	-0.0155
	(0.014)	(0.017)	(0.002)	(0.011)	(0.047)
N	25,766	23,859	23,998	23,710	22,851

Panel D: The effect of *Pseudo*CRASH experience on CEO compensation (Table 6)

Dependent variable	TOTALPAY	SALARY	BONUS	EQUITY	OPTION	STOCK
Model	(1)	(2)	(3)	(4)	(5)	(6)
*Pseudo*CRASH (t-1)	0.0000	0.0003	-0.0009	0.0019	0.0008	-0.0013
	(0.007)	(0.064)	(0.020)	(0.050)	(0.017)	(0.025)
N	18,481	18,481	18,481	18,481	18,481	18,481